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Simulated natural environments bolster the effectiveness of a mindfulness programme: a comparison with a relaxation-based intervention

ABSTRACT

This study assesses the effectiveness of incorporating the beneficial effects of exposure to nature in a 3-week mindfulness programme. Participants (n = 122) were randomly assigned to one of two intervention groups (mindfulness, relaxation group) under different simulated environmental conditions (two natural, two nonnatural environments) during an intervention lasting three weeks. The participants in the mindfulness group were asked to attend a weekly 1-h mindfulness programme. The relaxation group also spent 1 h per week on relaxation activities of their choice (e.g. reading books or magazines). Participants' wellbeing outcomes and nature connectedness were measured before and after the three-week intervention, and at one-week follow-up. The findings show that the mindfulness programme was more effective when carried out in a natural environment. In addition, the mindfulness group in natural environments continued to improve even after the intervention was completed. This study offers valuable insights into the benefits of combining a wellbeing intervention with exposure to nature.

1. Introduction

In 2015, the Health Survey for England found that 40% of adults had experienced at least one common mental health disorder during their lifetime, including depression, generalised anxiety disorder or post-traumatic stress disorder (Bridges, 2015). Mental health disorders are the leading cause of long-term disability, accounting for 28% of the national burden of disease, with an estimated economic cost of between £70-100 billion per year (Davies, 2014). With the prescription of antidepressants at record levels, and a huge demand for psychological therapies, health and social care providers are interested in cost-effective interventions to improve wellbeing and to prevent mental health problems (Bragg and Atkins, 2016). At the same time, there is a renewed interest in complementary and alternative therapies, such as yoga, meditation practices, and aromatherapy to support psychological resilience and prevent mental illness.

1.1. Mindfulness and mental health

Mindfulness practice has grown quickly as one such complementary and alternative approach to coping with certain forms of mental illness and symptoms of poor mental and physical health (Spijkerman *et al*., 2016). Mindfulness refers to a way of focusing on experiences in the present moment that derives from Eastern philosophies, such as Taoism and Buddhism. Kabat-Zinn (1994) defines mindfulness as "paying attention in a particular way: on purpose, in the present moment, nonjudgmentally" (p.4). The development of mindfulness skills leads to non-judgemental and non-reactive acceptance of all experience, which in turn results in an increase in psychological resilience and life satisfaction (Kabat-Zinn, 1994; Segal *et al*., 2002). The potential salutogenic benefits of mindfulness practice have been recognized (Keng *et al*., 2011; Mindfulness Initiative, 2015), and mindfulness practice has received a great deal of attention as an intervention in a clinical/medical setting to address specific disorders (e.g. chronic pain or anxiety). This has led to the development and widespread application of standardised mindfulness-based interventions (MBIs), which integrate the essence of traditional mindfulness practice with contemporary psychological practice in order to improve health and wellbeing (Gu *et al.*, 2015). The most widely used MBI is mindfulness-based

stress reduction (MBSR: Kabat-Zinn, 1982), which offers an intensive 8-week programme (as well as shorter 4-6-week versions) involving a range of formal sitting and walking meditation, body scanning, mindful movement and informal mindfulness practices. Reviews of the effects and clinical effectiveness of MBSR indicate positive results in terms of the treatment of a range of different physiological and psychosocial conditions, including stress reduction (Baer *et al*., 2012) and relief from emotional distress, depression and anxiety (Hofmann *et al*., 2010). Whilst this evidence demonstrates the significant mental health and wellbeing benefits of mindfulness-based interventions, there has been little research into combining mindfulness with restorative experiences, such as exposure to nature (e.g. Kaplan, 2001; Lymeus *et al*., 2017; Lymeus *et al*, 2018).

1.2. Natural environments and mental health

There is growing recognition of the important role of natural environments in mental health and wellbeing. For instance, presence of nature in the living environment has been associated with improvements in residents' mental health and wellbeing, such as lower stress and anxiety, higher cognitive function, and positive mood (e.g. Bowler *et al*., 2010; McMahan and Estes, 2015). In addition, Van den Berg *et al*. (2010) showed that natural environments in living areas can provide a buffer for residents against the adverse impacts of stressful life events.

Commonly suggested mechanisms for the health benefits of natural environments include the psychological processes of cognitive restoration and stress reduction (Gidlow *et al.*, 2016). It has been recognised for decades that connecting with nature produces psychologically beneficial effects described by two theories: Attention Restoration Theory (ART: Kaplan, 1995) and Stress Reduction Theory (SRT: Ulrich *et al.*, 1991). Both ART and SRT centre on restoration through the experience of nature. However, while ART focuses on the restoration of a functional capability (e.g. attention), SRT is concerned with the promotion of psycho-physiological stress reduction. ART proposes that natural environments can counter a limited resource that becomes depleted with overuse (i.e. attention) when the human-environment relationship is characterised by four qualities: being away, fascination, extent, and compatibility (Kaplan, 1995). Ulrich's (1991) SRT focuses on affective and physiological

responses, emphasising that natural environments can elicit more positively-toned emotional states, and reduce levels of physiological arousal and negative feelings. Support for ART and SRT has been provided by studies reporting that exposure to natural environments helps promote good mental health and wellbeing, by reducing stress and anxiety (Tyrväinen *et al*., 2014), improving cognitive function (Gidlow *et al*., 2016; Stevenson *et al*., 2018) and enhancing mood and positive affect (Aspinall *et al*., 2015).

Given this evidence of what may broadly be termed the mental health and wellbeing benefits of natural environments, health promotion has started to focus on 'green prescriptions' that seek to apply a 'healthy *dose* of nature' (Shanahan *et al.*, 2016). However, interventions aimed at improving health and wellbeing by just increasing access to urban nature may have limited impact on health and wellbeing outcomes (Hunter *et al.*, 2015). Bragg and Leck (2017) have characterised effective 'green care' interventions as an interaction between three 'key attributes': exposure to natural surroundings, social interaction and meaningful activity.

Several attempts have been made to incorporate forest environments into mental health promotion programmes. Forest walking and forest bathing are already popular in Japan, Taiwan and Korea, and are considered a type of alternative therapy due to their health benefits. Shin *et al.* (2013) found that walking in the forest, and especially meditative walking in the forest, has greater effects on outcomes such as happiness and self-esteem than walking in a gymnasium. In a forest-based rehabilitation programme, Sonntag-Öström *et al.* (2015) show that combining forest visits with other relaxation activities (e.g. breathing and focusing on an object) supports people with mental illness in coping with stress, and speeds up their recovery process. This suggests that meaningful activities combined with visits to natural environments may be needed to deliver sustained mental health and wellbeing outcomes.

1.3. Connectedness to nature

Bragg and Leck's (2017) emphasis on natural surroundings as the key component of effective green care raises the questions of how exposure to nature enhances the impact of the interventions being

delivered; this may partly be explained by the feeling of 'connecting with nature'. The feeling of nature connectedness is explained as an "individual's experiential sense of oneness with the natural world" (Mayer and Frantz, 2004, p.504) or "the affective, cognitive, and experiential relationship individuals have with the natural world or a subjective sense of connectedness with nature" (Nisbet *et al*., 2009, p.719). Thus, it could be that people who are connected to nature derive a sense of meaningful existence from that connection, leading to a boost in health and wellbeing (Howell *et al*., 2013). A high level of connectedness to nature is typically associated with greater happiness as well as life satisfaction, vitality and the ability to cope with a life problem (Mayer *et al*., 2009; Nisbet *et al*., 2011; Capaldi *et al*., 2014). Connectedness to nature is related positively to psychological wellbeing by regulating emotion and imbuing people with purpose and meaning in life by the feeling that they belong to the natural world (Trigwell *et al*., 2014). The growing evidence for the benefits of exposure to natural environments on mental health and wellbeing is promising, but few studies have explored the potential for enhancing wellbeing interventions by incorporating exposure to the natural environment or explored the pathways leading to recovery or resilience (e.g. Fabjański and Brymer, 2017). We need to better understand the complex psychological processes by which natural environments can promote sustainable mental health and wellbeing (Cleary *et al.*, 2017).

Recent studies have sought to define the relationship between mindfulness and nature connectedness. This discussion centres on a 'human-nature connection' being built through mindfulness practice, internal awareness, and attention to self and place (Barbaro and Pickett, 2016). Van Gordon *et al*. (2018) suggest that the experience of mindful awareness can be used to enhance nature connectedness and the restorative qualities of natural environments, and spending time in nature can in turn enhance mindful awareness and cultivate greater insight into the self and the present moment.

1.4. Aims and hypotheses

This study combines a mindfulness programme with the beneficial impacts of exposure to nature in an experimental research design to establish whether natural environments can enhance the mental health and wellbeing outcomes of the mindfulness programme. We hypothesise that the mental health and

wellbeing outcomes of the mindfulness programme would be enhanced when carried out in natural environments (Hypothesis 1); to clarify, we examined the effects on the outcomes of the mindfulness programme (mindfulness vs. relaxation-based intervention) when carried out in simulated natural vs. non-natural environments. This paper also investigates whether the characteristics of natural environments (i.e. woodland vs. parkland setting) make a difference to the health and wellbeing outcomes of the mindfulness programme. In addition, we explore pathways to enhancement of the mindfulness programme outcomes through nature connectedness. We propose that changes in nature connectedness mediate the effects of the mindfulness programme on mental health and wellbeing (Hypothesis 2).

2. Methods

2.1. Participants

The study was ethically approved by the Department of Landscape in accordance with the University of Sheffield's Research Ethics Policy (Reference Number 011490). Participants were recruited from students studying across all disciplines at the University of Sheffield through the university research volunteer email system. Participants were invited to participate in 'an experiment about relaxation activities in different settings' and gave their informed consent to be included in the study. No mention of the mindfulness programme was made in the recruitment email or information sheet. Sample size was determined a priori based on a power analysis using G*Power (Faul *et al.*, 2007). For power = 0.8 and α= 0.05 for an interaction effect size of f(v) = 0.25, we calculated that we needed 113 participants. From two waves of recruitment, 355 students agreed to participate in this study. 140 participants were randomly selected by stratified random sampling to ensure a proportionate number of male (62 male, 47%) and female students (78 female, 53%). Fifteen participants who did not complete the baseline questionnaire and three participants who did not complete the three sessions were excluded. This resulted in 122 (87%) participants who were included in the analysis (51 male, 70 female and 1 'prefer not to say'; mean age 22.80; range 18-41 years). Thirteen students (10.7%) had previous experience of mindfulness meditation and they were randomly assigned to the

intervention groups as follows: 4 to the mindfulness group with natural environments; 4 to the relaxation group with natural environments; 3 to the mindfulness group with non-natural environments; and 2 to the relaxation group with non-natural environments. All participants received a payment of £20 on completion of follow-up measurements.

2.2. Design

The experimental design combined a mindfulness programme and a relaxation group with an environmental condition (two natural, two non-natural simulated environments). Half of the participants were randomly assigned to a three-week mindfulness programme under four simulated environmental conditions: woodland, parkland, an urban setting and a room with white walls. The remainder were assigned to a relaxation group; see Figure 1 for a schematic overview of the experimental set-up. The participants in the mindfulness group were asked to attend a mindfulness programme lasting three weeks. The mindfulness programme was modelled on the 8-week standard MBSR programme (Kabat-Zinn, 1982). It had weekly one-hour group sessions with guided mindfulness practice (six-eight participants together). The sessions consisted variously of 10 minutes of mindfulness towards breathing (Weeks 1 to 3), 20 minutes of body scanning (Weeks 1 and 2), 20 minutes of sitting meditation (Weeks 2 and 3) and 20 minutes of mindfulness movement (Week 3). All sessions were led by the same qualified mindfulness instructor. In order to enhance the effectiveness of the three-week mindfulness programme, participants in this group were given mindfulness home practice to do alongside the sessions. The relaxation group spent one hour per week on relaxation activities of their choice (e.g. reading books or magazines) over a three-week period under the same four environmental conditions as the mindfulness groups. Their relaxation activities were carried out individually in a group setting (six-eight participants together). Participants were allowed to bring their aids to relaxation (e.g. book or music). We also provided some books/magazines and colouring sheets with colour pencils. Participants were asked to complete a questionnaire containing a battery of validated scales three times, immediately before and after the three-week intervention, and at one-week follow-up. The experiment was conducted over four weeks between February and March 2017, and then again during the same period in 2018.

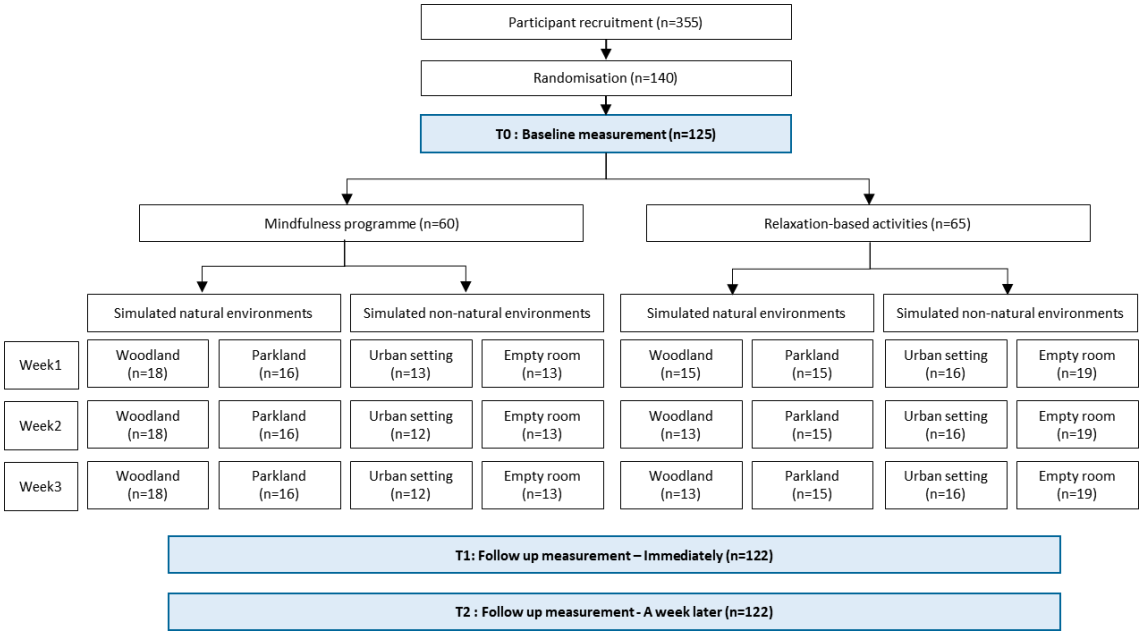

Figure 1. Research design

2.3. Simulated environments

Visual simulations, as proxies for environments, are widely used in experimental research and have been successfully applied in previous studies (e.g. Lymeus *et al.*, 2017). This experiment was conducted in a simulated environment laboratory with curtains closed to prevent outside views and slightly dimmed ceiling lights. Four images were shown on a 5.8m x 2.2m screen to simulate the experience of being in one of four common environments (two natural environments and two non-natural): woodland, parkland, an urban setting and a room with white walls (see Figure 2). The first image depicted a view inside woodland containing evenly distributed mature trees and a layer of ground covering vegetation, generating a sense of being surrounded by the woodland. The second image showed a view of parkland containing trees and shrubs at the edge of an open expanse of mown grass. The urban image showed an historical area in Sheffield. This setting contained no vegetation. This location was carefully chosen to avoid using busy commercial areas and main roads with high traffic volumes, to reduce the unfavourable bias to the urban setting compared with corresponding positive responses to natural environments. The last setting recreated a common setting for wellbeing interventions (e.g. a treatment room in a hospital or community setting). This setting contained no

vegetation. In order to provide the ambient sounds that would be experienced in the actual settings, audio clips were used to convey the sounds of nature -such as bird song and wind rustling the leaves of trees- in the simulated natural settings; typical urban noises- such as people talking in the distance and distant traffic- in the simulated urban setting; and a ticking clock in the indoor setting.

Figure 2. Four simulated environments

2.4. Questionnaire and measures

Psychometrically validated scales measured respondents' changes in relation to the health and wellbeing during the duration of study: at baseline (T0), after completion of the three-week intervention (T1), and at one-week follow-up (T2). The baseline questionnaire at T0 contained the psychometric scales and questions eliciting personal information. The latter asked participants to indicate their gender, age, ethnicity, postcode and any previous experience of mental health problems and mindfulness practice. The questionnaire at T1 contained the same psychometric scales. At T2 the psychometric scales were repeated and participants were also asked how much they liked their simulated environment.

2.4.1. Five Facet Mindfulness Questionnaire

The Five Facet Mindfulness Questionnaire (FFMQ-SF: Bohlmeijer *et al.*, 2011) measures five facets of mindfulness: non-judging, non-reactivity, acting with awareness, describing and observing. The FFMQ-SF contains 24 items measured on a five-point scale, ranging from 1 (never or rarely true) to 5 (very often or always true). We followed previous studies in calculating a total mindfulness score by totalling participant responses on all 24 items, with higher scores indicating greater mindfulness (e.g. Vøllestad *et al*., 2011; Goldberg *et al*., 2013). Cronbach's α was 0.76 for the total mindfulness score.

2.4.2. Nature Relatedness Scale

Respondents were also asked about 'connectedness to nature' to capture several facets of the way people viewed their relationship with the natural world and to measure people's interest in and desire for contact with nature, using a short-form version of the nature relatedness scale (NR-6: Nisbet and Zelenski, 2013). The NR-6 contains six items, comprising 'a sense of identification with nature' and 'contact with nature' dimensions, measured on a five-point scale ranging from 1 (disagree strongly) to 5 (agree strongly). Cronbach's α was 0.86 for the NR-6 score.

2.4.3. Positive and Negative Affect Schedule

Changes in self-reported mood and feelings were measured using the Positive and Negative Affect Schedule (PANAS: Watson *et al*., 1988). The PANAS is a self-reported adjective checklist that contains two 10-item subscales designed to measure positive (interested, excited, strong, enthusiastic, proud, alert, inspired, attentive, determined and active) and negative affect (distressed, upset, guilty, scared, hostile, irritated, ashamed, nervous, jittery and afraid). Respondents were asked how much they felt each of the 20 emotions (1= not at all, 5= extremely). Cronbach's α was 0.78 for the positive affect subscale, and 0.76 for the negative affect subscale.

2.4.4. Depression Anxiety Stress Scales

The Depression Anxiety Stress Scales (DASS-21) measures negative emotional states associated with depression, anxiety and stress (Lovibond and Lovibond, 1995; Antony *et al.*, 1998) using 21 items evaluated on a four-point scale (0= never applies to me, 3= almost always applies to me). The

depression scale assesses feelings of unhappiness, hopelessness, and lack of interest; the anxiety scale insecurity and uncertainty; and the stress scale difficulty relaxing, being easily upset, irritable and over reactive. Cronbach's α was 0.85 for the depression subscale, 0.73 for the anxiety subscale and 0.75 for the stress subscale.

2.4.5. Environmental preference

Participants were asked how much they liked/enjoyed their simulated environment using a Visual Analog Scale (VAS: Torrance *et al*., 2001) after the completion of the intervention. Participants were required to mark a point on a 100mm straight horizontal line where the left extremity is "not at all" and the right extremity is "very much". The scores were determined by measuring the distance (mm) from the left extremity to the participants' mark (from 0 to 100). A higher score suggests greater preference.

2.5 Procedure

Potential participants were emailed a link to a participant information sheet and asked to complete an online baseline questionnaire before taking part in the experiment. Next, they were randomly assigned to a mindfulness programme or to a relaxation group in one of four environments. At the start of the week, participants were contacted via email with instructions about the start of the study. However, to reduce potential bias from foreknowledge of the intervention, participants were not aware of the group/environment in which they were placed. After completing the three-week experiment, participants were asked to complete the initial questionnaire again. Finally, one week later, participants completed the questionnaire for the third time. The initial questionnaire was completed online, and the two follow ups were completed by the participants in person using a paper version of the questionnaire.

2.6. Analysis strategy

All analysis was carried out using SPSS for Windows version 24.0 using an alpha of .05, except for post-hoc t-tests where a more stringent alpha of .01 was used. We also report effect sizes; Cohen

(1988) suggests η^2= .01 is small, η^2= .06 medium and η^2= .14 large. Before proceeding with MANOVAs, initial checks were carried out for normality, homogeneity of variance and independent observation (see a Supplementary file 1).

First, repeated measures MANOVAs were used to investigate the effects of both interventions in the two natural environments and the two non-natural environments; this allowed comparisons within the two natural and two non-natural environments to be made. These analyses incorporated a between-subjects factor (woodland vs. parkland or urban setting vs. empty room) and three time-points (baseline (T0), post-intervention (T1) and one-week follow-up (T2)) for the health and wellbeing outcomes. These analyses revealed that there were no significant multivariate interactions between environment and time on all measures, $F(21,311)= 1.02$, $p= .44$, $\eta^2= .06$. We also found that there was no significant interaction between environment and time within the natural and non-natural conditions, for natural environments, $F(14,228)= 1.21$, $p= .27$, $\eta^2= .07$, and non-natural environments, $F(14,220)= 1.58$, $p= .09$, $\eta^2= .09$. Moreover, a one-way between-groups ANOVA conducted to explore the impact of environment on participants' preference showed that there was no significant difference between environments, $F(3,118)= 0.66$, $p= .58$, $\eta^2= .02$. Accordingly, a decision was made to examine differences only between the natural (woodland and parkland) and non-natural environments (urban setting and empty room).

Next, χ^2 tests and ANOVA were used to examine differences at baseline. In order to investigate the environmental impacts on the effectiveness of the intervention (Hypothesis 1), a MANOVA was conducted to examine these interaction effects: a 2 (mindfulness, relaxation group) x 2 (natural, non-natural environment) x 3 model (time: baseline (T0), post-intervention (T1) and one-week follow-up (T2)). Follow-up analysis was performed using one-way ANOVAs and t-tests. Two additional sets of analyses were carried out including gender and wave of recruitment as between-subjects factors; there were no interactions between these factors and time, group or environment. Finally, in order to explore whether nature connectedness acts as a pathway to enhanced mindfulness outcomes (Hypothesis 2), the mediating effect of changes in nature connectedness on the interventions' wellbeing outcomes were examined using MANCOVA and ANCOVA.

In order to ensure our findings were robust, we also used ANCOVA to examine differences for baseline differences in the measures after statistical adjustment. Results with MANOVA and ANCOVA were very similar. Therefore the results reported in the manuscript are those from MANOVA. However, the results of the ANCOVA can be found in a Supplementary File 2.

3. Results

Given that the effects of a mindfulness programme have been shown to differ according to age and gender, demographic and baseline data were examined (Katz and Toner, 2013). No significant differences in age (χ^2= 8.61, p= .20), gender (χ^2= 53.83, p= .37) and previous experience of mindfulness practice (χ^2= 7.67, p= .26) were found between the experimental conditions. Univariate ANOVAs revealed no baseline differences in any of the study measures by environment or group or the interaction of both, p> .05.

MANOVA found that the main effect of time (T0, T1 and T2) was significant at the multivariate level, F(14,105)= 4.66, p< .001, η^2= .38. There were no statistically significant interactions between time (at baseline, post and follow-up) and the two combined environments (natural, non-natural environments), F(14,105)= 1.30, p= .22, η^2= .15, or between time (at baseline, post and follow-up) and the two groups (mindfulness, relaxation group), F(14,105)= 1.72, p= .06, η^2= .19, at the multivariate level. Table 1 shows the means and standard deviations for all measurements by group and environment at baseline, post intervention and one-week follow-up. Univariate ANOVAs examined differences for each of the study measures.

Table 1 Baseline, post-test and follow up mean scores by group and environment

Outcome	Mindfulness group			Relaxation group		
	T0	T1	T2	T0	T1	T2
	M(SD) [95%CI*]	*M*(SD) [95%CI*]	*M*(SD) [95%CI*]	*M*(SD) [95%CI*]	*M* (SD) [95%CI*]	*M*(SD) [95%CI*]
FFMQ-SF - Mindfulness						
Natural environment	15.43(2.14) [11.24;19.62]	16.00(1.81) [15.37;16.64]	16.57(2.25) [15.79;17.36]	15.44 (1.73) [14.77;16.12]	15.71(1.61) [15.07;16.33]	15.70(1.94) [14.94;16.46]
Non-natural environment	15.54(1.30) [15.00;16.08]	15.88(1.72) [15.17;16.59]	16.09(1.49) [15.48;16.71]	15.22(1.70) [14.63;15.80]	15.20(2.04) [14.50;15.90]	14.91(2.09) [14.19;15.63]
NR-6 -Nature connectedness						

Natural environment	3.65(0.70) [3.41;3.89]	3.78(0.62) [3.56;3.99]	3.92(0.67) [3.69;4.15]	3.28(0.91) [2.93;3.63]	3.58(0.81) [3.26;3.90]	3.64(0.75) [3.34;3.93]
Non-natural environment	3.39(0.85) [3.39;3.03]	3.49(0.82) [3.14;3.83]	3.45(0.69) [3.15;3.74]	3.42(0.75) [3.16;3.68]	3.45(0.68) [3.22;3.69]	3.40(0.68) [3.17;3.63]
PANAS - Positive affect						
Natural environment	31.91 (6.42) [29.67;34.15]	34.59(5.79) [32.57;35.61]	36.06(6.73) [33.71;38.41]	30.71(4.92) [28.80;32.63]	32.75(6.35) [30.28;35.22]	32.86(5.10) [30.88;34.84]
Non-natural environment	31.64(5.59) [29.33;33.95]	33.92(6.12) [31.39;36.45]	34.36(6.86) [31.53;37.19]	31.00(7.12) [28.55;33.45]	32.57(6.13) [30.46;34.68]	32.20(5.76) [30.22;34.18]
PANAS - Negative affect						
Natural environment	25.68(6.60) [23.38;27.98]	22.85(7.09) [20.38;25.33]	20.09(5.63) [18.13;22.05]	24.36(6.83) [21.71;27.01]	21.68(6.50) [19.16;24.20]	20.82(6.51) [18.30;23.35]
Non-natural environment	24.28(6.41) [21.63;26.93]	21.84(6.48) [19.17;24.51]	21.00(5.29) [18.82;23.18]	25.66(5.56) [23.74;27.57]	23.54(6.58) [21.28;25.80]	25.37(8.28) [22.53;28.22]
DASS-21 - Depression						
Natural environment	11.18(9.40) [7.90;14.45]	6.53(6.35) [4.31;8.74]	5.06(5.44) [3.16;6.96]	10.93(6.05) [8.58;12.27]	7.21(5.06) [5.25;9.18]	6.93(6.29) [4.49;9.37]
Non-natural environment	10.16(8.33) [6.72;13.60]	7.28(4.93) [5.25;9.31]	5.68(3.95) [4.05;7.31]	8.29(5.74) [6.31;10.26]	10.23(9.12) [7.09;13.36]	11.37(10.62) [7.72;15.02]
DASS-21 – Anxiety						
Natural environment	11.71(7.78) [8.99;14.42]	9.35(6.78) [6.99;11.72]	7.59(5.52) [5.66;9.51]	9.43(6.55) [6.89;11.97]	7.79(5.89) [5.50;10.07]	8.86(5.56) [6.70;11.01]
Non-natural environment	10.80(6.65) [8.05;13.55]	9.68(7.73) [6.49;12.87]	8.96(6.85) [6.13;11.79]	9.71(6.23) [7.57;11.86]	9.20(6.53) [6.69;11.44]	9.77(8.01) [7.02;12.52]
DASS-21 – Stress						
Natural environment	15.12(8.30) [12.22;18.01]	13.88(6.91) [11.47;16.29]	10.35(7.29) [7.81;12.90]	13.21(5.99) [10.89;15.54]	12.07(7.00) [9.36;14.79]	11.36(8.15) [8.20;14.52]
Non-natural environment	13.76(6.17) [11.21;16.31]	12.32(7.13) [9.38;15.26]	12.80(6.53) [10.10;15.50]	13.43(5.93) [11.39;15.47]	15.60(6.99) [13.20;18.00]	12.57(6.82) [10.23;14.91]

*CI: Confidence Interval

3.1. Level of mindfulness

A time by group by environment univariate repeated measures ANOVA revealed a main effect of time on levels of mindfulness, $F(2,117)= 4.20$, $p= .02$, $\eta^2= .07$. A time by group by environment interaction was not found, $F(2,117)= 0.01$, $p= .99$, $\eta^2= .00$. However, there was a significant time by group interaction, $F(2,117)= 4.61$, $p= .01$, $\eta^2= .07$; Figure 3 suggests that the mindfulness group showed a steady increase in mindfulness across three time periods, whereas the relaxation group did not. ANOVA revealed no differences between the groups at T0, $F(1,120)= 0.25$, $p= .62$, $\eta^2= .00$, or at T1, $F(1,120)= 2.58$, $p= .11$, $\eta^2= .02$, but the mindfulness group (M=16.37, SD=1.97, CI=[15.86; 16.88]) reported greater mindfulness at T2 than the relaxation group (M=15.26, SD=2.05, CI=[14.75; 15.78]), $F(1,120)= 9.25$, $p= .03$, $\eta^2= .07$.

Paired samples t-tests were conducted to further investigate differences within the groups between times. Within the mindfulness group in natural environments, there was no statistically significant difference (using the $p < .01$ criteria) in mindfulness from T0 to T1, t(33)= -2.10, p= .04, η^2= .12, but there was a significant increase from T0 to T2, t(33)= -3.24, p= .003, η^2= .24. No significant difference was found from T0 to T1, t(24)= -1.04, p= .31, η^2= .04, or from T0 to T2, t(24)= -2.52, p= .02, η^2= .21, within the mindfulness group in non-natural environments. For the relaxation group in natural environments, t-tests revealed no significant difference in mindfulness from T0 to T1, t(27)= -0.98, p= .33, η^2= .04, or from T0 to T2, t(27)= -0.99, p= .33, η^2= .04; there was also no significant difference from T0 to T1, t(34)= 0.08, p= .94, η^2= .00, or from T0 to T2, t(34)= 1.21, p= .24, η^2= .04, within the relaxation group in non-natural environments.

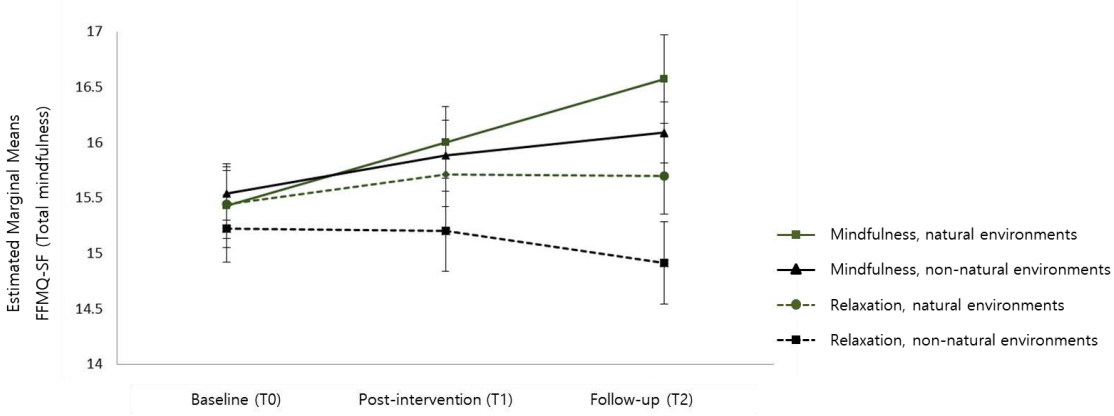

Figure 3. Interaction graph for mindfulness; Error bars represent 95% confidence intervals.

3.2. Nature connectedness

Time had a statistically significant effect on nature connectedness, F(2,117)= 4.86, p= .01, η^2= .08, but a time by group by environment interaction was not found, F(2,117)= 0.87, p= .42, η^2= .02. As shown in Figure 4, the mindfulness group in the natural setting showed a consistent improvement in nature connectedness. There was no significant time by group interaction, F(2,117)= 0.69, p= .51, η^2= .012, but a significant interaction effect was found between time and environment, F(2,117)= 3.14, p= .047, η^2= .05. The ANOVA revealed no differences between the groups at T0, F(1,120)= 0.26, p= .61, η^2= .00, or at T1, F(1,120)= 2.86, p= .09, η^2= .02, but there was a difference at T2: the

natural environment group (M=3.79, SD=0.72, CI=[3.61; 3.97]) reported greater nature connectedness than the group in the non-natural environment (M=3.42, SD=0.69, CI=[3.24; 3.60]), $F(1,120) = 8.62$, $p = .01$, $\eta^2 = .06$.

Paired samples t-tests revealed no statistically significant difference in nature connectedness from T0 to T1, t(33)= -1.67, $p = .11$, $\eta^2 = .08$, or from T0 to T2, t(33)= -2.67, $p = .012$, $\eta^2 = .18$, within the mindfulness group in natural environments. Similarly, no significant difference was found from T0 to T1, t(24)= -0.95, $p = .35$, $\eta^2 = .03$, or from T0 to T2, t(24)= -0.38, $p = .71$, $\eta^2 = .00$, within the mindfulness group in non-natural environments. For the relaxation group in natural environments, there was no significant difference in nature connectedness from T0 to T1, t(27)= -2.49, $p = .02$, $\eta^2 = .19$, but a significant increase from T0 to T2, t(27)= -2.91, $p = .007$, $\eta^2 = .24$; there was no statistically significant difference from T0 to T1, t(34)= -0.43, $p = .67$, $\eta^2 = .01$, or from T0 to T2, t(34)= 0.17, $p = .87$, $\eta^2 = .00$, within the relaxation group in non-natural environments.

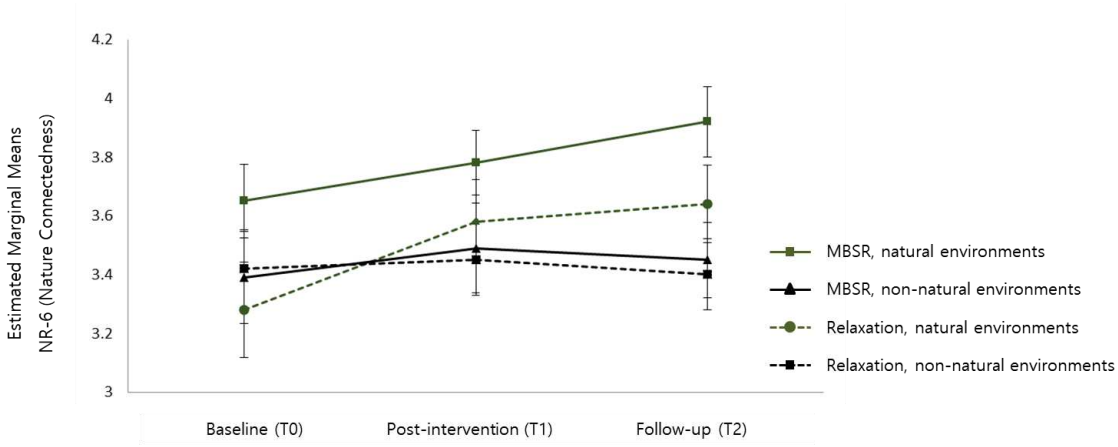

Figure 4. Interaction graph for nature connectedness; Error bars represent 95% confidence intervals.

3.3. Positive and Negative Affect

3.3.1. Positive affect

Time had a statistically significant impact on positive affect scores, $F(2,117) = 8.71$, $p < .001$, $\eta^2 = .13$, but a time by group by environment interaction was not found, $F(2,117) = 0.04$, $p = .96$, $\eta^2 = .001$. We also found no significant time by group interaction, $F(2,117) = 1.11$, $p = .33$, $\eta^2 = .02$, and no significant

interaction effect between time and environment, $F(2,117)= 0.51$, $p= .60$, $\eta^2= .01$. Although there was no statistically significant interaction, Figure 5 suggests a steady increase in positive emotions in all groups except the relaxation group in a non-natural environment.

Paired samples t-tests revealed no statistically significant difference in positive affect from T0 to T1, t(33)= -2.28, $p= .03$, $\eta^2= .14$, but there was a significant increase from T0 to T2, t(33)= -3.24, $p= .003$, $\eta^2= .24$, within the mindfulness group in natural environments. However, the mindfulness group in non-natural environments showed no significant difference from T0 to T1, t(24)= -1.91, $p= .07$, $\eta^2= .10$, or from T0 to T2, t(24)= -2.15, $p= .04$, $\eta^2= .16$. For the relaxation group in natural environments, t-tests revealed no significant difference in positive affect from T0 to T1, t(27)= -1.62, $p= .12$, $\eta^2= .09$, or from T0 to T2, t(27)= -1.62, $p= .12$, $\eta^2= .09$; there was no statistically significant difference from T0 to T1, t(34)= -1.42, $p= .16$, $\eta^2= .06$, or from T0 to T2, t(34)= -1.05, $p= .30$, $\eta^2= .03$, within the relaxation group in non-natural environments.

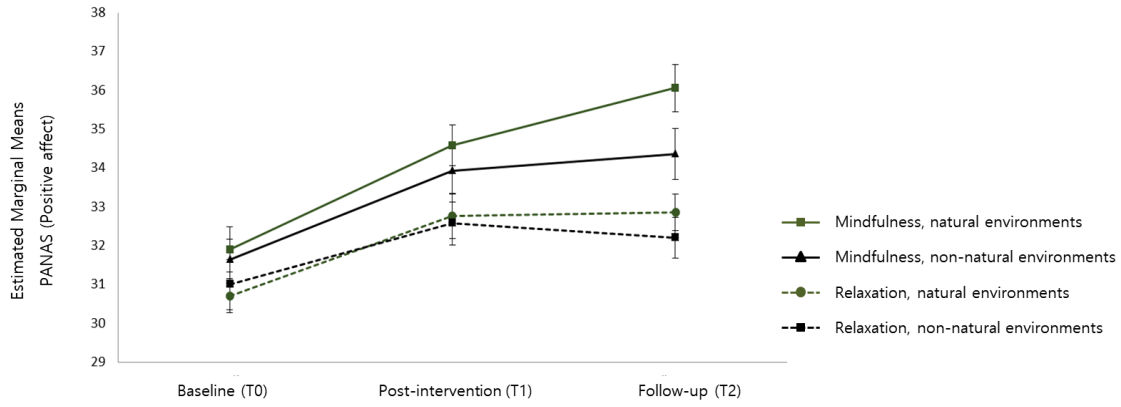

Figure 5. Interaction graph for positive affect; Error bars represent 95% confidence intervals.

3.3.2. Negative affect

Time had a significant impact on negative affect scores, $F(2,117)= 14.89$, $p < .001$, $\eta^2= .20$, but a time by group by environment interaction was not found, $F(2,117)= 0.10$, $p= .91$, $\eta^2= .002$. There was a significant time by environment interaction, $F(2,117)= 3.57$, $p= .03$, $\eta^2= .06$. ANOVA revealed no differences between the environments at baseline, $F(1,120)= 0.01$, $p= .98$, $\eta^2= .00$, or at post

intervention, $F(1,120)= 0.18$, $p= .67$, $\eta^2= .00$, but the group in natural environments (M=20.42, SD=6.00, CI=[18.89; 21.94]) reported lower negative affect at one-week follow-up than the group in non-natural environments (M=23.55, SD=7.46, CI=[21.62; 25.48]), $F(1,120)= 6.54$, $p= .01$, $\eta^2= .05$. There was also a significant interaction between time and group, $F(2,117)= 3.23$, $p= .04$, $\eta^2= .05$; Figure 6 suggests that the mindfulness group showed a steady decrease in negative affect across three time periods, whereas the relaxation group did not. ANOVA revealed no difference between the environments at T0, $F(1,120)= 0.00$, $p= .99$, $\eta^2= .00$, or at T1, $F(1,120)= 0.06$, $p= .81$, $\eta^2= .00$, but the mindfulness group (M=20.47, SD=5.46, CI=[19.05; 21.90]) showed lower negative affect at T2 than the relaxation group (M=23.35, SD=7.83, CI=[21.38; 25.32]), $F(1, 120)= 5.45$, $p= .02$, $\eta^2= .04$.

Paired samples t-tests revealed no statistically significant difference in negative affect from T0 to T1, $t(33)= 2.55$, $p= .02$, $\eta^2= .16$, but there was a significant decrease from T0 to T2, $t(33)= 6.50$, $p< .001$, $\eta^2= .56$, within the mindfulness group in natural environments. However, the mindfulness group in non-natural environments showed no significant difference from T0 to T1, $t(24)= 1.76$, $p= .09$, $\eta^2= .11$, but there was a significant decrease from T0 to T2, $t(24)= 2.83$, $p= .009$, $\eta^2= .25$. For the relaxation group in natural environments, t-tests revealed significant decreases in negative affect from T0 to T1, $t(27)= 2.77$, $p= .010$, $\eta^2= .22$, and from T0 to T2, $t(27)= 3.06$, $p= .005$, $\eta^2= .26$. However, there was no statistically significant difference from T0 to T1, $t(34)= 1.77$, $p= .09$, $\eta^2= .08$, or from T0 to T2, $t(34)= 0.20$, $p= .84$, $\eta^2= .00$, within the relaxation group in non-natural environments.

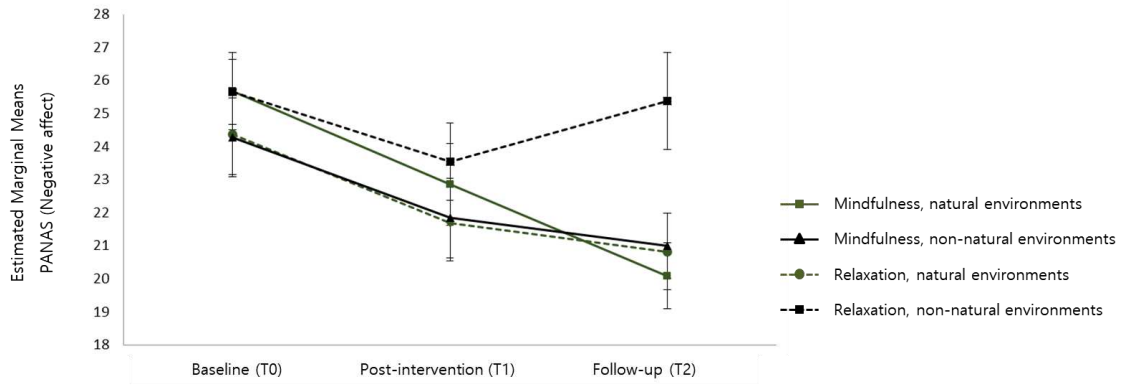

Figure 6. Interaction graph for negative affect; Error bars represent 95% confidence intervals.

3.4. Depression, Anxiety and Stress

3.4.1. Depression

A time by group by environment univariate repeated measures ANOVA revealed a main effect of time on depression scores, $F(2,117)= 10.39$, $p< .001$, $\eta^2= .15$; but a time by group by environment interaction was not found, $F(2,117)= 2.08$, $p= .13$, $\eta^2= .03$. There was a significant interaction effect between time and environment, $F(2,117)= 6.89$, $p= .001$, $\eta^2= .11$. ANOVA reported no difference between environments at T0, $F(1,120)= 2.63$, $p= .11$, $\eta^2= .02$, or at T1, $F(1,120)= 3.07$, $p= .08$, $\eta^2= .02$, but the difference in participants' level of depression between the natural and the non-natural environment was greater at T2, $F(1,120)= 5.17$, $p= .03$, $\eta^2= .04$. Furthermore, there was a significant interaction between time and group, $F(2,117)= 6.11$, $p= .003$, $\eta^2= .09$. ANOVA revealed no difference between the environments at T0, $F(1,120)= 0.89$, $p= .35$, $\eta^2= .00$, or at T1, $F(1,120)= 2.73$, $p= .10$, $\eta^2= .02$. However, Figure 7 suggests that the mindfulness group (M=5.32, SD=4.84, CI=[4.06; 6.58]) showed a lower level of depression at T2 than the relaxation group (M=9.40, SD=9.17, CI=[7.09; 11.71]), $F(1,120)= 9.24$, $p= .003$, $\eta^2= .07$.

Paired samples t-tests revealed a statistically significant decrease in depression from T0 to T1, $t(33)= 4.25$, $p< .001$, $\eta^2= .35$, and from T0 to T2, $t(33)= 5.29$, $p< .001$, $\eta^2= .46$, within the mindfulness group in natural environments. Similarly, the mindfulness group in non-natural environments showed no significant difference from T0 to T1, $t(24)= 2.70$, $p= .012$, $\eta^2= .23$, but a significant decrease from T0 to T2, $t(24)= 3.71$, $p= .001$, $\eta^2= .36$. For the relaxation group in natural environments, t-tests revealed significant decreases in depression from T0 to T1, $t(27)= 3.88$, $p= .001$, $\eta^2= .36$, and from T0 to T2, $t(27)= 3.41$, $p= .002$, $\eta^2= .30$. However, there was no significant difference from T0 to T1, $t(34)= -1.50$, $p= .14$, $\eta^2= .06$, or from T0 to T2, $t(34)= -1.79$, $p= .08$, $\eta^2= .09$, within the relaxation group in non-natural environments.

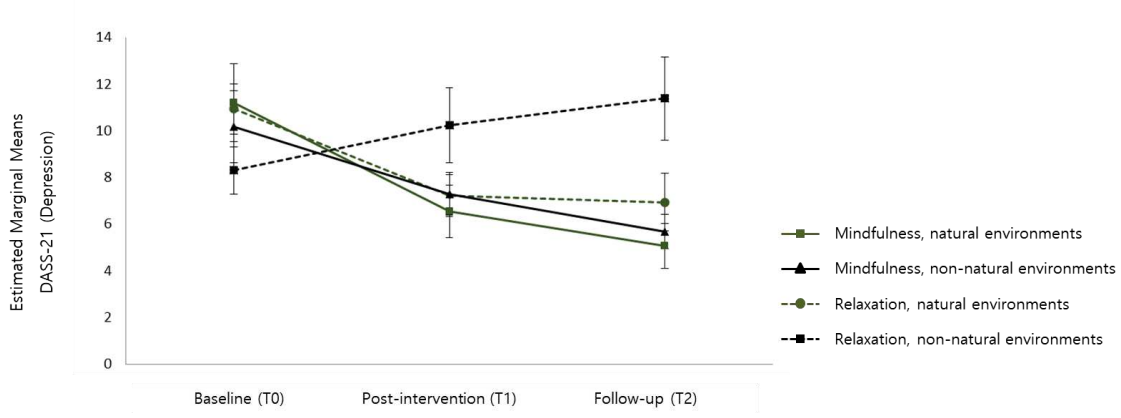

Figure 7. Interaction graph for depression; Error bars represent 95% confidence intervals.

3.4.2. Anxiety

A time by group by environment univariate repeated measures ANOVA revealed a main effect of time on anxiety scores, $F(2,117)= 6.06$, $p= .003$, $\eta^2= .09$. A time by group by environment interaction was not found, $F(2,117)= 0.36$, $p= .70$, $\eta^2= .01$. There was no significant time by environment interaction $F(2,117)= 1.09$, $p= .34$, $\eta^2= .02$, but a significant interaction effect was found between time and group, $F(2,117)= 3.45$, $p= .04$, $\eta^2= .06$; Figure 8 shows that the mindfulness group showed a steady decrease in anxiety across three time periods, whereas the relaxation group did not. However, a further ANOVA revealed no significant difference between the groups at T0, $F(1,120)= 0.25$, $p= .62$, $\eta^2= .01$, or at T1, $F(1,120)= 2.58$, $p= .11$, $\eta^2= .01$, or at T2, $F(1,120)= 1.01$, $p= .32$, $\eta^2= .00$.

Paired samples t-tests found no statistically significant difference in anxiety from T0 to T1, $t(33)= 2.39$, $p= .02$, $\eta^2= .15$, but a significant decrease from T0 to T2, $t(33)= 4.39$, $p< .001$, $\eta^2= .37$, within the mindfulness group in natural environments. However, no significant differences were found from T0 to T1, $t(24)= 1.18$, $p= .25$, $\eta^2= .05$, or from T0 to T2, $t(24)= 1.62$, $p= .12$, $\eta^2= .10$, within the mindfulness group in non-natural environments. For the relaxation group in natural environments, there were no significant difference in anxiety from T0 to T1, $t(27)= 1.99$, $p= .06$, $\eta^2= .13$, or from T0 to T2, $t(27)= 0.57$, $p= .57$, $\eta^2= .01$; there was also no significant difference from T0 to T1, $t(34)= -0.57$, $p= .57$, $\eta^2= .01$, or from T0 to T2, $t(34)= -0.05$, $p= .96$, $\eta^2= .03$, within the relaxation group in non-natural environments.

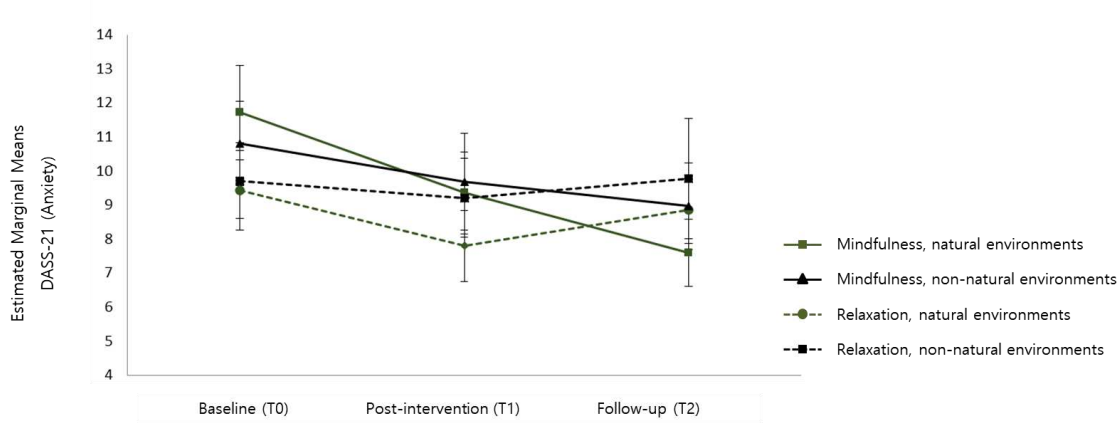

Figure 8. Interaction graph for anxiety; Error bars represent 95% confidence intervals.

3.4.3. Stress

As shown in Figure 9, time had a significant effect on stress scores, $F(2,117)= 5.99$, $p= .003$, $\eta^2= .09$. The time by group by environment interaction was significant, $F(2,117)= 3.91$, $p= .02$, $\eta^2= .06$. However, there was no significant interaction effect between time and group, $F(2, 117)= 1.18$, $p=.31$, $\eta^2= .02$ or between time and environment, $F(2,117)= 0.94$, $p= .39$, $\eta^2= .02$. The 3-way interaction suggests that the combined effect of the mindfulness programme and the natural environment are greater than the effect of either separately. However, the examination of univariate ANOVA at each time point revealed that there were no main effects of environment or group at each time point, nor there were any significant interaction effects at each time point.

Paired samples t-tests found no statistically significant difference in stress from T0 to T1, $t(33)= 0.98$, $p= .33$, $\eta^2= .03$, but there was a statistically significant decrease from T0 to T2, $t(33)= 3.32$, $p= .002$, $\eta^2= .25$, within the mindfulness group in natural environments. However, no significant difference was found from T0 to T1, $t(24)= 1.08$, $p= .29$, $\eta^2= .05$, or from T0 to T2, $t(24)= 0.69$, $p= .50$, $\eta^2= .02$, within the mindfulness group in non-natural environments. For the relaxation group in natural environments, t-tests revealed no significant difference in stress from T0 to T1, $t(27)= 0.99$, $p= .33$, $\eta^2= .04$, or from T0 to T2, $t(27)= 1.25$, $p= .22$, $\eta^2= .05$; there was no statistically significant difference in stress from T0 to T1, $t(34)= -1.96$, $p= .06$, $\eta^2= .10$, or from T0 to T2, $t(34)= 0.65$, $p= .52$, $\eta^2= .01$, within the relaxation group in non-natural environments.

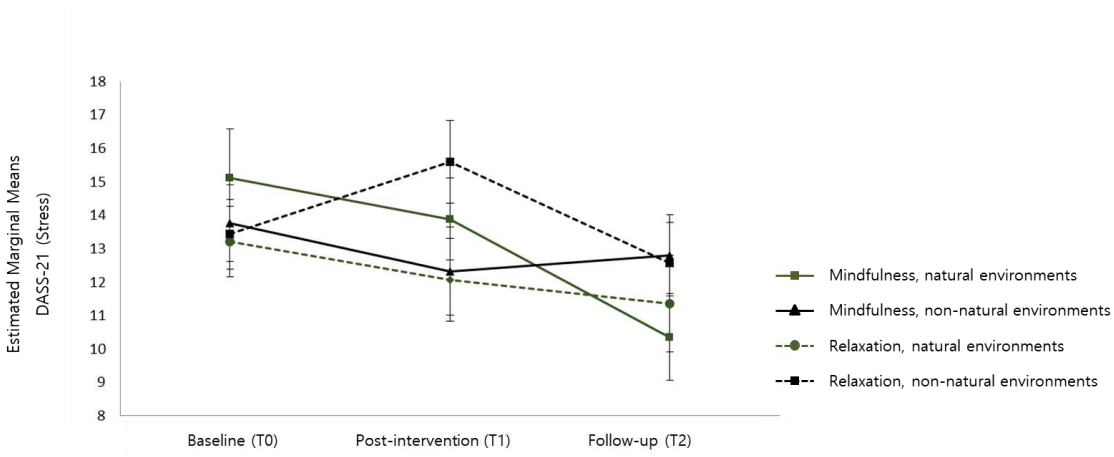

Figure 9. Interaction graph for stress; Error bars represent 95% confidence intervals.

3.5. Summary of findings

As Table 2 shows, this study revealed that all groups experienced significant changes in mental health and wellbeing outcomes during the experiment. There was a significant 2-way interaction between time and group; participants' levels of mindfulness, negative feelings, depression and anxiety showed different patterns over time depending on group (mindfulness vs. relaxation group). There was also a significant 2-way interaction between time and environment; the changes over time of participants' levels of nature connectedness, negative feelings and depression were affected by environments (natural vs. non-natural). The sole significant 3-way interaction was for stress; only participants in the mindfulness group in the natural environment improved from T0 to T2. To expand, the results of the one-way ANOVAs show that significant differences between environments or interventions were not observed until one week later (at T2; see table 2); these differences present after participants had returned to their ordinary routine.

Table 2 All main and interaction effects including the results of one-way ANOVA

Measure	**Effects**				**Significant difference**	**Key beneficiaries (group/environment)**
	Time	Time x Group	Time x Environment	Time x Group x Environment		
FFMQ-SF - Mindfulness	√	√	-	-	at T2	Mindfulness group in both environments
NR-6 Nature connectedness	√	-	√	-	at T2	Both groups in natural environments

PANAS Positive affect	√	-	-	-	-	All the groups improved
PANAS Negative affect	√	√	√	-	at T2	Mindfulness group in non-natural environments, and both groups in natural environments
DASS-21 - Depression	√	√	√	-	at T2	Mindfulness group in non-natural environments, and both groups in natural environments
DASS-21 – Anxiety	√	√	-	-	-	Mindfulness group in both environments
DASS-21 – Stress	√	-	-	√	-	Mindfulness group in natural environments

Note: baseline (T0), post-intervention (T1), one-week follow-up (T2)

3.6 Potential pathway: does nature connectedness mediate the effectiveness of the interventions on mental health and wellbeing?

We hypothesised that changes in nature connectedness (calculated as T2 minus T0) mediate the effectiveness of the interventions (mindfulness and natural environments) on mental health and wellbeing (i.e. PANAS and DASS-21). However, the change in nature connectedness was not a significant multivariate co-variate (p= .07) and so nature connectedness was not a pathway in this study.

4. Discussion

The results of our study confirmed some aspects of hypothesis 1: that stress is reduced when a mindfulness programme is combined with exposure to natural environments. Participants' stress levels generally decreased during the three-week mindfulness programme, but the mindfulness group in non-natural environments showed an increase in stress at one-week follow up, whereas stress levels in the group in natural environments continued to decrease even after the completion of the experiment. This indicates that the effect of the combination of the mindfulness programme and natural environments is greater than the effect of either the mindfulness programme in the non-natural environments or the relaxation group in natural environments. Our findings also suggest that the natural environments had a positive effect on the outcomes of both intervention groups (mindfulness and relaxation group). Both groups in the natural environments led to greater nature connectedness,

lower negative feelings and reduced depression and stress compared with those in the non-natural environments.

No significant difference was observed between the two natural environments: woodland and parkland. In one sense this is surprising given that differences in wellbeing outcomes have been linked with different types of environment; for example, Gatersleben and Andrews (2013) found that a natural environment with a high degree of openness and accessibility was more restorative than one that was low in openness and accessibility, such as very dense vegetation. Generally speaking however, when natural settings have been compared in recent experimental/interventional research differences between settings have tended to be small and non-significant (e.g. Van den Berg *et al*., 2014; Gidlow *et al*., 2016). In line with recent research, we did not find significant differences in health and wellbeing outcomes between the natural environments. However, given the negative associations with some environments e.g. those typified by dense vegetation (Gatersleben and Andrews, 2013) further research is needed to identify the characteristics of natural environments that best promote health and wellbeing. More research on the restorative effects of specific attributes of the natural environment would help to inform the design of wellbeing interventions and policies to improve public health and wellbeing.

Another interesting finding was the absence of changes for negative affect and depression in the relaxation group in non-natural environments, i.e. participants trying to relax without mindfulness practice in non-natural environments reported no reduction in negative affect and more depression. With increasing rates of poor mental health in the UK student population (Universities UK, 2015), students may try to 'switch off' or destress in built environments, such as rooms without views of nature, in darkness or low light levels. This finding therefore has important implications for promoting green campus space to give more opportunities for recovery from stress. Some studies already reported the positive effects of the natural environment in the university campus on students' quality of life (Hipp *et al*., 2016) and emotional restoration, such as decreasing stress and anxiety (Lau and Yang, 2009). Further studies could build on these findings and explore the impact of specific

characteristics of green spaces or the requirements of groups of students with different restorative needs.

The mediation analysis results do not support hypothesis 2 in the sense that changes in nature connectedness did not mediate the effects of the mindfulness programme/natural environment intervention on mental health and wellbeing even though nature connectedness increased in the natural environment. However, other studies have found that mindfulness is associated with nature connectedness. Wolsko and Lindberg (2013) found that greater nature connectedness was consistently associated with greater mindfulness, more engagement in outdoor activities, and greater psychological wellbeing. Similarly, Van Gordon *et al*. (2018) suggested that mindfulness can be used to enhance the restorative qualities of natural environments, and that experience in natural environments can enhance mindfulness. Nisbet *et al*. (2019) also found that individuals who practised mindfulness reported greater awareness of their surroundings, stronger nature connectedness, and better moods than individuals without mindfulness practice. Although changes in nature connectedness were not a pathway in this study, our findings do imply that exposure to nature had a role in sustaining the effects of the interventions in natural environments.

An explanation for the sustained mindfulness programme benefits in the natural environments may be the eudaimonic aspect of nature connectedness that may have been imperfectly assessed by our nature connectedness measure. Wellbeing can be broken down into two types: hedonic and eudaimonic. Hedonic wellbeing focuses on happiness, generally defined as the absence of negative affect and presence of positive affect, whereas eudaimonic wellbeing focuses on living life in a full and purposeful way (Deci and Ryan, 2008). Nature connectedness associates with several indicators of eudaimonic wellbeing, leading to sustained mental health benefits (Pritchard *et al*., 2019). For example, Nisbet *et al*. (2011) found that nature connectedness had a positive correlation with personal development, autonomy and purpose in life. Consistent with this finding, meaningfulness and vitality were found to be strongly linked with nature connectedness (Cervinka *et al*., 2012). Further work using eudaimonic wellbeing indicators is needed to fully understand the effects of nature connectedness, and could include other measures of nature connectedness such as the Nature

Connection Index (NCI). Further study also should establish the pathways within the mindfulness – nature connectedness – mental health and wellbeing nexus. Identifying pathways for the mental health and wellbeing outcomes of interventions in natural environments is important not only because it provides evidence about how existing interventions work, but also because it directs the development of interventions that maximize the health and wellbeing benefit uplift derived from natural environments.

Several limitations should be mentioned. First, this study was conducted in simulated environments using images and background sounds. Use of the simulated environment is common in experimental research on restorative environments (Fischer *et al*., 2018), but it raises questions about ecological validity; for example, reliance on slides or video excludes other sensory experiences, such as smell and touch (Gatersleben and Andrews, 2013). Further experiments, using actual environments, need to be carried out in order to validate our findings in the real world. Moreover, more research could help to develop research methodologies through comparison of the psychological benefits of mindfulness and other psychological interventions in simulated and actual natural environments. Second, it was not possible to explore a wider range of different environments. Further studies could apply our methodology to other environments to determine their capacity to enhance the benefits of MBSR. For example, it would be interesting to include wild forests or blue environments as both have been found to offer particular benefits for mental health and wellbeing (e.g. Lee *et al*., 2011). Third, extra mindfulness practice could have made a difference to the outcomes of the mindfulness group, but this study did not measure whether participants spent a similar amount of time doing mindfulness practice or relaxing between the classes. Fourth, we did not correct alpha values for multiple tests, so some findings may have occurred due to chance. Larger replication studies would be helpful in confirming our findings in similar environments and with other psychological interventions. Lastly, it was not feasible to recruit a representative sample of the wider population, which limits generalisability. Further research with a full MBSR programme and a wider population could help to improve the applicability and generalizability of our findings. Although the limited sample makes it difficult to

generalise these findings, the study supports an environmental approach to improve mental health of university students under academic and social pressures (Hunt and Eisenberg, 2010).

This paper has provided a fine-grained insight into the enhancement of a common wellbeing intervention through exposure to natural environments via its experimental, factorial design and the multiple outcome measures. We showed that 'mindfulness in nature' as a therapeutic approach could be an effective adjunct intervention, which could support resilience and mindfulness, and improve mental health and wellbeing. More evidence of the enhancement of wellbeing interventions when combined with natural environments would encourage policy makers and clinical commissioners to support the development of interventions involving natural settings.

Acknowledgement

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