



More than nature: Linkages between well-being and greenspace influenced by a combination of elements of nature and non-nature in a New York City urban park

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ABSTRACT

This study examines the association between the elements of an urban greenspace and users' subjective well-being (SWB). In addition to the urgency of addressing climate change, co-benefits such as health and well-being are stimulating increasing investment in urban green infrastructure. Previous studies have established a link between SWB and urban greenspace and identified connectedness to nature (CTN) as one contributor to this effect. Few studies, however, have examined the interactions of park elements as they contribute to CTN and SWB. The current work evaluates the relative importance of various elements of an urban greenspace for individuals' feelings of SWB and CTN. Possible determinants are investigated through mixed-methods analysis using data from a rating task and interviews conducted with park users in Washington Square Park, NYC. Findings indicate (1) trees are the most important element of nature contributing to a majority of participants' SWB and CTN, and (2) that for the majority of participants, SWB derives from both elements of nature and non-nature. Results also suggest that a majority of park users are responding to their experience of the park as a whole; this experience is identified as para-urban—characterized by occurring in a space set apart from the rest of the city.

1. Introduction

As the percentage of people living in cities increases in the United States (US Census Bureau, 2018) and around the world (UN DESA, 2018), the reasons for studying the impact of greenspace on urban residents' subjective well-being (SWB) continue to grow. In addition to the urgency of addressing climate change adaptation and resilience (Kabisch et al., 2016; Matthews et al., 2015), promoting city-dwellers' health and well-being is also stimulating increased investments in urban green infrastructure such as parks and gardens (Andersson et al., 2015; Elliott et al., 2019; Stahl Olafsson, 2019). SWB is one of the many proposed co-benefits of green infrastructure (Herzog et al., 2003; Kaplan, 1995; Nisbet et al., 2011; Tzoulas et al., 2007; Ulrich et al., 1991). A deeper understanding of the associations between SWB and green infrastructure design can provide increased knowledge of the ways that

urban greenspaces affect city residents. In turn, this knowledge can generate useful recommendations for planning and design of green infrastructure to enhance co-benefits, and can also guide the implementation of new strategies for improving well-being, climate change adaptation and resilience within urban areas (Swann et al., 2019). Thus, this study examines which elements of Washington Square Park—a small greenspace in Lower Manhattan, New York City—contribute to park users' SWB.

1.1. Urban greenspace, subjective well-being, and connection to nature

In addition to identifying relationships between urban greenspace and city-dwellers' physical health (Astell-Burt and Feng, 2019; Dickinson and Hobbs, 2017; Nesbitt et al., 2017; Russell et al., 2013), prior studies have shown that spending time in outdoor greenspaces improves

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people's SWB (Nesbitt et al., 2017; Russell et al., 2013). Here, 'subjective well-being' refers to an individual's self-reported feelings of positive affect and satisfaction with their life (Diener and Suh, 1997; Manderscheid et al., 2010). The construct is a subjective assessment that is influenced by multiple factors, such as physical health and current environment, but distinct from mental health and eudaimonic dimensions of well-being. (Das et al., 2020). It is frequently glossed as 'happiness' in everyday language and we employed this usage in our study (Diener et al., 2018).

One of the most commonly identified contributors to the observed relationship between urban greenspace and improved SWB is connectedness to nature (CTN). An individual's CTN is defined as their subjective feeling of being part of the natural world and is distinct from other environmental attitude measures (Mayer and Frantz, 2004; Nisbet et al., 2009). In prior studies, higher levels of CTN are associated with higher levels of SWB, leading researchers to propose that urban greenspace increases opportunities for CTN, and thus improves SWB (Carrus et al., 2015; Howell et al., 2013; McMahan and Estes, 2015; Nisbet et al., 2011; Schnell et al., 2019; Zelenski and Nisbet, 2014). While some studies have focused on better understanding the relationship between level of CTN and SWB (McMahan and Estes, 2015), other research has focused on identifying the attributes of individuals and/or urban greenspaces that affect CTN and/or SWB (Lumber et al., 2017). In particular, recent studies have attempted to identify the specific elements of urban greenspace contributing to CTN and/or SWB, with an eye toward informing future design interventions (Jorgensen and Gobster, 2010; Nordh et al., 2011; Van Dongen and Timmermans, 2019; Wang et al., 2019). For example, Deng et al. (2019) identified water elements and forests as significant contributors to perceived restorativeness, while McEwan et al. (2020) found individuals connecting to birdsong and street trees. Research in urban forestry has indicated that the presence of trees, a frequent greenspace element, has a positive effect on CTN and on SWB (Collins et al., 2019; Donovan et al., 2013; Nyelele et al., 2019). Additional studies have also indicated several other factors which may influence the relationship between CTN and SWB in the context of urban greenspace, including biodiversity, ethnicity, meaning in life, age, and how people interact with the space (Carrus et al., 2015; Hegetschweiler et al., 2017; Jarvis et al., 2020; Jennings et al., 2016; McMahan and Estes, 2015; Riechers et al., 2018).

While the studies cited above have linked CTN and SWB to particular elements of urban greenspace, other research suggests that improvements in SWB result from experiencing a greenspace's particular atmosphere (the intangible elements or ambience of the space), its perceived restorativeness, and/or the sense of place (here understood as comprised of degrees of place attachment, place dependence, and place identity) associated with it (Beery et al., 2015; Lai et al., 2020; Scannell and Gifford, 2017; Subiza-Pérez et al., 2020; Weijs-Perrée et al., 2020). Significantly, urban greenspace atmosphere and sense of place are not exclusively natural, but include elements of non-nature, such as other people or facilities. Thus, the association of atmosphere and sense of place with improved SWB in urban greenspace suggests that CTN alone may not be responsible for the observed improvements, but part of a broader set of contributing experiences (Fretwell and Greig, 2019; Russell et al., 2013; Zhang et al., 2015). This does not rule out the possibility, however, that some elements of urban greenspace contribute simultaneously to CTN, atmosphere, and sense of place, and consequently, to SWB.

1.2. Research questions

In order to better understand the relationship between CTN and SWB in the context of urban greenspace, this study evaluates which elements

of an urban greenspace contribute to CTN and SWB. Specifically, the work aims to evaluate whether the same elements of a public park in New York City (NYC) are identified by park goers as contributing to CTN and SWB, or if park goers identify separate elements contributing to CTN and SWB. As such, our primary research questions ask the following:

- 1 Which specific elements of the urban greenspace contribute to SWB and CTN?
- 2 How do the identified elements interact to deliver contributions to CTN and SWB?

In order to investigate our research questions, in the context of a detailed examination of which greenspace elements influence SWB and CTN in an urban park environment, we draw on the following methods: (1) a rating task of park elements along dimensions of SWB and CTN and (2) interviews, supplemented with ethnographic observations. This mixed methodology was used to identify associations between park elements, SWB, and CTN in a standardized fashion (the rating task), and to better understand possible reasons for observed associations or lack thereof (observation and interviews) (Fretwell and Greig, 2019; Kaźmierczak, 2013).

2. Materials and methods

A combination of research methods was chosen for the collection of primary data. A rating task was used to compare multiple predetermined park elements on dimensions of happiness (subjective well-being, or SWB) and connectedness to nature (CTN), as well as the relationship between ratings for happiness and CTN. The rating task was limited to asking about elements of nature, reflecting the study research questions. We separately conducted interviews to further explore the range of elements contributing to happiness and CTN, and to provide a deeper understanding of these contributions and of the relationship between happiness and CTN (Fretwell and Greig, 2019; Kaźmierczak, 2013). Interviews were open-ended, which allowed for a wider range of responses, such as discussion of social elements of the park. The implications of this study design are discussed further in the Results and Discussion sections below. The rating task and interviews were conducted among visitors of Washington Square Park in NYC. All aspects of this study were reviewed and approved by the Columbia University Institutional Review Board (IRB).

2.1. Case study area

Washington Square Park (WSP) is located in Lower Manhattan, with an area of 9.75 acres (Fig. 1a). The park has a rectangular shape with a path that circumscribes it and several paths that lead into a central plaza which contains a large fountain. The park has several amenities such as a dog park, playgrounds, and permanent chess boards (Fig. 1b). It contains a large amount of vegetation, including grassy areas, bushes, ornamental gardens, and trees. The perimeter of the park is fenced and vegetated with limited entry points; vegetation throughout the park is of mixed height, ranging from trees to shrubs to ground level plants. The east-west central axis is lined with trees, and ornamental plantings throughout the park utilize mixed-height plantings from shrubs to groundcovers.

This park was selected as our case-study area for three reasons. First, WSP is small enough that the park can be approached as a single unit, unlike larger parks in Manhattan, such as Central Park. Second, the park offers a number of different design elements, including a variety of green vegetation, walkways, and areas to socialize. Third, unlike other small parks in Manhattan, the vegetated elements include both lawns and

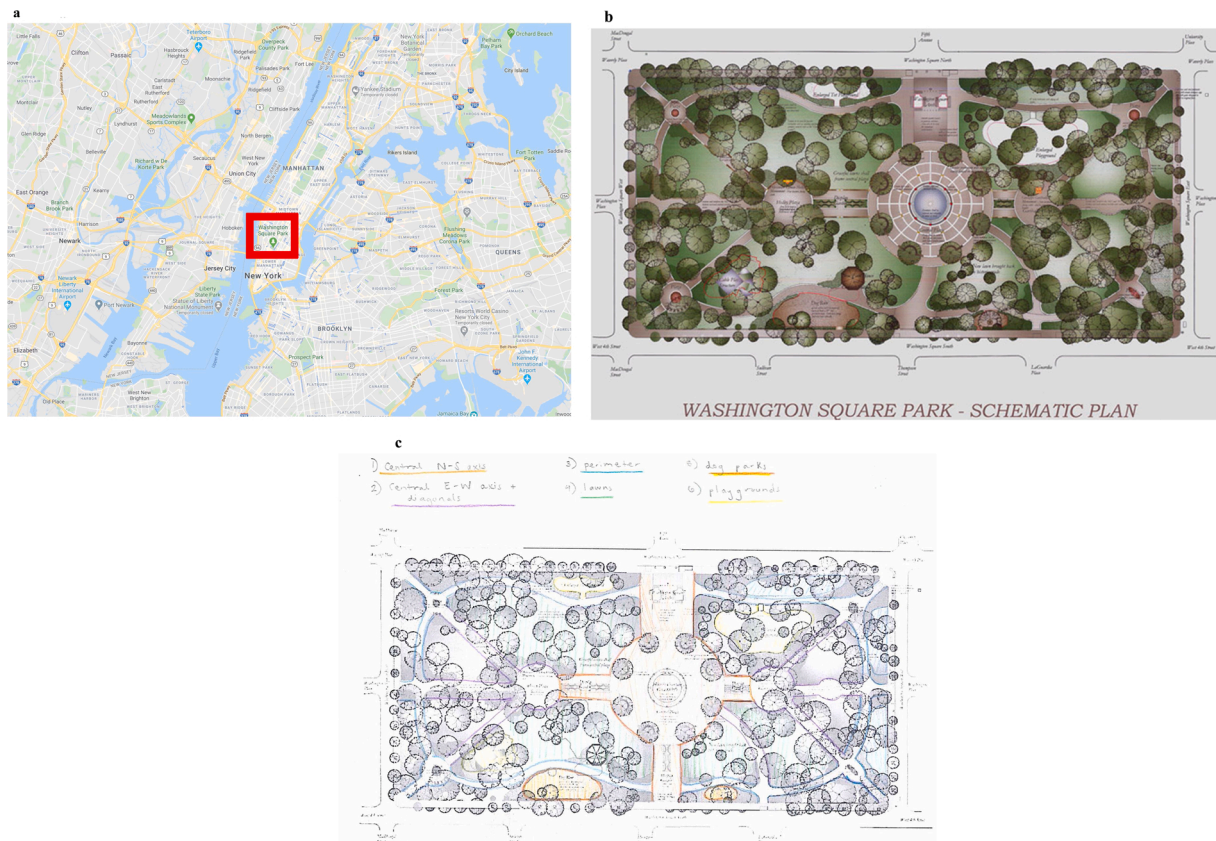


Fig. 1. a. Location of Washington Square Park, Manhattan, New York (Image source Google Maps). b. Schematic plan of Washington Square Park (Image source NYC Parks Department). c. Sector division of the park.

areas designed with more diverse plantings, in terms of species, flowering, and height.

For the purposes of this research project, the park was divided into sectors, to ensure that the range of landscape types within the park were represented during data collection. In determining the sector divisions, researchers conducted several site visits, paying particular attention to sight lines, entrance and exit points, landscaping, nodes of destination, and activities performed in the space. The main east-west and north-south entrance points and their transect across the park, as well as the central fountain and Washington Square Arch, were given their own sectors to ensure specific attention to entrance and exit points and nodes of destination. The interior and periphery of the park were disaggregated, as these areas contain different types of greenery. The most notable difference between these areas is the height of the plants, which was hypothesized to factor into SWB and CTN. This process created four distinct sectors within WSP: (1) Central N-S axis; (2) Central E-W axis and diagonals; (3) Perimeter; (4) Lawns (Fig. 1c). Notably, certain areas of WSP were excluded from research. In particular, the playgrounds and dog park were not used as data collection locations within the park. Dog parks were not accessible without a dog (though dog-owners outside the dog park area were included). Playgrounds were excluded after very low response rates during pilot testing.

2.2. Participant selection

The analysis is based on convenience samples of individuals in WSP. A total of 105 participants within WSP were sampled between June 2019 and August 2019. Field observations and data collection were conducted for a total of 13 separate days. On a given day, park users are

not evenly distributed throughout the park, with more individuals occupying the central axes than the perimeter or lawns. In order to ensure representation of the range of landscape types within the park in the sample, participants were purposively sampled according to location in the park. This ensured equal numbers of participants (approximately 25) from each of the four identified sectors. Within each sector, participants were initially selected at random, with more purposeful sampling in later rounds to achieve demographic representation of park users as visually assessed by researchers.

2.3. Data collection

Days for conducting data collection were determined based upon weather conditions (researchers did not sample during rain events), temperature (researchers did not sample during heat advisories), and researcher availability. Researchers collected the data between the hours of 11am and 3 pm. The completion rate was approximately 80 % (percent of individuals who, if approached, agreed to participate).

In pairs, researchers approached potential participants. Researchers obtained consent by explaining they were conducting research on human connection to nature and asked if the individual had a few minutes to complete a quick survey or answer a few questions, depending on which instrument was being administered. If park-goers further questioned the purpose of the research, they were told that they would learn more about the research after the questions were completed, so as not to bias responses. If the participant provided oral consent, the researchers first asked the participant “What brought you to Washington Square Park today?” and then either administered the rating task or conducted the interview. Administration of the rating task or interview

was alternated by day of data collection.

2.4. Rating task

Participants were asked to evaluate 11 elements of nature within the park on two dimensions: (1) the degree to which the element impacted feelings of happiness; and (2) the degree to which the element impacted CTN, on 10-point rating scales (see Appendix A for full task). The list of elements of nature was compiled by members of the research team based on initial site visits. The range of elements included both visual (e.g., sight of trees) and non-visual (e.g., feeling of breeze) sensory experiences. The presentation order of the two rating scales was assigned randomly, and items were presented in a fixed random order to all participants. Participants were asked to assign a numerical value for happiness and CTN for each element of nature, on a scale from 1 (does not increase my happiness/does not make me feel connected to nature) to 10 (greatly increases my happiness/makes me very connected to nature). After completing the task, participants were given the option to answer basic demographic questions including their age, gender, income, and race/ethnicity.

2.5. Interviews

Participants were asked to answer two questions: (1) when you think about your experience in Washington Square Park today, which parts of this experience make you happy?; and (2) can you tell me which elements of Washington Square Park make you feel most connected to nature, and can you tell me about that connection? The order in which these two questions were asked was alternated by participant. Researchers did not offer prompts, but did ask and respond to clarifying questions where necessary. Responses were thus open-ended, and respondents were free to indicate elements of both nature and non-nature in the park. Interviews lasted from 2–15 min, with researchers allowing participants to talk for whatever length the participant chose. Responses were recorded by one researcher while the other engaged in administering the interview. The researcher recording responses also entered observed demographic data.

3. Results

3.1. Participants

One hundred-five participants took part in this study. Fifty-four completed the rating task and 51 participated in interviews. Demographic data were obtained for 99 of 105 participants. The

demographic profile of the sample indicates an even representation of gender (49 % female, 50 % male). The age distribution of the sample shows a mean age of 35 ($sd = 15.9$). Participants who completed the rating task had a median annual income bracket of \$50,000 - \$75,000; income data were not available for interview participants as socio-demographics were assessed visually. Fifty-nine percent of the sample were identified as white, 12 % Black, 13 % Asian, and 7% Latinx. Compared with Manhattan's general population, this sample skews toward men, over-represents white New Yorkers, and under-represents Latinx (US Census Bureau, 2010; see Table 1).

3.2. Rating task results

We observed a positive ceiling effect for the mean ratings of both happiness and connectedness to nature (CTN) for the 11 elements (see Appendix B). Elements clustered towards the high end of the 10-point rating scale for CTN and subjective well-being (SWB). The range of ratings for the two dimensions was small: maximum and minimum scores were 8.60 and 6.83 for happiness, 8.46 and 6.01 for CTN.

Elements that were associated with the greatest happiness were the feeling of the breeze ($M = 8.60$, $SD = 1.94$), sight of trees ($M = 8.52$, $SD = 1.92$), and sight of open sky ($M = 8.38$, $SD = 1.98$). The elements that contributed least to happiness were the smell of flowers ($M = 6.82$, $SD = 2.37$) and smell of grass ($M = 7.15$, $SD = 2.36$). The ratings for the three elements associated with the greatest feelings of happiness did not differ significantly from one another, but did contribute to significantly higher happiness ratings compared to the other park elements examined. For example, the sight of trees led to significantly higher happiness compared with the sight of other green plants (paired $t(98) = 2.63$, $p = .009$).

As shown in Fig. 2, the park elements that participants rated highest for happiness had a high degree of overlap with the elements that scored highest for CTN. The elements that contributed most to CTN included the sight of trees ($M = 8.46$, $SD = 1.67$), feeling of breeze ($M = 8.40$, $SD = 1.98$), and sight of green plants ($M = 8.38$, $SD = 1.77$). The elements that contributed least to CTN were those related to the human-made fountain in the park, which included the sight of water in the fountain ($M = 6.01$, $SD = 2.53$), and the sound of that water ($M = 6.87$, $SD = 2.56$). For each park element, we calculated the correlation between each of the scales in the rating task, and observed significant positive correlations for each individual park element. We thus observed a strong relationship between how happy a park element made a participant feel, and how much that element made them feel connected to nature. The positive correlations between happiness and CTN ratings were strongest for the feeling of sun ($r = .77$, $p < .0001$), the feeling of breeze ($r = .66$, $p < .0001$) and the sight of trees ($r = .64$, $p < .0001$).

3.3. Interview results

Analysis of open-ended interview responses further explored which individual park elements contributed to participants' happiness and CTN. Interview data were uploaded into NVIVO 12 and an initial round of coding was performed to match the elements in the rating task and facilitate comparisons between the rating task and interview responses. A second round of coding was conducted to identify topics unique to the interview data. Codes were organized at two levels: thematic categories (e.g. immersive experience) and subcategories indexing specific elements or experiences (e.g. tree canopy).

Consistent with results from the rating task, trees were one of the most commonly mentioned contributors to happiness and CTN among park-goers. The most frequently mentioned elements for happiness were trees (8 respondents; 16 % of interview sample) and green plants (6 respondents; 12 % of interview sample). The most frequently mentioned

Table 1

Demographic characteristics of the study sample in comparison with Manhattan's general population.

Variable	Study Sample (n = 99)	Manhattan Gen Pop
Sex		
% female	49	53
% male	50	47
Age, <i>M</i>	35	36
Income, median	\$50–75k	\$82.4k
Race/ethnicity		
% white	59	47
% Black	12	18
% Asian	13	13
% Latinx	7	26*
% not responding	9	n/a

* Borough-wide survey data treat Latinx as a separate category from race/ethnicity. Our study survey did not.

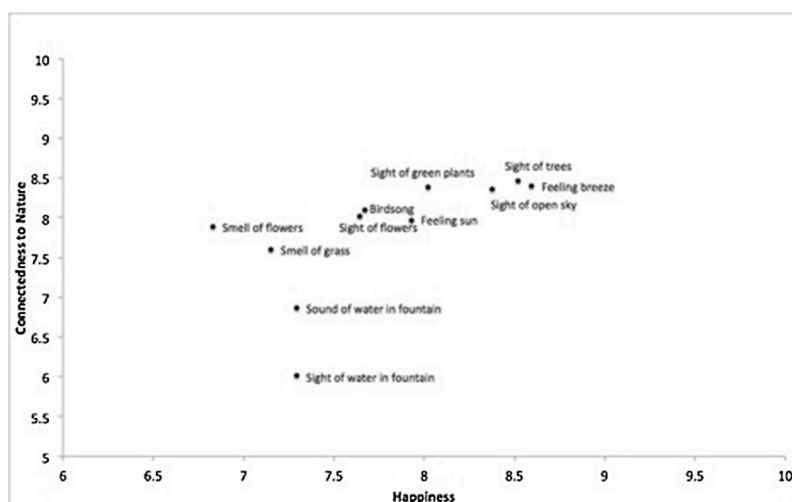


Fig. 2. Scatterplot of the 11 elements in WSP along the axes of happiness and CTN.

elements for CTN were also trees (36 respondents; 71 % of interview sample) and greenery (green plants, 10 respondents; 39 % of interview sample) (see Appendix C). Together, results from the rating task and interviews suggest that when considering elements of nature in WSP, trees most frequently lead to experiences of happiness.

Analysis of interview responses also identified certain elements of non-nature in the park that contributed to happiness and CTN (see Appendix D). These elements were not included as part of the rating task. Elements of non-nature are defined as those parts of the park consisting of human-made structures and social elements. (The fountain combines nature and non-nature, consisting of both a human-made structure—the basin—and an element of nature—the water. This study classifies the fountain as an element of nature.) The elements of non-nature most frequently mentioned with regard to happiness were people (25 respondents; 50 % of interview sample), with 11 respondents mentioning people-watching (21 % of interview sample) and 15 respondents mentioning people in general (29 % of interview sample). Music was also frequently mentioned (11 respondents; 21 % of interview sample).

Interview results also revealed that the co-presence of elements of both nature and non-nature contributed to experiences of happiness and CTN (Table 2). When asked to name what parts of the experience of WSP made them happy, 51 % of interview respondents ($n = 26$) named elements of both nature and non-nature in the park. For example, one participant responded: “Happy umm... the green. All trees and plants and all the people. People watching. And the shade. Places to sit in the shade.” Twenty-nine percent ($n = 15$) listed only elements of non-nature: “I like having a place to sit, there’s people, there’s music, it’s

nice to have a public space, where you don’t have to pay.” Twenty percent ($n = 10$) listed only elements of nature: “Being able to enjoy nature. And look at the sky.” In total, 80 % of respondents ($n = 41$) mentioned elements of non-nature as contributors to their experience of happiness in WSP.

3.4. Para-urban space

In addition to identifying trees as an element of nature in the park that contributed to SWB and CTN, interviews suggest that trees play a meaningful role in creating a sense of boundary between the park and the surrounding city. Interview respondents most often simply mentioned trees—alone or in conjunction with other park elements—as contributing to increased happiness. When respondents did elaborate they referenced shade (13 respondents; 25 % of interview sample), a sense of being immersed or covered (7 respondents; 14 % of interview sample), a connection to the past (5 respondents; 10 % of interview sample), and a feeling of rooted or groundedness (5 respondents; 10 % of interview sample). These more elaborate responses included statements like:

The leaves—being able to see sunshine filter through leaves is a very nice feeling. The sight of the sky. Being able to look up through the leaves and see blue sky and clouds.

The trees—it’s a little bit hard to describe. I think it is set apart from the rest of the city environment. [...] In a spot like this, because of

Table 2
Contributors to happiness by type of element from interview responses.

Contributor to Happiness	Number of Interview Respondents (% of Total)
Exclusively elements of nature	10 (20 %)
Mention of elements of nature	36 (71 %)
Exclusively elements of non-nature	15 (29 %)
Mention of elements of non-nature	41 (80 %)
Co-presence of elements of both nature and non-nature	26 (51 %)
	$n = 51$

Table 3
Type of para-urban experience by number of references and respondents from interview responses.

Component of Para-urban Experience	Number of References	Number of Discrete Respondents (% of interview sample)
Boundary	16	14 (27 %)
Boundary-In	8	7 (14 %)
Boundary-Out	6	5 (10 %)
Affective Experience	14	12 (23 %)
Atmosphere	13	10 (20 %)
Being in Nature	7	7 (14 %)
Total Para-urban Experience	50	30 (59 %)

the filtering of the light, of sound of the wind in leaves. The color that surrounds you. It's just a completely different environment than a block in any direction.

Given the complexity of these responses, the contribution of trees to feelings of happiness would seem to result not only from the presence of trees, but their interaction with other park elements such as sun and sky. This interaction, in particular the way it contributes to an experience of the park as a space separate from the surrounding city, exemplifies how the park functions as a "para-urban space." By para-urban space we refer to the ways the park was described by participants as a space that existed alongside, but distinct from, the urban milieu around it. The majority of interview respondents indicated their experiences of happiness in WSP derived from a sense of WSP as set apart from the surrounding city, a place where physical and/or affective experience differed from the city at large. We term this an experience of the park as a para-urban space.

We identified participants as experiencing para-urban space if they referenced a sense of physical boundary, either of being within something (the park) or something being outside (the city). We also included participants who discussed the atmosphere or affective experience of the park (as compared to elsewhere in the city) and/or the experience of being in nature (without reference to a physical boundary). As shown in Table 3, we found that 59 % of respondents indicated experiencing the park as a para-urban space.

Twenty-seven percent of respondents ($n = 14$) referenced a sense of physical boundary when relating their experiences of WSP. Of these, 14 % ($n = 7$) specifically discussed a boundary in terms of being within the park. These references are to material elements which they enjoy, and which are understood as not part of everyday city life. For example, one respondent stated: "I like the lawns to be honest. It's a city, so out of everywhere you can relax and lay down and read a book." Ten percent of respondents ($n = 5$) talked about a sense of physical boundary with reference to what was outside the park. Such statements included: "It's a nice break from walking around on the pavement all day." Of the 14 respondents indicating a sense of boundary, 64 % ($n = 9$) specifically referenced trees.

Twenty-three percent of respondents ($n = 12$) related some form of affective experience tied to their presence in a particular kind of space (the park). These responses included: "I think the trees. And it's de-stressing to come down here, to feel a connection." Similarly, 20 % of respondents ($n = 10$) referenced the atmosphere of the park as contributing to happiness, with statements like, "The fact that there is always music playing somewhere. No one looks like they are in a rush here." Finally, 14 % ($n = 7$) discussed their happiness in terms of being outside or in nature, while not referring explicitly to a sense of boundary between park and city. For example, "Being able to enjoy nature. And look at the sky."

Taken together, the results from the rating task and interviews provide depth, nuance and additional detail to the relationship between the park, SWB, and CTN. In particular, results complicate any straightforward association between CTN and SWB, suggesting that elements of non-nature play a meaningful role in the experience of happiness in the park. For example, while data indicate the significance of trees for participants' SWB and CTN, results also suggest that neither trees nor any particular set of natural elements is alone the dominant contributor to participants' happiness. Rather, results suggest that happiness is derived from the co-presence of elements of both nature and non-nature creating an experience of the park as a para-urban space.

4. Discussion

Results from both the rating task and interviews indicate that trees

were the most influential element of nature within the park. This finding aligns with results from earlier studies that find trees to be an important element of urban greenspace effects on subjective well-being (SWB) (Deng et al., 2019; McEwan et al., 2020; Nordh et al., 2011; Van Dongen and Timmermans, 2019; Wang et al., 2019). This result also supports previous research on the urban forest, which suggests trees provide important contributions to residents' CTN and various dimensions of well-being (Collins et al., 2019; Donovan et al., 2013; Nyelele et al., 2019). Trees were the highest rated and most frequently mentioned park element contributing to CTN. Trees were also one of the top-rated and most frequently mentioned elements of nature with respect to happiness. This finding indicates trees play an important role in participants' experience of the park, particularly with regard to CTN. In addition, our results show that other elements of nature, such as green plants and flowers, contribute to CTN and SWB, in concurrence with previous studies (Carrus et al., 2015; Howell et al., 2013; McEwan et al., 2020; Nesbitt et al., 2017; Russell et al., 2013; Schnell et al., 2019).

In our study, however, elements such as trees and greenery do not alone explain participants' happiness. Our results suggest that elements of both nature and non-nature contribute to SWB. While results from the rating task indicate that the same elements contribute to SWB and CTN for participants, there is much more variation in the results from interviews (see Appendix D). Interview data show greater difference between the elements selected for happiness and those selected for CTN, while also demonstrating greater variability in the types of items selected for happiness and CTN, respectively. This difference between rating task and interview results likely reflects the fact that interviews were unstructured and people were free to list elements of non-nature, such as music and people-watching. Such variation has been observed in previous studies, such as Irvine et al. (2013), which found divergence between the effects which park goers selected from a checklist and those which they freely listed in open-ended responses. Thus, while previous research has demonstrated CTN to be a distinct predictor of SWB (Nisbet et al., 2011; Zelenski and Nisbet, 2014), our results indicate that elements of both nature and non-nature are meaningful for study participants and contribute to experiences of happiness. This finding supports previous studies that identified both elements of nature and non-nature as salient contributors to SWB in urban greenspace (Fretwell and Greig, 2019; Lai et al., 2020), as well as research that suggests an important role for elements of non-nature and/or the interaction of elements of nature and non-nature (Beery et al., 2015; Russell et al., 2013; Scannell and Gifford, 2017; Subiza-Pérez et al., 2020; Zhang et al., 2015).

Data from interviews indicates that participants' SWB also derived, not only from the presence of particular kinds of elements in WSP, but also from experiences of WSP as a whole. Specifically, our results suggest that respondents' SWB derived from their experience of the park as a para-urban space. Throughout interviews, the majority of respondents mentioned their sense of the park as a place apart from the city, where they could observe and interact with the world in ways they considered different from ordinary urban life. These responses indicated that participants' SWB derived from the ability to locate within a space distinct from the surrounding urban milieu. This sense of contrast between park and city, and its association with SWB, is supported by previous studies which find perceived restorativeness, sense of place, and "time out," "escape," or "being away" as important dimensions of the association between urban greenspace, SWB, and CTN (Berto et al., 2018; Lai et al., 2020; Martyn and Brymer, 2016; Nordh et al., 2009; Subiza-Pérez et al., 2020).

While research has identified the importance of perceived restorativeness for improved SWB in urban greenspace (Berto et al., 2018; Carrus et al., 2015; Grahn and Stigsdotter, 2010; Nordh et al., 2009), few

studies have focused on the park as a space of contrast with the surrounding city. Fifty-nine percent of our interview respondents referenced such a distinction, what we term an experience of para-urban space. They referred to the park as physically or spatially separate from the surrounding city, as well as how the park felt and made them feel different from the city at large. This finding indicates that it is not discrete park elements alone that contribute to SWB, but their position within a space set apart from the surrounding city. By allowing interview respondents to freely associate elements of the park with experiences of happiness and CTN, we were able to identify the underlying concept of para-urban space that encompassed the diversity and range of responses in this study. Moreover, the phenomena of para-urban space provides a conceptual basis for exploring how perceptions of specific greenspace elements, such as trees, birds, or water (Deng et al., 2019; McEwan et al., 2020; Nordh et al., 2011; Van Dongen and Timmermans, 2019; Wang et al., 2019), and experiences of greenspace atmosphere or sense of place (Fretwell & Greig, 2019; Lai et al., 2020; Subiza-Pérez et al., 2020; Weijs-Perrée et al., 2020) interact and contribute to associations between CTN and SWB in urban greenspace.

The experience of WSP as a para-urban space is achieved through a variety of elements of both nature and non-nature within the park. The range of ways interviewees indicated an experience of para-urban space, and the variation in elements named as contributors to happiness in WSP, together suggest that participants draw on an individually-specific variety of elements of both nature and non-nature to compose an experience of para-urban space, and of happiness, in the park. This finding is congruent with Howell et al. (2013), who suggest park goers draw on multiple elements to render these spaces meaningful within their lives, and studies that find positive contributions to SWB are related to alignment between urban greenspace elements and peoples' preferences (Berto et al., 2018; Herzog et al., 2003; Wang et al., 2019), as well as studies that suggest having a multiplicity of types and scales of greenspace (Church, 2018), and developing attachment to green places (Zhang et al., 2015) are important for individual SWB.

Within holistic experiences of happiness in the park, trees continue to be meaningful. Indeed, the importance of trees as an element of nature contributing to happiness appears to be related to the experience of WSP as a para-urban space. Trees are frequently mentioned in connection with shading and canopy coverage, contributing to the sense of being separate from the city and in a space set apart from typical urban space. Second, trees played an important signaling role for park users. Through their size and verticality, contrast with the surrounding urban environment, and prominence as a landscape feature in the park, trees may help signify for respondents that the park was a para-urban space.

Together, these three results suggest that co-benefits of green infrastructure, particularly SWB, are related to the size of the infrastructure. The presence of trees, of multiple elements of both nature and non-nature, and feelings of being in or surrounded by the greenspace were key contributors to SWB for the majority of respondents. This would suggest that larger-scale green infrastructures, such as parks, are preferable for the delivery of co-benefits when compared to smaller, distributed forms of infrastructure, like bioswales. Numerous kinds of intermediate sized green infrastructures can be found in cities, however, such as community gardens, pocket parks, and greenstreets. Likewise, a high density of small-scale green infrastructure may also generate the experience of immersion (e.g., a tree-lined residential street). Further research is therefore required to better understand at what scales and densities green infrastructure can best deliver increases to subjective well-being. As cities like New York invest in green infrastructure for climate change adaptation and resilience, as well as human health and well-being, understanding when, where, and to what degree co-benefits

like increased SWB occur can help maximize the social and ecological benefits of green infrastructure.

The strong preference for trees, as both a way to connect to nature and a source of happiness, offers additional implications for green infrastructure and urban landscape design. In addition to their many benefits to stormwater management, heat island reduction, air quality improvement, and carbon sequestration, as well as their aesthetic value and contributions to mental and physical health and spiritual well-being (Collins et al., 2019; Colter et al., 2019; Donovan et al., 2013; Elliott et al., 2018; Han et al., 2020; Nyelele et al., 2019; Ziter et al., 2019), our study demonstrates that trees also contribute to SWB and CTN for park users. Given this, our results suggest that landscape architects and urban designers should incorporate trees into designs whenever possible. While our results suggest that trees can contribute to a para-urban experience by creating a sense of coverage or immersion, as well as boundary-signaling, the number and arrangement of trees needed to achieve this effect and its resulting effects on SWB warrant further investigation.

5. Conclusion

Park users' experiences of happiness and connectedness to nature (CTN) are related to the park landscape and atmosphere in complex ways. In this mixed-methods, field-based study, we identified trees as an important contributor to subjective well-being (SWB) and CTN compared with other elements in the park. In addition to trees and elements of nature, elements of non-nature in the park also contributed to participants' SWB. Finally, for the majority of participants, experiences of happiness derive from a para-urban experience. These three results suggest that most participants are having a multi-faceted experience and responding as much to the park as a whole, as any discrete, individual elements within it. These three findings have two implications for the future design of green infrastructure: they suggest that larger-scale infrastructures are better positioned to generate well-being co-benefits, and that infrastructures with trees are more likely to contribute to well-being.

As cities in the US and around the world seek to adapt and prepare for the challenges of climate change, we believe this understanding of how urban greenspace can be utilized to improve ecological resilience and human well-being is of great importance. Understanding how co-benefits, like SWB, can be most effectively delivered can strengthen the ability of green infrastructure to meet the needs of urban residents. This has become particularly clear during the 2020–21 Covid-19 pandemic, as urban residents have turned to greenspace for respite from stay-at-home orders and a place to recreate and socialize while following social distancing guidelines. Future research should investigate the scale and density at which green infrastructures most effectively deliver co-benefits, while considering how those scales and densities align with other demands on green infrastructure, like stormwater management and socially distanced recreation.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Rating task

Below, you'll find a list of 11 multi-sensory elements of nature. For each element described, please indicate to what extent they make you feel **connected to nature** on a scale of 1 – 10, with 1 meaning it does not make you feel connected to nature and 10 being it makes you feel very connected to nature. Please take your time to recall and reflect upon your experience of the element.

	Does not make me feel connected to nature							Makes me feel very connected to nature		
	1	2	3	4	5	6	7	8	9	10
Sound of birds chirping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling of sun on your skin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of other green plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of water in the fountain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of flowers blooming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of the open sky above	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sound of water in the water fountain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The smell of grass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smell of flowers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling of breeze against your skin/ hair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Now for the same set of elements, please indicate how much they increase your feeling of **happiness** on a scale of 1 – 10, with 1 meaning it does not increase your happiness and 10 being greatly increases your happiness. Please take your time to recall and reflect upon your experience of the element.

	Does not increase my happiness							Greatly increases my happiness		
	1	2	3	4	5	6	7	8	9	10
Smell of flowers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of the open sky above	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sound of water in the water fountain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of flowers blooming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling of sun on your skin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of water in the fountain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sound of birds chirping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of other green plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling of breeze against your skin/ hair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sight of trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The smell of grass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix B. Mean ratings of happiness and CTN of 11 element/sense combinations

Element	Happiness (mean)	CTN (mean)
1. Sounds of birds chirping	7.673	8.101
2. Feeling of sun on your skin	7.929	7.960
3. Sight of green plants	8.020	8.384
4. Sight of water in the fountain	7.293	6.010
5. Sight of flowers blooming	7.646	8.020
6. Sight of the open sky above	8.378	8.364
7. Sight of trees	8.519	8.462
8. Sound of water in the water fountain	7.293	6.867
9. The smell of grass	7.152	7.606
10. Smell of flowers	6.828	7.888
11. Feeling of breeze against your skin/ hair	8.596	8.404

Appendix C. Number of interview respondents mentioning 11 element/sense combinations for happiness and CTN

Element	Happiness (no. of respondents)	CTN (no. of respondents)
1. Birds	3	3
[Sound of birds]	[2]	[0]
2. Sun	4	0
[Feeling of sun]	[1]	[0]
3. Green Plants	6	10
[Sight of green plants]	[2]	[1]
4. Water	4	8
[Sight of water]	[0]	[0]
[Sound of water]	[0]	[0]
5. Flowers	4	3
[Sight of flowers]	[1]	[1]
[Smell of flowers]	[0]	[2]
6. Sky	1	3
[Sight of sky]	[1]	[3]
7. Trees	8	36
[Sight of trees]	[0]	[4]
8. Grass	2	10
[Smell of grass]	[0]	[3]
9. Breeze	1	4
[Feeling of breeze]	[0]	[2]

Appendix D. Number of interview respondents mentioning elements of non-nature for happiness and CTN

Element	Happiness (no. of respondents)	CTN (no. of respondents)
1. Arch	1	2
2. Free, public space	1	1
3. Music	11	0
4. Paths	0	1
5. People (general)	15	2
6. People-Watching	11	0
7. Street art	1	0

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