Effects of soothing images and soothing sounds on mood and well-being

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THE EFFECTS OF SOOTHING IMAGES AND SOOTHING SOUNDS ON MOOD AND WELLBEING

Introduction

Mental health disorders have been increasing at an alarming rate around the world (Choudhry, Mani, Ming & Khan, 2016). Psychological distress has further been heightened since the Covid-19 pandemic (Daly, Sutin & Robinson, 2020) with over a quarter of US adults with depression or anxiety symptoms not able to access mental health service (Nagata et al, 2021). Research has suggested that individuals could be left facing years on waiting lists before specialist help can be provided (Cardno & Sahraie, 2021). There is an urgency to accelerate development of accessible mental health interventions to reduce personal and societal burdens (Kessler et al., 2007).

Over the past two decades, there has been a growing evidence base for the use of compassion in the treatment for mental health disorders such as depression and anxiety (Inwood & Ferrari, 2018). In meta-analyses, greater self-compassion has been linked to decreased psychological distress including depression, anxiety and stress across age groups (MacBeth and Gumley, 2012; Marsh, Chan, & MacBeth, 2018). A key goal of Compassion Focused Therapy (CFT) is to rebalance the three interactive affective systems, namely threat-protection which detects threats and activates fight-or-flight responses; drive, which compels one to seek out the resources necessary for survival; and the soothing and contentment system which evokes feelings of soothe, quiescence and peace (Gilbert, 2009). CFT argued that a well-developed soothing system, would help balance the threat and drive systems and regulate their accompanying emotional responses, in turn enhancing an individual's mental health (Gilbert, 2014, 2015). When individuals are in this state, a condition of peace is enabled allowing the body to relax, digest, and pay attention with an open mind (Porges, 2007; Lopes & Silva, 2020). Studies showing the physiological mechanisms underpinning the link between affiliation and affect regulation have supported this model. For instance, research on the affect regulation system in neuroscience revealed that connection, physical touch, and social support have positive impacts on mood disorders, specifically those high in self-criticism (Leaviss & Uttley, 2015). The release of oxytocin and endorphins, two hormones that boost the relaxing effects of the parasympathetic nervous system and produce a sensation of peace, fulfilment, and contentment, respectively, is specifically increased by physical touch and the experience of being cared for.

A component of CFT is the use of mental imagery, where individuals are coached to generate compassionate feelings and activate their soothing system. In support of this, recent research showed that the concept of soothe is universally perceived as the interconnected states of feeling calm, relaxed, and at ease (Mok, Schwannauer & Chan, 2020). This was consistent with previous findings that soothing emotion is positively associated with self-compassion (Judge, Cleghorn, McEwan & Gilbert, 2012) and that feelings of soothe can promote positive changes in mood and well-being (Gilbert and Procter, 2006).

While mental imagery has generally been shown to be closely connected with emotion and plays an important role in the development and treatment of mental health disorders (Holmes and Matthews, 2010; Pictet, Coughtrey, Matthews and Holmes, 2011), it has been suggested that individuals with depression may find it harder to generate positive mental images (Blackwell et al, 2015) and therefore may not experience the benefits of mental imagery in interventions such as CFT or standard cognitive therapy (Rector, Bagby, Segal, Joffe & Levitt, 2000). By contrast, externally presented positive stimuli have been found to have powerful effect on individuals' emotions (Hackmann, Surawy, & Clark, 1998) and hence research has begun to explore if presenting individuals with positive images can elicit positive mood and well-being (Brown, Barton & Gladwell, 2013). Similar to research in mental imagery however, results on depressed individuals have been mixed. While some depressed individuals have been found to be responsive to externally presented positive stimuli (Görgen, Joormann, Hiller, & Witthöft, 2015), other have found that depressive symptom was negatively but weakly correlated with positive response to soothing images (Wilson et al, 2018). Overall, whether or not those with higher depressive symptoms respond well to these types of interventions is an important question that has yet been fully investigated.

Amongst all, images depicting nature scenes appear to elicit mood benefits. Findings have shown that when students viewed natural scenery compared to viewing urban scenery or not viewing scenery at all, their tension, depression, anger, fatigue and confusion decreased, whilst vigour, calmness, and concentration increased (Shin and Shin, 2019). Indeed, the psychological benefits of being in nature have been thoroughly researched (Bowler, Buyung-Ali, Knight & Pullin, 2010), with findings indicating that even brief nature contact can reliably improve hedonic and self-transcendent emotions (Neill, Gerard & Arbuthnott, 2018). Specifically, there has been increasing research on forest bathing ('shinrin-yoku'), which was designed to encourage individuals to spend more time in nature whilst paying mindful attention to one's senses (Hansen et al, 2017). For instance, Furuyashiki, Tabuchi, Norikoshi, Kobayashi and Oriyama (2019) found that, following a day-long forest bathing session, participants reported physiological and psychological benefits as well as improvements in mental health, including those with higher risk for depression. Additionally, significant increases in positive affect and vigour, and decreases in negative affect, anxiety, anger, fatigue and tension, were found in individuals after a 3-hour forest bathing session (Muro, Feliu-Soler, Canals, Parrado & Sanz, 2022). The health benefits of forest bathing have further been supported by a systematic review and meta-analysis which found that mental health can benefit, especially in anxiety reduction, in the short term (Kotera, Richardson and Sheffield, 2022), whilst Wen, Yan, Pan, Gu and Liu (2019) found that forest bathing activities may significantly improve both physical and psychological health.

Due to the strong evidence base for the effects of nature on mood and well-being, it is not surprising that there is also evidence
to suggest that listening to nature related sounds can yield similar positive effects, such as relieving stress and relaxing the mind and body (Tian, Kim & Bae, 2020). For many years, sound therapy has been employed as a viable approach of psychotherapy, with numerous positive study outcomes (Kučikienė & Praninskienė, 2018). Research suggests that bird (Ratcliffe, Gatersleben, & Snowden, 2013) and water sounds (White, et al, 2010) may aid stress restoration by encouraging positive affect, whilst findings also demonstrated enhanced stress recovery in those who were exposed to sounds of nature after inducing stress (Annerstedt et al, 2013).

While research on the effects of sounds is relatively limited, their potential health benefit could be indirectly supported by research in music therapy. According to Frühholz, Trost, and Grandean (2014), music elicits psychophysiological responses due to its influence on the limbic system, which is associated with emotions, feelings and sensations. Consistent with this, music therapy has been found to significantly reduce symptoms of anxiety and depression while also preventing cardiovascular diseases (Riberio et al., 2018). Additionally, music therapy has been shown to enhance parasympathetic activities and decrease congestive heart failure by reducing plasma cytokine and catecholamine levels (Okada et al., 2009). Based on research on the relationship between the autonomic nervous system and social-emotional processes, music therapies, such as the Safe and Sound intervention, have been developed (Porges, 2007).

Furthermore, it should be noted that auditory and visual stimuli are closely linked (Küssner & Eerola, 2019), with research suggesting that a combination of music and image/film can be an effective way to elicit emotions (Vines, Krumhansl, Wanderley, & Levitin, 2006). For example, Eldar, Ganor, Admon, Bleich, & Hendler, (2007) found that when music and films were combined, participants showed increased activity in the amygdala, hippocampus and lateral prefrontal regions, compared with listening to music alone. As such, it could be hypothesised that viewing images and listening to soothing sounds that depict nature may have a positive impact on mood and well-being.

Research Aims and Hypotheses

Taken together, research literature suggests that both nature-related visual and auditory stimuli have potential to be developed into interventions to improve wellbeing. Inspired by CFT, Project Soothe is an ongoing citizen science research project that has collected a bank of soothing images submitted by the public. Preliminary evidence suggested that viewing a random selection of 25-30 soothing images can increase positive affect and feelings of serenity, as well as reducing negative affect, depressive and anxious mood states (Guerreo, 2017; Wong, 2019; Yang, 2020). However, the hypothesis that mood effects may be enhanced by simultaneously viewing soothing images and listening to soothing sounds has not been tested. Furthermore, as noted above, individuals with mental health disorders such as depression may find it difficult to elicit positive imagery, and so it would be of value to investigate whether viewing visual images and listening to nature sounds simultaneously will elicit an improvement in mood and well-being in individuals with higher levels of depression or anxiety. This study therefore aimed to test the following hypotheses:

1) All three conditions (viewing soothing images vs. listening to nature sounds vs. a combination of both) will elicit a positive change in individuals' mood and well-being.
2) The combined condition will elicit a greater positive change in mood and well-being than the images only and sounds only conditions.

3) Baseline levels of depressive and anxiety symptoms will affect mood changes. Due to the mixed findings in previous research, we sought to perform exploratory analyses with no specific hypothesis regarding the direction of associations.

Design and Ethics

This research used a 2x3 mixed experimental design with one between-subject factor (conditions: soothing images only, soothing sound only, and combined) and one within-subject factor (time: pre- and post-intervention). There were two Independent Variables (IVs): conditions and time. The Dependent Variables (DVs) were transient mood and well-being states (positive affect, negative affect, serenity, and state depression). Participants were randomly assigned to one of the three conditions. The study received University ethics approval. An incentivising lucky draw for a £25 Amazon voucher or 0.5 course credits for university students was offered. Details of the visual and auditory stimuli are provided in Appendix 1 and 2 respectively.

Method

Participant Recruitment

Participants were recruited through social media and the British Library's and Project Soothe's networks. The study was also advertised to students through a University's research recruitment site. To be eligible for the study, participants needed to be over the age of 18 and had access to a computer, tablet or mobile device. There was no further inclusion or exclusion criteria. The research took place online using Qualtrics.

Participants

A total of 175 individuals consented to participate in the research. After excluding individuals with incomplete survey responses, the final sample consisted of 149 adults (108 females, 40 males and 1 transgender) aged between 18 and 83 years old (M = 35.88, SD = 15.63). Using G*Power 3.1, our *a priori* power analysis based on $\alpha = .05$, medium effect size of .25 (Cohen, 1988), and a power level of .80 (Farrokhyar et al., 2013), suggested a minimum sample size of 102. Our sample was therefore deemed to be sufficiently powered.

Demographic and Baseline Measures

Demographic Questionnaire:

Participants were asked to answer questions about their age and gender.

Baseline Measures:

Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer, & Williams, 2001) is a 9-item self-administered questionnaire to measure depressive symptoms. Participants were asked to rate each item on a Likert scale from 0 (not at all) to 3 (nearly every day) based on their experience over the last two weeks. A total score is 27, with scores lower than four being identified as no depression, and scores higher than four being identified as mild (5-9), moderately (10-14), moderately severe (15-19), and severe (20-27) depression. The PHQ-9 has been widely used and shown to be valid and reliable, with reports of an average sensitivity to depression of 81.3% (Mitchell, Yadegarfar, Gill & Stubbs, 2016) and high internal reliability (α = .87) (Kocalevent, Hinz, & Brähler, 2013).

Generalised Anxiety Disorder Scale-7 (GAD-7) (Spitzer, Kroenke, Williams, & Löwe, 2006) is a 7-item self-report questionnaire used to measure anxiety symptoms. Participants were asked to rate each item on a Likert scale from 0 (not at all) to 3 (nearly every day) based on their experiences over the last two weeks. The total score is 21, with scores lower than four being identified as none, and scores higher than four being identified as mild (5-9), moderate (10-14) and severe (15-21) anxiety. The GAD-7 has been found to have very high internal reliability (α = .92) and good test-re-test reliability (Spitzer et al, 2006).

Dependent Variables/Measures

Transient Mood States

International Positive and Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007) is a 10-item self-report questionnaire, measuring five positive and five negative affective states. Participants were asked to rate the extent to which each word describes the way they feel *at this moment* on a Likert Scale from 1 (not at all) to 5 (very much). The positive and negative affect subscales were analysed separately, giving each participant a score out of 25 for each subscale. The scale has demonstrated acceptable to good internal consistency (positive affect subscale: α = .75 and negative affect subscale: α = .80; Karim, Weisz, & Rehman, 2011) as well as high temporal stability for both subscales with .84 (p < .01) (Thompson, 2007).

Positive and Negative Affect Schedule-Expanded version-Serenity Subscale (PANAS-X-Serenity; Watson & Clark, 1999) is a self-report questionnaire designed to measure serenity based on three items (‘relaxed’, ‘calm’ and ‘at ease’). An additional item of “soothed” was included for the purpose of this study to capture the intended mood state of feeling soothed. This subscale was added on to the end of the I-PANAS-SF questionnaire and had the same instruction and scoring procedure as above, giving each participant a total score out of 20. Research has found an acceptable internal consistency of the scale ($\alpha = .74$; Watson & Clark, 1999).

Short Form of the Profile of Mood States –Depression-Dejection Subscale (POMS-SF-D; Shacham, 1983) is a self-report 8-item questionnaire measuring depressive mood states. Participants were asked to rate their feelings “at this moment” on a Likert Scale from 0 (not at all) to 4 (extremely), giving each participant a total score out of 32. Research has demonstrated a high internal consistency ($\alpha = .93$; Curran, Andrykowski, & Studts, 1995).

Interventions

The **soothing images** used in this research were collected from Project Soothe (www.projectsoothe.com). At the time of this study, Project Soothe had a database of over 800 images with five main themes: landscape, water features, flowers and trees, animals, and sky. For this research, 25 soothing images (five per theme), which had been rated the most soothing for their theme, were selected.

The 25 **soothing sounds** used were from the British Library’s sound archive, which were chosen to match the themes of the 25 images. The British Library’s curator of Wildlife and Environmental Sounds (co-author CT) found numerous sounds, which were then narrowed down by the curator and the first author (EW), along with an independent researcher to determine which sounds best matched each image.

In the **combined** condition, the same 25 soothing images and sounds were used as in the image only and sound only conditions, but were presented simultaneously as pairs. Each image/sound/pair were presented for 30 seconds (Brown et al, 2013), where participants were asked to rate how soothing they found the stimuli after each one, on a scale from 1 (not soothing at all) to 7 (very soothing). This was to engage them beyond passive viewing/ listening across all conditions.

Procedure

This was an online study where all stimuli, tasks, and questionnaires were presented and administered via Qualtrics, which also recorded all participants' responses. Within the same study platform, participants were first provided with an information sheet and asked to give written informed consent. They then completed the demographic questions and the baseline measures (PHQ-9 and GAD-7), followed by the primary outcome measures (i.e., I-PANAS-SF, PANAS-X serenity subscale, and the POMS-SF-D). Participants were then randomly allocated to one of the intervention conditions (images only n=49; sounds only, n=48; combined n=52) using a randomiser on Qualtrics. Once the intervention was completed, participants were presented with the outcome measures of I-PANAS-SF, PANAS X serenity subscale, and POMS-SF-D questionnaires to complete again. Towards the end, participants were given a debrief sheet. The procedure is summarised in a flow chart (see Appendix 3).

Data Analysis

Data analyses were conducted using the IBM Statistical Package for Social Science (SPSS) 26, with the significance level set to .05 and confidence intervals set to 95% in all cases. Preliminary analyses were conducted to check for missing data, normal distributions and outliers or extreme values. Results for parametric assumptions were mixed, while the Shapiro-Wilk test showed that only some of the variables were normally distributed, the histograms showed that most of the variables broadly followed normal distributions, and that transforming the data would unlikely achieve perfect normality. Parametric tests were therefore used to perform as the first-line analyses, while non-parametric tests were carried out at a second stage to verify the results. Furthermore, Levene's F tests showed that all variables met the assumption of homogeneity of variance. Finally, boxplots indicated that there were several outliers, but the 5% trimmed means for all measures suggest that the outliers did not strongly influence the mean; hence all data were retained.

The three conditions were compared in their demographic and baseline clinical variables using Pearson Chi-square test (for gender) and one-way ANOVAs (for other measures).

To address hypotheses 1 and 2, four parallel 2x3 mixed measures ANOVAs were conducted to test for changes in positive affect, negative affect, serenity, and depressive mood states respectively. Each ANOVA contained one within-subject variable (time: pre-test vs post-test) and one between-subject variable (condition: sounds only, image only, combined).

To address the third hypothesis, correlations were run to see whether change scores (post-test mood score minus pre-test mood scores) for negative affect, positive affect, serenity and depressive mood states correlated with baseline PHQ-9 and GAD-7 scores across the whole sample and within each condition. Due to linearity being violated, Spearman Rho non-parametric tests were conducted.

Results

Descriptive Analyses

Demographics

Table 1 shows the demographic characteristics of the three groups. There were no gender differences, $F(2,146) = 6.26$, $p = 1.80$, but a significant group difference in age, $F(2,145) = 3.68$, $p = .028$. Post hoc Tukey HSD test indicated that this was driven by participants in the sound condition being older than those in the image condition ($p = .023$) but not between other conditions. Age was therefore added as covariate in secondary analyses.

Baseline measures

For the PHQ-9, using the cut-off points stated above, 71 participants had no depression, 46 had 'mild' depression, 25 had 'moderate' depression, 5 had 'moderate severe' depression, and 2 participants had 'severe' depression. For the GAD-7, 78 participants had no anxiety, 42 had 'mild' anxiety, 20 had 'moderate' anxiety, and 9 had 'severe' anxiety.

The groups were matched in all baseline measures (see Table 1).

Table 1 ***Group Differences in Demographics, Baseline and Pre-test Measures***

	Total Participants		**Sound (n=48)**		**Image (n=49)**		**Combined (n=52)**		**Group Differences**	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F(2,146)*	*p(2-tailed)*
Age	35.88	15.63	39.67	16.03	31.33	13.67	36.69	16.22	3.68	**.028***
Depression (PHQ-9)	15.13	4.75	14.90	5.33	15.51	4.00	15.00	4.91	.23	.793
Anxiety (GAD-7)	12.30	4.63	12.58	4.76	12.55	4.02	11.81	5.06	.45	.636
Negative Affect T1	8.01	3.62	7.96	3.61	8.35	3.71	7.75	3.59	.35	.707
Positive Affect T1	12.98	4.21	12.85	4.38	12.80	3.48	13.27	4.71	.19	.828
Serenity T1	10.89	3.81	10.29	3.55	11.18	3.86	11.17	4.00	.88	.417

Depressive Mood T1	13.62	7.53	13.85	7.55	13.67	7.25	13.37	7.90	.05	.948

Note: * indicate statistical significance $p < .05$.

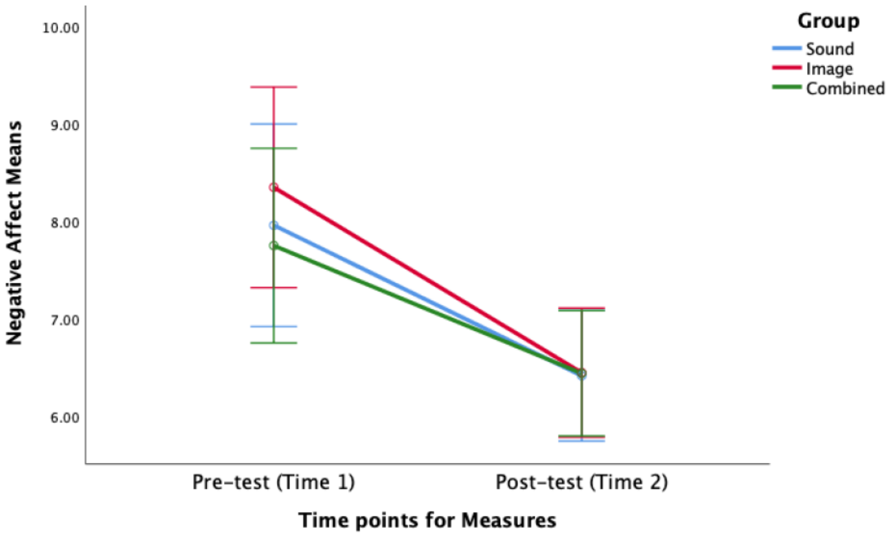
T1 refers to Time 1

Hypotheses One and Two

Changes in Negative Affect

Results showed that there was no significant main effect of group $F(2, 146) = .16$, $p = .854$, $d = .090$, or Time x Group interaction $F(2,146) = .63$, $p = .534$, $d = .19$. However, there was a significant main effect of Time, $F(1,146) = 52.85$, $p < .001$, $d = 1.20$ (see Figure 2), This indicated that all participants, regardless of group, showed a reduction in negative affect, supporting the first hypothesis but not the second hypothesis. Non-parametric test results replicated the same findings, with Friedman's test showing that there was a statistically significant difference in negative affect scores, pre- and post-intervention, $x^2(1) = 60.84$, $p < .001$.

Figure 1 ***Changes in Negative Affect before and after Intervention***

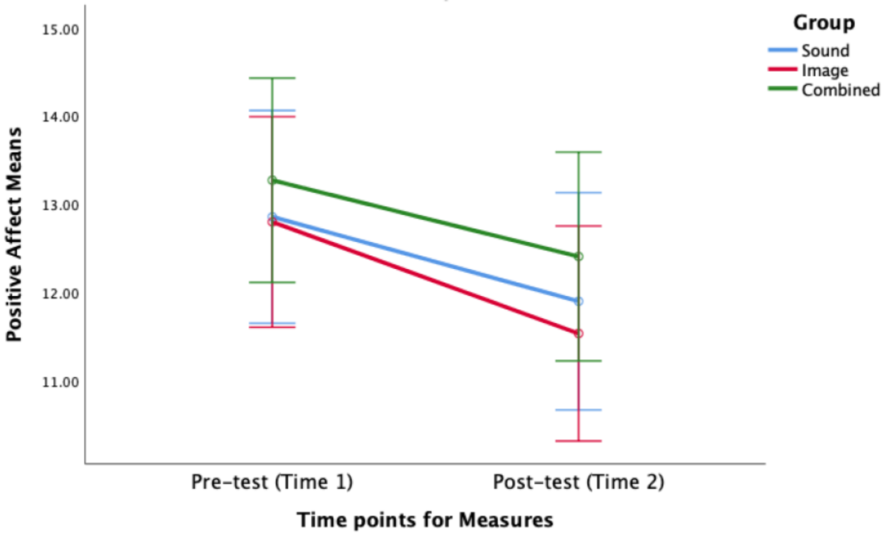


Note: Data refers to the Mean negative affect score of the three groups at Time 1 and Time 2 Error bars represent 95% Confidence Intervals (CI).

Changes in Positive Affect

There were no significant main effect of group $F(2, 146) = .38$, $p = .682$, $d = .14$, or Time x Group interaction, $F(2,146) = .21$, $p = .811$, $d = .11$. However, there was a significant main effect of Time, $F(1,146) = 15.16$, $p < .001$, $d = .64$, (see Figure 3). This indicated that all participants, regardless of group, showed a reduction in positive affect, which does not support the first hypothesis or second hypothesis. Non-parametric test results yielded similar results with Friedman's test showing a significant difference between pre- and post-intervention, $x^2(1) = 10.45$, $p = .001$.

Figure 2 ***Changes in Positive Affect before and after Intervention***

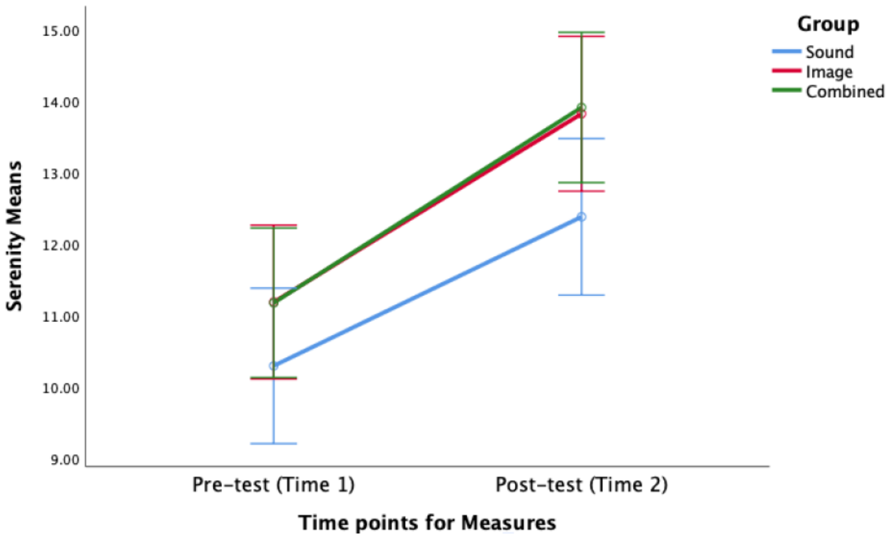


Note: Data refers to the Mean positive affect score of the three groups at Time 1 and Time 2 Error bars represent 95% Confidence Intervals (CI).

Changes in Serenity

There were no significant main effect of group $F(2, 146) = 2.18$, $p = .116$, $d = .35$, or Time x Group interaction, $F(2,146) = .36$, $p = .696$, $d = .14$. However, there was a significant main effect of Time, $F(1,146) = 55.76$, $p < .001$, $d = 1.23$ (Figure 4), driven by all participants showing an increase in serenity, supporting the first but not the second hypothesis. Non-parametric test yielded consistent results with Friedman's test showing a significant difference between pre- and post-intervention, $x^2(1) = 38.28$, $p < .001$.

Figure 3 ***Changes in Serenity before and after Intervention***

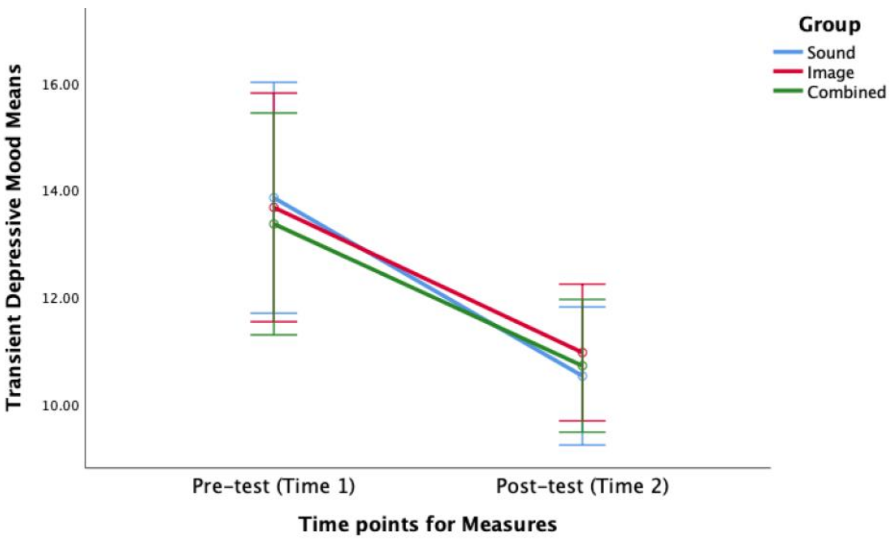


Note: Data refers to the Mean serenity score of the three groups at Time 1 and Time 2 Error bars represent 95% Confidence Intervals (CI).

Changes in Depressive Mood

There was no significant main effect of group $F(2, 146) = .03$, $p = .970$, $d = .000$, or Time x Group interaction, $F(2,146) = .26$, $p = .768$, $d = .13$. However, there was a significant main effect of Time, $F(1,146) = 47.77$, $p < .001$, $d = 1.15$ (Figure 5). This indicated all participants showed a reduction in depressive mood, supporting the first but not the second hypothesis. Consistent with this, non-parametric Friedman's test showed a significant difference between pre- and post-intervention, $x^2(1) = 50.00$, $p < .001$.

Figure 4 ***Changes in Depressive Mood before and after Intervention***



Note: Data refers to the Mean depressive mood score of the three groups at Time 1 and Time 2. Error bars represent 95% Confidence Intervals (CI).

Secondary Analyses with Age as Covariate (ANCOVA's)

Due to the unexpected findings of the conditions not being matched in age at baseline Analysis of Covariance (ANCOVA) tests were run with age as a covariate. Results remained similar for the main effect of time for negative affect, serenity and depressive mood. However, after controlling for age, the main effect of time for positive affect was no longer significant, $F(1,144) = 1.76$, $p = .186$, $d = .220$. See Appendix 4 for details.

Third Hypothesis

Effect of Baseline Depression across the sample

Results showed that baseline depression scores were significantly correlated with all mood changes. There was a significant negative correlation between baseline depression scores and change scores of negative affect, $r = -.55$, $n = 149$, $p < .001$ and change scores of depressive mood states, $r = -.46$, $n = 149$, $p < .001$. There were also significant positive correlations between baseline depression scores and change scores of positive affect, $r = .28$, $n = 149$, $p = .001$, and change scores of serenity, $r = .22$, $n = 149$, $p = .009$. (See Figure 5 in Appendix 5).

Effect for Baseline Anxiety across the sample

Results showed that baseline anxiety was correlated with all mood changes. There was a significant negative correlation between baseline anxiety and change scores in negative affect, $r = -.44$, $n = 149$, $p < .001$, and depressive mood states, $r = -.41$, $n = 149$, $p < .001$. There were also significant positive correlations between baseline anxiety scores and change scores in positive affect, $r = .33$, $n = 149$, $p < .001$, and change scores in serenity, $r = .27$, $n = 149$, $p = .006$. (See Figure 6 in Appendix 6).

Effects of Baseline Depression and Anxiety in Each Condition

The above analyses were repeated within each condition separately. The overall associations between baseline symptoms and mood changes were the same within each individual conditions, although some effects became non-significant, likely due to reduced sample sizes. Details are reported in appendix 7.

Discussion

Our findings showed that all conditions elicited a change in mood, in particular a decrease in negative affect and depressive mood states, as well as an increase in serenity affect (including the feeling of soothe). However, there was also a decrease in positive affect. No interaction effects were found meaning that the combined condition was not more effective. Thus, these findings mainly support hypothesis one, but not hypothesis two.

The findings that the image only condition elicited a positive change in mood and well-being is consistent with previous research that showed positive effects of viewing nature scenery on our psychological (Shin & Shin, 2019) and physiological health (Jo, Song & Miyazaki, 2019). These results also echo previous studies using Project Soothe images as a tool to decrease negative affect and depressive moods (Guerreo, 2017; Wong, 2019; Yang, 2020). Additionally, the current findings are consistent with previous demonstration of mood effects using nature related sounds (Kučikienė & Praninskienė, 2018; Ratcliffe et al, 2013). These findings implicate that exposure to nature related sensory stimuli, images or sounds, may be developed as a simple and easily accessible intervention that is capable of positively affecting mood. However, contrary to expectation, the combined condition did not elicit greater changes. It may be that using another form of auditory stimuli, such as music as in previous studies (Eldar et al, 2007; Vines et al, 2006), is more effective in eliciting changes in mood and well-being than sounds.

Indeed, research has found that music has health and psychological benefits (Cassileth, Vickers & Magill, 2003; Siedlecki & Good, 2006) due to its influence on the limbic system, which is associated with emotions, feelings and sensations. Music therapy has been used to reduce stress and pain, enhance emotional health and sleep quality (Beccaloni, 2011; Bruscia, 1991; Hedge, 2014; Standley, 2002; Chang, Lai, Chen, Hsieh & Lee, 2012; Harmat, Takács & Bódizs, 2008; Morin et al, 2006) and used in mental health treatment for depression and anxiety (Erkkilä et al, 2011). In a qualitative study, participants described listening to music as a way to distract from, or mask unpleasant emotional states, although it was acknowledged that this was a temporary solution (Stewart, Garrido, Hence, & McFerran, 2019).

Unexpectedly, this research found that positive affect decreased across all conditions. While this may seem contradictory to other research on the mood effects of viewing nature-related images (Dunn et al, 2004; Görgen et al, 2015) and listening to nature sounds (Ratcliffe et al, 2013; White et al, 2010), one explanation could be that the current sample was affected by boredom and fatigue due to the relatively long exposure times and multiple stimuli used. Another possible explanation is that participants' feelings of serenity and soothe increased after they experienced the intervention. According to Gilbert's (2009), the soothe system is key for regulation of the drive system, and thus when feelings of soothe increase, an individual's motivation may decrease This is further supported by the Stress Reduction Theory (Ulrich, 1981; Ulrich et al, 1991), which suggests that viewing scenery depicting nature can have a restorative effect and in turn can reduce our state of alertness. The items in the Positive Affect scale ('determined', 'alert, 'active', attentive' and 'inspired') appears to be tapping into the drive system, which might have been down-regulated when participants' soothe system was activated. Interestingly, when age was controlled for, the reduction of positive affect was no longer significant, suggesting that age had at least a partial influence on the unexpected findings of positive affect reported.

In addition to age, baseline depressive and anxious symptoms were also found to influence mood changes. Specifically, higher levels of baseline symptoms (depression or anxiety) were associated with a larger reduction in negative affect and depressive mood states, as well as a larger increase in serenity and a smaller reduction in positive affect. Therefore, it appears that individuals with higher levels of baseline depressive or anxiety symptoms benefit more from soothing images and sounds, which may suggest promising clinical applications.

Clinical Implications

This research has provided preliminary evidence that Project Soothe images and soothing sounds depicting nature can potentially be used as a digital tool to help improve mood and, upon further development and evaluation, could be integrated in therapeutic practices to aid in the treatment of mental health disorders. This research is in line with previous research on the benefits of forest bathing (Kotera et al., 2022; Wen et al., 2019) and adds to existing knowledge that exposure to nature is beneficial for our well-being. Much research has investigated the effects of not going outside and affiliating with nature, (Ribeiro et al., 2021). Findings have illustrated the substantial adverse effects of staying at home including emotional distress, depression and generalised anxiety (Brooks et al, 2020). Research comparing responses to viewing visual representations (images) of pleasant nature scenes versus experiencing a pleasant natural environment suggested that similar emotional responses can be evoked (Hartmann, Apaolaza & Alija, 2015). As such, the images and sounds used in this research have the potential to be used as an easily accessible and cost-effective tool with individuals who struggle to leave home due to anxiety or depression, or those who have difficulties accessing outdoors and nature, potentially giving them similar mental health benefits as to if they were directly experiencing nature outdoors. Our finding that higher level of depressive and anxiety symptoms was associated with larger positive change was particularly encouraging, suggesting that pre-existing mood symptoms do not hinder individuals from benefiting from exposure to soothing images and sounds. This may also be a potential activity to be integrated in Behavioural Activation interventions.

Limitations

Results should be interpreted in the context of the limitations. Firstly, participants commented that while they found many sounds soothing, they found the Common Cuckoo (Cuculus canorus) frustrating to listen to due to the repetitiveness of its call and they felt it overpowered other audio features present. Future research should investigate which sounds individuals find most soothing which may potentially boost the effectiveness of future interventions. Secondly, the 25 stimuli in each condition were shown for 30 seconds each, which may have caused boredom and a subsequent reduced attention to the stimuli (Eastwood, Frischen, Fenske, & Smilek, 2012). While it was necessary to control for exposure time due to the experimental nature of the study, and that the duration used was based on previous research (e.g., Brown et al, 2013), future intervention development should investigate the optimal length of time for individuals to view images or listen to sounds and/ or investigate how individual differences could be integrated to give the optimal results. Thirdly, the online setting may have introduced confounding variables such as distractors, loading speed and type of device used, all of which were not controlled for in this research. Fourthly, the mood measures were chosen as they are relatively short in order to reduce participants' burden. However, other measures such as the Depression, Anxiety and Stress Scale may have been a more suitable measure to detect individual differences in non-clinical samples. Furthermore, it is important to acknowledge that CFT is rooted in an evolutionary, functional analysis of basic social motivational systems and that Gilbert (2014) has placed important emphasis on the connection between the social element in compassion and attachment and their role in social imagery. In particular, the way a parent can calm a distressed child and provide a safe haven suggesting that the emotion system that underlies soothe and calm had a crucial role in the formation of attachment (Bell, 2001). The social element of a compassionate other that is supportive and helpful to the self is in fact one of the central imagery tasks used in CFT. Thus, future studies can consider extending the evaluation from nature related materials to imagery that tap into social affiliations. Finally, we did not have control groups which were exposed to non-nature-related stimuli and as such we cannot rule out the possibility that our findings were driven by other cognitive or emotional effects such as diverted attention. Future research could also investigate the effectiveness of the tools on different age groups as age was seen to potentially have at least a partial influence. It would be interesting to investigate how these tools can be adapted to suit individual differences and whether there are differences in clinically depressed and anxious individuals. Future research could also investigate the combination of music and soothing images.

Conclusion

In conclusion, this study showed that viewing soothing images, listening to nature sounds, and a combination of both, are all effective in eliciting serenity affect as well as reducing negative affect and depressive mood states. Given the rise in mental health disorders in particular during and in the aftermath of COVID pandemic, upon further evaluation, these tools could potentially be developed as easily accessible, cost-effective and far-reaching interventions that can be used to aid the treatment of these disorders in the general population.

References

Annerstedt, M., Jönsson, P., Wallergård, M., Johansson, G., Karlson, B., Grahn, P., Hansen, A. M., & Währborg, P. (2013). Inducing physiological stress recovery with sounds of nature in a virtual reality forest--results from a pilot study. *Physiology & behavior*, *118*, 240–250.

Beccaloni A. M. (2011). The medicine of music: a systematic approach for adoption into perianesthesia practice. *Journal of perianesthesia nursing: official journal of the American Society of PeriAnesthesia Nurses*, *26*(5), 323–330.

Bell, D. C. (2001). Evolution of care giving behavior. *Personality and Social Psychology Review, 5,* 216-229.

Benfield, J. A., Taff, B. D., Newman, P., & Smyth, J. (2014). Natural Sound Facilitates Mood Recovery. *Ecopsychology, 6*(3), 183-188.

Blackwell, S. E., Browning, M., Mathews, A., Pictet, A., Welch, J., Davies, J., Watson, P., Geddes, J. R., & Holmes, E. A. (2015). Positive Imagery-Based Cognitive Bias Modification as a Web-Based Treatment Tool for Depressed Adults: A Randomized Controlled Trial. *Clinical psychological science: a journal of the Association for Psychological Science*, *3*(1), 91–111.

Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC public health*, *10,* 456.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet (London, England), 395*(10227), 912–920.

Brown, D. K., Barton, J. L., & Gladwell, V. F. (2013). Viewing nature scenes positively affects recovery of autonomic function following acute-mental stress. *Environmental science & technology*, *47*(11), 5562–5569.

Brown, D. K., Barton, J. L., & Gladwell, V. F. (2013). Viewing nature scenes positively affects recovery of autonomic function following acute-mental stress. *Environmental science & technology*, *47*(11), 5562–5569.

Bruscia, K. (1991). *Case studies in music therapy (ed)*. Phoenixville, PA: Barcelona Publishers.

Cardno, S. J., & Sahraie, A. (2021). The expanding backlog of mental health patients: Time for a major rethink in COVID-19 policy.

Cassileth, B. R., Vickers, A. J., & Magill, L. A. (2003). Music therapy for mood disturbance during hospitalization for autologous stem cell transplantation: a randomized controlled trial. *Cancer*, *98*(12), 2723–2729.

Chang, E. T., Lai, H. L., Chen, P. W., Hsieh, Y. M., & Lee, L. H. (2012). The effects of music on the sleep quality of adults with chronic insomnia using evidence from polysomnographic and self-reported analysis: a randomized control trial. *International journal of nursing studies*, *49*(8), 921–930.

Choudhry, F. R., Mani, V., Ming, L. C., & Khan, T. M. (2016). Beliefs and perception about mental health issues: a meta-synthesis. *Neuropsychiatric disease and treatment*, *12*, 2807–2818.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences* (2nd *Ed.).* Academic Press.

Curran, S. L., Andrykowski, M. A., & Studts, J. L. (1995). Short Form of the Profile of Mood States (POMS-SF): Psychometric information. *Psychological Assessment*, *7*(1), 80–83.

Daly, M., Sutin, A. R., & Robinson, E. (2020). Longitudinal changes in mental health and the COVID-19 pandemic: evidence from the UK Household Longitudinal Study. *Psychological medicine*, 1–10.

Davis, W. B., Gfeller, K. E., & Thaut, M. H. (1999). *An introduction to music therapy: Theory and practice* (2nd ed.). McGraw-Hill, Boston.

Dunn, B. D., Dalgleish, T., Lawrence, A. D., Cusack, R., & Ogilvie, A. D. (2004). Categorical and dimensional reports of experienced affect to emotion-inducing pictures in depression. *Journal of abnormal psychology*, *113*(4), 654–660.

Eastwood, J. D., Frischen, A., Fenske, M. J., & Smilek, D. (2012). The Unengaged Mind: Defining Boredom in Terms of Attention. *Perspectives on psychological science: a journal of the Association for Psychological Science*, *7*(5), 482–495.

Eldar, E., Ganor, O., Admon, R., Bleich, A., & Hendler, T. (2007). Feeling the real world: limbic response to music depends on related content. *Cerebral cortex (New York, N.Y.: 1991)*, *17*(12), 2828–2840.

Erkkilä. J., Punkanen, M., Fachner, J., Ala-Ruona, E., Pöntiö, I., Tervaniemi, M., Vanhala, M., & Gold, C. (2011). Individual music therapy for depression: randomised controlled trial. *The British Journal of Psychiatry: the journal of mental science*, *199*(2), 132-139.

Farrokhyar, F., Reddy, D., Poolman, R. W., & Bhandari, M. (2013). Why perform a priori sample size calculation?. *Canadian journal of surgery. Journal canadien de chirurgie*, *56*(3), 207–213.

Frühholz, S., Trost, W., & Grandjean, D. (2014). The role of the medial temporal limbic system in processing emotions in voice and music. *Progress in neurobiology*, *123*, 1–17.

Frumkin, H., Bratman, G. N., Breslow, S. J., Cochran, B., Kahn, P. H., Jr, Lawler, J. J., Levin, P. S., Tandon, P. S., Varanasi, U., Wolf, K. L., & Wood, S. A. (2017). Nature

Contact and Human Health: A Research Agenda. *Environmental health perspectives*, *125*(7), 075001.

Furuyashiki, A., Tabuchi, K., Norikoshi, K., Kobayashi, T., & Oriyama, S. (2019). A comparative study of the physiological and psychological effects of forest bathing (Shinrin-yoku) on working age people with and without depressive tendencies. *Environmental health and preventive medicine*, *24*(1), 46.

Gilbert, P. (2009). Introducing compassion-focused therapy. *Advances in Psychiatric Treatment*, *15*(3), 199-208.

Gilbert, P. (2017). Compassion as a social mentality: An evolutionary approach. In P. Gilbert (Ed.), *Compassion: Concepts, research and applications* (pp. 31–68). Routledge/Taylor & Francis Group.

Gilbert, P., & Procter, S. (2006). Compassionate Mind Training for People with High Shame and Self-Criticism: Overview and Pilot Study of a Group Therapy Approach. *Clinical Psychology & Psychotherapy*, *13*(6), 353–379.

Görgen, S. M., Joormann, J., Hiller, W., & Witthöft, M. (2015). The Role of Mental Imagery in Depression: Negative Mental Imagery Induces Strong Implicit and Explicit Affect in Depression. *Frontiers in psychiatry*, *6*, (94).

Guerrero, A.(2017). *PROJECT SOOTHE: Effect of Imagery on Young People's Mood*. (Unpublished Master's dissertation, the University of Edinburgh, Scotland, United Kingdom). Retrieved from http://www.projectsoothe.com/research/4594445355

Hackmann, A., Surawy, C., & Clark, D. M. (1998). Seeing yourself through others' eyes: A study of spontaneously occurring images in social phobia. *Behavioural and Cognitive Psychotherapy*, *26*(1), 3–12.

Hansen, M. M., Jones, R., & Tocchini, K. (2017). Shinrin-Yoku (Forest Bathing) and Nature Therapy: A State-of-the-Art Review. *International Journal of Environmental Research and Public Health*, *14*(8), 851.

Harmat, L., Takács, J., & Bódizs, R. (2008). Music improves sleep quality in students. *Journal of Advanced Nursing, 62*(3), 327-335.

Hartmann, P., Apaolaza, V., & Alia, P. (2015). Nature imagery in advertising. *International Journal of Advertising, 32*(2), 183-210.

Hedge, S. (2014). Music-based cognitive remediation therapy for patients with traumatic brain injury. *Frontiers in Neurology, 5*(34).

Holmes, E. A., & Mathews, A. (2010). Mental imagery in emotion and emotional disorders. *Clinical psychology review*, *30*(3), 349–362.

Holmes, E. A., Lang, T. J., & Deeprose, C. (2009). Mental imagery and emotion in treatment across disorders: using the example of depression. *Cognitive behaviour therapy, 38 Suppl 1*, 21–28.

Inwood, E., & Ferrari, M. (2018). Mechanisms of Change in the Relationship between Self-Compassion, Emotion Regulation, and Mental Health: A Systematic Review. *Applied psychology. Health and well-being*, *10*(2), 215–235.

Jo, H., Song, C., & Miyazaki, Y. (2019). Physiological Benefits of Viewing Nature: A Systematic Review of Indoor Experiments. *International Journal of Environmental Research and Public Health, 16*(23), 4739.

Judge, L., Cleghorn, A., McEwan, K., & Gilbert, P. (2012). An exploration of group-based compassion focused therapy for a heterogeneous range of clients presenting to a community mental health team. *International Journal of Cognitive Therapy*, *5*(4), 420–429.

Karim, J., Weisz, R., & Rehman, S. U. (2011). International positive and negative affect schedule short-form (I-PANAS_SF): testing for factorial invariance across cultures. *Procedia Social and Behavioral Sciences, 15,* 2016-2022.

Kessler, R. C., Amminger, G. P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., & Ustün, T. B. (2007). Age of onset of mental disorders: a review of recent literature. *Current opinion in psychiatry*, *20*(4), 359–364.

Kocalevent, R. D., Hinz, A., & Brähler, E. (2013). Standardization of the depression screener patient health questionnaire (PHQ-9) in the general population. *General hospital psychiatry*, *35*(5), 551–555.

Kotera, Y., Richardson, M. & Sheffield, D. Effects of Shinrin-Yoku (Forest Bathing) and Nature Therapy on Mental Health: a Systematic Review and Meta-analysis. *Int J Ment Health Addiction* **20**, 337–361 (2022).

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*, *16*(9), 606–613.

Kučikienė D., & Praninskienė R. (2018). The impact of music on the bioelectrical oscillations of the brain. *Acta Medica Lituanica*, *25*(2), 101-106.

Küssner, M. B., & Eerola, T. (2019). The content and functions of vivid and soothing visual imagery during music listening: Findings from a survey study. *Psychomusicology: Music, Mind, and Brain*, *29*(2-3), 90–99.

Kuyken, W., & Brewin, C. R. (1994). Intrusive memories of childhood abuse during depressive episodes. *Behaviour research and therapy*, *32*(5), 525–528.

Leaviss, J., & Uttley, L. (2015). Psychotherapeutic benefits of compassion-focused therapy: an early systematic review. *Psychological medicine*, *45*(5), 927–945.

Liu, Q., He, H., Yang, J., Feng, X., Zhao, F., & Lyu, J. (2020). Changes in the global burden of depression from 1990 to 2017: Findings from the Global Burden of Disease study. *Journal of psychiatric research*, *126*, 134–140.

Liu, Z. (2020). Effectiveness of an Internet-based Well-being Tool (Soothe Vision Videos) among Chinese University Students: A Pilot Study [Unpublished Masters dissertation]. The University of Edinburgh.

Lopes, A. F., & Martins Silva, F. (2020). Compassion-Focused Therapy (CFT). In *EFPT Psychotherapy Guidebook* (2nd ed.).

MacBeth, A., & Gumley, A. (2012). Exploring compassion: a meta-analysis of the association between self-compassion and psychopathology. *Clinical psychology review*, *32*(6), 545–552.

Marsh, I. C., Chan, S., & MacBeth, A. (2018). Self-compassion and Psychological Distress in Adolescents-a Meta-analysis. *Mindfulness, 9*(4), 1011–1027.

McGinty, E. E., Presskreischer, R., Anderson, K. E., Han, H., & Barry, C. L. (2020). Psychological Distress and COVID-19-Related Stressors Reported in a Longitudinal Cohort of US Adults in April and July 2020. *JAMA*, *324*(24), 2555-2557.

Miranda, D., & Claes, M. (2009). Music listening, coping, peer affiliation and depression in adolescence. *Psychology of Music*, *37*(2), 215–233.

Mitchell, A. J., Yadegarfar, M., Gill, J., & Stubbs, B. (2016). Case finding and screening clinical utility of the Patient Health Questionnaire (PHQ-9 and PHQ-2) for depression in primary care: a diagnostic meta-analysis of 40 studies. *BJPsych open*, *2*(2), 127–138.

Mok, M., Schwannauer, M., & Chan, S. (2020). Soothe ourselves in times of need: A qualitative exploration of how the feeling of 'soothe' is understood and experienced in everyday life. *Psychology and psychotherapy*, *93*(3), 587–620.

Morin, C. M., Bootzin, R. R., Buysse, D. J., Edinger, J. D., Espie, C. A., & Lichstein, K. L. (2006). Psychological and behavioral treatment of insomnia:update of the recent evidence (1998-2004). *Sleep*, *29*(11), 1398–1414.

Muro, A., Feliu-Soler, A., Canals, J., Parrado, E., & Sanz, A. (2022). Psychological benefits of Forest Bathing during the COVID-19 pandemic: a pilot study in a Mediterranean forest close to urban areas. *Journal of Forest Research, 1*, 71-75.

Nagata, T., Ito, D., Nagata, M., Fujimoto, A., Ito, R., Odagami, K., Kajiki, S., Uehara, M., Oyama, I., Dohi, S., Fujino, Y., & Mori, K. (2021). Anticipated health effects and proposed countermeasures following the immediate introduction of telework in response to the spread of COVID-19: The findings of a rapid health impact assessment in Japan. *Journal of occupational health*, *63*(1), e12198.

Neill, C., Gerard, J., & Arbuthnott, K. (2018). Nature contact and mood benefits: contact duration and mood type. *The Journal of Positive Psychology, 14*(6), 1-12.

Okada, K., Kurita, A., Takase, B., Otsuka, T., Kodani, E., Kusama, Y., Atarashi, H., & Mizuno, K. (2009). Effects of music therapy on autonomic nervous system activity, incidence of heart failure events, and plasma cytokine and catecholamine levels in elderly patients with cerebrovascular disease and dementia. *International heart journal*, *50*(1), 95–110.

Pictet, A., Coughtrey, A. E., Mathews, A., & Holmes, E. A. (2011). Fishing for happiness: the effects of generating positive imagery on mood and behaviour. *Behaviour research and therapy*, *49*(12), 885–891.

Porges, S. W. (2007). The polyvagal perspective. *Biological Psychology*, *74,* 116-143.

Ratclifffe, E., Gaterslaben, B., & Snowden, P. (2013). Bird sounds and their contributions to perceived attention restoration and stress recovery. *Journal of Environmental Psychology, 36,* 221-228.

Rector, N. A., Bagby, R. M., Segal, Z. V., Joffe, R. T., & Levitt, A. (2000). Self-criticism and dependency in depressed patients treated with cognitive therapy or pharmacotherapy. *Cognitive Therapy and Research, 24*(5), 571–584.

Ribeiro, A. I., Triguero-Mas, M., Jardim Santos, C., Gómez-Nieto, A., Cole, H., Anguelovski, I., Silva, F. M., & Baró, F. (2021). Exposure to nature and mental health outcomes during COVID-19 lockdown. A comparison between Portugal and Spain. *Environment international*, *154*, 106664.

Ribeiro, M., Alcântara-Silva, T., Oliveira, J., Paula, T. C., Dutra, J., Pedrino, G. R., Simões, K., Sousa, R. B., & Rebelo, A. (2018). Music therapy intervention in cardiac autonomic modulation, anxiety, and depression in mothers of preterms: randomized controlled trial. *BMC psychology*, *6*(1), 57.

Shacham S. (1983). A shortened version of the Profile of Mood States. *Journal of personality assessment*, *47*(3), 305–306.

Shin, M. Y., & Shin, W. S. (2019). The Effects of Viewing Natural Scenery Indoors on Middle School Students' Changes in Mood States and Concentration. *Journal of People Plants Environment*, *22*(2), 199-207.

Siedliecki, S. L., & Good, M. (2006). Effect of music on power, pain, depression and disability. *Journal of advanced nursing*, *54*(5), 553–562.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine*, *166*(10), 1092–1097.

Standley J. M. (2002). A meta-analysis of the efficacy of music therapy for premature infants. *Journal of pediatric nursing*, *17*(2), 107–113.

Stewart, J., Garrido, S., Hense, C., & McFerran, K. (2019). Music Use for Mood Regulation: Self-Awareness and Conscious Listening Choices in Young People With Tendencies to Depression. *Frontiers in psychology*, *10*, 1199.

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.

Tian, Z., Kim, B-Y., & Bae, M. (2020). Study on the Acoustic Characteristics of Sunwapta Falls. *International Journal of Engineering Research and Technology, 13*(5). 962-966.

Ulrich, R. S. (1981). Natural Versus Urban Scenes: Some Psychophysical Effects. *Environment and Behavior, 13*(5), 523-556.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, *11*(3), 201–230.

Vines, B. W., Krumhansl, C. L., Wanderley, M. M., & Levitin, D. J. (2006). Cross-modal interactions in the perception of musical performance. *Cognition*, *101*(1), 80–113.

Watson, D., & Clark, L. A. (1999). The PANAS-X: Manual for the Positive and Negative Affect Schedule – Expanded Form. *Iowa Research Online.*

Wen, Y., Yan, Q., Pan, Y., Gu, X., & Liu, Y. (2019). Medical empirical research on forest bathing (Shinrin-yoku): a systematic review. *Environmental health and preventive medicine*, *24*(1), 70.

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and resorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, *30*(4), 482-493.

Wilson, A. C., Schwannauer, M., McLaughlin, A., Ashworth, F., & Chan, S. W. Y. (2018). Vividness of positive mental imagery predicts positive emotional response to visually presented Project Soothe pictures. *British Journal of Psychology, 109*(2), 259-276.

Wong, S. C. (2019). *The Effectiveness of Soothing Images and Videos in Improving University/College Students' Mood* [Unpublished Masters Dissertation]. The University of Edinburgh.

Yang, Y. (2020). *The Effects of Soothe Vision Well-being Tool on University Students' Mood: A pilot study in a Chinese sample* [Unpublished Masters dissertation]. The University of Edinburgh.

Appendices

Appendix 1: Project Soothe Images

Water Features


101


215


507


229


223

Landscape


472


383


93


236


569

Trees


474


174


168


54


180

Animals


419


175


364


171


150

Flowers


8


465


128


535


176

Appendix 2: British Library Sounds

Water Features

Black-throated Diver calls recorded at Glen Affic, Inverness, Scotland on 13 April 1979 by Richard Margoschis. Wildlife reference number 09950 (image 507)

Gentle waterfall falling onto beach recorded at Brook Chine, Isle of Wight, England on 24 March 2006 by Richard Beard. Wildlife reference number 147067 (Image 289)

Gentle waves on sand and shingle beach recorded at Totland Bay, Isle of Wight, England on 27 June 2006 by Richard Beard. Wildlife reference number 147218 (Image 101)

Water lapping against lake shore recorded at Ennerdale Water, Cumbria, England on 15 May 2010 by Alan Burbidge. Wildlife reference number 164342 (image 215)

Rough waves recorded at Steephill Cove, Isle of Wight, England on 23 March 2006 by Richard Beard. Wildlife reference number 147057 (image 165)

Upland stream recorded at Bunkhouse, Northumberland, England on 11 May 2008 by Alan Burbidge. Wildlife reference number 164717 (image 23)

Trees

Birds and batrachians recorded near Bialowiesza, Poland on 29 April 2001 by Ian Christopher Todd (image 474)

Deciduous wood atmosphere recorded at Loddiswell, Devon, England on 17 May 2000 by Phil Riddett. Wildlife reference number 72062 (image 180)

Lakeside atmosphere recorded in Canada by Phil Riddett. Wildlife reference number 114926 (image 174)

Blackbird song recorded at Culver, Devon, England on 15 May 1961 By Lawrence Shove. Wildlife reference number 104940 (image 168)

Raindrops on leaves recorded at Bukk Hills, Heves, Hungary on 15 May 2005 by Alan Burbidge. Wildlife reference number 146144 (image 54)

Landscape

Lowland heath with stream recorded at Ashdown Forest, East Sussex, England on 6 May 2001 by Phil Riddett. Wildlife reference number 101872 (image 383)

Strong wind blowing through grass recorded on the Isle of Mull, Scotland on 22 February 2001 by Simon T. Elliott. Wildlife reference number 170137 (Image 236)

Palearctic marshland recorded north of Urszulin, Poland on 25 April 2001 by Ian Christopher Todd. Wildlife reference number 90990 (image 93)

Dusk above Tambadi Surla recorded at Tambadi Surla, Goa on 1 February 1999 by Ian Christoper Todd. Wildlife reference number 72245 (Image 472)

Deciduous wood atmosphere recorded at Cserépfalu, Borsod-Abaúj-Zemplén, Hungary on 12 May 2003 by Phil Riddett. Wildlife reference number 116230 (image 569)

Flowers

Dawn soundscape from mixed woodland recorded in Southeastern Poland on 25 April 2001 by Ian Christoper Todd. Wildlife reference number 90981 (image 535)

Dawn chorus recorded at Lacave, Lot, France on 7 April 1996 by Kyle Turner. Wildlife reference number 92466 (image 465)

Woodland atmosphere recorded at Cserépfalu, Borsod-Abaúj-Zemplén, Hungary on 12 May 2003 by Phil Riddett. Wildlife reference number 116240 (Image 176)

Small breakers on a shingle beach recorded at Suffolk, England on 18 April 1992 by Richard Ranft. Wildlife reference number 62013 (Image 128)

Gentle waves recorded at Great Bay, Isles of Scilly, England on 6 September 2009 by Richard Beard. Wildlife reference number 163300 (image 8)

Animals

Purring cat recorded at Knockholt, Kent, England on 16 January 1996 by Phil Riddett. Wildlife reference number 66975 (image 466)

Shallow sea over long sandy bay recorded at Nea Kydonia, Crete, Greece on 20 September 2012 by Richard Beard. Wildlife reference number 183659 (image 364)

Farmland atmosphere recorded at North Huish, Devon, England on 15 May 2000 by Phil Riddett. Wildlife reference number 72045 (image 175)

Moorland atmosphere recorded at Dartmoor, Devon, England on 22 May 2000 by Phil Riddett. Wildlife reference number 72086 (image 150)

Dawn at Stara Bialowiesza recorded in Poland on 1 May 2001 by Ian Christopher Todd. Wildlife reference number 90985 (Image 171)

Appendix 3

Flowchart of Study Procedure

Appendix 4: Full ANCOVA Results

Age and Negative affect

Results showed that age did not impact the significant main effect of time found in the primary ANOVA analysis for negative affect, $F(1,144) = 10.21$, $p = .002$, d = . .531. However, there was a significant main effect of Age, $F(1,144) = 8.89$, $p = .003$, $d = .500$, although Time x Age interaction was non-significant, $F(1,144) = .13$, $p = .718$, $d = .063$. The main effect of age was driven by a significant negative association between age and negative affect, both pre-test, $b = -.05$, $t = -2.35$, $p = .020$, 95% *CI* [-.08, -.01] and post-test, $b = -.04$, $t = -3.38$, $p = .001$, 95% CI [-.06, -.02].

Positive affect

Results showed that age did impact the significant main effect of time found in the primary ANOVA analysis, $F(1,144) = 1.76$, $p = .186$, $d = .220$. **There was a significant main effect of Age, $F(1,144) = 13.45$, $p < .001$, $d = .610$, although not a significant Time x Age interaction, $F(1,144) = .04$, $p = .850$, $d < .001$. There was a positive association between age and positive affect, both pre-test, $b = .08$, $t = 3.49$, $p = .001$, 95% CI [.03, .12] and post-test, $b = .02$, $t = 3.26$, $p = .001$, 95% CI [.03, .12]. ***

Serenity

Results showed that age did not impact the significant main effect of time found in the primary ANOVA analysis, $F(1,144) = 17.70$, $p < .001$, $d = .700$. Additionally, there was not a significant main effect of Age, $F(1,144) = .35$, $p = .554$, $d = .090$, or a Time x Age interaction, $F(1,144) = 1.99$, $p = .161$, $d = .238$.

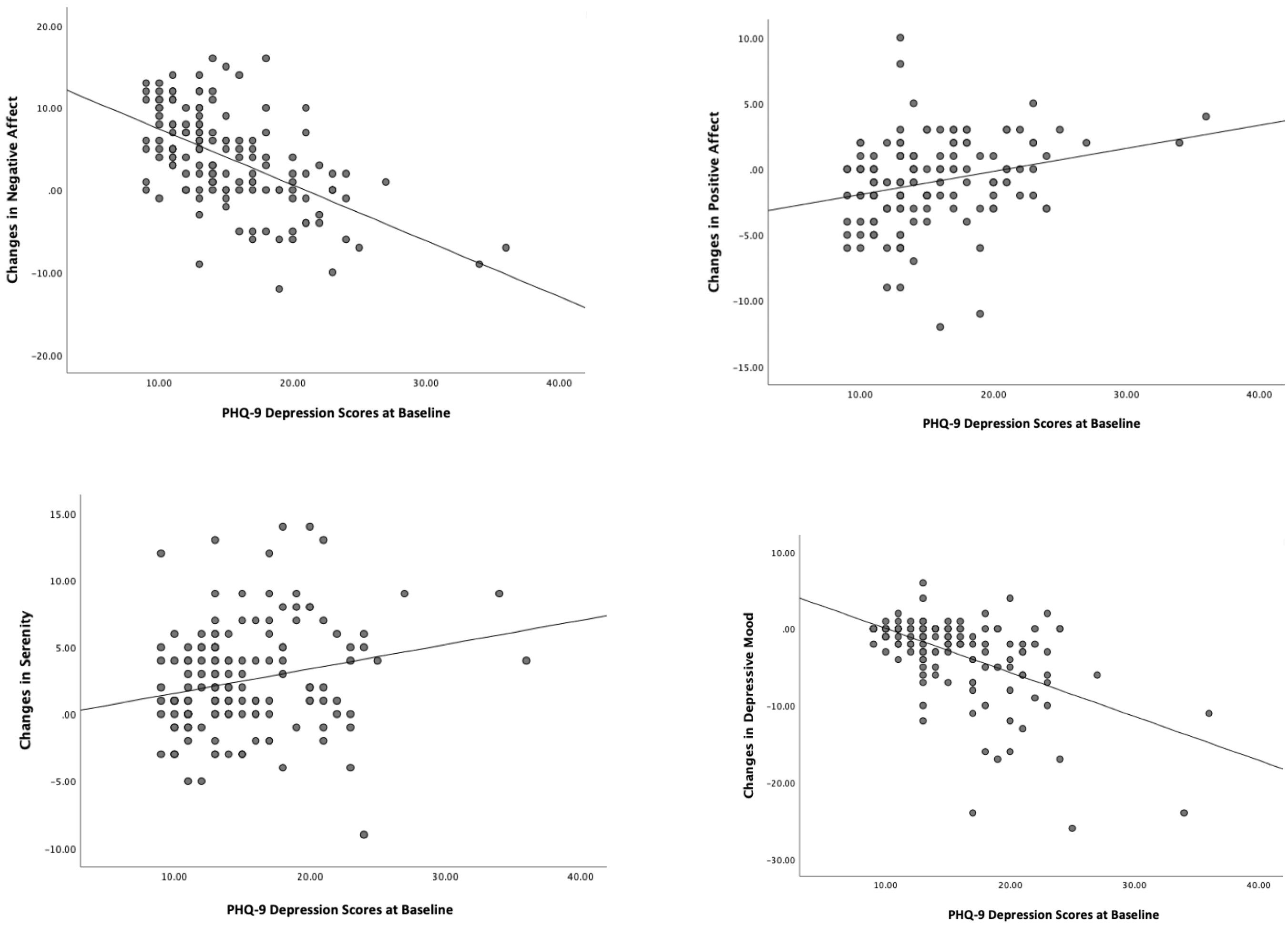
Transient Depressive Mood

Results showed that age did not impact the significant main effect of time found in the primary ANOVA analysis, $F(1,144) = 18.22$, $p < .001$, $d = .710$. However, there was a significant main effect of Age, $F(1,144) = 5.61$, $p = .019$, $d = .400$, but not a significant Time x Age interaction, $F(1,144) = 2.72$, $p = .101$, $d = .278$. There was a negative association between age and transient depressive mood, both pre-test, $b = -.09$, $t = -2.33$, $p = .021$, 95% CI [-.17, -.01] and post-test, $b = -.05$, $t = -2.06$, $p = .041$, 95% CI [-.10, -.002].

*Note: Results of ANCOVA differ to ANOVA results

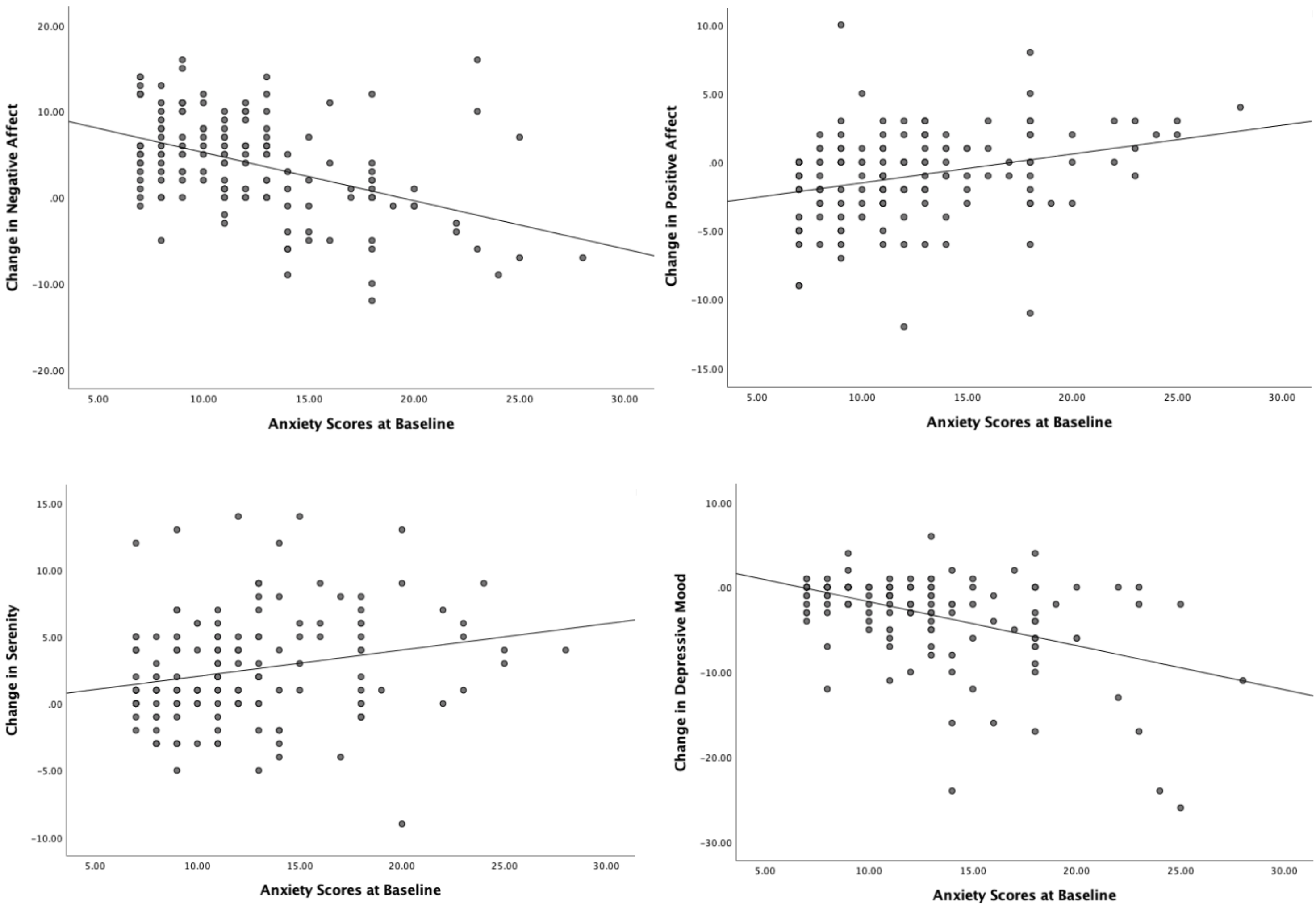
Appendix 5

Figure 5 Scatterplots showing the Relationships between Depressive Mood Changes and Baseline Variables



Appendix 6:

Figure 6 **Scatterplots showing the relationship between Anxious Mood Changes and Baseline Variable**



Appendix 7

Effects of Depression and Anxiety in Sounds Condition

In the sound condition, there were strong significant negative correlations between baseline depression/anxiety scores and changes in negative affect and depressive mood. Additionally, there was a strong significant positive correlation between baseline depression scores and changes in serenity. However, there were non-significant positive correlations between baseline anxiety scores and changes in serenity, as well as non-significant positive correlations between baseline anxiety and depression scores and positive affect (see Table 2 below for details).

Table 2 ***Spearman Rho Correlations for the Sound Condition***

Variable	1	2	3	4	5	6	7
1. PHQ-9 score	--						
2. GAD-7 score	.78*	--					
3. Changes in Negative Affect	-.58*	-.55*	--				
4. Changes in Positive Affect	**.20**	.26	.26	--			
5. Changes in Serenity	**.20**	.29***	-.04	.26	--		
6. Changes in State Depression	-.47*	-.42**	.40**	-.04	-.42**	--	

Note: * $p < .001$, ** $p < .01$, *** $p < .05$ (2-tailed).

Effects of Depression and Anxiety in Images Condition

In the image condition, there were strong significant negative correlations between baseline depression and anxiety scores, and changes in negative affect and depressive mood. Additionally, there were strong significant positive correlations between baseline depression and anxiety scores and changes in positive affect, as well as between baseline depression scores and changes in serenity scores. However, there was a non-significant positive correlation between baseline anxiety scores and change scores in serenity (see Table 3 below for details).

Table 3 ***Spearman Rho Correlations for the Image Condition***

Variable	1	2	3	4	5	6	7
1. PHQ-9 score	--						
2. GAD-7 score	.85*	--					
3. Changes in Negative Affect	-.52*	-.52*	--				
4. Changes in Positive Affect	.31**	.30**	.18	--			
5. Changes in Serenity	.28***	.24	-.14	.19	--		
6. Changes in State Depression	-.51*	-.48**	.39**	-.34**	-.46**	--	

Note: * $p < .001$, ** $p < .01$, *** $p < .05$ (2-tailed).

Effects of Depression and Anxiety in Combined Condition

In the combined condition, there were strong significant positive correlations between baseline depression and anxiety scores and change scores in positive affect. There were significant negative correlations between baseline depression and anxiety scores and changes in depressive scores. Additionally, there were significant negative correlations between baseline depression scores and changes in negative affect, and baseline anxiety scores and changes in serenity scores. However, there were non-significant negative correlations between baseline anxiety scores and changes in negative affect, and baseline depression scores and changes in serenity scores (see Table 4 below for details).

Table 4 ***Spearman Rho Correlations for the Combined Condition***

Variable	1	2	3	4	5	6	7
1. PHQ-9 score	--						
2. GAD-7 score	.75*	--					
3. Changes in Negative Affect	-.47*	-.20	--				
4. Changes in Positive Affect	.35***	.45*	.07	--			
5. Changes in Serenity	.18	.30**	-.11	.38**	--		
6. Changes in State Depression	-.43**	-.37**	.35*	-.40**	-.14	--	

Note: * $p < .001$, ** $p < .01$, *** $p < .05$ (2-tailed).