**Neighborhood satisfaction and use patterns in urban public outdoor spaces:
Multidimensionality and two-way relationships**

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Abstract

Neighborhood satisfaction and use patterns in public outdoor spaces are generally viewed as single entities, ignoring their multidimensionality as well as detailed associations between them. Such a general assessment raises questions of the kinds of neighborhood characteristics that accrue to satisfaction, and the variety of environmental affordances perceived by residents with respect to nearby outdoor settings. Given the significant role of these factors in people's life satisfaction and wellbeing, a nuanced approach is needed to help us better understand people-environment relationships and examine practical solutions for creating more livable neighborhoods. This study investigated two-way associations between four aspects of neighborhood satisfaction and three forms of use, as well as the role played by perceived barriers to neighborhood use in these associations. A random sample of 434 Chicago residents participated in a survey (mailed and on-site) with a five-point rating scale. The three major findings through generalized linear modeling include; 1) multidimensionality of both neighborhood satisfaction and use patterns as important to consider in people-environment studies, 2) the significant roles as predictors and as outcomes played by both neighborhood satisfaction and use patterns, with only one factor from each set showing a two-way relationship, and 3) the main effect of perceived barriers on three of the neighborhood satisfactions, and their interactive effect with several of the use pattern and satisfaction factors. These findings contribute to our understanding of people-environment relationships in urban public spaces and provide insights for improving neighborhood satisfaction and frequency of use of public outdoor spaces.

Keywords: Chicago, interaction analysis, people-environment relationship, perceived barriers, residential, urban outdoors.

1 **Introduction**

2 To what extent does a person's use of their nearby outdoor space affect their satisfaction
3 with their neighborhood environment? Alternatively, to what extent does satisfaction with one's
4 neighborhood impact how one uses it? Studies have examined these questions separately, and
5 have provided findings that support both perspectives. Much of that literature, however,
6 overlooks the multidimensionality of the constructs *use* and *neighborhood satisfaction*. It is also
7 not clear how perceived barriers to use affect the associations between neighborhood satisfaction
8 and use in urban residential areas. Given the significant role these factors play in people's life
9 satisfaction and wellbeing (e.g., Fernandez and Kulik, 1981; Kaplan and Kaplan, 1989; Kweon et
10 al., 2010; Ward Thompson and Aspinall, 2011), it is worth investigating multiple aspects of
11 satisfaction and use in detail. This study investigated different aspects of satisfaction with
12 neighborhood outdoor settings, various types of use of such spaces, and the possible associations
13 between these aspects in urban residential neighborhoods while controlling for perceived barriers
14 to neighborhood use.

15 ***What does it mean to be satisfied with a neighborhood?***

16 Research on neighborhood satisfaction has separately investigated a relatively wide range of
17 contributing factors including socio-demographics (Sallis et al., 2009; Kweon et al., 2010),
18 housing ownership (Basolo and Strong, 2002; Rohe, Van Zandt, and McCarthy, 2013), safety
19 (Cook, 1988; Burby and Rohe, 1989), and physical attributes of the environment (Kaplan, 2001;
20 Sirgy and Cornwell, 2002; Lee et al., 2008; Hur, Nasar, and Chun, 2010; Kweon et al., 2010;

Hur and Nasar, 2014). While providing valuable findings, most of these studies have examined neighborhood satisfaction as a single entity such as overall satisfaction (e.g., Galster and Hesser, 1981; Hur, Nasar and Chun, 2010; de Jong et al., 2012). Such a general assessment raises questions of the kinds of neighborhood characteristics that accrue to satisfaction. For instance, is it satisfaction with the appearance of a neighborhood or the quality of public spaces that plays an important role? Does the amount of available green features or the activities afforded by the outdoor settings share in people's perception of neighborhood satisfaction? Disregarding the multidimensionality of neighborhood satisfaction leaves such questions unanswered. One of the risks of not knowing the answers to these questions would be inability to create or redevelop neighborhood spaces that are responsive to users' perception. This may lead to formation of outdoor spaces that do not meet residents' needs and preferences. Some studies have focused on specific aspects of satisfaction such as neighborhood appearance and attractiveness (Gruber and Shelton, 1987; Parkes, Kearns, and Atkinson, 2002) and neighborhood safety (Cook, 1988; Lovejoy, Handy, and Mokhtarian, 2010). While previous research has demonstrated the multidimensionality of residential satisfaction (Amerigo and Aragones, 1997; Francescato, 2002), only a few studies have put multidimensionality of satisfaction as the center of investigation (e.g., Bonaiuto et al., 1999; Adriaanse, 2007; Fornara, Bonaiuto, and Bonnes, 2010). Further, few studies can be found on multiple dimensions of neighborhood satisfaction in association with different types of outdoor use. We argue that the complexity of environmental characteristics and people's perception warrant inclusion of a wider range of satisfactions. By investigating multiple aspects of neighborhood satisfaction (satisfaction with quality of public space, amount of green features, amount of affordances and neighborhood comfort), this study offers a richer understanding of people's perception of their physical environment which may have implications for practitioners in improving neighborhood satisfaction in residential areas.

What is meant by neighborhood use?

While the use of outdoor spaces has been shown to be important with respect to its positive effects on wellbeing (Ellis, Lee, and Kweon, 2006; Ward Thompson, 2011; Ward Thompson and Aspinall, 2011), use is often investigated as a single entity. For instance, use has been investigated in terms of walking in the neighborhood (Ball et al., 2001; Humpel, Marshall, et al., 2004), physical activity (Bjork et al., 2008), park use (Tinsley, Tinsley, and Croskeys, 2002), social activity (Hur and Morrow-Jones, 2008) and community gardening (Kaplan, 2001). However, the complexity of environmental attributes and affordances, as well as people's needs and preferences result in a multifaceted people-environment relationship that comprises a diversity of use patterns. Disregarding the diversity of use patterns in urban residential contexts leaves us with ambiguity that can translate both to ill-allocated financial resources and psychological impacts, resulting in decision-making procedures that may reduce the residents' likelihood of outdoor space use. This study investigated three types of use of outdoor spaces (green/social space use, active engagement with the environment, and walk to non-nature destinations) based on the purpose of being outdoors which can provide insights into ways to encourage people to spend more time outdoors.

The association between neighborhood satisfaction and use patterns

A few studies have reported an association between neighborhood satisfaction and the ways people use their outdoor spaces (e.g., Kaplan and Kaplan, 1989; Kaplan 2001; Kearney, 2006). These studies mostly identify use of outdoor spaces as the predictor of satisfaction level (e.g., Kaplan, 2001; Kearney, 2006), meaning that the more people use their nearby outdoor spaces, the more satisfied they are with their neighborhood. However, other findings raise doubts about accepting such a one-way relationship between satisfaction and use. As many studies have

revealed, people like outdoor settings depending on the extent to which the settings meet their needs (Kaplan and Kaplan, 1982). Having nature nearby can also be a potential response to many basic needs through offering a wide range of affordances to urban residents (Kaplan, Kaplan, and Ryan, 1998) and is thus associated with neighborhood satisfaction and use. 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 (Duvall, 2013).

Considering the possibility of this two-way association between neighborhood satisfaction and use raises a number of questions: Do all aspects of neighborhood satisfaction and use patterns have two-way associations? If not, what aspects of neighborhood satisfaction might predict what forms of use of outdoor spaces? What forms of use may predict neighborhood satisfaction? Finding answers to such questions gives us a richer understanding of prior environment-behavior studies while also providing insights into ways to both improve neighborhood satisfaction through encouraging specific forms of use, and to increase use of outdoor spaces through improving aspects of neighborhood satisfaction. By contrast, the cost of disregarding these associations in practice may result in investing on outdoor spaces that are underutilized, and having less satisfaction and sense of community in neighborhoods. To help answer some of these questions, this study investigated the possibility of two-way relationships between four dimensions of neighborhood satisfaction and three forms of use patterns.

Perception of barriers to neighborhood use

While many factors are likely to impact use patterns, particularly salient are residents' perceptions of barriers to use which may affect perceived accessibility, 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). Perceived 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 examined the extent to which perceived barriers affect each component of neighborhood satisfaction and use patterns.

Major questions

This study focuses on two major issues. First, identifying specific and useful components of neighborhood satisfaction, use patterns and barriers to neighborhood use that could be considered as measures for these concepts. Second, examining the relationships among the satisfactions and use patterns while controlling for the potential effect of barriers. Assuming that uses can influence satisfaction, or alternatively, that satisfaction may influence use patterns, and that barriers to neighborhood use may influence both satisfaction and use patterns, it was hypothesized that some dimensions of neighborhood satisfaction and use have two-way relationships, and barriers to neighborhood use play an interacting role between measures of satisfaction and use.

Methods

Study area

The study area covers 3,400 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 Fig. 1). Choice of this area was based initially on analysis of citywide GIS modeling considering criteria comprising median income¹, housing stock type², crime rate, and green spaces³. The GIS model characterized the study area by majority of multifamily houses as opposed to single-family houses and high rises (in order to target residents who do not have private backyards and thus primarily rely on public green spaces), low crime rate (in order to avoid the possible negative effects of high crime rate on the residents' use of public spaces), and residents with median incomes between \$25000 and \$75000 (in order to target approximately the middle-income class). The exact boundary of the study site was determined based on field investigations, considering availability of a variety of public green spaces including large and small parks, green boulevards, and very small community gardens.

The study site is predominantly residential with business/commercial land uses along the major streets. In addition to parks and green spaces shown in Figure 1, there are a number of educational areas (schools) distributed throughout the site, and a few small manufacturing sites in the south west. Adjacent to the study area in the south and west there is part of an industrial corridor as well.

[Insert Fig.1]

Research instrument

A survey, using a five-point rating scale was used for assessing a number of issues (Hadavi, 2015), including neighborhood satisfaction, use pattern, and barriers to use of outdoor spaces (Table 1). Demographic information was also collected. Both a printed version and a web link were used as formats.

Satisfaction with the neighborhood included two questions, one 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, including frequency of walking in the neighborhood for different purposes, frequency of use of specific public green spaces and recreational areas, and frequency of specific outdoor activities in the neighborhood. Survey items also included questions about potential barriers to using outdoor spaces (Table 1).

[Insert Table1]

Sample recruitment and characteristics

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 including both buildings close to green spaces (50% within a block) and far from them (50% more than four blocks). The target population (total of 5309 eligible households) was stratified by nine-digit zip codes to select a random sample of 2500 units. 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 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. We 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 data from 34 could not be analyzed due to either incompleteness or because the participant lived outside of the study area. Therefore, the total sample size used in this study was 434.

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. A comparison between demographic data from U.S. Census Bureau for Chicago City (2012) and that of the sample population shows that the study sample is generally younger and more educated than Chicago population. Demographic information collected through the survey (Table 2) shows that more than half of the sample population uses public transportation (bus or train) to get to work, which is twice the average for Chicago as a whole.

174

[Insert Table 2]

175

176 **Data analysis**

177 In light of the study's focus on generating resident-based neighborhood satisfaction and use
178 patterns, Exploratory Factor Analysis (EFA) was used (SPSS, version 22) to determine each of
179 the latent variables. Principal Components, with Varimax rotation and a maximum of 25
180 iterations for convergence, was followed for each of the constructs. Only the loadings with
181 absolute values greater than 0.50 were included in the analysis. The larger double loader was
182 selected if it was at least 0.05 greater than the alternative; otherwise the item was eliminated
183 from the final solution. Factor means were calculated and saved as latent variables. Cronbach
184 Alpha was calculated for each factor to test for reliability and only factors with Alpha
185 coefficients greater than .73 were retained. The use of EFA permits examination of categories or
186 patterns as opposed to an emphasis on the magnitude of the ratings of individual items.

187 After defining distinct latent variables, Pearson correlations were used to determine the
188 extent of relationship between the three sets of latent variables –neighborhood satisfaction, use
189 patterns and barriers to neighborhood use. Then in order to assess the influence of each of the
190 satisfaction measures on use patterns as well as the influence of each of the use patterns on
191 satisfaction, two separate analyses were carried out using *generalized linear modeling*. For each
192 analysis barriers to neighborhood use were included as binary measures (based on the sample
193 means) to examine their potential interactive effect. Despite the correlations between various

measures, Variance Inflation Factor (VIF) assessment showed that multicollinearity was not an issue in this study.

Results

Neighborhood satisfaction measures

Separate exploratory factor analyses (EFA) were conducted for the two neighborhood satisfaction questions (Table 1). As shown in Table 3, each question generated two distinct measures explaining different aspects of neighborhood satisfaction. The first two factors, concerning satisfaction with the quantity of nearby outdoor features, focus on the *Amount of Affordances* (Cr $\alpha = 0.84$) and the *Amount of Green Features* (Cr $\alpha = 0.77$). The Amount of Affordances 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 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” item 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,” with loadings $< .5$ were dropped from further analysis. The item “sense of community” was eliminated because of almost equal loadings on factors 3 and 4.

The mean values (Table 3) of the satisfaction factors suggest a moderate degree of participants' satisfaction with evaluated aspects of neighborhoods, with considerable variation among the items. Based on the factor means, participants are far more satisfied with the *amount* of green features (3.75) than with the *quality* of the public spaces (3.20). Satisfaction with the amount of sitting areas rated lowest (2.93) among the examined affordances. While the mean for Satisfaction with Neighborhood Comfort is relatively high (3.51), it would have been lower without the "Farmers market" item (mean 3.87). As would be expected nighttime safety is perceived far lower (2.97) than daytime safety which was rated positively (4.09).

[Insert Table 3]

Neighborhood use pattern measures

Three distinct use pattern measures emerged from the EFA (Table 4). Three items – "running," "biking," and "dog walking" – had loadings lower than the 0.5 criterion and were eliminated from further analysis. The first factor, *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 nature-based destinations such as boulevards or parks. The mean for this measure is at mid-scale, but some of the item means such as picnicking (2.23) and use of boulevard sitting areas (2.66) are less than mid-scale, while "walking for pleasure" and "parks with large trees" have means above 3.5.

The four items of the *Active Engagement* measure ($Cr\ \alpha = .76$), 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 ($Cr\ \alpha = .76$) all entail non-nature based reasons for walking and thus are designated as *Walk to Non-nature Destinations*. The mean, 3.92, indicates participants walk in the neighborhood “quite a bit” to run errands and reach needed destinations.

Barriers to neighborhood use

Two distinct factors for barriers to neighborhood use emerged through EFA (Table 5). The first factor, named *Various Perceived Barriers* ($Cr\ \alpha = 0.85$), 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* ($Cr\ \alpha = .81$) 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 in the study area. However, it is still important to explore how these perceived barriers are associated with neighborhood satisfaction and use.

[Insert Table 4]

[Insert Table 5]

253

254 *Associations between neighborhood satisfaction, use pattern, and barrier measures*

255 Pearson's correlation analysis (Table 6) shows that several of the satisfaction measures have
256 relatively high interrelations and one of the use patterns is correlated ($r > .40$) with the other two.
257 However, as shown in the highlighted area of Table 6, only one of the 12 correlations between
258 any of the satisfaction and use pattern factors is greater than .40, which is related to Satisfaction
259 with Quality of Public Spaces and Green/Social Space Use. The table also shows that Various
260 Perceived Barriers have significant negative correlations with all satisfaction and use measures
261 except for Active Engagement with the environment. While Transportation Barriers have
262 significant negative correlations with all neighborhood satisfaction measures, they show
263 significant negative correlation only with Green/Social Space Use.

264

[Insert Table 6]

265

266 *Neighborhood satisfaction as predictor of use pattern*

267 The first generalized linear model examined the four neighborhood satisfaction factors as
268 predictors of each of the three use patterns, adjusted for barriers to neighborhood use, to explore
269 both main effects of satisfaction and potential interaction effects with barriers. The results of
270 these analyses are presented in Table 7, with a separate row for each of the use patterns.

271 *Main effects.* Among the four satisfaction factors only Satisfaction with Quality of Public
272 Space has significant main effects on use patterns. Specifically, this factor has the strongest main

effect on Green/Social Space Use ($\beta=.63$), and its main effects on the other two forms of use, Active Engagement ($\beta=.39$) and Walk to Non-nature Destinations ($\beta=.32$) are substantially lower. There were no main effects related to perceived barriers to use.

Interaction effects. While satisfaction with Amount of Green Features and Neighborhood Comfort do not show main effects on use patterns, as shown in Table 7, Various Perceived Barriers interact with satisfaction with Amount of Green Features to predict Green/Social Space Use ($\beta=-.19$, $p<.05$), and also interact with Neighborhood Comfort to predict the frequency of Walking to Non-nature Destinations ($\beta=.38$, $p<.005$). This form of use is also affected by the interaction effects of Transportation Barriers and satisfaction with Amount of Green Features ($\beta=.21$, $p<.05$). These results show that with respect to Walking to Non-nature Destinations, both the perception of barriers and two of the satisfaction components have an interactive role. Furthermore, the effect of satisfaction with Amount of Green Features on the Use of Green/Social Space is moderated by the perception of Various Barriers.

Use pattern as predictor of neighborhood satisfaction

The second generalized linear model explored the effects of use patterns and their interaction effects with barriers on each of the four satisfaction factors. Both main effects of the predictors and the interaction effects of barriers were investigated, and the results are summarized in Table 8.

Main effects. Green/Social Space Use shows significant main effects on each of the four measures of neighborhood satisfaction. The main effects on satisfaction with Amount of Affordances ($\beta=.66$) and Quality of Public Space ($\beta=.72$) are higher than, and almost twice as great as the effects on satisfaction with Amount of Green Features ($\beta=.33$) and Neighborhood

Comfort ($\beta=.37$). By contrast, Active Engagement has main effects only on satisfaction with Amount of Affordances ($\beta=-.27$, $p<.05$). It should be noted that in this analysis, high-barrier is considered as the reference category, and there is a negative association between Active Engagement and satisfaction with Amount of Affordances.

While the first model showed that perceived barriers do not have main effects on use patterns, the second model demonstrates main effects of Various Perceived Barriers on three satisfaction measures, satisfaction with Amount of Affordances ($\beta=1.65$, $p<.005$), Amount of Green Features ($\beta=1.43$, $p<.01$) and Quality of Public Space ($\beta=.88$, $p<.05$).

Interaction effects. While Various Perceived Barriers do not have main effects on Neighborhood Comfort, they interact with two forms of use – Green/Social Space Use and Walk to Non-nature Destinations – to predict this satisfaction measure ($\beta=-.23$ and $.32$, respectively). Also, Transportation Barriers have interaction effects on the relationship between Walk to Non-nature Destination and satisfaction with Amount of Green Features in the neighborhood. In other words, the effect of walking to non-nature destinations in the neighborhood on satisfaction with amount of green is moderated by perceived transportation barriers, while the effects of the frequency of use of green/social spaces and walking to non-nature destinations on neighborhood comfort depend on people’s perception of those barriers that are not related to transportation.

[Insert Table 7]

[Insert Table 8]

314

315 *Summary*

316 The results are summarized in Figs. 2 and 3 and in the bullet points below.

- 317 - Use and satisfaction show different patterns of results when each is considered as an
318 outcome variable.
- 319 - When a multiplicity of dimensions of neighborhood satisfaction and forms of use is
320 considered, many of these elements play a significant role in the association with other
321 measures.
- 322 - Among the four satisfaction measures and three use measures, there was only one
323 significant two-way relationship, namely between satisfaction with Quality of Public
324 Space and Green/Social Space Use (Fig. 2).
- 325 - Barriers to neighborhood use have a main effect in predicting neighborhood satisfaction
326 but not neighborhood use.
- 327 - As shown in Fig. 3, two of the satisfaction measures and two of the use patterns are
328 included in an interactive cyclic relationship that relates to the two measures of barriers
329 to neighborhood use.

330

[Insert Fig. 2]

331

[Insert Fig. 3]

332

333 **Discussion and conclusion**

334 In this study we focused on the significance of considering the multidimensionality of both
335 neighborhood satisfaction and use patterns in environment-behavior studies and the necessity of
336 investigating the possible two-way relationships between multiple aspects of neighborhood
337 satisfaction and use in urban residential areas. As discussed earlier these issues can have
338 important practical consequences for creating or redeveloping outdoor spaces that are more
339 favored and more frequently used, resulting in investment on outdoor spaces that address
340 residents' neighborhood satisfaction.

341 This study examined the associations between four aspects of neighborhood satisfaction and
342 three forms of use and the interacting role of barriers to neighborhood use in a residential area in
343 Chicago based on the data collected from 434 survey participants. There were three major
344 findings; 1) multidimensionality of both neighborhood satisfaction and use patterns as important
345 to consider in environment-behavior studies, 2) the significant roles as predictors *and* as
346 outcomes played by both neighborhood satisfaction and use patterns, with only one factor from
347 each set showing a two-way relationship (Fig. 2), and 3) the main effect of perceived barriers on
348 three dimensions of the neighborhood satisfaction, and their interactive effect with several of the
349 use pattern and satisfaction factors. These findings contribute to our understanding of people-
350 environment relationships in urban public spaces and provide insights into how to improve
351 neighborhood satisfaction and frequency of use of outdoor spaces.

352 ***Multi-dimensionality of neighborhood satisfaction and use***

353 Investigating the participants' perceptions about both the amount and the quality of outdoor
354 green spaces, and their satisfaction in a more detailed manner in this study allows us to decipher

more about their satisfaction and needs in terms of multiple attributes and affordances of a complex environment. Two of these data-driven measures are directly related to the nature component of outdoor spaces, and the other two address the activities afforded by outdoor spaces and the degree of perceived safety and peacefulness in the neighborhood.

Instead of investigating neighborhood satisfaction as a single entity or focusing on one specific aspect of it as is the pattern in many studies (e.g. Galster and Hesser, 1981; Gruber and Shelton, 1987; Parkes, Kearns, and Atkinson, 2002; Hur, Nasar and Chun, 2010; de Jong et al., 2012), this study examined how people perceive and appreciate urban outdoor spaces in a more inclusive way. The findings demonstrate that different aspects of neighborhood satisfaction behave differently in relation with forms of use of outdoor spaces, highlighting the necessity of considering the multi-dimensionality of neighborhood satisfaction in environment-behavior studies.

In terms of patterns of use, the scope of this work goes beyond the consideration of a single entity such as walking in the neighborhood, park use, physical activity or gardening that have been separately investigated in previous studies (Kaplan, 2001; Tinsley, Tinsley, and Croskeys, 2002; Humpel, Marshall, et al., 2004). By investigating three forms of use (frequency of use of green/social spaces, active engagement with the environment such as playing or gardening, and walking in the neighborhood for non-nature purposes) the results show important differences in their roles with respect to multiple aspects of people's satisfaction with the environment as well as barriers to use. The findings thus indicate that examination of neighborhood satisfaction and use as single entities may be shortsighted given their differential roles in association with other aspects and perceived barriers to neighborhood use.

377 *Satisfaction and use*

378 In answer to the question regarding the extent to which neighborhood use predicts
379 satisfaction or satisfaction predicts use, this study found that these two factors *reinforce* each
380 other. While confirming previous findings, in terms of the general effects of use of outdoor
381 spaces on neighborhood satisfaction (e.g., Kaplan, 2001; Kearney, 2006), this study showed that
382 satisfaction with *quality of public space* and frequency of *use of green and social spaces* are
383 highly interrelated and have a two-way relationship (Fig. 2). More specifically, the more the
384 residents are satisfied with the overall appearance of the neighborhood, the variety of green
385 spaces, the amount of open space, and the opportunities for socializing, the more likely they are
386 to use their nearby green/social spaces and walk for pleasure in the neighborhood, **and** vice
387 versa. Acknowledging that this relationship with respect to nearby nature holds in both directions
388 is helpful in terms of understanding the multi-dimensional effects of physical attributes of the
389 environment on both neighborhood satisfaction and use patterns. It sheds light on ways to
390 improve satisfaction and frequency of use in public outdoor spaces through identifying important
391 attributes of the environment and improving them.

392 The findings show that satisfaction with quality of public space is also important in terms of
393 predicting all neighborhood use patterns investigated in this study; the more the residents are
394 satisfied with the quality of public space, the more likely they are to spend time outdoors for
395 many different purposes including walking either for pleasure or to reach a destination,
396 socializing and even getting actively involved with the environment through playing games or
397 gardening. This pattern of associations, however, was not found with respect to other aspects of
398 neighborhood satisfaction. Even when the participants are satisfied with the potential amount of
399 outdoor activities, amount of green features or the level of peacefulness and safety in the

neighborhood, they may resist using outdoor spaces if they perceive that there are barriers to neighborhood use.

By contrast, the use of green/social spaces may increase the level of different sources of neighborhood satisfaction. However, the impact of use on satisfactions is specific to the kind of use; more frequent walks to non-nature destinations or use of active recreation areas do not result in higher level of neighborhood satisfaction. These findings carry a practical message; in order to increase use and walking frequency in residential neighborhoods we need to increase the quality of public spaces through improving overall appearance of the neighborhood, amount and variety of green spaces and provide more opportunities for outdoor community gatherings and socializing. As the results show, improving the quality of public space is more likely to encourage more frequent use of green/social spaces that can lead to improving other aspects of neighborhood satisfaction. This is particularly important because a growing body of research has revealed the associations between neighborhood satisfaction and use and mental wellbeing in urban areas (Kaplan and Kaplan, 1989; Grahn and Stigsdotter, 2003; Ward Thompson and Aspinall, 2011).

Barriers to neighborhood use

While confirming the negative association between barriers and both neighborhood satisfaction and use patterns, this study also resulted in some findings that are not in line with the previous literature.

This study found that various perceived barriers including unpleasant open spaces, low maintenance, and lack of walkable sidewalks, sense of community and safety have significant main effects on three aspects of satisfaction including satisfaction with quality of public space

and amounts of both affordances and green elements in the neighborhood. Despite the multifaceted nature of barriers and satisfaction measures investigated in this study, it is safe to consider that these findings are consistent with the literature in terms of the negative effects of barriers such as unpleasantness (Parkes, Kearns, and Atkinson, 2002), safety concerns (Lee, 1981; Cook, 1988) and low maintenance (Hur and Nasar, 2014) on neighborhood satisfaction. Furthermore, Amberger and Eder's (2012) finding that perception of favored nearby outdoor green spaces is positively related to sense of community, offers a partial explanation for our finding of lack of sense of community as a barrier to neighborhood use being negatively associated with aspects of neighborhood satisfaction.

The discrepancies from the literature are related to the association between barriers and use patterns. As documented previously, the frequency of use of outdoor spaces is negatively influenced by many barriers such as unpleasant appearance of the neighborhoods (Giles-Corti et al., 2005), safety issues (Ward Thompson and Aspinall, 2011) and long distances (Wright Wendel, Zarger, and Mihelcic, 2012). This study, however, does not show *main effects* of perceived barriers on use patterns. Given the strong associations between aspects of satisfaction and use, it is plausible to consider that barriers have influence on use patterns through their effects on satisfaction. Moreover, the lack of main effects of transportation barriers on either satisfaction or use patterns is a further discrepancy from the literature. As shown in Fig. 3, our results point to a complex interactive role that both transportation and various perceived barriers play with respect to two of the satisfaction measures and two of the use patterns.

These findings suggest that in urban neighborhood studies it is essential to consider the significant complex role of both transportation and non-transportation barriers in understanding the associations between various aspects of neighborhood satisfaction and use. The complexity

of the relationships shown in Fig. 3 reminds us of the significance of multidimensionality of satisfaction and use and their strong interrelations while controlling for barriers. By highlighting the significant interacting role of barriers, it also illuminates that investigation of neighborhood satisfaction without considering its interrelations with use patterns and barriers may be shortsighted.

Next steps

This study uncovered some important dimensions of residential preferences and use patterns that can also be helpful in a variety of contexts. They could, for example, be useful both in the context of strategies for engaging in physical activity and for planning and design solutions.

Engagement strategies. These strategies in environment-behavior studies are based on accepting that satisfaction with some specific aspects of the environment can positively affect the frequency of use of such spaces. For example, Duvall (2012) showed that “awareness plans” can provide a strategy for engaging in specific aspects of the environment to encourage more frequent use of outdoor spaces. Our findings point to some of the significant attributes of the environment that specifically associate neighborhood satisfaction with the frequency of use of public outdoor spaces. Since engagement-based strategies aim to positively affect environmental satisfaction (Duval, 2013), focusing on the environmental attributes highlighted in our study may be useful in improving engagement plans which ultimately result in more future outdoor activities.

Planning and design solutions. The relatively fine-grained examination of four distinct satisfaction measures and three distinct use measures in addition to specific barriers to use can provide insights into appropriate planning and design considerations for new urban

developments and redevelopment projects. This study highlights specific attributes of the environment that contribute to higher level of satisfaction as well as some specific negative attributes of the environment. Attention to these qualities could help planners and designers create better places to live in urban areas according to residents' preferences. For instance, these findings suggest that in order to improve use of outdoor spaces, we need to improve residents' satisfaction with quality of public space by providing varieties of green spaces, opportunities for socializing in outdoor spaces, increasing the amount of open spaces and improvements in their overall appearance. This work also suggests that these improvements may not be effective as long as there are perceived barriers to neighborhood use. Therefore, we also need to improve maintenance, walkability and sense of community, while reducing safety concerns and physical barriers.

While revealing many useful findings that contribute to the current literature, this study raises several unanswered questions due to limitations and calls for further investigations. With respect to the sample, there are potential biases related to both the low response rate of the mailed survey and the use of on-site data collection. On-site participants are among residents who are more likely to use neighborhood outdoor spaces in general, but that may or may not mean that they are more satisfied with what is available to them. Reaching residents who are less satisfied with their neighborhoods as well as those who use it less frequently would be both useful and challenging. It is also important to reiterate that the distribution of data on perceived barriers to neighborhood use was skewed towards the lower end of the scale, meaning that in general, barriers played a minor role for study participants. More variability with respect to perceived barriers could permit a better understanding of their role. Further, the interaction effects of various perceived barriers and satisfaction with amount of green features on use of

green/social spaces (Table 7), call for further study. As Table 8 shows, among the participants who have the same level of satisfaction with amount of green features, those who perceive more barriers in the neighborhood are likely to use green/social spaces more frequently. This is also true in terms of the interaction effects of barriers and use of green/social spaces on neighborhood comfort. Further investigation is required to consider other factors that may intervene in these relationships.

In addition, the *negative* main effect of active engagement on satisfaction with amount of affordances (Table 8) leaves room for further investigations. Our findings show that in a perceived high-barrier situation, those who are more actively involved with the outdoor spaces are less satisfied with the amount of activities afforded by the outdoor public spaces. One reason might be because those who are more involved in outdoor activities are more aware of the shortages in the neighborhood or would like to have more opportunities for outdoor activities. The existing literature shows that teens and younger adults are more interested in using sports fields and also people who have children prefer to have more playgrounds nearby (Hadavi, Kaplan and Hunter, 2015). Further research on the role of demographics is needed to better understand these findings.

Neighborhood satisfaction and use patterns are necessarily impacted by many factors. Future research can further our understanding of how the physical attributes of the environment are associated with each of these aspects of neighborhood satisfaction and use patterns, shedding light on ways to create better livable spaces for residents through meeting their needs and preferences.

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Table 1 Survey questions on neighborhood satisfaction, use patterns and barriers to use

Neighborhood satisfaction	
Thinking about your nearby environment, how do you feel about the amount of the following?	Public green spaces Large trees Shrubs and bushes Lawns Flower beds Vegetable gardens Sitting areas Outdoor gathering/picnic areas Children's play areas 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 Amount of open space Variety of the green spaces Street lighting Farmers market Sense of community Peacefulness Safety for walking during the day Safety for walking at night Opportunities for outdoor community/friends gathering
scale: 1= not at all satisfied, 2= a little, 3= somewhat, 4= quite a bit, 5= very satisfied	
Use patterns	
How often do you walk within your neighborhood?	For pleasure To visit someone To visit a green space To walk a dog To make a purchase To get to a metro/bus stop To go to recreational areas/clubhouse/coffee shop/restaurant 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 Boulevard seating areas Park-like square Playlot/playground Sports fields Park with large trees Outdoor gathering/picnic areas
How often do you do each of these in your neighborhood?	Outdoor sitting and watching Running Biking Outdoor community/friends gathering Picnicking Resting on the lawn Garden at a community garden
scale: 1= never or rarely, 2= a little, 3= occasionally, 4= often, 5= very often	
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	

Table 2. Sample characteristics

	Study sample (%)
Gender	
Female	59.6
Male	40.4
Marital status	
Married or with partner	52.5
single	46.3
Children	
No	71.7
Yes	27.2
Education level	
Less than high school	.9
High school	2.1
Technical degree	1.6
Some college	13.1
College degree	45.6
Post-graduate degree	35.9
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
25,000-34,999	8.6
35,000-49,999	15.5
50,000-74,999	19.5
75,000-100,000	16.7
100,000+	24.5
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
Car	39.6
Bus	18.0
Train	36.2
Bike	22.6
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

Table 3. Neighborhood Satisfaction factors and factor loadings

Item (Mean)		F1*	F2*	F3	F4
		Amount of Affordances	Amount of Green Features	Quality of Public Space	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

*Since all the survey questions used a unipolar scale except for satisfaction with the amount of affordances and green features, for these factors the bipolar scale was recoded as a unipolar scale going from 1= much too much or much too little to 5=about right.

Table 4. Neighborhood Use Patterns factors and factor loadings

Item (Mean)		F1 Green/Social Space Use	F2 Active Engagement	F3 Walk to Non- nature Destinations
Green/Social Space Use	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		
Active Engagement	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 Non-nature Destinations	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

Table 5. Barriers to Neighborhood Use factors

Item (Mean)		F1 Various Perceived Barriers	F2 Transportation Barriers
Various Perceived 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	
Transportation Barriers	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

Table 6. Correlations between components of neighborhood satisfaction and use pattern (Pearson Correlation, 2-tailed significance test)

		Neighborhood satisfaction				Neighborhood use patterns			Barriers to Neighborhood use	
		Amount of Affordances	Amount of Green Features	Quality of Public Space	Neighborhood Comfort	Green/Social Space Use	Active engagement	Walk to Non-nature Destinations	Various Perceived Barriers	Transportation Barriers
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 Engagement	.058	.013	.263**	.082	.480**	1			
	Walk to Non-nature Destinations	.178**	.096*	.355**	.344**	.429**	.132**	1		
Barriers to neighborhood use	Various Perceived Barriers	-.335**	-.175**	-.398**	-.366**	-.227**	-.044	-.120*	1	
	Transportation Barriers	-.225**	-.162**	-.308**	-.207**	-.134**	.021	-.094	.393**	1

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

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

Table 7. The effects of neighborhood satisfaction measures on three forms of use while considering the interaction effects of perceived barriers to use *

			Main effects of Satisfaction measures								Main effects of Barrier measures				Interaction between High/Low Various Perceived Barriers and Satisfaction measures								Interaction between High/Low Transportation Barriers and Satisfaction measures							
			Amount of Affordances		Amount of Green Features		Quality of Public Spaces		Neighborhood Comfort		Various Perceived Barriers		Transportation Barriers		Amount of Affordances		Amount of Green Features		Quality of Public Spaces		Neighborhood Comfort		Amount of Affordances		Amount of Green Features		Quality of Public Spaces		Neighborhood Comfort	
Predicted variables		R ^{2**}	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P
Use measures	Green/Social Space Use	.41	ns***		ns		.63	.000	ns		ns		ns		ns		-.19	.034	ns		ns		ns		ns		ns		ns	
	Active Engagement	.09	ns		ns		.39	.000	ns		ns		ns		ns		ns		ns		ns		ns		ns		ns		ns	
	Walk to Non-nature Destinations	.17	ns		ns		.32	.000	ns		ns		ns		ns		ns		.38	.001	ns		.21	.030	ns		ns		ns	

* High barriers are made as the reference groups in these analyses

** Adjusted R Squared

*** Statistically not significant

Table 8. The effects of use patterns measures on four aspects of neighborhood satisfaction while considering the interaction effects of perceived barriers to use*

		Main effects of Use measures						Main effects of categorized Barrier measures				Interaction between High/Low Various Perceived Barriers and Use measures						Interaction between High/Low Transportation Barriers and Use measures					
		Green/Social Space Use		Active Engagement		Walk to Non-nature Destinations		Various Perceived Barriers		Transportation Barriers		Green/Social Space Use		Active Engagement		Walk to Non-nature Destinations		Green/Social Space Use		Active Engagement		Walk to Non-nature Destinations	
Predicted variables	R ^{2**}	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P	β	P
Satisfaction measures	Amount of Affordances	.22	.66	.000	-.27 .015	ns		1.65	.002	ns		ns		ns		ns		ns		ns		ns	
	Amount of Green Features	.06	.33	.002	ns***	ns		1.43	.008	ns		ns		ns		ns		ns		ns		.30	.033
	Quality of Public Spaces	.49	.72	.000	ns	ns		.88	.021	ns		ns		ns		ns		ns		ns		ns	
	Neighborhood Comfort	.28	.37	.000	ns	ns		ns		ns		-.23	.030	ns		.32	.001	ns		ns		ns	

* High barriers are made as the reference groups in these analyses

** Adjusted R Squared

*** Statistically not significant

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 Source: <https://data.cityofchicago.org/browse?tags=gis>