

How to increase nature connectedness? Effectiveness and mechanisms of a gratitude journal intervention

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Abstract

1. Nature connectedness can promote pro-environmental behaviour and psychological well-being, but little is known about how nature connectedness can be strengthened. Interventions that seek to enhance nature connectedness by promoting direct nature contact may be impractical because urban areas often lack opportunities for interactions with nature in the daily lives of people.
2. This study examines the effects of a gratitude journal exercise on nature connectedness, psychological well-being, and engagement in wildlife gardening. Participants ($N = 114$) were either asked to write down daily three things relating to nature that they were grateful for over a 14-day period or they were assigned to one of two control groups (a traditional gratitude condition and an activity list condition).
3. Compared to the two control groups, there were no significant differences in any of the outcome variables during the 14-day period and at 1-week and 3-month follow-ups. However, significant increases in all those outcome variables emerged independent of the group. Qualitative data analysis suggests that the journal exercise promoted increases in the outcome variables by generating self-knowledge as well as positive emotions and attitudes. Moreover, participants noted that the journal activity made them think about nature in new ways, presumably through answering daily survey questions on nature connectedness.
4. We suggest that the mere activity of regularly reflecting on one's relationship with nature may increase nature connectedness. Interventions that encourage people to contemplate the interconnectedness between themselves and nature could be a viable strategy to strengthen human–nature relationships, especially in urban areas that lack opportunities for interactions with nature. The findings of this study can inform future research concerned with the processes of strengthening nature connectedness and the design of interventions that employ nature-based journal exercises.

KEYWORDS

gratitude, nature connectedness, positive psychology intervention, pro-environmental behavior, subjective well-being, wildlife gardening

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1 | INTRODUCTION

It has long been argued that feeling a strong connection with nature is an important driver of engagement in behaviours that protect the environment (Leopold, 1949; Mayer & Frantz, 2004). Furthermore, nature connectedness is positively associated with various dimensions of psychological well-being (Capaldi et al., 2014; Pritchard et al., 2020). There is growing concern among researchers and practitioners that people are increasingly disconnected from nature, which can have adverse effects on people's engagement in pro-environmental behaviour and their well-being (Louv, 2008; Miller, 2005; Soga & Gaston, 2016). While strengthening nature connectedness may contribute to both human and environmental well-being, it is largely unclear how nature connectedness can be enhanced in people that have limited access to nature.

The present research investigates the effects of an adaptation of a gratitude journal exercise, a widely used positive-psychology intervention, on people's nature connectedness, psychological well-being and one domain of pro-environmental behaviour, engagement in wildlife gardening. The findings from this research could inform the design of interventions to promote nature connectedness and offer insights into mechanisms by which relationships with nature can be strengthened. Furthermore, they might contribute to our understanding of the influence of nature connectedness on psychological well-being and on behaviours that support biodiversity in private gardens.

1.1 | Nature connectedness

There is a growing body of psychological research investigating people's relationship with nature (Ives et al., 2017). Various conceptualizations and measures of nature connectedness have been developed in recent years, which mostly focus on the cognitive and affective aspects of people's relationship with nature (Restall & Conrad, 2015; Tam, 2013). According to Schultz (2002), nature connectedness refers to the inclusion of nature in one's cognitive representation of self. Based on the idea put forward by Aron et al. (1991), that in close social relationships one's representation of self and other people are integrated, Schultz (2002) argued that people with strong nature connectedness show a substantive overlap between their representations of self and nature. Nature connectedness is assumed to be formed through experiences with nature during childhood (Kahn & Kellert, 2002), a notion that is supported by studies demonstrating a positive relationship between the time spent in nature during childhood and the degree of nature connectedness in adulthood (Cleary et al., 2018; van Heezik et al., 2021). Several studies have also found significant associations between the time spent in nature during adulthood and nature connectedness while accounting for childhood nature experiences, which points to the importance of regular nature experiences throughout life for enhancing nature connectedness (Cleary et al., 2018; Pensini et al., 2016; Rosa et al., 2018).

The majority of the global population is living in urban areas, which may offer limited opportunities for interactions with nature in people's immediate living environments (Soga & Gaston, 2016). Encounters with nature in urban areas are often characterized by biological uniformity, the notion that only a few but widespread animal and plant species are present in an area, which can reinforce humans' alienation from nature (Miller, 2005). Therefore, the effectiveness of interventions that aim to foster nature connectedness through increasing people's direct contact with nature could be influenced by the quantity and quality of natural areas in people's immediate living environments. However, studies have suggested that the degree to which people feel connected to nature in urban green spaces may also depend on other factors unrelated to the physical properties of nature, such as the types of activities (Richardson et al., 2021), being mindful (Nisbet et al., 2019), and perceptions of wildness during nature exposure (Samus, Freeman, van Heezik, et al., 2022). Therefore, behavioural interventions that address people's thoughts, emotions and perceptions of nature may be of particular relevance to strengthening human–nature relationships in people who have limited access to nature.

Several recent studies have tested interventions to strengthen nature connectedness (Barragan-Jason et al., 2022; Sheffield et al., 2022). The majority of those interventions aim to strengthen nature connectedness by increasing people's contact with nature or virtual representations thereof. For example, interventions include single nature visits (Nisbet & Zelenski, 2011), repeated nature visits (Choe et al., 2020), multiple-day trips (Barton et al., 2016) or watching a video of nature (Yeo et al., 2020). In contrast, a small number of interventions do not explicitly ask participants to spend more time in nature (Sheffield et al., 2022). Passmore and Holder (2017) demonstrated that participants who undertook a 2-week photo exercise asking them to take pictures of natural objects and describe their emotions towards them, had a higher level of general connectedness than a wait-list control group. However, the effect of the intervention in comparison to an active control group, who took pictures of human-built objects, was only close to statistically significant. Richardson and Sheffield (2017) asked participants to write down three good things in nature in the evening for 5 days. In comparison to a control group that listed three factual things, the intervention group showed significantly higher increases in nature connectedness shortly after the intervention and at a follow-up 2 months later. A similar diary writing approach was applied by McEwan et al. (2019), who used a smartphone app to prompt participants once a day during a 7-day period to notice and write down things in urban green spaces that they valued. In this case, there was no statistically significant improvement in nature connectedness in comparison with people in a control group who were asked to write down things that they valued in-built settings instead. However, nature connectedness was found to have increased significantly in both groups. The aforementioned studies offer preliminary evidence in support of the idea that nature

connectedness can be enhanced by promoting people's awareness of nature in their daily lives or by inducing positive thoughts and emotions towards nature. While those types of interventions are relevant for people that have limited access to nature, as they do not require them to spend more time in nature, there is a need for more well-controlled intervention research.

Interventions that ask people to actively notice positive things in nature (e.g. McEwan et al., 2019; Richardson & Sheffield, 2017) are based on the Three Good Things journal, a widely used intervention that has been shown to increase human well-being (Gander et al., 2013; Mongrain & Anselmo-Matthews, 2012; Seligman et al., 2005). In a study by Seligman et al. (2005), participants were asked to make a journal entry in the evening to list three good things that happened during the day. The Three Good Things journal can be considered part of a group of positive psychology interventions that aim to enhance human well-being by promoting individuals' gratitude towards their lives (Parks & Biswas-Diener, 2013). Gratitude has been conceptualized as an orientation towards the positive in life (Wood et al., 2010). In a series of studies, Emmons and McCullough (2003) focused more explicitly on gratitude by asking participants to think back over the past week or day and write down five things that they were grateful for in their lives. Participants who filled in a daily gratitude journal and well-being questionnaire over a 14-day period showed higher levels of positive affect during the intervention period compared to a control group. The positive effects of gratitude journal interventions, also referred to as Counting One's Blessings, on various dimensions of human well-being have been demonstrated in several studies (e.g. Cunha et al., 2019; Froh et al., 2008; Kerr et al., 2015).

In contrast to the above-mentioned wider conceptualization of gratitude as a kind of life orientation, gratitude has also been defined as a positive emotion in response to receiving a benefit resulting from an intentional act by another person (Emmons & Crumpler, 2000; Tsang, 2006; Wood et al., 2010). Gratitude has thus been considered to serve an important social function, the formation and maintenance of interpersonal relationships (Algoe, 2012; Algoe et al., 2008). The extent to which people experience feelings of gratitude has been found to be associated with one's sense of social connectedness (Lee et al., 2015). Emotions of gratitude towards a romantic partner experienced during 1 day have been found to be associated with feelings of connectedness with that partner on the next day (Algoe et al., 2010). Gratitude journal exercises have also been shown to increase connectedness with other people (Kerr et al., 2015) and perceived friendship quality (O'Connell et al., 2018). These same relational emotions that support connection to other people, such as gratitude, may also promote nature connectedness (Petersen et al., 2019). Gratitude towards nature has been shown to be highly correlated with nature connectedness (Tam, 2022). Against this backdrop, the present study examines whether a behavioural intervention that asks people to regularly express gratitude towards nature enhances people's nature connectedness.

1.2 | Relationships between nature connectedness, psychological well-being and engagement in wildlife gardening

Nature connectedness has been found to be associated with indicators of hedonic and eudaimonic well-being (Capaldi et al., 2014; Pritchard et al., 2020). While nature connectedness is also related to other dimensions of connectedness, such as connectedness to other people or one's country, nature connectedness has been found to significantly predict well-being after controlling for general connectedness (Zelenski & Nisbet, 2012). Nature connectedness may contribute to well-being by satisfying the basic human need for relatedness (Cleary et al., 2017).

Nature connectedness is also recognized as an important determinant of actions to protect the environment as it increases people's concern for the environment and their willingness to engage in actions to protect nature (Leopold, 1949; Mayer & Frantz, 2004; Schultz, 2002; Zelenski et al., 2015). Consequently, nature connectedness has been found to be associated with a range of pro-environmental behaviours (Mackay & Schmitt, 2019; Whitburn et al., 2019). Actions that support biodiversity in private gardens is one dimension of pro-environmental behaviour and have received increased research interest because of growing concerns about global biodiversity loss (Aronson et al., 2017; Mumaw & Mata, 2022). Private gardens cumulatively cover a large proportion of the total area in many cities and can provide habitats for native and endangered species (Loram et al., 2007; Thompson et al., 2003). Because urbanization contributes to global biodiversity loss and the structure and management of private gardens play an important role in supporting urban biodiversity, encouraging people to engage in behaviours that enhance biodiversity in their gardens is one measure to mitigate biodiversity loss (Goddard et al., 2010; Mumaw & Mata, 2022). Biodiversity-friendly gardening behaviours include actions that provide resources and habitats for flora and fauna and are often referred to as wildlife gardening (Gaston et al., 2007; Mumaw & Bekessy, 2017). Only a few studies such as van Heezik et al. (2020) have tested interventions to promote wildlife gardening behaviours. The extent to which people engage in wildlife gardening and the presence of wildlife-friendly features in people's gardens have been shown to be associated with nature connectedness (Kiesling & Manning, 2010; Prévot et al., 2018; Samus, Freeman, Dickinson et al., 2022).

1.3 | The present study

The main aim of this study was to examine the influence of a behavioural intervention on people's nature connectedness. We used an adaptation of the Counting One's Blessings intervention, in which we asked participants to list things in nature that they are grateful for in the evenings over a 14-day period. Participants also filled in daily surveys before filling in the gratitude lists as well

as surveys before (T1), 1 week after (T2) and 3 months after (T3) the 14-day period. We randomly assigned participants to the nature gratitude group or two control groups, a traditional gratitude group or an activity list group. Activity list groups ask people to write down activities that they did during the past day, and they are frequently used as control groups in gratitude journal interventions (Davis et al., 2016). The traditional gratitude group was included to demonstrate that the predicted increase in nature connectedness is due to the expression of gratitude towards nature and not because of the expression of gratitude towards one's life in general. Participants assigned to the traditional gratitude group were asked to write down three things that they were grateful for in their lives. We hypothesized that participants in the nature gratitude group would show more nature connectedness in comparison with the traditional gratitude group and the activity list group (Hypothesis 1). Our hypothesis aligns with the conceptualization of gratitude as an emotion directed towards a benefactor, which can enhance feelings of social connectedness. In this intervention, the benefactor is nature rather than a person, and accordingly, we expected increases in nature connectedness.

The secondary aim of this study was to investigate the effects of the intervention on psychological well-being and engagement in wildlife gardening. We predicted that both the nature gratitude and traditional gratitude group would show higher levels of psychological well-being compared to the activity list group (Hypothesis 2). Regarding engagement in wildlife gardening, we hypothesized that the nature gratitude group would show higher engagement in wildlife gardening practices in comparison to the traditional gratitude and activity list groups (Hypothesis 3). We also explored the mechanisms by which the intervention influenced well-being and engagement in wildlife gardening. Participants in both the nature gratitude group and traditional gratitude groups were asked to regularly express gratitude, although the objects to which gratitude was expressed was different. Therefore, both groups might have higher levels of gratitude in comparison with the activity list group. In this case, it would be unclear whether the predicted increase in psychological well-being and engagement in wildlife gardening in the nature gratitude group is due to an increase in nature connectedness or gratitude. To account for this alternative explanation, we also investigated one research question: What is the role of gratitude and nature connectedness in increasing well-being and engagement in wildlife gardening behaviour?

2 | METHODS

2.1 | Participants

Ethical approval for this research was obtained from the departmental ethics committee (D21/332). The sample size required for this study was determined based on power calculations in GPower (Faul et al., 2007) with an $\alpha=0.05$, 90% power and a correlation between the repeated measures of $r=0.50$. In order to show a significant

interaction effect of $f=0.15$ on nature connectedness (Passmore & Holder, 2017; Richardson & Sheffield, 2017) in a 3 (time) \times 3 (group) repeated-measures analysis of variance (ANOVA), the required sample size was determined to be $N=117$. We expected a 30% dropout rate over the course of the study and thus aimed to recruit 167 participants. While dropout rates in online positive psychology interventions can range from 29% to 83% (Mitchell et al., 2010), we expected attrition to be at the lower end of this range as we financially compensated participants and they only received full compensation if they had completed the last survey. The study was advertised as 'daily reflections and well-being' on social media (i.e. facebook) in groups of local districts and neighbourhoods, job search sites and classified advertisements in the New Plymouth region, North Island, New Zealand. Participants had to be at least 18 years of age, live in New Plymouth (population approximately 80,000) and have access to a garden to participate in the study. In line with our a priori sample size calculation, we ceased recruitment as soon as 167 people had signed up for the study. Only participants who filled out all the main surveys at T1, T2 and T3 and completed at least six journal entries were included in the study. The final sample was $N=114$ with a fairly even spread across the nature gratitude ($n=36$), traditional gratitude ($n=40$) and activity list groups ($n=38$). Participants dropped out at the following time points: 29 participants did not complete survey T1, 18 participants either withdrew from the study during the diary intervention period or completed less than six diary entries, three participants did not complete survey T2, and three participants did not complete survey T3. Participants were spread across seven different age groups (18–24 years = 7.0%, 25–34 = 29.8%, 35–44 = 28.9%, 45–54 = 16.7%, 55–64 = 7.9%, 65–74 = 7.9%, 75 and over = 1.8%), and the majority of the sample was female (88.6%).

2.2 | Procedure

Participants first provided written informed consent and then signed up for this study by completing a short survey that assessed whether they fulfilled the study requirements. They also chose a starting date for their journal exercise from a 2-month period in the late spring/early summer. The journal exercise always started on Thursdays and lasted 14 days. Participants were randomly assigned to one of the three journal groups independent of their starting date. After filling out the survey, participants received an email confirming their starting date and including general instructions on the study with specific information relating to their journal group. The link to the first survey (T1) was emailed to the participants 2 days before the start of the journal exercise and had to be completed before the start of the 14-day intervention period. On the first day of the intervention period, a link to the journal was emailed to the participants and they were asked to fill in the survey after 7 PM on the first day and on at least 10 evenings over the next 14 days. Participants were instructed to use this link for all of their diary entries. Participants also received reminder emails on seven evenings over the course of the 14-day intervention period to keep participants engaged in the study. First,

participants filled in a survey about their daily well-being and daily nature connectedness. Next, instructions relating to their journal group assignment (nature gratitude, traditional gratitude or activity list) were displayed (please see Appendix A) and followed by three text boxes. The instructions for the nature gratitude and traditional gratitude group were adapted from Emmons and McCullough (2003).

One week after the end of the intervention, participants filled in the second survey (T2). After completion of the survey, they were sent a voucher (NZ \$20) by post. Half of the participants also received a brochure that included information about wildlife gardening to examine whether having that information influenced their engagement in wildlife gardening. Because this was a subordinate research question and due to the limited scope of this paper, we do not discuss this aspect in more detail. However, we note that the brochure did not have a significant effect on engagement in wildlife gardening or any other study variable. Three months after the end of the intervention period, participants filled in the last survey (T3). A second voucher (NZ \$20) was sent to participants upon completion of the last survey.

2.3 | Measures

The following measures were included in the main survey at T1, T2 and T3, except feature richness which was only assessed at T1 and T3. We also included daily measures of positive affect, negative affect, gratitude and nature connectedness at the beginning of the daily journal entry. Diary methods have several advantages over global self-reports, such as a reduction of recall bias and the ability to study people's experiences in their natural contexts (Bolger et al., 2003; Reis, 1994). An overview of the procedure and measures is shown in Figure 1.

2.3.1 | Nature connectedness

We used the Connectedness to Nature Scale developed by Mayer and Frantz (2004), which assesses people's affective relationship

with nature. Participants rated their agreement with 14 statements (e.g. 'I often feel a sense of oneness with the natural world around me') on 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The measure yielded acceptable internal consistency (T1 Cronbach's $\alpha=0.80$, T2 $\alpha=0.82$, T3 $\alpha=0.84$). Daily nature connectedness was assessed by amending three items from the scale to read as a daily measure (i.e. 'Today I felt a sense of oneness with the natural world around me', 'Today I felt a kinship with animals and plants' and 'Today I felt as though I belong to the Earth as equally as it belongs to me'). The daily measure yielded acceptable internal consistency ($\alpha=0.85$). A composite score for daily nature connectedness during the intervention period was calculated for each participant by adding up the daily scores on the scale and averaging them. Following Emmons and McCullough (2003), the first diary entry of each participant was omitted because it was collected before participants completed the gratitude list for the first time. We also included filler items in the daily survey as well as the surveys at T1, T2 and T3 to make the aim of study more ambiguous. Those items asked participants to indicate their agreement with statements relating to their sense of connectedness with their house, work, community, neighbourhood, city and with important people in their lives.

2.3.2 | Psychological well-being

We used measures that capture both hedonic and eudaimonic dimensions of well-being. The Flourishing Scale (Diener et al., 2010) includes eight items that tap into several drivers of human flourishing, such as social relationships, purpose in life, self-respect, optimism and competence. Participants indicated their agreement with these statements (e.g. 'I lead a purposeful and meaningful life') on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale yielded acceptable internal consistency (T1 $\alpha=0.88$, T2 $\alpha=0.87$, T3 $\alpha=0.88$). The Satisfaction with Life Scale (Diener et al., 1985) was used to assess people's evaluation of their overall life satisfaction. It included five statements (e.g. 'In most ways my

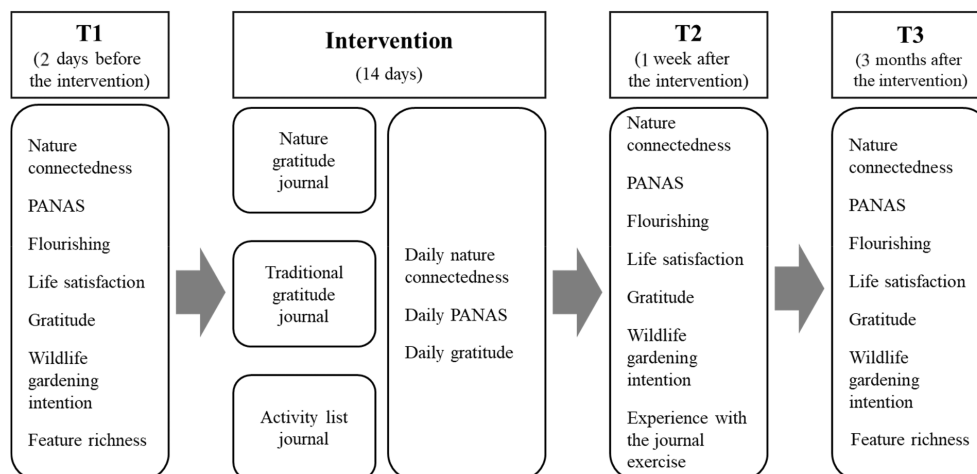


FIGURE 1 Study procedure and measures.

life is close to my ideal') that were assessed on 7-point scales from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale was internally consistent (T1 $\alpha=0.90$, T2 $\alpha=0.88$, T3 $\alpha=0.88$). The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) includes 10 positive emotions (e.g. 'excited') and 10 negative emotions (e.g. 'hostile'). Participants indicated to what extent they had felt each emotion over the previous week on a scale from 1 (very slightly or not at all) to 5 (extremely). The scales for both positive affect (T1 $\alpha=0.88$, T2 $\alpha=0.89$, T3 $\alpha=0.91$) and negative affect (T1 $\alpha=0.84$, T2 $\alpha=0.83$, T3 $\alpha=0.89$) were internally consistent. Daily positive affect and daily negative affect were assessed with a shortened form of the PANAS (Thompson, 2007), which included five positive and five negative emotions. Participants indicated the degree to which they have experienced these emotions today on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The measure was internally consistent (daily positive affect $\alpha=0.83$; daily negative affect $\alpha=0.76$). Composite scores for positive affect and negative affect were calculated excluding the first journal entry as indicated above.

2.3.3 | Gratitude

Participants indicated the extent to which they experienced three emotions (i.e. grateful, thankful, appreciative) over the previous week. This measure was developed by Emmons and McCullough (2003) and it was integrated into the PANAS. The scale was internally consistent (T1 $\alpha=0.89$, T2 $\alpha=0.88$, T3 $\alpha=0.89$). The three items were also integrated into the short form of the PANAS to assess daily gratitude. The daily gratitude measure was internally consistent ($\alpha=0.92$). As with the other daily measures, we calculated a composite score without the first journal entry.

2.3.4 | Wildlife gardening

Engagement in wildlife gardening practices was measured by asking participants to indicate the number of wildlife-friendly features (feature richness) in their gardens. This measure was adapted from a feature richness indicator used in one of our previous studies (Samus et al., 2023). Participants were asked to select features present in their gardens at T1 and T3 from a list of nine features (e.g. deadwood, bird feeder, a wild area). Feature richness was not assessed at T2 because we did not expect changes to gardens within the short time frame from T1 to T2. Moreover, we wanted to limit participants' exposure to the features presented in this measure as it might have resulted in learning effects and thus influenced behaviour. In addition to feature richness, we assessed people's intention to engage in wildlife gardening at T1, T2 and T3, using four items developed by us (Samus et al., 2023). People indicated their agreement with three statements, each one referring to one of the three categories of wildlife friendly features, such as items, wildness characteristics and plants (e.g. 'How much wildness do you intend to allow in your garden over this summer?') on 7-point

scales from 1 (*none*) to 7 (*a lot*). The fourth item asked participants to indicate their agreement with a statement (i.e. 'Over this summer, I plan to garden in a way that attracts as many birds, insects, and reptiles to my garden as possible') on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The intention measure yielded acceptable internal consistency (T1 $\alpha=0.67$, T2 $\alpha=0.74$, T3 $\alpha=0.75$).

2.3.5 | Experience with the journal exercise

Two open questions at the end of the survey T2 asked people about their experience with the journal exercise (i.e. 'How was the diary activity for you overall? Please describe in a few sentences' and 'Have you learned anything from the diary activity? Please describe in a few sentences'). Both questions were followed by a text box.

2.4 | Analytical approach

We conducted statistical analysis using IBM SPSS 28 to test the hypotheses laid out in Section 1.3. Analysis of variance (ANOVA) was used to test whether the number of diary entries made in the 14-day intervention period and the baseline scores on nature connectedness differed between the groups. To assess changes in nature connectedness, well-being and engagement in wildlife gardening from pre- to post-tests between the intervention groups, we applied repeated-measures ANOVA with time (T1, T2 and T3) as the within-subjects variable and group (nature gratitude, traditional gratitude and activity list) as the between-subjects variable. Whenever Mauchly's test indicated a violation of the assumption of sphericity, we used the Greenhouse-Geisser correction. Repeated-measures ANOVA was followed up with Bonferroni-adjusted post hoc tests. Analysis of covariance (ANCOVA) was used to assess differences in daily nature connectedness, daily gratitude and daily well-being during the intervention period between the groups. The baseline measures of the outcome variables were included as the covariate.

We also conducted exploratory analyses, which examined potential mechanisms by which the intervention influenced the outcome variables. First, answers to the open questions at T2 were explored using thematic analysis guided by Braun and Clarke (2006). MAXQDA was used to analyse the data. After familiarization with the data, we coded the data using an inductive approach by creating codes and themes based on the data. Themes and subthemes were formed in a recursive process which involved identifying common patterns and relationships in the data and collating codes into themes and subthemes. Second, we coded all the data that referred to nature and explored common patterns within the references made to nature. This deductive approach was driven by the main focus of this study on nature connectedness and aimed to explore potential mechanisms by which the intervention promoted nature connectedness and its relationship to well-being and wildlife gardening. We also calculated the percentage of participants in each group that referred to a theme to

obtain a descriptive quantitative measure that indicates whether the themes were present in all groups. In addition, we modelled the effect of change in nature connectedness on change in psychological well-being and engagement in wildlife gardening, while controlling for change in gratitude. We ran two multiple regression models predicting each outcome variable; one for the T2 score and one for T3 score. The models for T2 included the T2 scores on gratitude and nature connectedness as predictor variables, while controlling for their baseline scores and the baseline score of the outcome variable. The models for T3 included the T3 scores on gratitude and nature connectedness as predictor variables while controlling for their baseline scores and the baseline score of the outcome variable.

3 | RESULTS

3.1 | Tests of hypotheses

3.1.1 | Preliminary analysis

On average, participants made 10.22 ($SD=2.05$) diary entries ranging from 6 to 14 entries: 10.19 ($SD=2.00$) in the nature gratitude group, 10.15 ($SD=2.06$) in the traditional gratitude group and 10.32 ($SD=2.14$) in the activity list group. There were no statistically significant differences between the groups in regard to the number of entries, $F(2,111)=0.066$, $p=0.936$, $\eta_p^2=0.00$ and the baseline scores on nature connectedness, $F(2,111)=0.522$, $p=0.595$, $\eta_p^2=0.01$. Means and standard deviation of the study variables assessed at T1, T2 and T3, and during the 14-day diary period are shown in Appendix B.

3.1.2 | Nature connectedness

The time by group interaction effect on nature connectedness was not significant, $F(4,222)=0.923$, $p=0.451$, $\eta_p^2=0.02$. There were also no statistically significant differences in daily nature connectedness over the 2-week intervention period, $F(2,110)=0.006$, $p=0.994$, $\eta_p^2=0.00$. Therefore, Hypothesis 1, which predicted higher nature connectedness for the nature gratitude group in comparison to the traditional gratitude group and the activity list group, was not supported. However, there was a significant main effect of time on nature connectedness, $F(2,222)=14.839$, $p<0.001$, $\eta_p^2=0.12$. Mean scores of nature connectedness significantly increased across all groups from T1 to T2 ($p=0.003$) and from T1 to T3 ($p<0.001$), but not from T2 to T3 ($p=0.081$).

3.1.3 | Psychological well-being

The time by group interaction effect on all the well-being indicators was not significant; positive affect, $F(4,222)=0.694$, $p=0.597$, $\eta_p^2=0.01$, negative affect, $F(4,222)=0.368$, $p=0.831$, $\eta_p^2=0.01$,

life satisfaction, Greenhouse–Geisser, $F(3.68,203.97)=1.334$, $p=0.261$, $\eta_p^2=0.02$ and flourishing, Greenhouse–Geisser, $F(3.64,201.74)=0.990$, $p=0.409$, $\eta_p^2=0.02$. Furthermore, there was no significant difference between the diary groups on daily ratings of positive affect, $F(2,110)=1.011$, $p=0.367$, $\eta_p^2=0.02$, and negative affect, $F(2,110)=1.263$, $p=0.287$, $\eta_p^2=0.02$. Therefore, the data do not support our prediction that the nature gratitude group and traditional gratitude group would show higher psychological well-being than the activity list group (Hypothesis 2). However, the analysis revealed a significant main effect of time on positive affect, $F(2,222)=17.138$, $p<0.001$, $\eta_p^2=0.13$, negative affect, $F(2,222)=7.323$, $p<0.001$, $\eta_p^2=0.06$, life satisfaction, Greenhouse–Geisser, $F(1.84,203.97)=13.304$, $p<0.001$, $\eta_p^2=0.11$ and flourishing, Greenhouse–Geisser, $F(1.82,201.74)=9.662$, $p<0.001$, $\eta_p^2=0.08$. Post hoc tests showed that positive affect ($p<0.001$), life satisfaction ($p=0.001$), and flourishing ($p<0.001$) significantly increased, while negative affect significantly decreased ($p=0.002$) from T1 to T2. Significant increases were also detected from T1 to T3 for positive affect ($p<0.001$), life satisfaction, ($p<0.001$), and flourishing ($p=0.002$), but the change in negative affect between T1 and T3 was non-significant ($p=1.0$). Changes from T2 to T3 for positive affect ($p=1.0$), life satisfaction ($p=0.434$), and flourishing ($p=1.0$) were not significant. Negative affect significantly increased from T2 to T3 ($p=0.002$).

3.1.4 | Gratitude

The time by group interaction effect on gratitude was not significant, Greenhouse–Geisser, $F(3.78,210.23)=1.511$, $p=0.203$, $\eta_p^2=0.03$. There was a significant difference between the groups on daily scores on gratitude, $F(2,110)=3.937$, $p=0.022$, $\eta_p^2=0.07$. The traditional gratitude group had significantly higher daily gratitude than the activity list group during the intervention period ($p=0.032$), but not in comparison with the nature gratitude group ($p=0.094$). The difference in daily gratitude between the nature gratitude group and the activity list group was not significant ($p=1.0$). A main effect of time emerged for gratitude, Greenhouse–Geisser, $F(1.89,210.23)=6.702$, $p=0.002$, $\eta_p^2=0.06$. Gratitude increased from T1 to T2 ($p=0.015$) and from T1 to T3 ($p=0.007$), but not from T2 to T3 ($p=1.00$).

3.1.5 | Wildlife gardening

The time by group interaction effect was not significant for both indicators of engagement in wildlife gardening; intention, Greenhouse–Geisser, $F(3.74,207.34)=1.968$, $p=0.105$, $\eta_p^2=0.03$ and feature richness, $F(2,111)=2.540$, $p=0.083$, $\eta_p^2=0.04$. The results do not support Hypothesis 3 which predicted higher engagement in wildlife gardening in the nature gratitude group compared to the traditional gratitude group and activity list group. There was a significant main effect of time on intention, Greenhouse–Geisser,

$F(1.87,207.34)=44.130$, $p<0.001$, $\eta_p^2=0.29$, and feature richness, $F(1,111)=65.706$, $p<0.001$, $\eta_p^2=0.37$. Intention significantly increased from T1 to T2 ($p<0.001$) and from T1 to T3 ($p<0.001$), but not from T1 to T3 ($p=0.074$).

3.2 | Exploratory analysis—Qualitative data

We identified two main themes that captured participants' perceived effects of the intervention on them: self-knowledge as well as positive emotions and attitudes. Participants also made some additional comments that referred mostly to the administration of the study and included general evaluative statements about the diary exercise. Those statements were allocated to a miscellaneous theme and are not discussed in detail here. In the remainder of this section, we first describe the two themes along with the corresponding subthemes and then describe references made to nature. When using quotes from participants, we include the diary group they belonged to at the end of the quote; that is, nature gratitude (NG), traditional gratitude (TG) and activity list (AL). The percentages of people from each group who made statements in relation to specific themes are shown in Table 1.

3.2.1 | Self-knowledge

Self-knowledge refers to one's understanding of typical thoughts, behaviours and feelings (Vazire & Carlson, 2010). An increase in self-knowledge was evident in participants' statements referring to learning experiences about themselves, specifically (1) insights into emotions and how they relate to daily events, (2) insights into values, identity, and relationships, (3) action-knowledge, and (4) mindfulness.

Insights into emotions and daily events

Many participants described an increase in their awareness of the events, encounters and activities happening during their day and how they influenced moods and feelings. One participant noted: 'There are erratic changes in feelings dependent on the things going on in my life. Noticed I'm happier when my daughter is home and things are going well, feels negative and bleak when I have negative

forces touch me in some capacity' (NG). The questions that asked people to reflect on their feelings during the day may have promoted an increased awareness of the relationship between daily events and emotions. For example, one participant noticed: 'that a single event in the day could color so many of my responses to a question' (AL).

Insights into values, identity, and relationships

Many participants reported that the journal exercise offered reflection and learning about one's life in general. For some participants this subtheme was evident in statements that referred to learning about what is important to them in general or more specifically, for example, 'neighbours' (AL) or 'the natural world' (AL). One participant noted: 'A timely reminder of those things I hold dear. At this time of year with so much going on, it is easy to lose focus' (NG). Others described that the diary activity changed the way they identify and relate to other people or nature, for example, 'It also reiterated to me how simple things such as knowing people in my community solidify my identity in the community' (AL). Many participants also noticed that the diary activity challenged them to think about their life and relationships in new ways. For example, 'Many of the questions were not things I would normally think about or consider so it also made me aware or mindful of them' (TG).

Action-knowledge

Several participants noticed that the diary activity helped them to come up with specific actions that they wanted to undertake in order to increase their well-being, for example, 'better time management' (TG), improving work-life 'balance' (AL) or to 'plant more things' (AL). One participant noted: 'I have learned that being active is a goal of mine that I want to achieve and something I want to adapt into my every-day life' (TG).

Mindfulness

Mindfulness refers to the ability to be present in the moment and to have a non-judgmental attitude towards one's experience (Bishop et al., 2004); it can also increase self-knowledge (Carlson, 2013). Some participants explicitly reported an increase in mindfulness, for example, 'I learnt to be much more mindful than what I had been' (NG). Others reported how the diary activity increased present moment awareness during the day: 'There were moments in the day when I was in an experience that I thought this is (any feeling) I will

TABLE 1 Number and percentage of statements allocated to each theme.

Themes	Number of participants from all groups (N = 114)	Number of participants from each group		
		Nature gratitude (n = 36)	Traditional gratitude (n = 40)	Activity list (n = 38)
Self-knowledge	76 (67%)	25 (69%)	23 (58%)	28 (74%)
Positive emotions and attitudes	49 (43%)	16 (44%)	23 (58%)	10 (26%)
Nature	41 (36%)	17 (47%)	11 (28%)	13 (34%)
Miscellaneous	94 (82%)	27 (75%)	33 (83%)	34 (89%)

Note: Percentages refer to the number of people referring to the theme over the total number of people in the group.

use this tonight in reflecting. I feel I had more purposefully acknowledged some feelings during the day because of knowing I would be writing about it' (AL). Some participants also noticed that they had a greater inclination to accept thoughts and emotions as they are, which was evidenced in a statement like: 'To sit with feelings instead of trying to get rid of them' (AL).

3.2.2 | Positive emotions and attitudes

Participants reported that the diary activity made them think more positively about their life and experience more positive emotions, specifically more gratitude, during the intervention period.

Positive attitude

Many participants noticed that the diary exercise helped them to think about their life in a more positive way, such as about one's life in general, one's 'surroundings' (AL), and by focusing on the things that were 'achieved' (NG) on that day. One participant noted: 'Interesting I found myself reflecting over my day and seeking out the positives. Sometimes I forget there is always a flip side. The diary activity helped to remind me to look for the positives' (TG).

Gratitude

Many participants described that they were more grateful for things in their life by using terms such as thankful, grateful, fortunate or appreciative. One participant noticed that she 'learnt to start appreciating smaller things that [she] hadn't noticed' (NG) and another participant found 'things to be thankful for' and that 'life isn't necessarily about the big celebratory moments there are plenty of little normal things to be grateful for' (TG).

3.2.3 | Nature

References to nature were found within all of the aforementioned themes and subthemes. Many participants noticed that the diary activity made them think more about nature and pay more attention to it. One participant noted: 'It also helped to remind me to be and observe the wildlife in my garden. I found I spent more time in the garden just observing whereas prior to this activity I was often so busy creating in the garden I forgot to go and just enjoy it' (TG). For some participants, this included learning about 'connections between emotions and nature and the greater picture of life' (AL). For several participants, the raised awareness of nature resulted in a greater understanding of the benefits nature provides for them and made them more grateful towards nature. This notion was evidenced in statements such as 'I learned through awareness the importance of the connection to our world around us' (NG) and 'it has made me more aware of the connection between my actions/feelings during the day. I've noticed that when I'm busy (and stressed) I don't tend to have as much connection with nature/animals as I should, and that's when I need it the most' (AL).

Some participants noticed that reflecting on one's day made them think about their relationship with nature, for example, 'It was a good opportunity to be able to reflect every day on what was important to me and made me think about things such as am I at one with nature and how I view my living situation' (TG). Specifically, the daily survey questions assessing people's nature connectedness may have challenged people to think in new ways about their relationship with nature. This notion is reflected in participants' comments, 'I found the question about nature and my connection to earth etc. not something I think about ever' (AL) and 'Helps me to stop and think about myself and how I feel which I never do as I'm always busy. I have noticed I don't think much about nature or how I'm actually feeling as I'm always in survival mode' (TG). Thinking about nature in new ways may not only have affected the degree to which people feel connected to nature but also translated into actions in people's gardens. One participant noted that the diary made him 'think about nature more' and that one of the learnings was to 'plant more things to get nature to come to you. And it also helps the planet' (AL).

3.3 | Exploratory analysis—Multiple regression

The standardized beta coefficients and p-values of nature connectedness and gratitude in the multiple regression models predicting well-being and engagement in wildlife gardening behaviour are displayed in Table 2. The full regression models can be found in Appendix C. Multicollinearity was not an issue as the highest variance inflation factor in all models was 2.89, which is well below the critical threshold (Myers, 1990). Nature connectedness was not significantly associated with any well-being measure at T2. In contrast, gratitude was significantly associated with all well-being measures at T2. At T3, nature connectedness was a significant predictor of flourishing and positive affect while gratitude was significantly associated with all well-being measures. Nature connectedness also significantly predicted feature richness as well as intention to engage in wildlife gardening at T2 and T3.

4 | DISCUSSION

This study examined the effects of a behavioural intervention, an adaptation of a gratitude journal exercise, on nature connectedness. Participants were randomly assigned to a 14-day journal exercise, which asked participants to write down three things that they were grateful for in nature, or to two control groups. The nature gratitude group did not show significantly higher levels of nature connectedness than the two control groups, a traditional gratitude group and an activity list group, during the intervention period or at 1-week and 3-month follow-up. However, participants' nature connectedness significantly increased from baseline to 1 week after the intervention, independent of the type of journal exercise those participants were assigned to. This increase was maintained at 3 months after the intervention period. Moreover, there were no significant differences

TABLE 2 Standardized beta coefficients in the multiple regression models predicting well-being and engagement in wildlife gardening behaviour at T2 and T3 ($N=114$).

Predictor	Positive affect	Negative affect	Life satisfaction	Flourishing	Wildlife gardening intention	Feature richness
T2						
Gratitude	0.55***	-0.23*	0.16*	0.25***	0.03	
Nature connectedness	0.07	0.04	0.09	0.00	0.35**	
T3						
Gratitude	0.62***	-0.36***	0.26***	0.30***	0.13	0.07
Nature connectedness	0.28***	-0.18	0.10	0.26**	0.44***	0.26*

Note: At T2, the T2 scores on gratitude and nature connectedness were included, whereas at T3, the T3 scores were included. The regression models included the T1 scores of the respective outcome variables, gratitude and nature connectedness as control variables.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

in well-being and engagement in wildlife gardening between the groups, but the results indicate that participants' scores on these outcome variables increased from before the diary period to 1 week and 3 months after the intervention period in all groups. While the effect of time on nature connectedness and the well-being measures is considered a medium-size effect according to recommendations by Cohen (1988), the effect on wildlife gardening intention and feature richness is considered large. Positive psychology interventions have small to medium effects on well-being in comparison with control groups (Bolier et al., 2013; Carr et al., 2020). The effects of interventions on nature connectedness are also small to medium (Barragan-Jason et al., 2022; Sheffield et al., 2022). However, the effects might be overestimated when effect sizes are calculated for pre- and post-test changes within intervention groups instead of in comparison to control groups (Sheffield et al., 2022). Therefore, understanding the mechanisms behind the changes among participants in this study is important to evaluate the practical and scientific significance of those effects.

Increases in the outcome variables may be due to demand characteristics. People may have had the expectation that the journal exercise would enhance their well-being, especially because the study was titled 'daily reflections and well-being'. In a meta-analysis examining the effects of gratitude interventions on well-being, Davis et al. (2016) found that gratitude interventions showed significantly better effects on measures of psychological well-being only in comparison to measurement-only control groups but not in comparison with matched-activity control groups. Matched-activity control groups ask participants to engage in similar tasks to the gratitude journal exercise, for example, listing activities or events. Davis et al. (2016) argued that positive effects of gratitude interventions on well-being might operate through placebo effects. While this is a plausible explanation for the increases in our outcome variables, our research design and qualitative data analysis suggest that our intervention effect is not merely a placebo.

While participants may have been aware that enhancing their well-being was a central aim of the study, nature connectedness was a less obvious subject of investigation. We included filler items

in all surveys, which asked about people's relationships with work, other people and their living environment, to make the main goal of the study more ambiguous. Nevertheless, items assessing nature connectedness were frequently used, such as in the surveys before and after the intervention period and in the daily surveys during the intervention period. Furthermore, one requirement to participate in the study was that participants had to have access to a garden. Therefore, people may have guessed the purpose of the study and responded in a socially desirable manner on items assessing their relationship with nature. However, these assumptions do not necessarily explain increases in garden feature richness, because this measure, despite being a self-report, relates to physical properties in people's gardens and may be less prone to social desirability compared to introspective measures. One explanation may be learning effects for participants resulting from filling in the feature richness measure at T1, which encouraged them to add these features to their garden.

We also assessed participants' responses to two open questions 1 week after the 14-day intervention period to explore how the journal exercise may have influenced the outcome variables. The qualitative data analysis suggests that participants noticed that they had more positive emotions and attitudes as a result of the journal exercise. This observation somewhat corresponds with Lyubomirsky and Layous (2013), who argued that positive psychology interventions enhance well-being by increasing positive thoughts, positive emotions, positive behaviour and satisfying needs. The qualitative data analysis further suggests that participants increased their self-knowledge, by (1) gaining insights into their emotions and how they relate to specific encounters or events during the day, (2) gaining insights into their values, identity and relationships, (3) obtaining action-knowledge and (4) being more mindful. The daily survey of positive and negative affect may have played a central role in enhancing people's awareness of their emotions. Furthermore, the activity of thinking back over the past day and listing either three daily activities, things to be grateful for in nature, or things to be grateful for in life, may have promoted a higher general awareness of the relationship between emotions and certain events that happened during the past day. Raising awareness of one's emotions, thoughts,

and behaviour through mood monitoring exercises is often an initial step in clinical interventions, such as cognitive behavioural therapy, and can also be used in positive psychology interventions that aim to enhance well-being (Karwoski et al., 2006).

Schlegel et al. (2011) argued that knowledge about one's true self, which refers to one's understanding of who one really is, supports well-being by increasing meaning in life. The daily survey questions on people's relationships with nature may have supported learning about one's true self and specifically the role of nature in it, as some comments suggest that the questions challenged people to think in new ways about their life in general and their relationship with nature. How people think about themselves, such as focusing on one's inner experience or expanding one's awareness of the self to the outer world, may play an important part in strengthening nature connectedness (Lengieza & Swim, 2021). Gould and Schultz (2021) observed similar comments from study participants responding to interview questions and survey items exploring people's relationship with nature. The authors argue that for many people their relationship with nature is processed implicitly until it is made explicit, for example, through reflecting on them in research studies. In the present study, participants in all groups reflected daily on their relationship with nature by answering three survey questions, which could have made their nature connectedness more explicit. This idea is also supported by the finding that a substantial proportion of the participants in all groups made statements that referred to nature when being asked about their experiences with the journal exercise. Furthermore, many participants noted learning experiences about themselves generally and the importance of nature for them in particular.

Urban areas can lack opportunities to interact with nature (Miller, 2005; Soga & Gaston, 2016), and within urban areas, access to nature is often unevenly distributed putting poorer and minority neighbourhoods at a disadvantage (Wen et al., 2013; Wolch et al., 2014). While nature experiences are assumed to promote nature connectedness (Cleary et al., 2018; Kals et al., 1999), urban areas may not always provide for those experiences in the daily lives of people. Therefore, behavioural interventions that address individual-level factors, such as thoughts, emotions, and perceptions in relation to nature, may be one important measure to enhance nature connectedness of urban dwellers. The findings of this study do not provide robust evidence for the idea that interventions that ask people to express gratitude towards nature promote nature connectedness. However, they provide initial, qualitative support for the idea that the mere act of regularly reflecting on the relationship between one's self and nature might enhance nature connectedness. This study may thus stimulate important future research on the mechanisms behind promoting nature connectedness as well as on interventions in applied contexts. While interventions that ask people to reflect on their relationship with nature can be relatively easy to undertake for many people, they might not be as enjoyable as actual visits to nature and do not provide the same health benefits produced by physical activity.

Our exploratory analysis showed that changes in nature connectedness were significantly associated with changes in flourishing

and positive affect 3 months after the intervention, while controlling for changes in gratitude. No significant relationships were found between changes in nature connectedness and the other well-being measures, but changes in gratitude consistently predicted changes in all well-being measures. While gratitude and nature connectedness may have played a role in increasing well-being, we cannot rule out the opposite causal direction such that well-being increased gratitude and nature connectedness. Nevertheless, nature connectedness is assumed to promote well-being by satisfying people's basic need for relatedness (Cleary et al., 2017) and Lyubomirsky and Layous (2013) argued that one mechanism by which positive psychology interventions enhance well-being may be by satisfying basic psychological needs, such as competence, relatedness and autonomy. In addition to the daily survey questions on nature connectedness, people also answered questions concerning their connectedness to other people, their work or their house, which may also have promoted well-being by increasing people's general feelings of connectedness.

The qualitative data analysis points to alternative explanations for the notion that demand characteristics accounted for increases in nature connectedness and well-being. We identified two mechanisms, self-knowledge as well as positive emotions and attitudes, which may have promoted increases in the outcome variables. This finding may be relevant for future research and the design of positive psychology interventions and explain inconsistent results regarding the effectiveness of gratitude interventions in comparison to active control groups. One limitation of this study is that our qualitative analysis relied on two open questions in an online survey and thus did not allow for further exploration of potential mechanisms by which the diary activity increased nature connectedness. Therefore, other explanations for increases in the outcome variables may have remained undetected. Participants' responses to the open questions may also been influenced by the preceding questions in the survey as the open questions were answered at the end of the survey. Due to these limitations, our alternative explanations to the idea that demand characteristics accounted for increases in the outcome variables should be considered with caution. Nevertheless, our findings warrant more research that examines the role of regular reflections on one's relationship with nature and in combination with monitoring daily experiences and emotions. Future research could examine the influence of regular reflections on nature connectedness, for example, through answering survey questions or interviews, in comparison with control conditions that do not reflect on relationships with nature but other domains of connectedness.

5 | CONCLUSION

Strengthening people's nature connectedness can offer benefits for both people and the environment. Interventions that support direct interactions with nature may enhance nature connectedness but they can be unfeasible for many people living in urban areas with limited access to green spaces. We examined the effects of an

adaptation of a widely applied positive psychology intervention that does not require direct interactions with nature, a gratitude journal, on nature connectedness, psychological well-being and engagement in wildlife gardening. The nature gratitude group did not show significant increases in nature connectedness, well-being and engagement in wildlife gardening in comparison with two control groups. However, we found significant increases in all outcome variables independent of the journal group. While these increases may be due to demand characteristics, exploratory analyses of qualitative and quantitative data point to an alternative explanation. The journal exercise may have enhanced people's self-knowledge and promoted positive emotions and attitudes. Specifically, regularly answering questions about nature connectedness may have led people in all groups to reflect on their relationship with nature and recognize how important nature is to them. Therefore, we hypothesize that increases in nature connectedness in all journal exercise conditions were due to the journaling activity, specifically repeated reflections on one's relationship with nature. While this explanation needs to be regarded with caution, due to likely possibility of demand characteristics affecting people's self-reports, our findings warrant future studies that examine the effects of people regularly reflecting on and monitoring emotions towards nature. The data also suggest that the more people gained in nature connectedness from before to after the intervention, the more they increased in their intention to engage in wildlife gardening, wildlife-supporting features they had in their garden as well as flourishing and positive affect 3 months after the intervention. Therefore, nature connectedness could have played a role in promoting increases in our outcome variables but the effect may also be in the opposite direction, such that well-being increased nature connectedness. Understanding how nature connectedness can be strengthened is of high interest to researchers and practitioners in environmental and health domains. This paper contributes to a small but growing body of research that has immense societal relevance, as it points to potential mechanisms by which behavioural interventions may enhance nature connectedness and identifies an important avenue for future research in human-nature relationships.

AUTHOR CONTRIBUTIONS

Andreas Samus conceived the ideas, collected and analysed the data with feedback from Katharine J. M. Dickinson, Claire Freeman and Yolanda van Heezik. The first draft of this paper was written by Andreas Samus and all authors contributed equally to review and editing. All authors gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data underlying the results presented in this paper are accessible on the Zenodo data repository: <https://doi.org/10.5281/zenodo.13744680>. Demographic information and qualitative data are not included to ensure the anonymity of the participants. Please contact the authors for access to qualitative data for research purposes.

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REFERENCES

- Algoe, S. B. (2012). Find, remind, and bind: The functions of gratitude in everyday relationships. *Social and Personality Psychology Compass*, 6(6), 455–469. <https://doi.org/10.1111/j.1751-9004.2012.00439.x>
- Algoe, S. B., Gable, S. L., & Maisel, N. C. (2010). It's the little things: Everyday gratitude as a booster shot for romantic relationships. *Personal Relationships*, 17(2), 217–233. <https://doi.org/10.1111/j.1475-6811.2010.01273.x>
- Algoe, S. B., Haidt, J., & Gable, S. L. (2008). Beyond reciprocity: Gratitude and relationships in everyday life. *Emotion*, 8(3), 425–429.
- Aron, A., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close relationships as including other in the self. *Journal of Personality and Social Psychology*, 60(2), 241–253.
- Aronson, M. F. J., Lepczyk, C. A., Evans, K. L., Goddard, M. A., Lerman, S. B., MacIvor, J. S., Nilon, C. H., & Vargo, T. (2017). Biodiversity in the city: Key challenges for urban green space management. *Frontiers in Ecology and the Environment*, 15(4), 189–196. <https://doi.org/10.1002/fee.1480>
- Barragan-Jason, G., de Mazancourt, C., Parmesan, C., Singer, M. C., & Loreau, M. (2022). Human-nature connectedness as a pathway to sustainability: A global meta-analysis. *Conservation Letters*, 15(1), e12852. <https://doi.org/10.1111/conl.12852>
- Barton, J., Bragg, R., Pretty, J., Roberts, J., & Wood, C. (2016). The wilderness expedition: An effective life course intervention to improve young people's well-being and connectedness to nature. *The Journal of Experimental Education*, 39(1), 59–72. <https://doi.org/10.1177/1053825915626933>
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, 11(3), 230–241. <https://doi.org/10.1093/clipsy.bph077>
- Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology*, 54(1), 579–616. <https://doi.org/10.1146/annurev.psych.54.101601.145030>
- Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health*, 13(1), 119. <https://doi.org/10.1186/1471-2458-13-119>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, 5, 976. <https://doi.org/10.3389/fpsyg.2014.00976>
- Carlson, E. N. (2013). Overcoming the barriers to self-knowledge: Mindfulness as a path to seeing yourself as you really are. *Perspectives on Psychological Science*, 8(2), 173–186. <https://doi.org/10.1177/1745691612462584>
- Carr, A., Cullen, K., Keeney, C., Canning, C., Mooney, O., Chinseallaigh, E., & O'Dowd, A. (2020). Effectiveness of positive psychology

- interventions: A systematic review and meta-analysis. *The Journal of Positive Psychology*, 16(6), 749–769. <https://doi.org/10.1080/17439760.2020.1818807>
- Choe, E. Y., Jorgensen, A., & Sheffield, D. (2020). Does a natural environment enhance the effectiveness of mindfulness-based stress reduction (MBSR)? Examining the mental health and wellbeing, and nature connectedness benefits. *Landscape and Urban Planning*, 202, 103886. <https://doi.org/10.1016/j.landurbplan.2020.103886>
- Cleary, A., Fielding, K. S., Bell, S. L., Murray, Z., & Roiko, A. (2017). Exploring potential mechanisms involved in the relationship between eudaimonic wellbeing and nature connection. *Landscape and Urban Planning*, 158, 119–128. <https://doi.org/10.1016/j.landurbplan.2016.10.003>
- Cleary, A., Fielding, K. S., Murray, Z., & Roiko, A. (2018). Predictors of nature connection among urban residents: Assessing the role of childhood and adult nature experiences. *Environment and Behavior*, 52(6), 579–610. <https://doi.org/10.1177/0013916518811431>
- Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Academic Press.
- Cunha, L. F., Pellanda, L. C., & Reppold, C. T. (2019). Positive psychology and gratitude interventions: A randomized clinical trial. *Frontiers in Psychology*, 10, 584. <https://doi.org/10.3389/fpsyg.2019.00584>
- Davis, D. E., Choe, E., Meyers, J., Wade, N., Varjas, K., Gifford, A., Quinn, A., Hook, J. N., Van Tongeren, D. R., Griffin, B. J., & Worthington, E. L., Jr. (2016). Thankful for the little things: A meta-analysis of gratitude interventions. *Journal of Counseling Psychology*, 63(1), 20–31. <https://doi.org/10.1037/cou0000107>
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, 49(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13
- Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D.-W., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*, 97(2), 143–156. <https://doi.org/10.1007/s11205-009-9493-y>
- Emmons, R. A., & Crumpler, C. A. (2000). Gratitude as a human strength: Appraising the evidence. *Journal of Social and Clinical Psychology*, 19(1), 56–69.
- Emmons, R. A., & McCullough, M. E. (2003). Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. *Journal of Personality and Social Psychology*, 84(2), 377–389. <https://doi.org/10.1037/0022-3514.84.2.377>
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191. <https://doi.org/10.3758/BF03193146>
- Froh, J. J., Sefick, W. J., & Emmons, R. A. (2008). Counting blessings in early adolescents: An experimental study of gratitude and subjective well-being. *Journal of School Psychology*, 46(2), 213–233. <https://doi.org/10.1016/j.jsp.2007.03.005>
- Gander, F., Proyer, R. T., Ruch, W., & Wyss, T. (2013). Strength-based positive interventions: Further evidence for their potential in enhancing well-being and alleviating depression. *Journal of Happiness Studies*, 14(4), 1241–1259. <https://doi.org/10.1007/s10902-012-9380-0>
- Gaston, K. J., Fuller, R. A., Loram, A., Macdonald, C., Power, S., & Dempsey, N. (2007). Urban domestic gardens (X): Variation in urban wildlife gardening in the United Kingdom. *Biodiversity and Conservation*, 16(11), 3227–3238. <https://doi.org/10.1007/s10531-007-9174-6>
- Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: Biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25(2), 90–98. <https://doi.org/10.1016/j.tree.2009.07.016>
- Gould, R. K., & Schultz, P. W. (2021). Challenges to understanding non-material dimensions of human-nature connections, and how to address them. *Ecology and Society*, 26(3), Article 14. <https://doi.org/10.5751/ES-12604-260314>
- Ives, C. D., Giusti, M., Fischer, J., Abson, D. J., Klaniecki, K., Dorninger, C., Laudan, J., Barthel, S., Abernethy, P., Martín-López, B., Raymond, C. M., Kendal, D., & von Wehrden, H. (2017). Human–nature connection: A multidisciplinary review. *Current Opinion in Environmental Sustainability*, 26–27, 106–113. <https://doi.org/10.1016/j.cosust.2017.05.005>
- Kahn, P. H., & Kellert, S. R. (2002). *Children and nature: Psychological, sociocultural, and evolutionary investigations*. MIT Press.
- Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior*, 31(2), 178–202. <https://doi.org/10.1177/00139169921972056>
- Karwoski, L., Garratt, G. M., & Ilardi, S. S. (2006). On the integration of cognitive-behavioral therapy for depression and positive psychology. *Journal of Cognitive Psychotherapy*, 2, 159–170. <https://doi.org/10.1891/jcop.20.2.159>
- Kerr, S. L., O'Donovan, A., & Pepping, C. A. (2015). Can gratitude and kindness interventions enhance well-being in a clinical sample? *Journal of Happiness Studies*, 16(1), 17–36. <https://doi.org/10.1007/s10902-013-9492-1>
- Kiesling, F. M., & Manning, C. M. (2010). How green is your thumb? Environmental gardening identity and ecological gardening practices. *Journal of Environmental Psychology*, 30(3), 315–327. <https://doi.org/10.1016/j.jenvp.2010.02.004>
- Lee, L.-N., Tong, E. M. W., & Sim, D. (2015). The dual upward spirals of gratitude and basic psychological needs. *Motivation Science*, 1(2), 87–97. <https://doi.org/10.1037/mot0000018>
- Lengieza, M. L., & Swim, J. K. (2021). The paths to connectedness: A review of the antecedents of connectedness to nature. *Frontiers in Psychology*, 12, 763231.
- Leopold, A. (1949). *A Sand County almanac: And sketches here and there*. Oxford University Press.
- Loram, A., Tratalos, J., Warren, P. H., & Gaston, K. J. (2007). Urban domestic gardens (X): The extent & structure of the resource in five major cities. *Landscape Ecology*, 22(4), 601–615. <https://doi.org/10.1007/s10980-006-9051-9>
- Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder*. Algonquin Books.
- Lyubomirsky, S., & Layous, K. (2013). How do simple positive activities increase well-being? *Current Directions in Psychological Science*, 22(1), 57–62. <https://doi.org/10.1177/0963721412469809>
- Mackay, C. M. L., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology*, 65, 101323. <https://doi.org/10.1016/j.jenvp.2019.101323>
- Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, 24(4), 503–515. <https://doi.org/10.1016/j.jenvp.2004.10.001>
- McEwan, K., Richardson, M., Sheffield, D., Ferguson, F. J., & Brindley, P. (2019). A smartphone app for improving mental health through connecting with urban nature. *International Journal of Environmental Research and Public Health*, 16(18), 3373. <https://doi.org/10.3390/ijerph16183373>
- Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution*, 20(8), 430–434. <https://doi.org/10.1016/j.tree.2005.05.013>
- Mitchell, J., Vella-Brodrick, D., & Klein, B. (2010). Positive psychology and the internet: A mental health opportunity. *E-Journal of Applied Psychology*, 6, 30–41. <https://doi.org/10.7790/ejap.v6i2.230>
- Mongrain, M., & Anselmo-Matthews, T. (2012). Do positive psychology exercises work? A replication of Seligman et al. *Journal of Clinical Psychology*, 68(4), 382–389. <https://doi.org/10.1002/jclp.21839>

- Mumaw, L., & Bekessy, S. (2017). Wildlife gardening for collaborative public-private biodiversity conservation. *Australasian Journal of Environmental Management*, 24(3), 242–260. <https://doi.org/10.1080/14486563.2017.1309695>
- Mumaw, L., & Mata, L. (2022). Wildlife gardening: An urban nexus of social and ecological relationships. *Frontiers in Ecology and the Environment*, 20(6), 379–385. <https://doi.org/10.1002/fee.2484>
- Myers, R. H. (1990). *Classical and modern regression with applications* (2nd ed.). Duxbury.
- Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. *Psychological Science*, 22(9), 1101–1106. <https://doi.org/10.1177/0956797611418527>
- Nisbet, E. K., Zelenski, J. M., & Grandpierre, Z. (2019). Mindfulness in nature enhances connectedness and mood. *Ecopsychology*, 11(2), 81–91. <https://doi.org/10.1089/eco.2018.0061>
- O'Connell, B. H., O'Shea, D., & Gallagher, S. (2018). Examining psychosocial pathways underlying gratitude interventions: A randomized controlled trial. *Journal of Happiness Studies*, 19(8), 2421–2444. <https://doi.org/10.1007/s10902-017-9931-5>
- Parks, A. C., & Biswas-Diener, R. (2013). Positive interventions: Past, present, and future. In *Mindfulness, acceptance, and positive psychology: The seven foundations of well-being* (pp. 140–165). New Harbinger Publications, Inc.
- 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>
- Pensini, P., Horn, E., & Caltabiano, N. J. (2016). An exploration of the relationships between adults' childhood and current nature exposure and their mental well-being. *Children, Youth and Environments*, 26(1), 125–147. <https://doi.org/10.7721/chilyoutenvi.26.1.0125>
- Petersen, E., Fiske, A. P., & Schubert, T. W. (2019). The role of social relational emotions for human-nature connectedness. *Frontiers in Psychology*, 10, 2759. <https://doi.org/10.3389/fpsyg.2019.02759>
- Prévot, A.-C., Cheval, H., Raymond, R., & Cosquer, A. (2018). Routine experiences of nature in cities can increase personal commitment toward biodiversity conservation. *Biological Conservation*, 226, 1–8. <https://doi.org/10.1016/j.biocon.2018.07.008>
- Pritchard, A., Richardson, M., Sheffield, D., & McEwan, K. (2020). The relationship between nature connectedness and eudaimonic well-being: A meta-analysis. *Journal of Happiness Studies*, 21(3), 1145–1167. <https://doi.org/10.1007/s10902-019-00118-6>
- Reis, H. T. (1994). Domains of experience: Investigating relationship processes from three perspectives. In *Theoretical frameworks for personal relationships* (pp. 87–110). Lawrence Erlbaum Associates, Inc.
- Restall, B., & Conrad, E. (2015). A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, 159, 264–278. <https://doi.org/10.1016/j.jenvman.2015.05.022>
- Richardson, M., Hamlin, I., Butler, C. W., Thomas, R., & Hunt, A. (2021). Actively noticing nature (not just time in nature) helps promote nature connectedness. *Ecopsychology*, 14(1), 8–16. <https://doi.org/10.1089/eco.2021.0023>
- Richardson, M., & Sheffield, D. (2017). Three good things in nature: Noticing nearby nature brings sustained increases in connection with nature/Tres cosas buenas de la naturaleza: Prestar atención a la naturaleza cercana produce incrementos prolongados en conexión con la naturaleza. *PsyEcology*, 8(1), 1–32. <https://doi.org/10.1080/21711976.2016.1267136>
- Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology*, 9, 1055. <https://doi.org/10.3389/fpsyg.2018.01055>
- Samus, A., Freeman, C., Dickinson, K. J. M., & van Heezik, Y. (2022). Relationships between nature connectedness, biodiversity of private gardens, and mental well-being during the Covid-19 lockdown. *Urban Forestry & Urban Greening*, 69, 127519. <https://doi.org/10.1016/j.ufug.2022.127519>
- Samus, A., Freeman, C., Dickinson, K. J. M., & van Heezik, Y. (2023). An examination of the factors influencing engagement in gardening practices that support biodiversity using the theory of planned behavior. *Biological Conservation*, 286, 110252. <https://doi.org/10.1016/j.biocon.2023.110252>
- Samus, A., Freeman, C., van Heezik, Y., Krumme, K., & Dickinson, K. J. M. (2022). How do urban green spaces increase well-being? The role of perceived wildness and nature connectedness. *Journal of Environmental Psychology*, 82, 101850. <https://doi.org/10.1016/j.jenvp.2022.101850>
- Schlegel, R. J., Hicks, J. A., King, L. A., & Arndt, J. (2011). Feeling like you know who you are: Perceived true self-knowledge and meaning in life. *Personality and Social Psychology Bulletin*, 37(6), 745–756. <https://doi.org/10.1177/0146167211400424>
- 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 US. https://doi.org/10.1007/978-1-4615-0995-0_4
- Seligman, M. E. P., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress: Empirical validation of interventions. *American Psychologist*, 60(5), 410–421. <https://doi.org/10.1037/0003-066X.60.5.410>
- Sheffield, D., Butler, C. W., & Richardson, M. (2022). Improving nature connectedness in adults: A meta-analysis, review and agenda. *Sustainability*, 14(19), 1249. <https://doi.org/10.3390/su141912494>
- Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human-nature interactions. *Frontiers in Ecology and the Environment*, 14(2), 94–101. <https://doi.org/10.1002/fee.1225>
- Tam, K.-P. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, 34, 64–78. <https://doi.org/10.1016/j.jenvp.2013.01.004>
- Tam, K.-P. (2022). Gratitude to nature: Presenting a theory of its conceptualization, measurement, and effects on pro-environmental behavior. *Journal of Environmental Psychology*, 79, 101754. <https://doi.org/10.1016/j.jenvp.2021.101754>
- Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *Journal of Cross-Cultural Psychology*, 38(2), 227–242. <https://doi.org/10.1177/0022022106297301>
- Thompson, K., Austin, K. C., Smith, R. M., Warren, P. H., Angold, P. G., & Gaston, K. J. (2003). Urban domestic gardens (I): Putting small-scale plant diversity in context. *Journal of Vegetation Science*, 14(1), 71–78. <https://doi.org/10.1111/j.1654-1103.2003.tb02129.x>
- Tsang, J.-A. (2006). Gratitude and prosocial behaviour: An experimental test of gratitude. *Cognition and Emotion*, 20(1), 138–148. <https://doi.org/10.1080/02699930500172341>
- van Heezik, Y., Freeman, C., Falloon, A., Buttery, Y., & Heyzer, A. (2021). Relationships between childhood experience of nature and green/blue space use, landscape preferences, connection with nature and pro-environmental behavior. *Landscape and Urban Planning*, 213, 104135. <https://doi.org/10.1016/j.landurbplan.2021.104135>
- van Heezik, Y. M., Freeman, C., Davidson, K., & Lewis, B. (2020). Uptake and engagement of activities to promote native species in private gardens. *Environmental Management*, 66(1), 42–55. <https://doi.org/10.1007/s00267-020-01294-5>
- Vazire, S., & Carlson, E. N. (2010). Self-knowledge of personality: Do people know themselves? *Social and Personality Psychology Compass*, 4(8), 605–620. <https://doi.org/10.1111/j.1751-9004.2010.00280.x>

- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037//0022-3514.54.6.1063>
- Wen, M., Zhang, X., Harris, C. D., Holt, J. B., & Croft, J. B. (2013). Spatial disparities in the distribution of parks and green spaces in the USA. *Annals of Behavioral Medicine*, 45(supplement_1), S18–S27. <https://doi.org/10.1007/s12160-012-9426-x>
- Whitburn, J., Linklater, W., & Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology*, 34(1), 180–193. <https://doi.org/10.1111/cobi.13381>
- Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landscape and Urban Planning*, 125, 234–244. <https://doi.org/10.1016/j.landurbplan.2014.01.017>
- Wood, A. M., Froh, J. J., & Geraghty, A. W. A. (2010). Gratitude and well-being: A review and theoretical integration. *Clinical Psychology Review*, 30(7), 890–905. <https://doi.org/10.1016/j.cpr.2010.03.005>
- Yeo, N. L., White, M. P., Alcock, I., Garside, R., Dean, S. G., Smalley, A. J., & Gatersleben, B. (2020). What is the best way of delivering virtual nature for improving mood? An experimental comparison of high definition TV, 360° video, and computer generated virtual reality. *Journal of Environmental Psychology*, 72, 101500. <https://doi.org/10.1016/j.jenvp.2020.101500>
- Zelenski, J. M., Dopko, R. L., & Capaldi, C. A. (2015). Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of Environmental Psychology*, 42, 24–31. <https://doi.org/10.1016/j.jenvp.2015.01.005>
- Zelenski, J. M., & Nisbet, E. K. (2012). Happiness and feeling connected: The distinct role of nature relatedness. *Environment and Behavior*, 46(1), 3–23. <https://doi.org/10.1177/0013916512451901>

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APPENDIX A

A.1 | Instructions for the different groups in the daily journal

Nature gratitude group: There are many things in nature, both large and small, that we might be grateful about. Please take a moment to think back over the past day and write down in the boxes below up to three things in nature that you are grateful or thankful for. Please describe in one or two sentences.

If you have difficulties writing about things from the past day, think back over times in your life when you were happy in nature or think about how nature in general benefits you.

Traditional gratitude group: There are many things in our lives, both large and small, that we might be grateful about. Please take a moment to think back over the past day and write down in the boxes below up to three things in your life that you are grateful or thankful for. Please describe in one or two sentences.

If you have difficulties writing about things from the past day, think back over times in your life when you were happy or think about the things in your life in general that benefit you.

Activity list group: There are many things that we do during the day, both large and small. Please take a moment to think back over the past day and write down in the boxes below up to three activities that you did. Please describe in one or two sentences.

For example, this can include particular meetings you attended, interactions with other people, or meals you had today. If you have difficulties writing about things from the past day, think about activities you did in a more distant past.

APPENDIX B

Means and standard deviations of study variables in the three conditions.

	T1 (pre-test)			T2 (1-week follow up)			T3 (3-month follow up)		
	Nature gratitude (n = 36)	Traditional gratitude (n = 40)	Activity list (n = 38)	Nature gratitude (n = 36)	Traditional gratitude (n = 40)	Activity list (n = 38)	Nature gratitude (n = 36)	Traditional gratitude (n = 40)	Activity list (n = 38)
Nature connectedness	4.76 (0.66)	4.92 (0.80)	4.79 (0.75)	4.99 (0.66)	5.00 (0.66)	4.93 (0.73)	4.97 (0.72)	5.19 (0.66)	5.03 (0.78)
Positive affect	3.01 (0.74)	2.97 (0.79)	3.14 (0.72)	3.37 (0.76)	3.37 (0.66)	3.32 (0.68)	3.33 (0.84)	3.28 (0.77)	3.42 (0.86)
Negative affect	1.84 (0.51)	1.92 (0.77)	1.94 (0.60)	1.61 (0.58)	1.71 (0.59)	1.76 (0.46)	1.80 (0.81)	1.88 (0.66)	2.05 (0.81)
Life satisfaction	4.71 (1.27)	4.60 (1.43)	4.47 (1.26)	4.77 (1.16)	4.95 (1.12)	4.83 (1.23)	4.86 (1.16)	4.99 (1.18)	4.95 (1.07)
Flourishing	5.43 (0.87)	5.29 (0.97)	5.43 (0.73)	5.52 (0.80)	5.57 (0.74)	5.58 (0.73)	5.55 (0.74)	5.61 (0.75)	5.57 (0.77)
Gratitude	3.65 (0.86)	3.71 (0.94)	3.84 (0.83)	3.99 (0.77)	4.05 (0.69)	3.85 (0.75)	3.83 (0.93)	4.05 (0.76)	4.08 (0.78)
Wildlife gardening intention	3.41 (1.44)	3.87 (1.31)	3.98 (1.32)	4.42 (1.44)	4.31 (1.11)	4.56 (1.29)	4.60 (1.16)	4.53 (1.27)	4.73 (1.25)
Feature richness	2.39 (1.79)	3.13 (1.94)	3.13 (1.86)				3.97 (2.38)	3.90 (1.97)	4.34 (1.94)

	Daily survey		
	Nature gratitude (n = 36)	Traditional gratitude (n = 40)	Activity list (n = 38)
Nature connectedness	4.54 (1.06)	4.69 (0.75)	4.57 (0.99)
Positive affect	2.85 (0.68)	3.00 (0.57)	3.00 (0.58)
Negative affect	1.47 (0.45)	1.36 (0.27)	1.43 (0.29)
Gratitude	3.34 (0.84)	3.65 (0.61)	3.38 (0.67)

Note: Standard deviations are presented in parentheses after the mean.

APPENDIX C

Tables C1–C6.

TABLE C1 Multiple regression models predicting positive affect ($N = 114$) and negative affect ($N = 114$) at T2.

Predictors	T2 positive affect				Predictors	T2 negative affect			
	<i>b</i>	SE	β	<i>p</i>		<i>b</i>	SE	β	<i>p</i>
T1 positive affect	0.37	0.08	0.40	<0.001	T1 negative affect	0.40	0.07	0.46	<0.001
T1 gratitude	-0.03	0.07	-0.04	0.629	T1 gratitude	0.01	0.06	0.02	0.842
T1 nature connectedness	-0.04	0.09	-0.04	0.706	T1 nature connectedness	-0.05	0.10	-0.06	0.647
T2 gratitude	0.52	0.07	0.55	<0.001	T2 gratitude	-0.18	0.07	-0.23	0.018
T2 nature connectedness	0.07	0.10	0.07	0.508	T2 nature connectedness	0.03	0.11	0.04	0.796
	$F(5,108) = 35.596, p < 0.001$					$F(5,108) = 7.315, p < 0.001$			
	$R^2 = 0.62$					$R^2 = 0.25$			

TABLE C2 Multiple regression models predicting life satisfaction (N = 114) and flourishing (N = 114) at T2.

Predictors	T2 life satisfaction				Predictors	T2 flourishing			
	<i>b</i>	SE	β	<i>p</i>		<i>b</i>	SE	β	<i>p</i>
T1 life satisfaction	0.65	0.05	0.73	<0.001	T1 flourishing	0.66	0.05	0.75	<0.001
T1 gratitude	0.04	0.09	0.03	0.636	T1 gratitude	-0.03	0.06	-0.04	0.584
T1 nature connectedness	-0.07	0.14	-0.05	0.606	T1 nature connectedness	-0.07	0.09	-0.07	0.400
T2 gratitude	0.26	0.10	0.16	0.010	T2 gratitude	0.26	0.06	0.25	<0.001
T2 nature connectedness	0.16	0.15	0.09	0.294	T2 nature connectedness	-0.01	0.10	0.00	0.961
$F(5,108) = 52.331, p < 0.001$					$F(5,108) = 55.540, p < 0.001$				
$R^2 = 0.71$					$R^2 = 0.72$				

TABLE C3 Multiple regression model predicting wildlife gardening intention (N = 114) at T2.

	<i>b</i>	SE	β	<i>p</i>
T1 wildlife gardening intention	0.59	0.07	0.63	<0.001
T1 gratitude	0.01	0.11	0.01	0.939
T1 nature connectedness	-0.32	0.19	-0.18	0.104
T2 gratitude	0.05	0.13	0.03	0.731
T2 nature connectedness	0.66	0.21	0.35	0.002
$F(5,108) = 24.270, p < 0.001$				
$R^2 = 0.53$				

TABLE C4 Multiple regression models predicting positive affect ($N=114$) and negative affect ($N=114$) at T3.

	T3 positive affect					T3 negative affect			
	<i>b</i>	SE	β	<i>p</i>		<i>b</i>	SE	β	<i>p</i>
T1 positive affect	0.47	0.09	0.43	<0.001	T1 negative affect	0.57	0.10	0.48	<0.001
T1 gratitude	-0.16	0.07	-0.17	0.036	T1 gratitude	0.08	0.08	0.10	0.301
T1 nature connectedness	-0.30	0.09	-0.27	0.001	T1 nature connectedness	0.16	0.13	0.16	0.206
T3 gratitude	0.61	0.06	0.62	<0.001	T3 gratitude	-0.33	0.09	-0.36	<0.001
T3 nature connectedness	0.31	0.09	0.28	<0.001	T3 nature connectedness	-0.19	0.13	-0.18	0.148
$F(5,108)=50.247, p<0.001$					$F(5,108)=10.142, p<0.001$				
$R^2=0.70$					$R^2=0.32$				

TABLE C5 Multiple regression models predicting life satisfaction ($N=114$) and flourishing ($N=114$) at T3.

	T3 life satisfaction					T3 flourishing			
	<i>b</i>	SE	β	<i>p</i>		<i>b</i>	SE	β	<i>p</i>
T1 life satisfaction	0.60	0.06	0.70	<0.001	T1 flourishing	0.54	0.06	0.62	<0.001
T1 gratitude	-0.08	0.09	-0.06	0.368	T1 gratitude	-0.08	0.06	-0.10	0.189
T1 nature connectedness	-0.19	0.13	-0.12	0.148	T1 nature connectedness	-0.20	0.09	-0.20	0.032
T3 gratitude	0.36	0.09	0.26	<0.001	T3 gratitude	0.27	0.07	0.30	<0.001
T3 nature connectedness	0.15	0.13	0.10	0.262	T3 nature connectedness	0.27	0.09	0.26	0.005
$F(5,108)=45.825, p<0.001$					$F(5,108)=37.126, p<0.001$				
$R^2=0.68$					$R^2=0.63$				

TABLE C6 Multiple regression model predicting wildlife gardening intention ($N=114$) and feature richness ($N=114$) at T3.

	T3 wildlife gardening intention					T3 feature richness			
	<i>b</i>	SE	β	<i>p</i>		<i>b</i>	SE	β	<i>p</i>
T1 wildlife gardening intention	0.48	0.07	0.53	<0.001	T1 feature richness	0.70	0.08	0.63	<0.001
T1 gratitude	-0.07	0.11	-0.05	0.567	T1 gratitude	-0.02	0.18	-0.01	0.908
T1 nature connectedness	-0.29	0.18	-0.18	0.111	T1 nature connectedness	-0.14	0.29	-0.05	0.634
T3 gratitude	0.19	0.12	0.13	0.122	T3 gratitude	0.16	0.20	0.07	0.407
T3 nature connectedness	0.75	0.18	0.44	<0.001	T3 nature connectedness	0.75	0.29	0.26	0.012
$F(5,108)=21.020, p<0.001$					$F(5,108)=24.272, p<0.001$				
$R^2=0.49$					$R^2=0.53$				