



Shared time in nature increases feelings of social connection amongst university students

Lauren Henderson, Laura Tipper, Sioned Willicombe, Merideth Gattis*

School of Psychology, Cardiff University, UK

ARTICLE INFO

Handling editor: L. McCunn

Keywords:

Natural environments
Interpersonal closeness
Social connection
Nature connection

ABSTRACT

While the impact of nature on individual psychological outcomes has been widely researched, few studies have investigated the impact of time in nature on social connection across individuals. We conducted a within-subjects experiment to evaluate whether natural environments increase feelings of interpersonal closeness, or social connection. Fifty-two undergraduate students completed search tasks with a social partner in a city park and an office. Self-reported social connection was significantly higher following task completion in the natural environment compared to indoors. Self-reported nature connection was also significantly higher following task completion in the natural environment compared to indoors. These results are consistent with the proposal that shared time in nature increases feelings of social connection as well as nature connection. These findings have important implications for understanding the relations between nature and community building.

1. Introduction

The impact of nature on people has been widely investigated, yielding correlational and experimental evidence that spending time in nature is associated with numerous positive psychological outcomes, including increased attention, positive affect, and reduced stress (Bratman et al., 2019; Hartig et al., 2014; Schertz & Berman, 2019). Most of these studies have focused on the benefits of nature for individuals, but time in nature may also benefit relations between people, in particular subjective feelings of social connection. Social connection is important because it predicts numerous aspects of wellbeing such as fulfilment, motivation, persistence, and self-esteem (Holt-Lunstad, 2021; Patrick et al., 2007; Walton et al., 2012; Yang et al., 2016). Few studies have investigated the effect of time in nature on social connection, and those that have done so have primarily used correlational designs (Goldy & Piff, 2020; Hartig et al., 2014). Our study used an innovative experimental design to investigate the impact of shared time in nature on social connection. Below we briefly review the literature on social connection and nature connection to provide background for the hypothesis that shared time in nature increases feelings of social connection.

2. Social connection

Social connection is a fundamental human need (Baumeister & Leary, 1995; Deci & Ryan, 1985). Although relationship goals and behaviours change with development, across the lifespan humans consistently feel a need to be psychologically close, or related, to other people (except for those experiencing social anhedonia, who report a disinterest in social contact) (Ang, 2019; Brown et al., 2007; Carmichael et al., 2015). When this need for social connection is unmet, people report not only higher levels of loneliness and depression but also higher levels of suicidal thoughts (Cacioppo et al., 2010; Chen et al., 2020; Malone et al., 2012). Conversely, when people feel more socially connected, they report higher levels of self-esteem, motivation, and positive affect, persist longer with tasks, and live healthier, longer, and more fulfilled lives (Holt-Lunstad, 2021; Patrick et al., 2007; Walton et al., 2012; Yang et al., 2016).

One of the most widely used tools for measuring social connection is the Inclusion of Other in the Self scale (IOS; Aron et al., 1992), in which people are asked to report feelings of interpersonal closeness with another person or group by choosing between pairs of differently overlapping circles (see Fig. 1A). The IOS thus focuses on the quality, rather than quantity, of social interactions, an approach supported by evidence that quality is a more consistent index of social connection across the lifespan and more strongly related to psychological and health

* Corresponding author. School of Psychology, Cardiff University, Park Place, Cardiff, CF10 3AT, UK.

E-mail address: gattism@cardiff.ac.uk (M. Gattis).

<https://doi.org/10.1016/j.jenvp.2024.102343>

Received 15 June 2023; Received in revised form 12 April 2024; Accepted 28 May 2024

Available online 31 May 2024

0272-4944/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

outcomes (Ang, 2019; Baumeister & Leary, 1995; Feeney & Collins, 2015; Holt-Lunstad, 2021; Starzyk et al., 2006). Feelings of social connection as measured by the IOS are related to a wide range of positive outcomes, including higher levels of perspective taking, empathy, helping, and wellbeing, as well as lower levels of prejudice, loneliness, and depression (Aron et al., 2004; Carmichael et al., 2015; Cialdini et al., 1997). Feelings of social connection are also malleable: when people are told they belong to the same group or share interests with other people, and when people take the perspective of another person, they report more self-other overlap on the IOS compared to control conditions (Batson et al., 1997; Myers & Hodges, 2012; Walton et al., 2012).

3. Nature connection

E. O. Wilson argued that another fundamental drive for humans is *biophilia*, a preference for natural environments that match the habitats in which humans evolved (Wilson, 1984). In the decades since Wilson's proposal, numerous correlational studies have identified small-to medium-sized associations between people's experience of nature and psychological outcomes, even when controlling for other factors (Bratman et al., 2019; Hartig et al., 2014). The term nature, in these contexts, refers to the physical aspects of the natural world surrounding us, including fauna, flora, geological features and landscapes from non-human origins, and is also commonly referred to as the natural environment (Hartig et al., 2014). A meta-analysis of 32 experimental

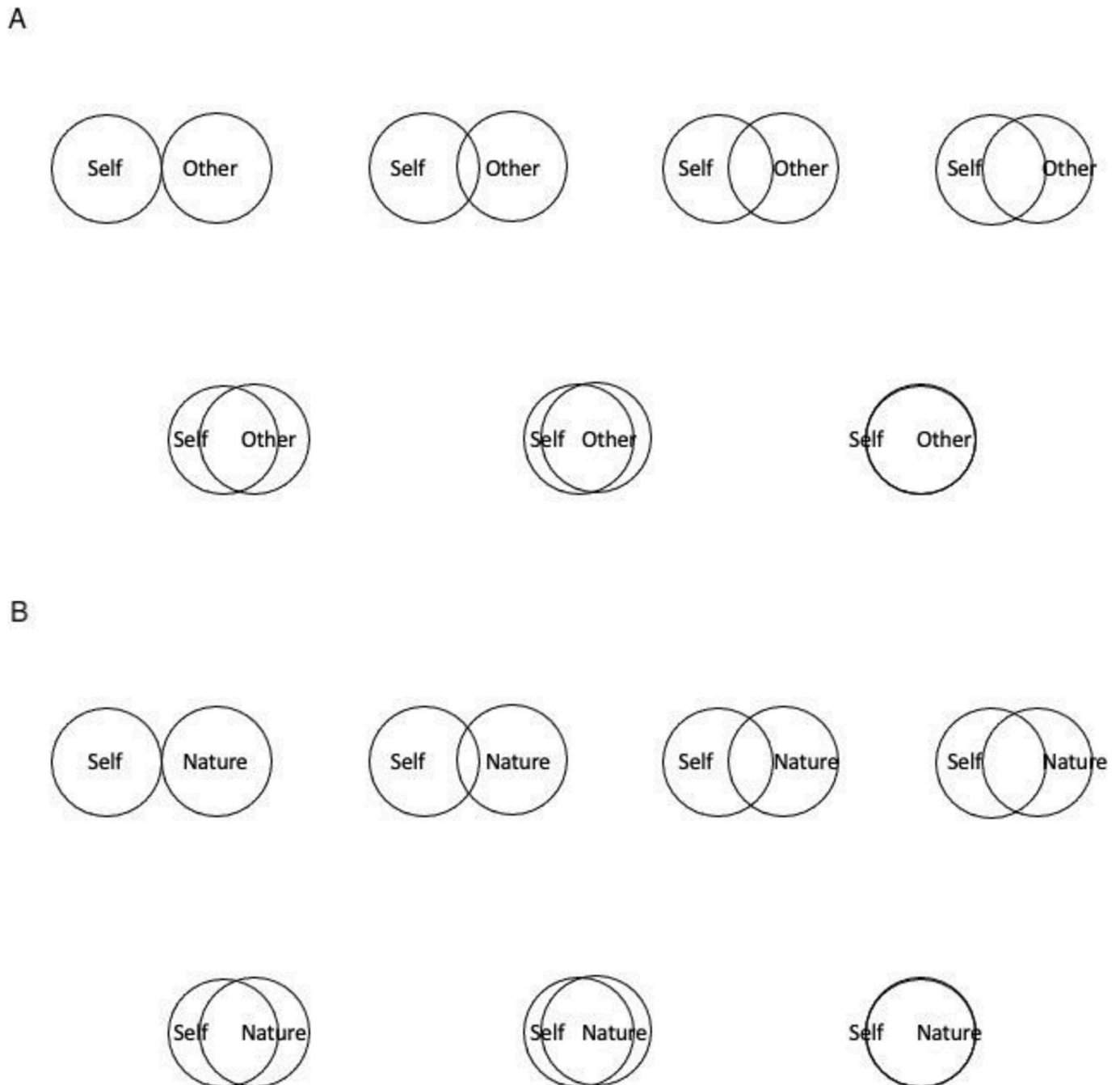


Fig. 1. The Inclusion of Other in Self (IOS) (A) and Inclusion of Nature in Self (INS) (B) scales were the dependent measures for social connection and nature connection, respectively.

studies found that time in natural environments such as parks or nature preserves leads to more positive emotional states or hedonic wellbeing compared to control conditions such as time in an urban or built environment (McMahan & Estes, 2015). Time in nature is also positively associated with eudaimonic wellbeing, the feeling that life is fulfilling or worthwhile. For example, White et al. (2017) reported correlational analyses indicating that the relation between visiting natural environments and eudaimonic wellbeing is stronger than the association between good health and eudaimonic wellbeing. Interestingly, the pattern of associations observed by White and colleagues suggested that the wellbeing benefits of visiting natural environments are similar to the benefits of living with a partner.

Several researchers have proposed that time in nature improves wellbeing because it increases feelings of connection to nature and thus fulfils the biophilia drive (Capaldi et al., 2015; Kellert & Wilson, 1993; Mayer & Frantz, 2004; Zelenski & Nisbet, 2014). Connection to nature is typically measured through self-report tools such as the Inclusion of Nature in Self scale (INS) (Schultz, 2002). In the INS, much like the IOS, people choose between pairs of differently overlapping circles to indicate how connected they feel to nature (see Fig. 1B). Evidence from both correlational and experimental studies confirms that time in nature increases feelings of connection to nature and subjective wellbeing (Capaldi et al., 2015; Mayer & Frantz, 2004; Mayer et al., 2009).

4. Natural environments and social connection

Natural environments may also improve relations between people and communities more generally. In ethnographic studies people have described their experiences of green spaces as closely linked to their feelings of social connection and community, both because they meet new people there and because green spaces provide opportunities for more focused interactions with family and friends (Dinnie et al., 2013; Egerer et al., 2019; Rantala & Puhakka, 2020). Evidence of relations between green spaces and frequency of social interactions is mixed, with some but not all studies yielding evidence of more frequent social interactions in greener spaces (Coley et al., 1997; Kuo et al., 1998; Maas et al., 2009).

The theoretical basis for linking natural environments and social connection lies within human needs and motivations, in particular the need for relatedness (Baumeister & Leary, 1995; Deci & Ryan, 1985). Maas et al. (2009) argued that green spaces might benefit people psychologically not because green spaces necessarily increase social contact, but because green spaces increase feelings of community and thereby decrease loneliness. They described these feelings of community as both emotional attachment to a neighbourhood and a sense of connection with place. Similarly, Zelenski and Nisbet (2014) proposed that nature connection overlaps with a general sense of connection, including connection with friends, partners, and strangers. They used multiple versions of the IOS together with the INS to evaluate relations between a general sense of connection (a composite of closeness to country, culture, family, music, home, and friends) and nature connection and wellbeing. They reported medium-sized relations between general connection and nature connection and between general connection and wellbeing. Several other studies have yielded correlational evidence of positive relations between natural environments and feelings of social connection or cohesion (de Vries et al., 2013; Oh et al., 2022; Weinstein et al., 2015).

Surprisingly few experimental studies have evaluated whether natural environments influence social connection. Izenstark and Ebata (2017) reported that mothers and daughters showed greater dyadic cohesion, as rated by independent observers, after a walk in an arboretum compared to a walk in an indoor shopping mall. Cameron-Faulkner et al. (2018) found that parents and children had more connected conversations while exploring an arboretum compared to an indoor education centre. Passmore and Holder (2017) asked undergraduates to be mindful over a two-week period of either natural or

human-built objects and scenes; after the intervention, those instructed to focus on natural objects and scenes had higher scores for a general sense of connection compared to those instructed to focus on built objects and scenes. Importantly, however, none of these studies evaluated whether natural environments influenced people's subjective feelings of social connection, and as reviewed above, previous research indicates that subjective feelings of social connection are an important predictor of other positive outcomes. An experimental evaluation of the hypothesis that natural environments influence feelings of social connection is therefore needed.

5. Our study

Our study examined whether shared time in a natural environment increases social connection amongst university students. National and international surveys indicate that about 1/3 of university students experience problems with mental health, including social anxiety (e.g., Auerbach et al., 2018). Furthermore, in correlational studies of psychosocial factors related to student mental health, feelings of low social support have been associated with a higher risk of depressive symptoms (Duffy et al., 2020). University students are therefore an especially relevant population for examining the potential benefits of natural environments for social connection.

We used a within-participant experimental design in which people completed search tasks with a social partner in a natural environment (a city park) and a control environment (a university office). Our principal hypothesis was that shared time in nature would lead to greater social connection compared to shared time in the control environment. We also predicted that shared time in nature would increase nature connection relative to shared time in a built environment, based on previous evidence (Capaldi et al., 2015; Mayer et al., 2009). Finally, we also evaluated an alternative hypothesis, namely that changes in social connection might be influenced by stable individual characteristics, such as feelings of belonging, or what Zelenski and Nisbet called general connectedness (Malone et al., 2012; Zelenski & Nisbet, 2014).

6. Methods

6.1. Participants

Fifty-two university undergraduate students (average age 19 years) participated in exchange for course credit. An a priori power analysis using G*Power version 3.1.9.7 (Faul et al., 2007) indicated a sample size of $N = 47$ was needed to achieve 90% power for detecting a medium effect in a Wilcoxon signed ranks test with a significance criterion of $\alpha = 0.05$. An additional 25 participants were excluded as they did not return for the second session. Cardiff University, where the study took place, is located in the city centre of Cardiff, the capital of Wales, and has approximately 30,000 students. All study procedures were reviewed and approved by the university ethics committee and adhere to the tenets of the Declaration of Helsinki including informed consent.

6.2. Design and procedure

The study used a pre-post experimental design (see Fig. 2) with two within-participants conditions: a shared search task in nature (a city park) and a shared search task in a control location (a university office). Participants completed the second session two to ten days after the first. The order of conditions was counter-balanced so that half of the participants were randomly assigned to the nature condition first and half of the participants were randomly assigned to the control condition first.

Each participant was paired with a new partner for each session. Participants signed up independently and were not aware that the study would involve working in pairs. At the start of each session, we asked participants to indicate whether they already knew their task partner, using an adapted version of the Personal Acquaintance Measure (PAM;

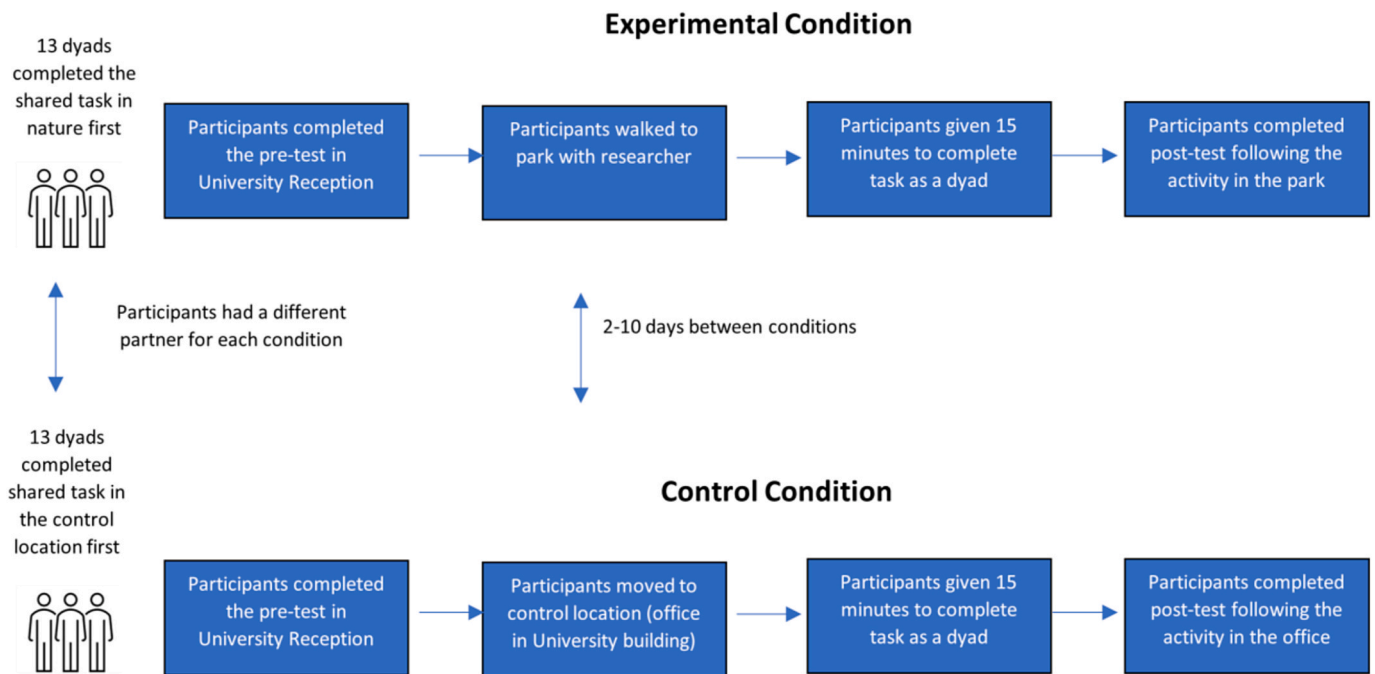


Fig. 2. The experimental design contrasted two within-participants conditions: a search task in nature and a search task in a control location. The order of tasks was counterbalanced across participants.

Starzyk et al., 2006). In both conditions most participants indicated that they did not know each other. In the natural environment 47 participants reported that they had not previously met their assigned partner, and 5 reported that they had previously met their assigned partner but did not know them well. In the control condition 46 participants reported that they had not previously met their assigned partner and 6 reported that they had met the assigned partner but did not know them well.

For both conditions, a researcher gave participants a laminated sheet containing a list of adjectives (*beautiful, camouflaged, disgusting, fragile, frightened, interesting, moving, noisy, peaceful, scary, singing*) and instructed the participants: “With your partner, see if you can find the things listed. I will give you 15 min to complete this task.” In the park, the dyad searched the natural environment for items that fit the adjectives. In the control condition, the dyad searched for the adjectives in ten laminated wordsearch puzzles provided by the researcher. Both conditions thus involved a search task which required focused attention to their immediate environment. Furthermore, in both conditions participants completed the search tasks collaboratively. In both conditions the researcher withdrew and waited for the participants to return after completing the task.

Before and after taking part in each condition, participants completed a brief survey on Qualtrics. The survey measures are described in detail below.

6.3. Measures

6.3.1. Social connection

To measure social connection, we asked participants to complete the Inclusion of Other in the Self (IOS) scale (Aron et al., 1992) before and after taking part in each condition. The IOS is a single-item pictorial measure that evaluates social connection by asking people to choose between pairs of differently overlapping circles (panel A in Fig. 1) to describe how close they feel to another person or group. In this study participants, who were all students, were asked to evaluate how close they felt “to other students”. Psychometric evidence indicates that the IOS has good test-retest reliability, construct validity, and predictive validity (Aron et al., 1992). In addition, the IOS is influenced by social

interactions (e.g., Tan et al., 2015).

6.3.2. Nature connection

To measure nature connection, we asked participants to complete the Inclusion of Nature in Self scale (INS; Schultz, 2002) before and after taking part in each condition. The INS is a single-item pictorial measure that was developed from the IOS and evaluates nature connection (Panel B in Fig. 1). We asked study participants to choose between pairs of differently overlapping circles to describe how connected they feel to nature. Psychometric evidence supports the construct validity of the INS (Mayer & Frantz, 2004; Schultz, 2001). In addition, the INS is sensitive to experimental manipulations of exposure to nature (e.g., Crawford et al., 2017).

6.3.3. Belonging

To measure stable individual differences in feelings of belonging, we asked participants to complete the 12-item General Belongness Scale at the start of each session (GBS; Malone et al., 2012). The GBS asks people to rate their agreement versus disagreement with statements such as “I have close bonds with family and friends” on a 7-point Likert scale from strongly disagree to strongly agree. Psychometric evidence supports the reliability and validity of the GBS in measuring stable individual differences in achieved belongingness (Malone et al., 2012). Internal consistency was high ($\alpha = 0.91$) and test-retest reliability was high ($r = 0.87$).

7. Results

7.1. Preliminary analyses

Table 1 presents the descriptive statistics for social connection and nature connection pre-and post-intervention for each condition, as well as feelings of belonging at the start of each of the two sessions. Shapiro-Wilk tests indicated that all variables had a non-normal distribution.

7.2. Main analyses

To evaluate the principal hypothesis that shared time in nature

Table 1

Descriptive statistics for social connection (IOS), nature connection (INS), and belonging (GBS) including tests of normality.

DV	Condition	Occasion	Mean	SD	Shapiro-Wilk	Significance
IOS	Control	Pre-test	3.44	1.59	0.94	0.01
		Post-test	3.48	1.54	0.94	0.01
	Nature	Pre-test	3.23	1.70	0.91	<0.01
		Post-test	3.90	1.68	0.95	0.02
INS	Control	Pre-test	3.56	1.46	0.89	<0.01
		Post-test	3.37	1.53	0.91	<0.01
	Nature	Pre-test	3.63	1.30	0.93	<0.01
		Post-test	4.38	1.33	0.89	<0.01
GBS	Session 1		63.83	11.01	0.91	<0.01
	Session 2		63.94	10.16	0.95	0.03

increases feelings of social connection, we compared the pre- and post-IOS responses for both the nature and control conditions using Wilcoxon signed-rank tests. Feelings of social connection significantly increased after the shared task in the park ($Z = -3.43, p < 0.001$) with a large effect size (0.48). Feelings of social connection did not increase significantly after the shared task indoors ($Z = -0.32, p = .75$) with a small effect size (0.04).

To address the secondary hypothesis that shared time in nature increases nature connection, we compared the pre- and post-INS responses for both the nature condition and the control condition using Wilcoxon signed-rank tests. Nature connection significantly increased after the shared task in the park ($Z = -3.64, p < 0.001$) with a large effect size (0.50). Nature connection significantly decreased after the shared task indoors ($Z = -2.02, p = 0.03$) with a small effect size (0.198).

To evaluate the alternative hypothesis that changes in social connection are influenced by stable individual differences, such as feelings of belonging, we first conducted a simple linear regression to evaluate the relation between participants' pre-test GBS scores and pre-test IOS scores. This single regression examined the relation between GBS and IOS for all participants at the beginning of the study and collapsed across condition, since half of our participants did the experimental condition first and half did the control condition first. The regression was significant, with a small positive effect, $R^2 = 0.14, F(1, 50) = 8.34, p = 0.01$, indicating that feelings of belonging and social connection are somewhat related constructs, but the overlap is small. We then calculated differences in pre-versus post-intervention IOS scores and ran two separate linear regressions for the experimental and control conditions, with GBS as the predictor variable and change in IOS as the outcome variable. If changes in social connection following shared task completion are due to stable individual differences in feelings of belonging, we should observe a positive relation between GBS and change in IOS for both conditions. Pre-existing feelings of belonging did not predict change in social connection for the experimental condition, $R^2 = 0.01, F(1, 50) = 0.67, p = 0.42$, or the control condition, $R^2 = 0.01, F(1, 50) = 0.03, p = 0.86$.

8. Discussion

We used a within-participant experimental design to examine whether shared time in nature increases social connection. People reported stronger feelings of social connection after completing a search task with a partner in a natural environment. In contrast, social connection did not change after completing a search task in a control environment, a university office. Consistent with previous evidence, spending time in the natural environment also increased feelings of nature connection (Capaldi et al., 2015; Mayer et al., 2009).

Most studies evaluating the impact of nature on human health and wellbeing have focused on the benefits of nature for individuals, such as improvements to attention and affect (Bratman et al., 2019; Hartig et al., 2014; Schertz & Berman, 2019). Few studies have investigated whether

spending time in nature benefits relations between people, and studies that have done so have primarily used correlational designs (de Vries et al., 2013; Oh et al., 2022; Weinstein et al., 2015; Zelenski & Nisbet, 2014). The experimental design of our study provides a much-needed test of causality, and our results support the hypothesis that spending time with other people in natural environments increases social connection.

Our study builds on existing experimental evidence that people behave in a more connected manner in natural environments (e.g., Cameron-Faulkner et al., 2018). By focussing on people's subjective experience, our study demonstrates that people also *feel* more connected to other people in natural environments. Subjective feelings of social connection are important because they predict numerous other aspects of health and wellbeing such as self-esteem, motivation, persistence, and fulfilment (Holt-Lunstad, 2021; Patrick et al., 2007; Walton et al., 2012; Yang et al., 2016). Future studies might include both observational measures of behaviour and self-reported subjective feelings of social connection to evaluate the extent to which observed behaviour and subjective experience are independent versus related effects of spending time with social partners in natural environments.

Our study also considered the possibility that stable individual differences in feelings of belonging, or general connectedness, might influence people's more dynamic feelings of social connection, or interpersonal closeness (Malone et al., 2012; Zelenski & Nisbet, 2014). We reasoned that if stable individual differences in belonging influence more dynamic feelings of social connection during shared tasks, we would observe a relation between belonging and change in social connection for both conditions, but we did not. Although feelings of belonging were related to initial feelings of closeness to other students, they did not predict change in social connection for the experimental or control condition.

8.1. Implications and potential applications

The results of our study have important implications for understanding the potential contribution of nature to community building (Minkler, 2012). Maas et al. (2009) proposed that people benefit from green spaces because green spaces increase feelings of community and decrease loneliness. Ethnographers have also described how green spaces provide opportunities for meeting new people and for focused interactions with familiar people (Dinnie et al., 2013; Egerer et al., 2019; Rantala & Puhakka, 2020). The results of our study are consistent with both proposals, but also suggest that it is the combination of social partners and natural environments that benefits social connection. Future studies should consider alternate designs that would allow comparisons across different group sizes in natural and built environments to better evaluate these proposals.

The results of our study also highlight the potential benefits of nature as a promising context for improving educational and wellbeing outcomes in university settings. Nature-based teaching and learning is a key component of primary and secondary education, supported by evidence of substantial benefits to motivation and wellbeing (Jucker & von Au, 2022; Waite et al., 2016). The results of our study suggest that there may be advantages to incorporating nature-based teaching and learning into university education as well. Nature-based teaching and learning has the potential to increase social connection and thereby help to alleviate mental health problems amongst university students (Auerbach et al., 2018; Duffy et al., 2020). Our study was brief, however, and the tasks that students completed were unrelated to their degree course. Targeted research is needed to evaluate the potential benefits of nature-based teaching and learning in university settings.

Empirical evaluations of how shared time in nature influences feelings of social connection have the potential to inform a wide variety of real-world issues including not only outdoor education programmes but also planning recommendations for residential areas and social programmes to relieve loneliness. To appropriately inform such issues,

researchers need to build a strong evidence base that includes both qualitative and quantitative evidence, including evidence from experiments. Evidence from experimental studies is challenging but essential because experimental designs allow us to draw stronger causal inferences about the influence of natural environments on social connection, and as a result will provide a stronger basis for interventions and programme design.

8.2. Limitations and future directions

One of the challenges of testing causal hypotheses about how natural versus built environments influence human health and wellbeing is defining appropriate comparisons across dramatically different contexts. To examine the effects of natural versus built environments on social connection and nature connection, we asked pairs of participants to complete analogous search tasks in both a natural and a built environment. In both conditions participants searched for the same list of items, although in the natural environment the task focused their attention on the qualities of nature, whereas in the control condition, the task focused their attention on written texts containing those words. In both conditions students completed the search tasks collaboratively. These similarities across the two tasks help to strengthen the causal inferences that we can draw from the comparison. Nonetheless, the conditions differed in several ways. One difference is that in the natural environment participants could see not only their task partner but also other people visiting the park, whereas in the control environment the participants did not encounter any other people. The primary difference between the two conditions was however the context of natural versus built environments and it is this difference to which we attribute the observed effects on social connection as well as nature connection. This interpretation is consistent with [Passmore and Holder's \(2017\)](#) report that when individuals were asked to attend to either natural or built aspects of their environment, attention to natural but not built environments led to increases in a general sense of connection. Future studies should evaluate how task requirements and environments together influence social connection as well as nature connection.

Previous researchers have proposed that time in nature improves wellbeing by increasing feelings of nature connection, which fulfils the biophilia drive ([Capaldi et al., 2015](#); [Kellert & Wilson, 1993](#); [Mayer & Frantz, 2004](#); [Zelenski & Nisbet, 2014](#)). Our findings suggest another interesting possibility: time in nature may improve wellbeing by increasing feelings of social connection, thus fulfilling the fundamental human need to be psychologically close, or related, to other people ([Baumeister & Leary, 1995](#); [Deci & Ryan, 1985](#)). Future studies should include measures of hedonic and eudaimonic wellbeing to compare and evaluate how shared time in nature influences not only social connection and nature connection, but also how those factors in turn influence wellbeing.

9. Conclusions

Our study provided an experimental test of the hypothesis that shared time in nature influences feelings of social connection. The study design and results offer a new avenue for furthering our understanding of the links between natural environments and human health and wellbeing. Future studies should build on this important initial step by testing alternative accounts and developing recommendations for interventions and programme design.

Author note

The authors have no conflicts of interest to declare. All study procedures were reviewed and approved by the university ethics committee and adhere to the tenets of the Declaration of Helsinki including informed consent. The preregistration and study data are available at <http://osf.io/npw32/>.

CRedit authorship contribution statement

Lauren Henderson: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft. **Laura Tipper:** Conceptualization, Methodology, Investigation, Writing – review & editing. **Sioned Willicombe:** Conceptualization, Methodology, Investigation, Writing – review & editing. **Merideth Gattis:** Conceptualization, Methodology, Supervision, Writing – review & editing.

References

- Ang, S. (2019). Life course social connectedness: Age-cohort trends in social participation. *Advances in Life Course Research*, 39, 13–22. <https://doi.org/10.1016/j.alcr.2019.02.002>
- Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, 63(4), 596–612. <https://doi.org/10.1037/0022-3514.63.4.596>
- Aron, A., McLaughlin-Volpe, T., Mashek, D., Lewandowski, G., Wright, S. C., & Aron, E. N. (2004). Including others in the self. *European Review of Social Psychology*, 15(1), 101–132. <https://doi.org/10.1080/10463280440000008>
- Auerbach, R. P., Mortier, P., Bruffaerts, R., Alonso, J., Benjet, C., Cuijpers, P., Demyttenaere, K., Ebert, D. D., Green, J. G., Hasking, P., Murray, E., Nock, M. K., Pinder-Amaker, S., & Sampson, N. A. (2018). WHO world mental health surveys international college student project: Prevalence and distribution of mental disorders. *Journal of Abnormal Psychology*, 127(7), 623–638. <https://doi.org/10.1037/abn0000362>
- Batson, C. D., Sager, K., Garst, E., Kang, M., Rubchinsky, K., & Dawson, K. (1997). Is empathy-induced helping due to self-other merging? *Journal of Personality and Social Psychology*, 73(3), 495–509.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497–529. <https://doi.org/10.1037/0033-2909.117.3.497>
- Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., De Vries, S., Flanders, J., ... Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, 5(7), Article eaax0903. <https://doi.org/10.1126/sciadv.aax0903>
- Brown, L. H., Silvia, P. J., Myin-Germeys, L., & Kwapił, T. R. (2007). When the need to belong goes wrong: The expression of social anhedonia and social anxiety in daily life. *Psychological Science*, 18(9), 778–782. <https://doi.org/10.1111/j.1467-9280.2007.01978.x>
- Cacioppo, J. T., Hawkey, L. C., & Thisted, R. A. (2010). Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago health, aging, and social relations study. *Psychology and Aging*, 25(2), 453–463. <https://doi.org/10.1037/a0017216>
- Cameron-Faulkner, T., Melville, J., & Gattis, M. (2018). Responding to nature: Natural environments improve parent-child communication. *Journal of Environmental Psychology*, 59, 9–15. <https://doi.org/10.1016/j.jenvp.2018.08.008>
- Capaldi, C. A., Passmore, H. A., Nisbet, E. K., Zelenski, J. M., & Dopko, R. L. (2015). Flourishing in nature: A review of the benefits of connecting with nature and its application as a wellbeing intervention. *International Journal of Wellbeing*, 5(4). <https://doi.org/10.5502/ijw.v5i4.449>
- Carmichael, C. L., Reis, H. T., & Duberstein, P. R. (2015). In your 20s it's quantity, in your 30s it's quality: The prognostic value of social activity across 30 years of adulthood. *Psychology and Aging*, 30(1), 95–105. <https://doi.org/10.1037/pag0000014>
- Chen, Z., Poon, K., DeWall, C. N., & Jiang, T. (2020). Life lacks meaning without acceptance. *Journal of Personality and Social Psychology*, 119(6), 1423–1443. <https://doi.org/10.1037/pspi0000238>
- Cialdini, R. B., Brown, S. L., Lewis, B. P., Luce, C., & Neuberg, S. L. (1997). Reinterpreting the empathy-altruism relationship: When one into one equals oneness. *Interpersonal Relations and Group Processes*, 73(3), 481–494.
- Coley, R. L., Kuo, F. E., & Sullivan, W. C. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior*, 29, 468. <https://doi.org/10.1177/001391659702900402>
- Crawford, M. R., Holder, M. D., & O'Connor, B. P. (2017). Using mobile technology to engage children with nature. *Environment and Behavior*, 49(9), 959–984. <https://doi.org/10.1177/0013916516673870>
- De Vries, S., Van Dillen, S. M., Groenewegen, P. P., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion, and physical activity as mediators. *Social Science & Medicine*, 94, 26–33. <https://doi.org/10.1016/j.socscimed.2013.06.030>
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Dinnie, E., Brown, K. M., & Morris, S. (2013). Community, cooperation, and conflict: Negotiating the social well-being benefits of urban greenspace experiences. *Landscape and Urban Planning*, 112, 1–9. <https://doi.org/10.1016/j.landurbplan.2012.12.012>
- Duffy, A., Keown-Stoneman, C., Goodday, S., Horrocks, J., Lowe, M., King, N., Pickett, W., McNevin, S. H., Cunningham, S., Rivera, D., Bisdounis, L., Bowie, C. R., Harkness, K., & Saunders, K. E. A. (2020). Predictors of mental health and academic outcomes in first-year university students: Identifying prevention and early-intervention targets. *BJPsych Open*, 6(3), e46. <https://doi.org/10.1192/bjo.2020.24>
- Egerer, M., Ordóñez, C., Lin, B. B., & Kendal, D. (2019). Multicultural gardeners and park users benefit from and attach diverse values to urban nature spaces. *Urban Forestry*

- and Urban Greening, 46, Article 126445. <https://doi.org/10.1016/j.ufug.2019.126445>
- Feehey, B. C., & Collins, N. L. (2015). A new look at social support: A theoretical perspective on thriving through relationships. *Personality and Social Psychology Review, 19*, 113–147. <https://doi.org/10.1177/1088868314544222>
- Goldy, S. P., & Piff, P. K. (2020). Toward a social ecology of prosociality: Why, when, and where nature enhances social connection. *Current Opinion in Psychology, 32*, 27–31. <https://doi.org/10.1016/j.copsyc.2019.06.016>
- Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health, 35*(1), 207–228. <https://doi.org/10.1146/annurev-publhealth-032013-182443>
- Holt-Lunstad, J. (2021). The major health implications of social connection. *Current Directions in Psychological Science, 30*(3), 251–259. [10.1177/0963721421999630](https://doi.org/10.1177/0963721421999630)
- Izenstark, D., & Ebata, A. T. (2017). The effects of the natural environment on attention and family cohesion: An experimental study. *Children, Youth, and Environments, 27* (2), 93–109. <https://doi.org/10.7721/chilyoutenvi.27.2.0093>
- High-quality outdoor learning: Evidence-based education outside the classroom for children. In Jucker, R., & von Au, J. (Eds.), *Teachers and society*, (2022). Springer. <https://doi.org/10.1007/978-3-031-04108-2>
- Kellert, S. R., & Wilson, E. O. (Eds.). (1993). *The biophilia hypothesis*. Washington DC: Island Press.
- Kuo, F. E., Sullivan, W. C., Coley, R. L., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology, 26*(6), 823–851.
- Maas, J., van Dillen, S. M. E., Verheij, R. A., & Groenewegen, P. P. (2009). Social contacts as a possible mechanism behind the relation between green space and health. *Health & Place, 15*, 586–595. <https://doi.org/10.1016/j.healthplace.2008.09.006>
- Malone, G. P., Pillow, D. R., & Osman, A. (2012). The general belongingness scale (GBS): Assessing achieved belongingness. *Personality and Individual Differences, 52*(3), 311–316. <https://doi.org/10.1016/j.paid.2011.10.027>
- Mayer, F., & Frantz, C. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*, 503–515. <https://doi.org/10.1016/j.jenvp.2004.10.001>
- Mayer, F., Frantz, C., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior, 41*, 607–643. doi:10.1177/0013916508319745.
- McMahan, E. A., & Estes, D. (2015). The effect of contact with natural environments on positive and negative affect: A meta-analysis. *The Journal of Positive Psychology, 10*, 507–519. <https://doi.org/10.1080/17439760.2014.994224>
- Minkler, M. (2012). *Community organizing and community building for health and welfare*. New Brunswick, NJ: Rutgers University Press.
- Myers, M. W., & Hodges, S. D. (2012). The structure of self-other overlap and its relationship to perspective taking. *Personal Relationships, 19*, 663–679. <https://doi.org/10.1111/j.1475-6811.2011.01382.x>
- Oh, R. R. Y., Zhang, Y., Nghiem, L. T. P., Chang, C. C., Tan, C. L. Y., Quazi, S. A., et al. (2022). Connection to nature and time spent in gardens predicts social cohesion. *Urban Forestry and Urban Greening, 74*, Article 127655. <https://doi.org/10.1016/j.ufug.2022.127655>
- Passmore, H. A., & Holder, M. D. (2017). Noticing nature: Individual and social benefits of a two-week intervention. *The Journal of Positive Psychology, 12*(6), 537–546. <https://doi.org/10.1080/17439760.2016.1221126>
- Patrick, H., Knee, C. R., Canevello, A., & Lonsbary, C. (2007). The role of need fulfillment in relationship functioning and well-being: A self-determination theory perspective. *Journal of Personality and Social Psychology, 92*(3), 434–457. <https://doi.org/10.1037/0022-3514.92.3.434>
- Rantala, O., & Puhakka, R. (2020). Engaging with nature: Nature affords well-being for families and young people in Finland. *Children's Geographies, 18*(4), 490–503. <https://doi.org/10.1080/14733285.2019.1685076>
- Schertz, K. E., & Berman, M. G. (2019). Understanding nature and its cognitive benefits. *Current Directions in Psychological Science, 28*(5), 496–502. <https://doi.org/10.1177/0963721419854100>
- Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology, 21*, 327–339. <https://doi.org/10.1006/jenvp.2001.0227>
- Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In P. Schmuck, & W. P. Schultz (Eds.), *Psychology of sustainable development* (pp. 61–78). Springer. https://doi.org/10.1007/978-1-4615-0995-0_4
- Starzyk, K. B., Holden, R. R., Fabrigar, L. R., & MacDonald, T. K. (2006). The personal acquaintance measure: A tool for appraising one's acquaintance with any person. *Journal of Personality and Social Psychology, 90*(5), 833–847. <https://doi.org/10.1037/0022-3514.90.5.833>
- Tan, Q., Zhan, Y., Gao, S., Fan, W., Chen, J., & Zhong, Y. (2015). Closer the relatives are, more intimate and similar are we: Kinship effects on self-other overlap. *Personality and Individual Differences, 73*, 7–11. <https://doi.org/10.1016/j.paid.2014.08.038>
- Waite, S., Passy, R., Gilchrist, M., Hunt, A., & Blackwell, I. (2016). *Natural Connections Demonstration Project 2012-2016: Final report*. Natural England Commissioned Report NECR215. <https://publications.naturalengland.org.uk/publication/6636651036540928>
- Walton, G. M., Cohen, G. L., Cwir, D., & Spencer, S. J. (2012). Mere belonging: The power of social connections. *Journal of Personality and Social Psychology, 102*(3), 513–532. <https://doi.org/10.1037/a0025731>
- Weinstein, N., Balmford, A., DeHaan, C. R., Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: The links among contact with natural environments, community cohesion, and crime. *BioScience, 65*(12), 1141–1153. <https://doi.org/10.1093/biosci/biv151>
- White, M. P., Pahl, S., Wheeler, B. W., Depledge, M. H., & Fleming, L. E. (2017). Natural environments and subjective wellbeing: Different types of exposure are associated with different aspects of wellbeing. *Health & Place, 45*, 77–84. <https://doi.org/10.1016/j.healthplace.2017.03.008>
- Wilson, E. O. (1984). *Biophilia*. Massachusetts: Harvard University Press.
- Yang, Y. C., Boen, C., Gerken, K., Li, T., Schorpp, K., & Harris, K. M. (2016). Social relationships and physiological determinants of longevity across the human life span. *Proceedings of the National Academy of Sciences, 113*(3), 578–583. <https://doi.org/10.1073/pnas.1511085112>
- Zelenski, J. M., & Nisbet, E. K. (2014). Happiness and feeling connected. *Environment and Behavior, 46*(1), 3–23. <https://doi.org/10.1177/0013916512451901>