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Walking in Two French Neighborhoods: A Study of How Park Numbers and Locations Relate to Everyday Walking

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Abstract

Research indicates that people are drawn to green spaces with attractive amenities. This study extends that finding by comparing walking patterns in two neighborhoods with different numbers of parks; parks did not differ in rated attractiveness nor did neighborhoods differ substantially in rated walkability. Adults, aged 32–86 years ($n = 90$), drew their 3 most recent walking routes on maps of their neighborhood. Analyses showed that participants' round trips were longer by 265.5 meters (.16 mile) in the neighborhood with a single, large, centrally located park ($p < .02$). However, participants in the neighborhood with multiple, small, more distributed parks, visited more streets, $p < .001$, more streets with green spaces, $p < .038$, and used more varied routes, $p < .012$. Results suggest there are potential benefits to both layouts. Large centralized parks may invite longer walks; smaller, well-distributed parks may invite more varied routes suggestive of appropriation and motivation processes. Both layouts might be combined in a single neighborhood to attract more walkers.

1. Introduction

There is considerable interest in how urban form can support or constrain healthy physical activity (e.g., Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, 2003). This interest has grown as research increasingly shows the negative effects of inactivity, including increased risk of obesity, diabetes, cardiovascular diseases, as well as some cancers (Lakka, Laaksonen, Lakka, Männikkö, Niskanen, Rauramaa, & Salonen, 2003; Manson, Skerrett, Greenland, & VanItallie, 2004; Tremblay, Colley, Saunders, Healy, Owen, 2010). In order to understand why some people get regular physical activity, many researchers have turned

their attention to identifying local environmental features related to healthy activities such as walking. This work has shown a positive relation between physical activity and proximity to green spaces (Giles-Corti, Broomhall, Knuiman, Collins, Douglas, Ng, Lange & Donovan, 2005; Honold, Lakes, Beyer, & van der Meer, 2015; Kaczynski & Henderson, 2007; Stigsdotter, Ekholm, Schipperijn, Toftager, Kamper-Jørgensen, & Randrup, 2010). Indeed, communities continue to create parks on the assumption that parks will be an amenity that encourages physical activity among citizens (Clark, 2006; Woodbridge, Woodbridge & Byrne, 2005; Woudstra & Fieldhouse, 2000).

The present research continues this inquiry and examines adults' reported walking and jogging in relation to neighborhood green spaces in two neighborhoods in a mid-sized French town. The neighborhoods are in close proximity and similar in size, however, the types and distributions of green spaces are very different. This provides an opportunity to ask if the different distributions of green spaces might be related to different use patterns and distances walked. One neighborhood has multiple small public green spaces, fairly well distributed around the neighborhood, whereas the other has a single large park in the center of the development plus one plaza close to the park. Public green areas in both neighborhoods might serve as attractors, providing support for more walking as people seek these destinations. But parks could also represent a form of constraint to more diverse walking: If people walk to and stay in a single park, they might reduce their walks to other routes and destinations. This research capitalized on the different numbers and distributions of parks to ask if these different physical arrangements are related to residents' use of public green spaces, total distances walked per route, and more varied routes.

1.1 Walking to Parks as Exercise

Although there have been many studies that evaluate the health benefits of neighborhood parks, results are inconsistent as to whether people who live close to a park are likely to walk more in the neighborhood. Indeed, a meta-analysis of 50 studies found mixed results regarding the relationship between proximity to parks and physical activity. Although most associations were positive (17 studies), almost as many yielded mixed results (15 studies) while others showed no significant associations at all (11 studies, Kaczynski & Henderson, 2007).

Researchers have considered two environmental factors that might relate to neighborhood physical activity, the attractiveness of large parks and the walkability of the neighborhood. Much of this research uses self-reports that provide indirect evidence of neighborhood-based physical activity. Several studies emphasized the popularity of large parks that offer varied opportunities (Cohen, McKenzie, Sehgal, Williamson, Golinelli & Lurie, 2007; Cohen, Marsh, Williamson, Pitkin, Martinez, Setodji, & McKenzie, 2010). Two additional studies explicitly noted that large parks attract neighborhood walkers (e.g., Baran, Smith, Moore, Floyd, Bocarro, Cosco, & Danninger, 2014; White, Pahl, Ashbullby, Herbert, & Depledge, 2013). Consistent with this, an Australian study found that, compared to smaller parks, people reported walking farther to get to large parks (more than 2 hectares/4.9 acres) with multiple attractive amenities, such as paths, shade, and water features (Giles-Corti et al.,

2005). Although this study suggests people walk to large parks, in many studies, it is not clear that park visitors actually walked to the park.

Other research suggests that neighborhood “walkability” might be an important predictor of walking to parks. For example, in a study of British people over 65, reported walking was more likely for residents who lived close to an attractive open space, especially if they perceived the paths to (and inside) the park to be safe and attractive (Sugiyama, Ward Thompson, & Alves, 2009). In a study of older women, both perceived neighborhood walkability and proximity to a park were associated with more pedometer-measured steps (King, Brach & Belle, 2003). As a reverse example, participants in a German study reported not walking to an attractive and psychologically restorative park because the routes to/from the park were unpleasant, although many reported walking on a close by, highly vegetated canal (Honold, Lakes, Beyer, & van der Meer, 2015).

Neighborhood walkability was also a key predictor of walking to parks in a large metropolitan area in the United States. Researchers identified people who had and had not walked to their nearby park and then identified the most likely home-to-park routes for both groups. Trained assistants rated these estimated routes on 12 features expected to predict walking (e.g., maintenance, safety, interesting sights). The objective ratings were higher for walkers’ most likely routes, supporting the idea that their walkable neighborhood had supported the choice to walk (Dills, Rutt, & Mumford, 2012). A comparison of large parks in Belgium and the USA found that in both countries, neighborhood walkability was a significant predictor of total park visitors as well as the number of physically active visitors (Van Dyck, Sallis, Cardon, Deforche, Adams, Geremia, & De Bourdeaudhuij, 2013).

Although in many studies it is unclear if people walk or drive to neighborhood parks, the eight studies above indicate that people will walk, especially if the neighborhood is walkable and the parks offer amenities. The Giles-Corti et al. (2005) research in Australia is particularly intriguing because participants reported walking farther to reach large parks with multiple amenities. Thus proximity alone may not support neighborhood walking, however, a combination of proximity and walkable routes may provide the needed support for neighborhood physical activity. In addition, the Giles-Corti et al. study suggests that a benefit of large parks is that they might induce people to walk farther to reach an attractive park, especially if there are walkable routes. One question in the present article is whether people choose walkable routes and another is whether they report walking farther in the neighborhood with a single large park, a park substantially larger than parks in the comparison neighborhood.

1.2 Multiple small parks may also invite walking

A complement to the idea that large parks attract walkers is that the presence of multiple small parks might also encourage walking if people walk from one park to the next, encountering a variety of green spaces. Furthermore, we know that proximity is often related to park use (e.g., Giles-Corti et al., 2005; Walker & Crompton, 2012). It follows that a neighborhood with multiple parks might increase park use because of ease of access. Thus, an additional research question is whether multiple, small, well-distributed parks might also be related to physical activity. In particular, we ask if multiple small parks are more likely to

lead to more varied neighborhood routes or if walking farther to a single large park provides more opportunities to choose more varied routes.

Three research strands are relevant to the idea that route variety might occur more frequently in some neighborhoods than others: 1. multiple attractive destinations for walking, a walkability guideline; 2. creating intrinsic interest as a strategy for maintaining an exercise routine; and 3. research on neighborhood exploration and appropriation of space. These ideas are all related to how much variety participants create in their routes and if this variety is related to other indices of physical activity.

1.2.1 Walkability guidelines, such as multiple attractive destinations—Interest in creating environments where people want to walk led to the development of “walkability guidelines” that articulate key environmental supports for walking (Ameli, Hamidi, Garfinkel-Castro, & Ewing, 2015; Cervero & Kockelman, 1997; Ewing & Cervero, 2010; Ewing, Handy, Brownson, Clemente, & Winston, 2006; Moudon & Lee, 2003). One of the central concepts is that communities should have “multiple destinations” that encourage neighborhood walks. The present research focuses on green spaces as one notable example of a destination that could invite walking (Kaplan, R. & Kaplan, S., 1989, 2002). Thus, providing small parks in a variety of locations may attract some walkers because the parks are pleasant, nearby, and easily accessed. Furthermore, knowing there are multiple small parks may draw people from one park to the next, thereby increasing physical activity by adding more places to visit during a walk. Indeed, Giles-Corti et al. (2005) recommended neighborhood redesigns that could increase distances walked by adding walking trails to connect multiple small parks into a longer string. With respect to the single-park neighborhood, route variety could also occur if participants use alternate routes for traveling to and from the large park and close by plaza.

1.2.2 Intrinsic interest—A second theoretical rationale supporting the idea that parks might encourage more varied walking routes is the literature showing that people can maintain behaviors by creating intrinsic rewards (Frederick-Recascino, 2002; Isen & Reeve, 2005; Nigg, Borrelli, Maddock & Dishman, 2008; Silva, Vieira, Coutinho, Minderico, Matos, Sardinha, & Teixeira, 2010). This orientation could also be relevant to both neighborhoods because there are many ways of creating intrinsic interest, all of which depend on the perspective of the individual. Developing personal intrinsic rewards is recommended because extrinsic rewards (e.g., money, treats, etc.) often yield behaviors that are not sustained unless the reward is maintained. With intrinsic rewards, people continue the behavior because they enjoy it or get other psychological satisfactions from it (Ferrand, Perrin & Nasarre, 2008; Sansone, Weir, Harpster & Morgan, 1992), including a sense of efficacy (Renninger, 2010).

Research shows that when people want to maintain a behavior, one strategy is specifically to add variety to how it is performed (Dimmock, Jackson, Podlog, & Magaraggia, 2013; Sansone et al., 1992). With respect to neighborhood walks, variety might include visiting multiple attractive spaces, using several different routes, or using loop routes that cover different territory out and back. Indeed, to find this kind of enjoyment, people in both the single and multi-park neighborhoods might route themselves past a particularly attractive

view or detour towards a square where there is a lot of social activity. Consistent with this, people who created interest in environmental features as they walked were able to maintain new exercise regimens for several weeks (Duvall, 2011).

1.2.3 Appropriation and attachment—The literature on the appropriation of space and the related literature on place attachment provide another theoretical perspective that suggests that both a single large park and widely distributed parks might be related to increased variety in participants' neighborhood walking routes (Altman & Low, 1992; Benages-Albert, Di Masso, Porcel, Pol, Vall-Casas, 2015; Felonneau, 1994; Korosec-Serfaty, 1976, 1984; Lewicka, 2011; Low, 1992; Manzo & Devine-Wright, 2014; Pol, 1996). Appropriation researchers suggest that people explore, investigate, and use their neighborhood. Through these activities and over time, they become psychologically attached to it (Brunson, Kuo & Sullivan, 2001; Childs, 2004; Moser, Ratiu, & Fleury-Bahi, 2002). In an extension of these ideas, researchers who found an association between neighborhood attachment and the perceived size of the neighborhood suggested that appropriation had increased familiarity with larger areas of the neighborhood, simultaneously strengthening place attachment (Moser et al., 2002, Table 1). Another study used extensive interviews with long-term residents of a river corridor and found that memories and attachment had accumulated slowly over time as people experienced and enjoyed their neighborhood (Benages-Albert et al., 2015).

With respect to the present research, appropriation processes might encourage exploratory behaviors that draw residents from one attractive feature to another, enabling greater variety in chosen walking routes. In the multi-park neighborhood, residents might be drawn from one public space to another, whereas in the single park neighborhood, residents would be drawn by any number of attractors (scenic views, shopping opportunities, architecture) to add variety. The net effect in both neighborhoods might be longer and more varied routes.

Although they emphasize different psychological processes (visiting multiple destinations; intrinsic interest; appropriation and attachment), these three strands of research are similar in showing how neighborhood parks might attract people to visit them or at least pass by during a neighborhood walk. Seeking a variety of parks or other destinations might encourage longer walks to more parts of the neighborhood, a complement to research showing that people walk farther to reach a single large park (Giles-Corti et al., 2005).

1.3 Research Questions

There are three research questions related to park size and distribution: 1. Are visits to green spaces more frequent than would occur by chance? 2. Do people walk farther to reach a distant but large park compared to distances walked to nearby but smaller green spaces (cf. Giles-Corti et al., 2005)? 3. Do people vary their routes in order to access a variety of green spaces (where varied routes are indicated by the number of unique segments visited, the number of green segments visited, and the use of loops, or different routes out and back)?

2. Method

2.1 Comparing neighborhood walkability and participants' route choices

Several walkability indicators were used to compare the two neighborhoods to determine if they were similar in walkability or if they differed in ways that would compete with park size and layout as explanations for participants' route lengths and variety. Detailed statistics and neighborhood comparisons are provided in the Appendix. One measure is the Irvine Minnesota Inventory (IMI) of walkability which has established reliability and validity (Boarnet, Day, Alfonzo, Forsyth & Oakes, 2006; Boarnet, Forsyth, Day, & Oakes, 2011). The IMI measures 7 neighborhood features that contribute to walkability: traffic safety; crime safety; population density; diverse destinations; access for walking; attractiveness; and a new measure, architectural features. In addition to comparing neighborhoods on these 7 features, within each neighborhood, IMI ratings of participants' chosen routes were compared to the neighborhood IMI ratings. This tested whether participants chose routes that were more walkable than typical in their neighborhood.

A second measure of walkability is street connectivity, or the number of intersections per unit area. This allows comparison of the two neighborhoods on the ease with which pedestrians can access all parts of their neighborhood (Dill, 2004; Ellis, Hunter, Tully, Donnelly, Kelleher, & Kee, 2016). Connectivity was complemented with Route Directness scores for each participant (Moudon, Lee, Cheadle, Garvin, Johnson, Schmid, Weathers, & Lin, 2006, Table 3, row 1), a measure of how efficiently individuals actually walked to their destinations (viz., a walked route compared to the "crow flies" route). Details of these comparisons are presented in the Appendix.

2.2 Participant recruitment

Two trained and experienced interviewers worked with city leaders to encourage participation in a study of neighborhood attitudes and park use. City leaders discouraged uninvited contacts with residents, so interested residents needed to contact the research team in order to participate. Outreach for the research employed multiple ways to reach prospective participants (radio interview, newspaper story, notices posted in local shops and buildings, and presentations at two city council meetings or "réunions de quartier"). Being on the agenda at city hall provided publicity and credibility for the study. Letters of invitation were distributed at the meetings and posted in public settings so that residents could contact the researchers to set up an interview for a convenient time. All adults who contacted the researchers were invited to participate as long as they could walk without difficulty. Using multiple outreach strategies was intended to reach a diverse group of residents. Interviews lasted 45 minutes to 1.5 hours.

Interview and IMI data were collected in summer and winter in order to enhance the generality of the findings. Summer interviews were held between June and September and winter interviews were held between November and February. Data were collected during 2009 and 2010.

2.3 Neighborhoods

Participants were invited from two distinct but proximal neighborhoods in a French town. One neighborhood, the “multi-park” neighborhood, comprises the original medieval town center with many historic buildings, a mix of narrow, winding and two-lane streets, and a small pedestrianized area where no vehicles are allowed; it covers 70.7 hectares (173 acres) (Figure 1). This neighborhood contains a mix of small plazas, river views, and larger parks and gardens. The other neighborhood, the “single park” neighborhood, was built in the early 1950’s to replace an area devastated during World War II. It has some angled streets but primarily comprises short- and medium-length two-lane streets arranged in a rectangular grid pattern; this neighborhood covers 96.4 hectares (237 acres) (Figure 2). The single park neighborhood was built around a rectangular central park filled with trees, bushes, lawn, and a large pond; the park has no sports amenities except for the walking paths used by walkers and joggers; a loop walk inside the park is 654 meters (about .4 of a mile). At 5 hectares (~12 acres), this park is large enough to meet Giles-Corti et al.’s (2005) inclusion criterion of more than 2 hectares. Figures 3 and 4 provide photos of parks in the multi-park neighborhood, and Figures 5 and 6 provide two views of the large central park.

2.4 Interviews

Interviewers were able to enroll 90 adult participants over the course of a summer and winter. Forty-eight participants lived in the multi-park neighborhood (n ’s = 24 in summer and 24 in winter); 42 participants lived in the single park neighborhood (n ’s = 26 in summer and 16 in winter). Prior to beginning the interviews, verbal informed consent was obtained using the university’s protocol. Interviewers explained that the purpose of the study was to learn about residents and their experiences living in the neighborhood. Participants were interviewed to ascertain their demographics and backgrounds, as well as to learn how frequently they walked in the neighborhood, how often they visited local parks, and their attitudes towards walking and visiting parks in the neighborhood (see questions in Table 1). Interviewers were trained not to influence respondents’ answers but simply to record answers and probe with follow-up questions if clarification was needed.

2.5 Walking routes and adjustment for segment lengths

The interviewers gave each participant a map of the neighborhood and asked each to draw his/her perceived neighborhood boundary, mark his or her home, and then draw the routes (round trip) used for their three most recent walks or jogs in the neighborhood, regardless of the purpose of the walk. These routes were used to measure the percent of segments traversed that were adjacent to a green space, total distances walked, and route variety as indexed by the number of unique segments, number of unique green segments, and the number of loops (different routes out and back).

Most participants (65 of 90 total, 72%) had used different routes for all three walks, but others repeated a route rather than choosing additional distinct routes. Repeating a route did not mean these participants took fewer walks, so analyses used the mean distances walked per route. Percentages providing 3 different routes in summer are 79% in the multi-park and 65% in the single park neighborhood; those providing 3 different routes in winter are 100% in the multi-park and 31% in the single park neighborhood. One single park winter

interviewee took no walks and provided no routes. To indicate this lack of walking, this individual was assigned scores of zero for analyses of distance walked, number of loops, number of unique segments, and percent of unique segments that were green (patterns of results do not differ if this participant is omitted). One single park neighborhood summer interviewee did not provide route maps but said he walked all the segments in the neighborhood; as a conservative estimate of his walking measures, he was assigned the mean for his group for all values.

Segment length adjustments. Adjusting walkability for segment length provides a more accurate estimate of the actual walkability available in a neighborhood. Short segments provide brief exposures to low/high walkable features while longer segments provide much longer times to experience the walkability level. Therefore the walkability ratings for each segment were divided by segment length to better capture the walkability experience. The length of each segment was measured with the Ruler Tool on Google Earth. Segment lengths were measured from the midpoints of the beginning and ending intersections. Test-retest reliability on 20% random samples in each neighborhood indicated almost perfect agreement, $r(36) = .999$. Accuracy of the Ruler Tool for the study area was assessed by measuring environmental features of known dimensions (e.g., professional sports fields); the correlation between the obtained measure and the known sizes was $r = 1.00$. Google Earth and the Ruler Tool have been used in other research when GIS data are not available, such as for measuring road widths (Pinkerton, Rosu, Janssen, & Pickett, 2013) or proportion roads with sidewalks (O’Loughlen, Pickett, & Janssen, 2011).

2.6 Identifying and rating public green spaces

The IMI ratings (detailed in the Appendix) were used to identify segments with a public plaza, park, river edge, or garden. These spaces have different purposes, but in these neighborhoods they share the common features of being places set aside for people to enjoy. All were for public use and all had some green, especially trees for shade and/or plantings for color. Plazas were typically smaller, and celebrated a person or event with a plaque or statue. For convenience, the terms “park,” “green space,” or “public space” are used to refer to all four kinds of settings. None of these spaces was designed for sports; they provide attractive settings for walking, jogging, socializing, relaxing, playing with children, reading, and so on. Each public space was rated for attractiveness using the 3-point scale of the IMI (1 = unattractive, 2 = neutral or mixed, 3 = attractive).

Examination of the IMI-identified public spaces indicated that the multi-park neighborhood contained 23 street segments associated with 13 greenspaces (plaza, park, river edge or garden) and these were widely distributed in the neighborhood (Figure 1). The single park neighborhood contained 17 total street segments associated with 2 public spaces (Figure 2). Most of these segments (12 of the 17, or 71%) were the central park and streets that edged the park; the remainder comprised a plaza a few blocks from the central park. Note that people in the single park neighborhood who walked to the central park had ready access to multiple green segments simply by walking on segments that surrounded the park; the path through the park was counted as a single segment. The high number of segments around this park would not bias distances walked, which were based on segment lengths, but it should

make it easier for those using the central park to accumulate higher percentages of green spaces traversed.

2.7 Dependent Measures

2.7.1 Use of public spaces—One research question was whether participants' drawn route maps showed they visited green segments more than would be expected by chance. If so, it suggests they were actively seeking out public spaces when choosing routes in their neighborhood. To evaluate this question, individuals' "proportion of green segments visited" was compared to the "proportion of green segments available in the neighborhood." Each participant's "proportion of green segments visited" was the number of different green segments the individual had traversed divided by the total number of segments (green and not green) that s/he had traversed. Single sample *t*-tests compared these values to the "proportion of green segments available," which is simply the number of public green segments divided by the total number of rated segments in the neighborhood. A related question is whether visiting green spaces was related to more walking, a question tested by correlating the number of green spaces per route with the total distance walked.

2.7.2 Distances walked—Route lengths or "distances walked roundtrip" were computed by summing the lengths of all segments traversed in each mapped route. The trail through the single park was included if the participant drew that segment on his/her map; this was the only park interior clear enough to be included in distance measures. Segments that were part of loops were included once and segments that were traversed twice – i.e., both out and back – were included twice in computing these sums. Because participants had provided different numbers of routes (between 1 and 3), these summed distances were averaged to yield a single index of the mean distance traveled per route.

2.7.3 Distance from home to the closest park—Participants lived variable distances from their closest public space which might make it more difficult for some participants to walk to a green space. The Google Earth Ruler Tool was used to estimate the walking distance ("street network route") from each home to the closest segment with a public space (park, plaza, river edge, or garden). Participants marked their homes on their route maps but did not indicate the address (for confidentiality). When more than one park was close, multiple routes were measured and the shortest was used as the proximity measure. Test-retest reliability on a 24% random sample was $r = .98$.

2.7.4 Variety in participants' routes—Route variety is an indicator of how much participants changed their routes. Three indicators of route variety were computed. First coded were how many of each participant's route maps included "loops," indicating the participant chose different routes for leaving and returning home. For this index, complete loops (no repeated segments) were scored 1 and partial loops were scored .5 to roughly reflect how much of the route was on different segments. As a second index of variety, counts were made of the number of unique segments used by each participant across all of his or her mapped routes; and a third index is the number of unique green segments across all mapped routes. The question was whether these three indices of route variety differed between the two neighborhoods.

2.8 Data analyses

Except where noted, data were analyzed using a 2 (Neighborhood: multi-park/single park) by 2 (Season: summer/winter) ANOVA or ANCOVA. Because older participants might have difficulty walking longer distances and one of our primary measures was distance walked, walking data were analyzed covarying participant age. Although the two neighborhoods differed in percent employed, employment status was not significant when included as an additional covariate in the analysis of mean route length, $F(1, 84) = .023, p = .88$, and was not included in further analyses. To simplify the presentation of results, most group means and analyses are presented in tables with verbal descriptions in the text.

3. Results

The purpose of this study is to ask if two distinct park layouts are related to different amounts of walking by adult participants. There are three aims or research questions: 1. Are visits to green spaces more frequent than would occur by chance; 2. Do people walk farther to reach a distant but large park; 3. Is route variety more likely in the neighborhood with multiple small green spaces or in the neighborhood with a single large park (where variety is measured as number of unique segments used, number of unique green segments used, and number of loops in routes)? The Results begins with a brief description of similarities in neighborhood walkability and participant route choices (details in the Appendix), continues with interview data on participants' views of their neighborhoods and parks, then establishes the similarity of access to green spaces in the two neighborhoods, and then addresses the three research questions.

3.1 Comparisons of Neighborhood Walkability Indices

Prior to comparing the neighborhoods on the primary dependent measures, route lengths and variety, three analyses compared the neighborhoods on walkability. Results of these analyses are detailed in the Appendix and generally show that walkability does not differ between the two neighborhoods, leaving park size and distribution as viable explanations for route differences.

In particular, analyses of walkability suggest that:

1. Overall, objectively rated walkability is comparable in the two neighborhoods, although the neighborhoods differ on particular IMI features.
2. Participants' walking routes did not mirror neighborhood walkability ratings, but were higher on some features, suggesting specific preferences. In the single park neighborhood, attractiveness was higher on chosen routes than in the neighborhood as a whole; in the multi-park neighborhood, attractiveness, population density, and diverse destinations were all higher on chosen routes than in the neighborhood.
3. Rated street connectivity was significantly higher in the multi-park than single-park neighborhood. However,
4. chosen routes in both neighborhoods yielded high Route Directness scores that did not differ between the neighborhoods, suggesting both groups chose efficient routes despite the multi-park's higher connectivity score.

In summary, although there were differences between the two neighborhoods in environmental features, chosen routes were more attractive and more direct than typical in the neighborhoods, suggesting that participants in both neighborhoods made the most of the walking opportunities available to them.

3.2 Comparison of participant's demographics and perceptions of neighborhood walkability

Interviews indicated that participants from the two neighborhoods were quite similar in demographic characteristics and residential histories (see Table 1 for all demographic and attitudinal comparisons; question numbers are indicated in the text for easier use of the Table). Both groups of participants comprised adult to elderly samples, with all participants at least 32 years of age and mean ages in the early 50's (Question 1); 16.7% are in their 30's, evenly distributed between the neighborhoods (multi-park, $n = 8$; single park, $n = 7$). The neighborhoods were similar in numbers of male and female participants (Question 2) and proportions living with a partner and living alone (Question 4), however, those in the single park neighborhood were more likely to be working compared to those in the central neighborhood (Question 3).

Both groups of participants were similar in their views of and satisfactions with their neighborhoods. Both groups had lived in their neighborhood approximately 15 years (Question 5), expressed high satisfaction with their choice of neighborhood (Question 6, both means above 3 on the 4-point scale), said they often visited a neighborhood park (Question 10, both means close to 3, or "often," on the 4-point scale), and reported that their neighborhood was "accessible" or easy to get around (Question 11, means of 2.9 where 3 = "completely agree"). The two groups did differ significantly in their ratings of the neighborhood's pleasantness for walking, with the multi-park participants giving a half-step higher rating (Question 13, 3.9 vs. 3.3, $p < .003$); similarly, multi-park residents had been more active in the neighborhood in the previous week, being more likely to report they had run errands (Question 7) and had engaged in more pleasurable activities in their neighborhood (Question 8, 2.7 vs. 1.4 of 5 pleasurable activities, $p < .000$).

Of particular importance for traveling around the neighborhoods, both groups described their neighborhoods as safe, with most reporting they felt secure when walking in their neighborhood (Question 12, almost 3 on the 3-point scale) and only about 10% in each group deliberately avoiding certain areas in their neighborhood because of discomfort or fear (Question 9). Overall, Table 1 suggests that the two groups did not differ in their perceptions of accessibility, enjoyment of walking, or in their perceived safety walking in their neighborhoods. However, multi-park residents rated their neighborhood higher on being pleasant for walking and reported spending more time in their neighborhood on errands and pleasant activities.

3.3 Comparison of reasons for using neighborhood green spaces

As shown in Table 2, more than 75% of participants in both groups said they visited their local parks, a nonsignificant difference in use rates ($p = .26$). Table 2 also shows that the two groups differed in reasons for visiting parks. Multi-park participants emphasized the calm

and natural beauty of parks and that parks provided good places to take their children or grandchildren; few described socializing in their parks. In contrast, in the single park neighborhood, the emphasis was on socializing with friends or family in their park; a smaller percentage visited their park not to socialize but for the calm beauty; only two walked with their children in the park (difference in types of reasons, $p < .001$).

3.4 Availability and attractiveness of public green spaces in the two neighborhoods

Are the neighborhoods similar in the numbers, proximities, and attractiveness of parks adjacent to a green segment? If parks are equally accessible and attractive in the two neighborhoods, this allows a focus on the primary research question, the relation between park sizes and layouts and participants' use patterns. As shown in Table 3, there are 23 green street segments in the multi-park and 17 in the single park neighborhood, indicating nonsignificant differences in the numbers and proportions of green segments available in the two neighborhoods. As further support for the similarity of parks in the two neighborhoods, the objective IMI attractiveness ratings for the spaces are high (most are close to 3.0 on the 3-point scale), and do not differ significantly (Table 3). The two neighborhoods do differ in proximity to participants' closest parks, with those living in the single park neighborhood situated farther from their closest public space compared to participants in the multi-park neighborhood (approximately 37 meters, Table 4). These comparisons indicate that neither park presence nor attractiveness is likely to be responsible for differential use of parks in the two neighborhoods, although proximity might facilitate use in the multi-park neighborhood.

3.5 Walking Measures

3.5.1 Walking route lengths and chance availability of parks—Did participants visit neighborhood green spaces, and were participants from one neighborhood more likely than others to visit these spaces? Participants were considered to have visited a public space if their route included a segment with a green space, regardless of its size. Although they lived farther from their closest park, participants in the single park neighborhood were significantly more likely to visit at least one green segment while on their neighborhood routes: More than one-fourth of their unique route segments adjoined a park, which is significantly more than would have occurred by chance (25.5% vs. 15.6%, Table 4). In contrast, in the multi-park neighborhood, 21.9% of participants' unique route segments included a park, which is not significantly different from the chance park availability of 21.5%. Thus, residents of the single park neighborhood were more likely to visit a segment in and around their park or its nearby plaza. This difference occurred although their public spaces were more distant and although public spaces were equally available in the two neighborhoods (the proportions of segments adjacent to public spaces were the same).

3.5.2 Route lengths and their correlation with park visits—A primary question of this research is whether people walk farther out and back to a large, centrally located park such as in the single park neighborhood. Single park residents' average round trip route lengths were longer (estimated mean = 1329.1 meters or 1.33 Km) than were those in the multi-park neighborhood (estimated mean = 1063.6 meters or 1.06 Km; see Table 4). The difference between groups in route lengths is small (.2 Km, or .12 miles) but significant, $p < .02$, covarying participants' ages. In part, this greater route length is consistent with the

greater distance to their centrally located park. However, support for the idea that parks attract walkers and may be related to longer routes is that in both neighborhoods, mean distances walked per route are strongly and positively correlated with the average number of green segments per route. That is, the more green segments visited, the longer the walk (covarying participants' ages, Table 4, final row). Note that in the multi-park neighborhood, where public green spaces were farther apart, this significant correlation represents more effort than was needed in the single park neighborhood, where most green spaces were adjacent and easier to accumulate during a walking route.

3.5.3 Variety in route choices in the two neighborhoods—The final question is whether route variety differs between the two neighborhoods. Does walking farther to their park enable single park neighborhood participants to choose more varied routes? Or does the presence of multiple scattered parks in the multi-park neighborhood provide more opportunities for varied routes and varied views? The three indicators of variety in walking routes are the mean number of unique green segments visited, the total number of unique segments visited (total unique segments, regardless of green features) and the number of loops in their routes (different segments out and inbound). The evidence favors multi-park neighborhood residents as choosing more varied routes (Table 5, covarying participant age). Participants in the multi-park neighborhood included significantly more unique green segments on their routes, traversed significantly more unique segments (green and non-green) on their routes, and were significantly more likely to use loops that varied their routes, compared to participants in the single park neighborhood. It is also noteworthy that the analyses in Tables 4 and 5 show that the age covariate played a significant role in only one analysis, proximity to the closest park. Other activity measures were not related to participant age.

4. Discussion

Although there is considerable research on the relation between proximity to parks and park use, we found no research that asked if the distribution of multiple green spaces in a neighborhood plays a role in their use. The present research provided an examination of this question by comparing walking distances and route variety for adult participants in two neighborhoods, one with a single central park and a nearby plaza, and the other with numerous smaller but distributed green spaces. Results indicate benefits to both layouts. On average, residents whose neighborhood provided a single large park lived farther from their closest park than did participants whose neighborhood offered multiple small public spaces. Despite this barrier, participants in the single park neighborhood walked significantly farther in order to visit their park. Although the between-groups mean difference was small (between 1/10th and 2/10th of a mile per trip), it would likely accumulate over time, increasing the overall health benefits of walking for this group.

Participants in the neighborhood with multiple small public spaces also took advantage of their neighborhood's amenities. Data derived from their route maps revealed more route variety on all three indicators than exhibited by participants from the single park neighborhood. They used more unique segments, more unique green segments, and more loops or different routes out and back. Such use of varied routes is consistent with the

frameworks that guided this project, each derived from a different research literature, but all converging on the idea that people walk when the built environment provides support (interesting and safe places to visit, options for different walking routes, and settings where appropriation and attachment can occur). In the long term, multi-park participants may engage in more sustained walking simply because the varied routes and destinations help them to maintain interest in visiting their neighborhood.

An important issue is whether the results can be attributed to the different park layouts or are due to other preexisting factors that would relate to walking, such as participants' views of the safety and attractiveness of their respective neighborhoods, and objective measures of neighborhood walkability. As shown in Table 1, participants felt equally safe in their respective neighborhoods, and as indicated in the Appendix, IMI ratings in the two neighborhoods indicated that both provided equal safety from crime and access to multiple destinations. There are neighborhood differences on specific IMI features, however, on balance, overall walkability appears to be similar for both neighborhoods.

More interesting is examination of participants' chosen routes versus neighborhood-wide ratings. Comparisons indicated that both groups had chosen to walk on segments that were significantly more attractive than the IMI attractiveness rating in their neighborhood as a whole (see Appendix for details). A similar comparison of Route Directness showed that both groups had chosen routes that were almost as direct as "crow-fly" distances. Thus, despite the substantially lower connectivity index obtained in the single park neighborhood, those participants chose routes that provided as much efficiency as did the streets in the multi-park neighborhood. These are encouraging data and suggest that people can optimize neighborhood walks by finding attractive and efficient routes if enough are provided in the neighborhood.

Interviews suggested the two groups of participants were very similar in demographic qualities, and had similar attitudes towards their neighborhoods and towards walking in their neighborhoods. Both groups rated their neighborhood as highly accessible (both means were 2.9 on the 3-point scale), and although the single-park group gave a lower rating to "pleasantness for walking," the absolute value was in the positive range of the scale and very close to the responses in the multi-park neighborhood (.6 units lower). Thus neither group attributed their route patterns to difficulty getting around their neighborhood or to unpleasant routes (cf. Baran et al., 2014). In addition, age was not a factor in any analyses except to show that older people lived farther from their closest park (Table 4). This pattern supports other research suggesting that walking is a healthy behavior that is available to people of all ages (e.g., Sugiyama & Ward Thompson, 2007; Sugiyama et al., 2009).

There were some intriguing attitudinal differences that favored the multi-park neighborhood. Compared to the single-park group, these participants reported spending more time in their neighborhood on both errands and pleasurable activities, described their neighborhood as more pleasant for walking, and expressed substantially more overall satisfaction with their neighborhood. Although they visited more green segments, their visits were at a chance level (whereas the single park residents exceeded a chance level of use of green segments). It may be that parks were an important aspect of route decisions in the multi-park neighborhood,

but other neighborhood features also attracted them, such as destinations for socializing or shopping. Future research could use *en route* recordings or probe participants for more details about features they enjoyed and looked forward to seeing as they walked (cf. Brown, Werner, Amburgey & Szalay, 2007).

Our interviews did not directly tie participants' behaviors and attitudes to how public green spaces were distributed in their neighborhoods. However, future research should examine the possibility that small public spaces contribute a distinct benefit by virtue of their availability. An attractive but distant large park may be so inaccessible people cannot walk there to enjoy it. This does not discount the importance of larger parks for their greater amenities and the additional distance walked, but suggests that small parks play important roles in creating pleasant communities. This point may be particularly relevant in communities with dense housing that limits the availability of large green spaces close to residences. Nearby neighborhood or "vest pocket" parks may provide settings that combine walking, relaxing, spending time with family and seeing neighbors, even without providing large playing fields or natural areas (Nordh & Ostby, 2013). The present research suggests that parks do not need to be large to attract users, and an overemphasis on large parks may overlook important benefits of small neighborhood green spaces (<http://parkscore.tpl.org/methodology.php>).

This is a correlational study and caution is important before attributing differences to any particular feature. Our emphasis on the availability and distribution of green spaces may have obscured alternative explanations for participants' route choices. One possibility is that the route differences represent differences in preferences on the part of the residents rather than the drawing power of the multiple public spaces. It is also possible that what we interpreted as specific attraction to public green spaces was actually attraction to other features at these spaces, such as the social activities that might be found there. Consistent with this, a Chicago (United States) study suggested that social life and sense of community were more important than nature at attracting residents to city parks (Fan, Das & Chen, 2011).

There are additional limitations to the study. First, participants were 32 years and older, with 30% in both neighborhoods between 60 and 86 years of age. While such an age span has merits, the sample does limit the ability to generalize to people in their twenties and younger. It is possible that people in their twenties would not be so drawn to neighborhood walking and would prefer larger parks with more sports facilities. More in-depth analyses of motives for walking, route choices, and park selection should be examined. Finally, although this study drew from literatures on intrinsic interest, appropriation and attachment processes that might encourage people to walk from one small park to another, it is important to acknowledge the relevance of these psychological processes for visitors to larger parks. For example, the park itself in addition to the intervening neighborhood could provide opportunities for a variety of routes and destinations, appropriation, and so on. There could be many places within large parks to explore, enjoy, become attached to, and continue to seek out over multiple visits -- ideas that could be tested in future research.

The project has potential implications for community design. It may be that the optimum neighborhood design provides many kinds of gathering spaces so that a variety of small and

large destinations is available to encourage more neighborhood physical activity. Although they proved to be popular places for participants to visit, the small parks in the present research were not evenly distributed in this neighborhood. Community planners might identify an ideal pattern of distribution in which small parks are close enough to draw people from one park to the next, but are better distributed in the neighborhood so that more residents have access to one or more parks. Furthermore, it may be that parks are only one part of what makes a neighborhood attractive for walking (cf. Ward Thompson, 2013). Indeed, an analysis of walking among the elderly found they walked more when retirement villages were embedded in communities that offered multiple attractive destinations; in contrast, retirement villages with many on-site amenities yielded less total walking among residents (Nathan, Wood, & Giles-Corti, 2014).

The study contributes to the growing body of literature on walkability and added the novel theoretical constructs of intrinsic interest and appropriation processes as ways to maintain walking. Additional research is needed to understand how people use their neighborhoods in healthful ways, especially the interplay among a variety of neighborhood features and amenities in addition to green spaces. Furthermore, additional strategies might be devised for using attractive environmental features to increase distances traveled in order to reach healthy exercise levels (Giles-Corti & Donovan, 2003). As Manusset (2012) suggested, many communities are at critical points in their development and planning decisions need to be made carefully and thoughtfully, so that communities provide walkable routes to attractive green destinations.

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Appendix. Examination of neighborhood walkability and connectivity (control variables)

1. Overview

This section examines three questions that might compete with attraction to green spaces as explanations for participants' routes. First, trained raters assessed walkability to ask if the two neighborhoods differ in walkability indicators. Second, using the same ratings, the walkability of participants' routes was compared to general neighborhood walkability to determine if participants chose to use more walkable parts of their neighborhood. Third, an additional measure of accessibility, "street connectivity," was compared to assess whether the neighborhoods differed in access for walkers/joggers. As a complement to this, participants' "Route Directness" scores (Moudon et al., 2006, Table 3 row 1) were compared to "crow-fly" distances to compare the neighborhoods on how efficiently participants' walked to destinations.

1.1 Walkability ratings

Walkability was assessed for all blocks in each neighborhood, using city-defined neighborhood boundaries. A "block" or "segment" refers to a section of a street between two cross streets or dead end(s). There are 107 blocks in the multi-park and 109 blocks in the single-park neighborhood. Walkability for each segment was assessed using a version of the Irvine Minnesota Inventory (IMI) (Boarnet, Alfonzo, Forsyth, & Oakes, 2006) specifically adapted to France (Author, 2013). This measure of walkability has demonstrated reliability (i.e., multiple raters agree) and validity (i.e., counts of pedestrians are consistent with the walkability ratings; Boarnet, Forsyth, Day, & Oakes, 2011). The IMI is based on general principles of walkability, or sets of physical features that invite people out into the community. All of the 7 IMI features contribute to walkability; to simplify the presentation of results, the features are organized into the three categories of "safety," "access/community" and "pleasurability." Safety from crime and safety from traffic comprise the safety category. Walking access (good sidewalks, multiple routes), population density (sufficient people to populate the streets) and multiple destinations (places to visit, shop, enjoy, etc.) comprise the access/community category. Attractiveness and architectural features comprise the pleasurability category. Architectural features are a new IMI category added for the French context (See note to Appendix Table 1 for complete list of architectural items).

The IMI for French communities contains 208 individual items which were used to rate each street segment in the 2 study areas. These individual items were combined into the 7 categories so that every segment has a distinct walkability profile. IMI data were collected by 2 trained raters with inter-rater reliability data collected on a 5% sample of streets.

Percent agreement was very high, ranging from 90% – 100%, and averaging 99.7% for all items.

In the IMI rating form, the number of categories for rating each feature varies from 2 (absent/present) to 7. This allows sensitive measurement but also makes it necessary to convert the raw scores to *z*-scores prior to averaging items into a mean score for each feature. The *z*-scores were based on all 216 segments in the study so the two neighborhoods could be compared for walkability. Features that occurred rarely could result in extreme *z*-scores, a problem that was minimized by “Winsorizing” (extreme scores pulled towards the mean so that no *z*-score exceeded ± 3.11) or by merging similar items into a single set (e.g., separate ratings of “types of natural settings” were combined into a single “nature feature” and averaged with other “attractiveness” items).

1.2 Street connectivity and directness of participants' routes

Street Connectivity—As an additional measure of walkability, GIS data were used to compute an index of connectedness, or how easy it is to get from one part of a neighborhood to another. A common measure is “intersection density,” computed as the number of intersections per total neighborhood area (Dill, 2004). A recent evaluation of the six major connectivity indices recognized intersection density’s validity: It was one of two measures that were highly correlated with observed physical activity (Ellis, Hunter, Tully, Donnelly, Kelleher, & Kee, 2016). A 5-category index is used for interpreting the intersection density values, with a “5” indicating the highest connectivity; the categories and corresponding number of intersections per square mile are: 1 = < 80; 2 = 80 – 250; 3 = 250 – 290; 4 = 290 – 330; and 5 = > 330 (Aurbach, 2005). In the present study, intersections were created utilizing the “Feature Vertice to Point” tool in ArcMap with the “Both Ends” point type utilized. These features were then manually cleaned to remove duplicate or erroneous records. All intersections were included in the estimates (meetings of two roads, two pedestrian pathways, or a road and pedestrian pathway). Neither area has roadways that exclude pedestrians (e.g., no freeways)

Route Directness—To assess whether participants’ routes in the two neighborhoods were differentially constrained by connectivity, we computed for each participant an additional index, Route Directness. Route Directness is computed as $[(\text{Direct Route}/\text{Chosen Route}) * 100]$, where the length of the most direct route to a destination (i.e., “crow fly” distance) is divided by the length of the participant’s actual route to the same destination (Moudon et al., 2006, Table 3 row 1). A score of 100% indicates the chosen route is the same as the most direct route (viz., out and back on a single street), whereas numbers below 100% indicate decreasing levels of directness in the chosen route. Route Directness scores in the two neighborhoods can be compared to see if one group of participants used less direct routes and if this is related to lower street connectivity. Route Directness was computed for one randomly selected route for each participant. After these scores were computed, Route Directness for a randomly selected subgroup (22% of the sample) was re-measured to assess inter-rater reliability, which was very high, $r(18) = .97$.

2. Results

2.1. Comparisons of walkability ratings between neighborhoods

A preliminary question is whether the two neighborhoods differ in walkability, as estimated from IMI ratings. As shown by asterisks in Appendix Table 1, the two neighborhoods differ significantly or marginally significantly on 5 IMI scores, with some favoring each neighborhood, resulting in similar overall levels of rated walkability. As to safety and as indicated by the asterisk, the single-park neighborhood offers more safety from traffic but the two are do not differ on safety from crime (both scores at the neutral point). With respect to access/community, the single-park neighborhood has higher population density, the two neighborhoods do not differ in the variety of destinations, but the multi-park area offers more route access (albeit marginally significant). As to the pleasurability indicators, the multi-park area has higher attractiveness ratings while the single-park neighborhood has higher scores on historical architectural features. In sum, Appendix Table 1 shows the two neighborhoods differ on specific features but have similar overall IMI ratings, especially on the key measures of safety and access/community.

Appendix Table 1

Neighborhood Differences in Walkability: Mean Score of each Feature Per Km (z values) with SDs in parentheses

Walkability Feature	Multi-park ($n = 107$ segments)	Single Park ($n = 109$ segments)	$F(1, 214)$	Partial η^2
Safety: Multi- vs Single Park				
Traffic Safety*	-3.33 (5.97) <	2.19 (7.77)	34.28, $p < .001$	.14
Crime Safety	-.15 (6.25) =	-.19 (7.84)	0.00, $p = .96$	.00
Access/Community: Multi- vs Single Park				
Density*	-4.26 (8.76) <	2.66 (12.19)	22.89, $p < .001$	.10
Diverse Destinations	-.29 (5.63) =	-.87 (9.16)	0.31, $p = .58$	.001
Access for Walking ⁺	.85 (8.12) >	-1.61 (4.91)	7.27, $p < .008$	.03
Pleasurability: Multi- vs Single Park				
Attractiveness*	2.40 (6.38) >	-2.38 (4.41)	41.07, $p < .001$	.16
Historical Features*	-2.64 (9.90) <	1.49 (10.91)	8.47, $p < .004$	.04

Note: Negative values indicate the mean is below average, positive values indicate the mean is above average for the 2 communities. Obtained p values are shown in column 4. Asterisks in column 1 indicate difference is significant (+ indicates marginally significant) by the Bonferroni adjusted alpha level of .007; arrowheads show directions of effects.

Historical Features (to adapt the IMI to French history and culture): Buildings with different setbacks; interesting architecture; historic architectural features; stone sculptures; carved pediments or window frames; corbels or support brackets; visible beams; wrought iron gates; copper placards; wrought iron railings; no bars; oversized windows; narrow windows; recessed entrances; doors below street level; cellar doors

2.2 Did participants choose more walkable routes than typical for their neighborhood? IMI Walkability Scores for Neighborhood and Participant Routes

The question of whether people chose walkable routes is addressed in Appendix Table 2, which estimates whether people chose more walkable routes than typical for their

neighborhood. This table compares IMI ratings for all neighborhood segments actually used by participants versus all segments in their neighborhood; multi-park data are above and single park data are below. Note that including participants' chosen segments in the neighborhood IMI scores reduces the potential difference between the two and yields a conservative test. In the multi-park neighborhood, with respect to safety, participants' chosen routes were significantly less safe than the general neighborhood. Note that in contrast to these IMI ratings, survey results indicated the multi-park neighborhood was perceived to be safe (items 9, 11, 12, 13, Manuscript Results Table 1). This inconsistency may indicate that people know the relative safety of their neighborhoods. With respect to access/community, multi-park participants' chosen routes are on segments with significantly more housing density and have more diverse destinations than the neighborhood as a whole; in addition, chosen routes provide less access than the neighborhood as a whole. And with respect to the pleurability indicators, chosen routes are more attractive but offer fewer historical architectural features than the neighborhood. In contrast, in the single park neighborhood, for most IMI features, the chosen routes are similar to the general neighborhood walkability (using the Bonferroni criterion of .007). The one significant difference between chosen routes and the general neighborhood is that chosen routes were more attractive compared to segments in the entire neighborhood. Thus in both neighborhoods, participants tended to choose more attractive features on their routes. Contrary to notions of walkability theory, multi-park participants chose segments with lower traffic safety, crime safety and accessibility. IMI Ratings for routes in the single park neighborhood were fairly typical for the neighborhood.

Appendix Table 2

Do participants seek out more walkable segments in their neighborhood? IMI scores per km for participants' routes compared to their neighborhood's average IMI walkability scores, z-scored Means (SDs).

a. Multi-park Neighborhood			
Walkability Feature	Mean z (SD) for Segments Used by Participants (n = 48 participants)	Mean z (SD) for Neighborhood (n = 107 segments)	Single sample t(47)
Safety in Multi-park Neighborhood			
Traffic Safety*	-5.05 (1.87) <	-3.33 (5.97)	-6.36, $p < .001$
Crime Safety*	-1.37 (2.10) <	-.15 (6.25)	4.02, $p < .001$
Access/Community in Multi-park Neighborhood			
Density*	-3.05 (1.94) >	-4.26 (8.76)	4.34, $p < .001$
Diverse Destinations*	1.30 (1.73) >	-.29 (5.63)	6.39, $p < .001$
Access for Walking*	-.45 (1.84) <	.85 (8.12)	-4.90, $p < .001$
Pleasurability in Multi-park Neighborhood			
Attractiveness*	5.90 (2.62) >	2.40 (6.38)	9.28, $p < .001$
Architectural Features*	-3.68 (2.80) <	-2.47 (9.32)	3.00, $p < .004$
a. Single Park Neighborhood			

a. Multi-park Neighborhood			
Walkability Feature	Mean z (SD) for Segments Used by Participants (<i>n</i> = 48 participants)	Mean z (SD) for Neighborhood (<i>n</i> = 107 segments)	Single sample <i>t</i> (47)
Walkability Feature	Mean (SD) for Segments Used by Participants (<i>n</i> = 42 participants)	Mean (SD) for Neighborhood (<i>n</i> = 109 segments)	Single sample <i>t</i> (41)
Safety in Single Park Neighborhood			
Traffic Safety	1.53 (3.00) =	2.19 (7.77)	-1.43, <i>p</i> = .160
Crime Safety	-1.00 (5.05) =	-.19 (7.84)	-1.04, <i>p</i> = .305
Access/Community in Single Park Neighborhood			
Density	.62 (5.50) <	2.66 (12.19)	-2.41, <i>p</i> < .021
Diverse Destinations	-1.23 (2.18) =	-.87 (9.16)	-1.07, <i>p</i> = .290
Access for Walking	-1.17 (1.54) =	-1.61 (4.91)	1.86, <i>p</i> < .070
Pleasurability in Single Park Neighborhood			
Attractiveness*	-0.99 (1.99) >	-2.38 (4.41)	4.52, <i>p</i> < .001
Architectural Features	-.30 (4.98) =	.56 (9.65)	-1.12, <i>p</i> = .269

Note: Obtained *p* values are shown in column 4. Asterisks in column 1 indicate difference is significant by the Bonferroni adjusted alpha level of .007. One winter garden neighborhood participant reported no walks and is assigned scores of zeroes to indicate zero routes traveled. Results do not change if that individual is omitted.

2.3 Ease of access (intersection density or “connectivity”) and Route Directness

The IMI measure of “accessibility” favored the multi-park neighborhood, albeit at a marginally significant level. An alternative estimate of pedestrian access, intersection density, is not assessed by the IMI. Intersection density is an estimate of the ease with which participants can access their neighborhood via streets and sidewalks as well as paths not associated with a street. Intersection density for the multi-park neighborhood is 3.79 intersections per hectare, a category 5 value, indicating the highest level of connectivity on the 1 to 5 scale. In contrast, there were 2.14 intersections per hectare for the single park neighborhood, a less accessible category 2 value. These values and their categories indicate considerably more access in the multi-park neighborhood. A visual comparison of the street networks in Figures 1 and 2 confirms that the multi-park neighborhood offers more intersections, although they tend to cluster in the upper portion of the neighborhood.

Despite these differences at the neighborhood levels, Route Directness scores based on participants’ actual route choices were high (76.1% for multi-park and 81.3% for single-park, where 100% is perfect directness), and do not differ between the two neighborhoods, indicating that both groups of participants chose walking routes that were similar in directness, Multi-park, *M* = 76.1%, *SD* = 13.3, *n* = 48; Single park, *M* = 81.3%, *SD* = 14.8, *n* = 41, *F*(1, 85) = 2.52, *p* = .12, *MSE* = 199.32, partial η^2 = .03.

3. Discussion

Comparison of the IMI ratings between neighborhoods indicated that each neighborhood had higher mean scores on some features and lower on others, but that overall, the two were

similar in walkability. Comparisons between walkability of participants' chosen routes and neighborhood ratings indicated that multi-park participants' routes had higher IMI ratings on density, diversity, and attractiveness (route scores were lower than their neighborhood on traffic and crime safety, access and architecture). Single park participants' routes were higher on only attractiveness; otherwise route scores did not differ from neighborhood means. In sum, IMI route ratings indicate that both groups chose routes that were more attractive than typical for the neighborhood. Multi-park participants' routes also favored density and diversity; single park participants' routes did not differ from the neighborhood on the other categories.

Although the two neighborhoods differed in measured connectivity and favored the multi-park neighborhood, participants' Route Directness scores did not differ and were relatively high (approximately 75%, where 100% is a "crow-fly" route), suggesting the single park participants had chosen more efficient routes than typical in their neighborhood.

Manuscript Highlights

People walk farther to reach large, attractive parks.

This research compares two neighborhoods with distinct park sizes and distributions.

Both small, well-distributed parks and a single large park attracted walkers.

Routes were farther to the large park but were more varied to reach the small parks.

Both large and small parks can support sustained walking.

Figure 1.
Map of Multi-Park Neighborhood

Figure 2.
Map of single-park neighborhood.

Figure 3.
Park in multi-park neighborhood

Figure 4.
Park in multi-park neighborhood

Figure 5.
Pond in single park neighborhood

Figure 6.
Walkway in single park

Table 1

Demographic characteristics, residential histories, and activities in neighborhood

	Multi-park	Single park	Statistical test
Demographic characteristics			
1. Mean age	51 years Range: 37–74 12 were 60 or older	52 years Range: 32–86 12 were 60 or older	$t(88) = .46, p = .64$
2. Sex	56% female	62% female	$\chi^2(1, N = 90) = .30, p = .59$
3. Employed	77%	100%	$\chi^2(1, N = 90) = 10.96, p < .001$
4. Live alone/partner/other	44% / 54% / 2%	31% / 67% / 2%	$\chi^2(2, N = 89) = 3.36, p < .19$
Residential history			
5. Years living in neighborhood	15.4	17.9	$F(1, 85) = .35, p = .55$ $MSE = 282.58$, partial $\eta^2 = .004$
*6. How satisfied are you with your choice of neighborhood (1 = not at all satisfied; 4 = very satisfied)	3.4 (.12)	3.2 (.94)	$F(1, 85) = .56, p = .45$, $MSE = .990$, partial $\eta^2 = .007$
Everyday Activities			
	Multi-park	Single park	
In the last week did you go into your neighborhood in order to (Percent saying “Yes”):			
7. Do errands	98%	81%	Kappa = .081, $p < .007$
8. Sum of 5 pleasurable reasons (walk; have fun; relax in neighborhood; time with children or grandchildren; visit friends or family)	2.7 (.88)	1.4 (1.12)	$F(1, 86) = 43.06, p < .000$, partial $\eta^2 = .334$, $MSE = .973$
9. There are places I want to go but avoid (Percent Yes)	8%	12%	$\chi^2(1) = .317, p = .573$
*10. I visit a neighborhood park (1 = never; 2 = rarely; 3 = often; 4 = daily)	2.6 (.77)	2.8 (1.13)	$F(1, 86) = .08, p = .78$, partial $\eta^2 = .001$, $MSE = .85$
*11. Neighborhood is “accessible” (French term, “practicable”) (1 = not at all; 3 = very)	2.9 (.39)	2.9 (.33)	$F(1, 85) = .105, p = .747$, partial $\eta^2 = .001$, $MSE = .128$
12. Do you feel insecure when walking in your neighborhood? (1 = often; 3 = never)	2.8 (.41)	2.8 (.44)	$F(1, 85) = .574, p = .451$, partial $\eta^2 = .007$, $MSE = .175$
13. Neighborhood is pleasant for walking (not at all agree = 1; strongly agree = 4)	3.9 (.49)	3.3 (1.06)	$F(1, 80) = 11.49, p < .001$, partial $\eta^2 = .126$, $MSE = .630$
*14. Satisfaction with neighborhood (1 = not at all satisfied; 6 = very satisfied)	5.7 (.86)	4.6 (1.45)	$F(1, 86) = 16.58, p < .000$, partial $\eta^2 = .16$, $MSE = 1.40$

* For items with an asterisk: In the original question, a low score indicated a favorable response. These scores were reversed so that in the table, for all questions, a high score indicates the most favorable response.

Table 2

Reasons for visiting parks (open-ended responses from participants who visited parks)

Neighborhood	Socializing in natural beauty	Calm setting of natural beauty	Walk with children	Total
Multi-park	3 (7.1%)	27 (64.3%)	12 (28.6%)	42 (of $N = 48$) 87.5% used parks
Single park	19 (57.6%)	12 (36.4%)	2 (6.0%)	33 (of $N = 42$) 78.5% used parks
Total	22	39	14	75 (of $N = 90$)

Comparison of two neighborhoods on reasons for visiting parks χ^2 (df = 2, $N = 75$) = 23.81, $p < .001$. Table excludes 6 participants from multi-park and 9 from single park neighborhood who said they did not visit parks, a nonsignificant difference in use rates, χ^2 (df = 1, $N = 90$) = 1.29, $p = .26$.

Table 3

Comparison of segments and public spaces between the neighborhoods: Objective features and trained rater assessments

Neighborhood size	Multi-park neighborhood 70.7 hectares	Single park neighborhood 96.0 hectares	Test of differences between neighborhoods
Segments with public spaces	$n = 23$ segments ^a (21.5% of 107)	$n = 17$ segments ^a (15.6% of 109)	χ^2 (df = 1, N = 216) = 1.24, $p = .26$
IMI Attractiveness	Mean (SD) n segments	Mean (SD) n segments	for unequal variances ^c
Ratings by segment ^b			
Park	2.83 (.41) 6	3.00 (.00) 7	$t(5) = -1.00, p = .36$
Plaza	2.87 (.34) 16	3.00 (.00) 13	$t(15) = -1.46, p = .16$
Garden	2.70 (.67) 10	3.00 (.00) 17	$t(9) = -1.41, p = .19$
Riverbank	3.00 (.00) 14	None present	NA
Other	3.00 (.00) 5	3.00 (.00) 3	(no variance)
Numbers and sizes of parks, plazas, gardens, riverbanks, or other public green spaces	$n = 13$ green spaces <u>Acres</u> Mean = 0.86 Range = 0.07 – 4.24 <u>Hectares</u> Mean = 0.35 Range = 0.03 – 1.72	$n = 2$ green spaces <u>Acres</u> Mean = 5.67 Range = 0.53 – 10.80 <u>Hectares</u> Mean = 2.29 Range = 0.21 – 4.37	

^aThe number of segments do not equal the n 's for attractiveness ratings because some segments had more than one of these features.

^bRatings were made using the Irvine-Minnesota Inventory (IMI); 3 is the highest possible attractiveness rating (see text).

^cdf's differ from sample n 's due to adjustment for unequal variance.

Table 4

Participant route lengths and use of green spaces (covarying age)

	Multi-park residents' routes (<i>n</i> = 48) est. Mean (SE)	Single park residents' routes (<i>n</i> = 42) est. Mean (SE)	<i>F</i> (1, 85)	Partial η^2
Mean distance to park and route length (SD) in meters and feet				
Mean distance from home to closest park Levene's <i>p</i> = .26; Age, <i>p</i> < .001	104.3 m (9.29) 342.1 ft (30.48)	140.6 m (10.21) 461.1 ft (33.50)	6.92 <i>p</i> < .01 MSE = 4133.29	.07
Mean route length Levene's <i>p</i> < .01; Age, <i>p</i> = .16	1063.6 m (76.30) 3490 ft (250.33)	1329.1 m (83.90) 4360 ft (275.26)	5.48 <i>p</i> < .02 MSE = 278995.94	.06
Use of green segments				
	Multi-park	Single park		
Percent green segments used per participant vs. percent green segments in neighborhood	21.9 vs. 21.5 <i>t</i> (47) = .28, <i>p</i> = .78	25.5 vs. 15.6 <i>t</i> (41) = 3.87, <i>p</i> < .001		
Green segments per route Levene's <i>p</i> < .001; Age, <i>p</i> = .80	1.34 (.17) Range 0 – 4.33 Mdn = 1.33	1.47 (.19) Range 0 – 1.00 Mdn = 1.00	0.29, <i>p</i> = .59 MSE = 1.41	.00
Correlation of mean green segments per route with route length (covarying age)	<i>r</i> (45) = .59 <i>p</i> < .000	<i>r</i> (39) = .55 <i>p</i> < .000		

Table 5

Variety in participants' routes: Unique segments and loops (covarying age)

Variable & covariate (age)	Multi-park	Single park	<i>F</i> (1, 85)	Partial η^2
Mean unique segments visited Levene's $p = .17$; Age $p = .96$	19.0 (1.21)	10.7 (1.33)	21.45 $p < .001$ MSE = 69.81	.20
Mean unique green segments visited Levene's $p = .38$; Age $p = .87$	4.02 (.36) Range 0 – 13 Mdn = 4.00	2.90 (.39) Range 0 – 13 Mdn = 3.00	$F(1, 85) = 4.45$ $p < .038$ MSE = 6.18	.05
Mean loops per route (different route out-back) Levene's $p = .12$; Age $p = .11$	.19 (.03)	.07 (.04)	6.56, $p < .012$ MSE = .05	.07