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Mindfulness and Virtual Environments - The Impact of Mediated Nature on Anxiety, Affect, Worry and Levels of Mindfulness.

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ABSTRACT

The first chapter of this thesis is a review of the literature exploring empirical evidence of mindfulness applied within natural settings, to address the question of what are the beneficial effects of employing such an approach. This included experimental studies, investigating the impact of applying mindfulness based interventions *to* and *within* nature. The overall pattern of results provides some support that the integration of mindfulness and natural stimuli has a larger beneficial effect than that of mindfulness or nature alone. However, the discussion explores a number of methodological limitations and suggests that there is a need for more stringent experimental research in this area. Future research should ensure there are control groups as part of the experimental design, balanced samples and link findings to theory.

Chapter 2 of this thesis is an empirical paper investigating the impact of mindfulness applied within a context of virtual reality environments to explore effects on mood, anxiety and levels of mindfulness. 61 participants were randomised into one of three groups; mindfulness of nature, mindfulness of neutral, progressive muscle relaxation (PMR) and nature. Participants completed a short practice at baseline in the lab and continued with home practice using virtual reality environments of nature or urban scenes for a total of 5 sessions. Participants in the mindfulness conditions completed a mindfulness practice in the lab followed by instructions to watch the videos mindfully during home practice, participants in the PMR condition completed a PMR exercise in the lab and were given no specific instructions prior to viewing the video during home practice. On average, from baseline to post-intervention, all participants demonstrated significant improvement on outcomes of anxiety, mood, mind wandering, worry and state mindfulness regardless of which group they were in. Participants also demonstrated a decline in positive affect over time with no changes to trait levels of mindfulness. The overall pattern suggests there was no significant effect of group. There was partial support that the mindfulness of nature intervention increased mindful acceptance more than PMR and nature condition. The discussion makes links to theory and previous research. Methodological limitations are considered including how the mindfulness was delivered and the use of low-tech virtual reality viewers. Future research should employ these methodological recommendations, include complete transparency of protocols and explore brief interventions of integrating mindfulness and nature in controlled experiments.

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Declaration of Authorship

I, David Araci, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

Mindfulness and Virtual Environments - The Impact of Mediated Nature on Anxiety, Affect, Worry and Levels of Mindfulness.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

Signed: David Araci

Date: 25th May 2018

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Myself because, let's face it, I did the work. These 20,000 words didn't write themselves.

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Chapter 1: The effects of mindfulness within natural environments: A systematic review

1.1 Introduction

Clinical psychologists working within mental health services are often faced with limited resources and there are often high demands of practitioners across settings (Galvin & McCarthy, 1994; Moore & Cooper, 1996). Therefore there is interest in efficacious and cost-effective therapeutic interventions. Mindfulness has seen an upsurge of evidence-based research and has been pivotal in the development of third-wave therapies applied across diagnoses (Baer, 2003). Mindfulness is often delivered as part of a larger therapeutic model (e.g. Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999) and Dialectical Behaviour Therapy (DBT; Linehan, 1993)). However, evidence suggests brief mindfulness interventions have a beneficial effect on psychological and physiological states (Shearer, Hunt, Chowdhury, & Nicol, 2016; Zeidan, Johnson, Gordon, & Goolkasian, 2010). Similarly, the field of Ecotherapy purports exposure to nature produces beneficial effects on psychological and physiological states (Annerstedt & Währborg, 2011; Berto, 2014; McMahan & Estes, 2015), due to our innate connection with nature. Ecotherapeutic approaches range from simple, unguided exposure to natural stimuli, to manualised approaches with specific aims and interventions.

As discussed in subsequent sections, both mindfulness based approaches and Ecotherapeutic practice demonstrate efficacy for alleviation of clinical symptoms for a range of mental health difficulties as well as improving subjective well-being in non-clinical samples. Evidence in clinical samples reports mental health diagnoses and typically measures outcomes in regards to changes in standardised measures indicative of symptomatology of disorders, i.e. anxiety, low-mood, psychological distress. Measures of subjective well-being examine broader quality of life in terms of happiness, life-satisfaction and positive affect and is a construct often measured in non-clinical samples. This review will critique recent efforts to combine mindfulness and ecotherapeutic practices and explore outcomes for both clinical, and non-clinical samples.

1.1.1 Mindfulness.

Mindfulness has its roots in Eastern religious practices such as Buddhism and Hinduism (Hanh, 2016; Kabat-Zinn, 1982; Wallace & Shapiro, 2006). Within Buddhism, mindfulness has a central role on the path to ending personal suffering (Silananda, 1995). There has been growing interest in the literature since mindfulness entered Western settings and are embedded in third-wave therapeutic approaches (see Segal, Williams, & Teasdale, 2012). Since the 1990s there has been a continuous increase in academic papers researching mindfulness (Williams & Kabat-Zinn,

2011). There remains a continued lack of agreement upon a definition of mindfulness (Baer, 2011; Grossman, 2008) and these vary in the literature. One of the most popular is presented by Kabat-Zinn which states mindfulness as "paying attention in a particular way: on purpose, in the present moment and non-judgementally" (Kabat-Zinn, 1994, p. 4). Similarly, Bishop et al., (2004) describe mindfulness as a two-component process with attention maintained on immediate experience, within an orientation characterised by openness, curiosity and acceptance. Mindfulness has been described as being difficult to define using language and is something best understood through experience, specifically the experience of non-judgemental observation (Gunaratana, 2011).

Although rooted in Eastern meditative traditions, mindfulness is often delivered within Western based psychological therapies. Mindful practices delivered within therapeutic approaches are done so from a secular framework (Langer, 1989) often delivered in such contexts independent of their cultural and religious origins (Kabat-Zinn, 1982; Linehan, 1993). Even within therapeutic modalities the practice of mindfulness is varied, from longer formal meditative practices to informal, shorter, practices incorporated into aspects of daily life. Formal mediations often centre on internal physical sensations and are employed in Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1982) which incorporates mindfulness in order to manage chronic pain and stress, and Mindfulness-Based Cognitive Therapy (MBCT; (Segal et al., 2012) which integrates mindfulness with cognitive-therapy to enable people to bring an awareness of depressive cycles and observe, rather than react, to thoughts. Informal meditative practices of both internal sensations and exploration of external stimuli are employed in ACT which aims to build acceptance of what is out of one's control, and commit to action that enriches one's life, and DBT which includes teaching of skills including mindfulness, emotion regulation, distress tolerance and interpersonal effectiveness. Formal meditation is described as a sustained and disciplined introspection allowing the individual to learn how the mind works and observe its contents, whereas informal practice refers to applying mindfulness skills that alert the individual to the present moment, with acceptance, to everyday life (Germer, Siegel, & Fulton, 2005). In all therapeutic modalities the aim is to cultivate non-judgemental present moment awareness, noticing when and where the mind wonders, each time it does so bringing attention back to the area of focus, all the while acting with self-compassion.

Mindfulness based therapeutic approaches have been reviewed extensively, and meta analyses exist, with promising findings across clinical presentations and healthy participants, showing positive measureable outcomes in anxiety (Baer, 2003; Grossman, Niemann, Schmidt, & Walach, 2004; Hofmann, Sawyer, Witt, & Oh, 2010; Khoury et al., 2013; Powers, Zum Vörde Sive Vörding, & Emmelkamp, 2009), stress (Chiesa & Serretti, 2009; Khoury et al., 2013), depression (Baer, 2003; Grossman et al., 2004; Hofmann et al., 2010; Khoury et al., 2013; Piet & Hougaard, 2011; Powers et al., 2009), subjective well-being (Keng et al., 2011), pain management (Baer, 2003; Grossman et al., 2004), mental health in cancer patients (Zainal, Booth, & Huppert, 2013), emotional reactivity and behavioural control (Keng et al., 2011; Panos, Jackson, Hasan, & Panos,

2014). However, to date reviews focus on mindfulness based interventions embedded within a wider therapeutic framework and no detailed reviews explore the effects of brief mindfulness practices alone.

Limited empirical evidence suggests benefits from brief standalone (detached from therapeutic model) mindfulness interventions. University students completing four sessions of a standalone mindfulness intervention demonstrated lowered levels of physiological and psychological symptoms of stress compared to active and no treatment controls (Shearer et al., 2016). Another study utilising students implemented a briefer mindfulness intervention consisting of three sessions, summating to less than an hour, compared to a sham meditation and control group. Findings again support that brief mindfulness was beneficial compared to controls in terms of mood, fatigue, confusion and cardiovascular variables (Zeidan et al., 2010). Even single standalone sessions have demonstrated beneficial outcomes when compared to active and no treatment controls. Evidence from single mindfulness sessions ranging from 5-20 minute practices have shown immediate outcomes of better tolerance of distress in nicotine deprived smokers following a distress task (Paz, Zvielli, Goldstein, & Bernstein, 2017), increased empathy (Tan, Lo, & Macrae, 2014), increased relaxation (Vinci et al., 2014), increased calmness in children (Nadler, Cordy, Stengel, Segal, & Hayden, 2017), reduced discrimination (Lueke & Gibson, 2016), reduced perceived pain intensity on a pain induction procedure (Lewandowski, 2016), increased pain tolerance (Liu, Wang, Chang, Chen, & Si, 2013), reduced negative affect and reduced state anxiety (McClintock & Anderson, 2015; Vinci et al., 2014).

Brief mindfulness interventions, even of a single session, can produce greater levels of state mindfulness (Kemper, 2017; Luberto & McLeish, 2018; McClintock & Anderson, 2015; Tan et al., 2014; Vinci et al., 2014; Watier & Dubois, 2016) which impacts on immediate beneficial effects to the individual as reported previously. Therefore, evidence suggests practice increases state mindfulness which in turn promotes beneficial outcomes. When exploring longer term benefits from single session brief mindfulness interventions, the evidence is less clear. Although it has been noted that a brief 10 minute mindfulness intervention can significantly increase state mindfulness, relaxation and reduce negative affect (NA) compared to controls, the mindfulness intervention did not influence responses on outcome measures following a NA manipulation task (Vinci et al., 2014). The authors suggest the intervention may not have been robust enough to maintain the initial gains. Conversely a single 15 minute mindfulness practice resulted in no changes to self-reported smoking urges in smokers, but a significant reduction of actual cigarettes smoked over 7 days (Bowen & Marlatt, 2009). Such studies demonstrate conflicting evidence in regards to the longer-term effects of brief mindfulness. Correlational analyses suggests limited associations between trait mindfulness and state mindfulness following single session intervention (Bravo, 2016). However increased trait mindfulness is related to regular mindfulness practice which increases state mindfulness (Kiken, Garland, Bluth, Palsson, & Gaylord, 2015). Further

research needs to be conducted in order to examine these links and mediating variables, however this is complicated due to the discrepant operationalisation of both state and trait mindfulness in the literature.

1.1.2 Ecotherapy and natural stimuli.

Treatment approaches that include the natural world come under the umbrella term Ecotherapy; a form of applied Ecopsychology (Buzzell & Chalquist, 2009; Chalquist, 2009). Ecotherapeutic approaches are delivered in a number of modalities, all with the emphasis of increasing interaction between the individual and natural stimuli. Ecotherapy includes interventions such as adventure therapy, animal assisted interventions, care farming, green gyms, green exercise, nature arts and crafts, social and therapeutic horticulture, and wilderness therapy (MIND, 2013). Ecotherapeutic approaches employ the properties of nature to address a range of physical, psychological and social benefits (see Mcsweeney, Rainham, Johnson, Sherry, & Singleton, 2015). Three leading theories stem from evolutionary psychology and suggest an innate connection with nature. The Biophilia hypothesis states we evolved as a species in rural environments, where it was beneficial to connect with nature in order to increase chances of survival (Kellert & Wilson, 1993). Although as a species we have been living in urbanized environments, the need to connect with nature remains an innate drive (Kellert & Wilson, 1993). Attention restoration theory (ART; Kaplan, 1995; Kaplan & Kaplan, 1989) suggests natural environments have a restorative effect on attention which occurs through cognitive pathways. ART suggests restorative aspects of nature are facilitated due to the effortless way in which humans attend to nature which in turn 'recharges' our directed attentional capacity which may have become fatigued. Stress Recovery Theory (SRT; Ulrich, 1983), suggests natural environments promote physiological stress recovery. Similar to ART, SRT is also based on the assumption brought from Biophilia that human physiology has evolved in natural environments and, therefore, humans are tuned to process natural stimuli more efficiently than urban environments. Although both SRT and ART assert a bottom-up processing style of natural environments, SRT suggests restoration follows from an initial affective response to natural environments (Ulrich, 1983) rather than ART's proposed cognitive pathway.

Empirical evidence provides support for the restorative experience of natural environments. A meta-analysis demonstrated a moderate increase in positive affect (PA) and a, smaller, decrease in NA following exposure to natural environments over control conditions (McMahan & Estes, 2015). Another meta-analysis demonstrated positive changes to well-being following exposure to natural stimuli, most notably a decrease in negative emotions such as anger and sadness, with some support that natural environments prompted greater attention compared to synthetic environments (Bowler, Buyung-Ali, Knight, & Pullin, 2010). Further reviews summarise that natural environments have a positive impact on people with mental health difficulties (Annerstedt & Währborg, 2011; Mantler & Logan, 2015).

Much of the literature also documents similar restorative effects when exposed to simulated or 'mediated' versions of nature such as pictures and slides (see Levi & Kocher, 1999) although beneficial effects may be greater in outdoor nature compared to laboratory based simulated environments (Kjellgren & Buhrkall, 2010).

1.1.3 Rationale for this review.

As described, previous reviews have explored the effect of mindfulness exercises on various outcomes, and similarly reviews have explored the use of nature in a therapeutic context across various outcomes. However there has been little attention given to applying mindfulness interventions *within* natural contexts and measuring outcomes. A rapid evidence assessment (brief review utilising a systematic approach) conducted by Ambrose-Oji (2013) highlighted literature that explored the unification of these two interventions. However the review was published in a research report for the Mersey Forest and was not peer reviewed. The review provides a discussion of theoretical papers describing the unification of mindfulness and natural stimuli however the included studies demonstrate few measurable outcomes. Furthermore, once accessing full articles in order to inform the current review it was noted some papers did not explicitly describe mindfulness, or meditative practices consistent with mindfulness. For instance, much of the evidence discussed explores the effects of Shinrin-yoku, (forest bathing) which is defined as making contact with, and taking in the atmosphere of the forest (Park, Kagawa, Kasetani, Miyazaki, & Tsunetsugu, 2010). Shinrin-yoku varies in how it is delivered but typically involves being immersed in forest environments, often bringing an awareness to as many of the senses as possible. However, the extent to which individuals are provided guidance on attending to their present moment experiences, in a mindful way, is often not clearly described in the literature.

To date no review has critiqued studies that examine the effects of mindfulness practice in a natural setting or with natural stimuli. The aim of the current study is to investigate measurable outcomes following mindful exposure within nature.

1.2 Method

1.2.1 Search strategy.

A systematic search of the literature was conducted on 22nd November 2017, using Web of Science, PsychINFO, PsychARTICLES, MEDLINE, CINAHL, and GreenFILE databases with no restriction on language. These databases were selected as they cover a range of journals consistent with the topic of the current review. The search term 'mindfulness AND (natur* OR eco* OR wood* OR forest* OR green* OR outdoor* OR tree*)' were entered in the 'subject' field of PsychINFO, PsychARTICLES, MEDLINE, CINAHL and GreenFILE, and the 'topic' field of Web of Science. GreenFILE was selected as an additional database following initial searches as it contains articles related to environmental research, not accessed by the other databases listed.

Reference lists of selected key articles and other reviews were examined. Researchers in the field of Ecopsychology were contacted to identify additional relevant studies (Appendix A). Dr Paul Stevens, Editor of the Journal of Ecopsychology was initially contacted to discuss research related to the current review. Subsequent to this discussion researchers at various institutes were contacted to discuss their work and if they were aware of any relevant research with replies from Dr Giuseppe Carrus, Freddie Lymeus, Dr Miles Richardson. Duplicate papers were removed from the total number of identified records. Abstracts from the records were screened and full-text articles were retrieved to assess eligibility. Figure 1 demonstrates the search strategy employed.

1.2.2 Inclusion and exclusion criteria.

The current paper aimed to explore any measurable outcomes from applying mindfulness within natural environments (MNAT). To maximise the amount of MNAT studies for the current review, all samples, interventions (applying MNAT approaches) and measurable outcomes were accepted. The inclusion criteria were:

1. There was an intervention in which participants were engaged in a mindful manner within natural stimuli.
2. Quantitative outcomes.
3. Any publication format.

The exclusion criteria were:

1. The paper describes theoretical discussions only of integrating mindfulness and nature.
2. The article was a review or meta-analyses.
3. Qualitative accounts.
4. The article includes immersion in nature but does not describe mindful, meditative, attentional or awareness guidance within nature.

1.2.3 Quality assessment.

The quality of included articles was assessed using the QualSyst Quality Assessment Checklist (Kmet, Lee, & Cook, 2004). The QualSyst was selected as it was developed to support the need for identifying standard, reproducible criteria to critically appraise the quality of various studies. It is especially practical for the current review as it can be applied to assess quality of diverse study designs; found during the current review process due to the broadness of the inclusion criteria and domains of research. The QualSyst provides "a systematic, reproducible and quantitative means of simultaneously assessing the quality of research encompassing a broad range of study designs" (Kmet et al., 2004, p.11). The quantitative checklist was employed for the current review as included studies were quantitative. The tool evaluates study design, participants, randomisation, blinding, statistical analysis and results. It offers overall scores (0-28) and allows for comparison with other reviewers. Kmet et al., (2004) report a liberal cut-off score of 55%, and conservative score of 75%. In the current review, a second reviewer was employed, with both reviewers using the QualSyst independently. Discrepant rating scores were discussed and agreement reached in all cases, with each score falling at 68% or higher (Appendix B).

1.2.4 Data extraction.

Figure 1 demonstrates the identification and inclusion of studies using the PRISMA flow diagram (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). The initial search retrieved 2,683 articles, with an additional 18 articles included from other sources; referenced in previous review, contact with experts, examining references of relevant papers (see Horsley, Dingwall, & Sampson, 2011). After removing duplicates a total of 1,895 articles were included. After screening the abstracts, 59 articles remained and full texts were reviewed. Following review of the full text of the 59 articles a further 47 articles were excluded.

Of these 47 full text articles reviewed and excluded, 14 articles were excluded due to being theoretical discussions lacking outcomes. 17 articles were excluded due to not containing a specific mindfulness, meditative, attentional or awareness intervention component. As described earlier, although there is a wealth of literature around Shinrin-yoku, the empirical literature purports mere immersion in forest environments without explicit guidance on mindful awareness and attention (see below). 11 studies were excluded due to no exposure to natural stimuli. Five studies were excluded due to being qualitative accounts with no quantifiable outcome data.

As discussed, there is literature on Shinrin-yoku which shares many characteristics of combining mindfulness and ecotherapeutic approaches. This topic became known during the initial search and became worthy of consideration for the current review. The reviewer searched for literature on Shinrin-yoku and its effects on the individual. The majority of papers described immersion in forest environments but no paper detailed any guidance on attending to aspects of the

forest, or the participants' own experience, in a mindful manner and therefore the studies were excluded for analysis. To provide transparency, a subsequent search was made to assess Shinrin-yoku literature on 5th December 2017 using Web of Science, PsychINFO, PsychARTICLES, MEDLINE, CINAHL, and GreenFILE. The search terms 'shinrin* OR "forest bathing"' were entered in the 'subject' field of PsychINFO, PsychARTICLES MEDLINE, CINAHL and GreenFILE, and the 'topic' field of Web of Science. Figure 2 demonstrates the search strategy employed.

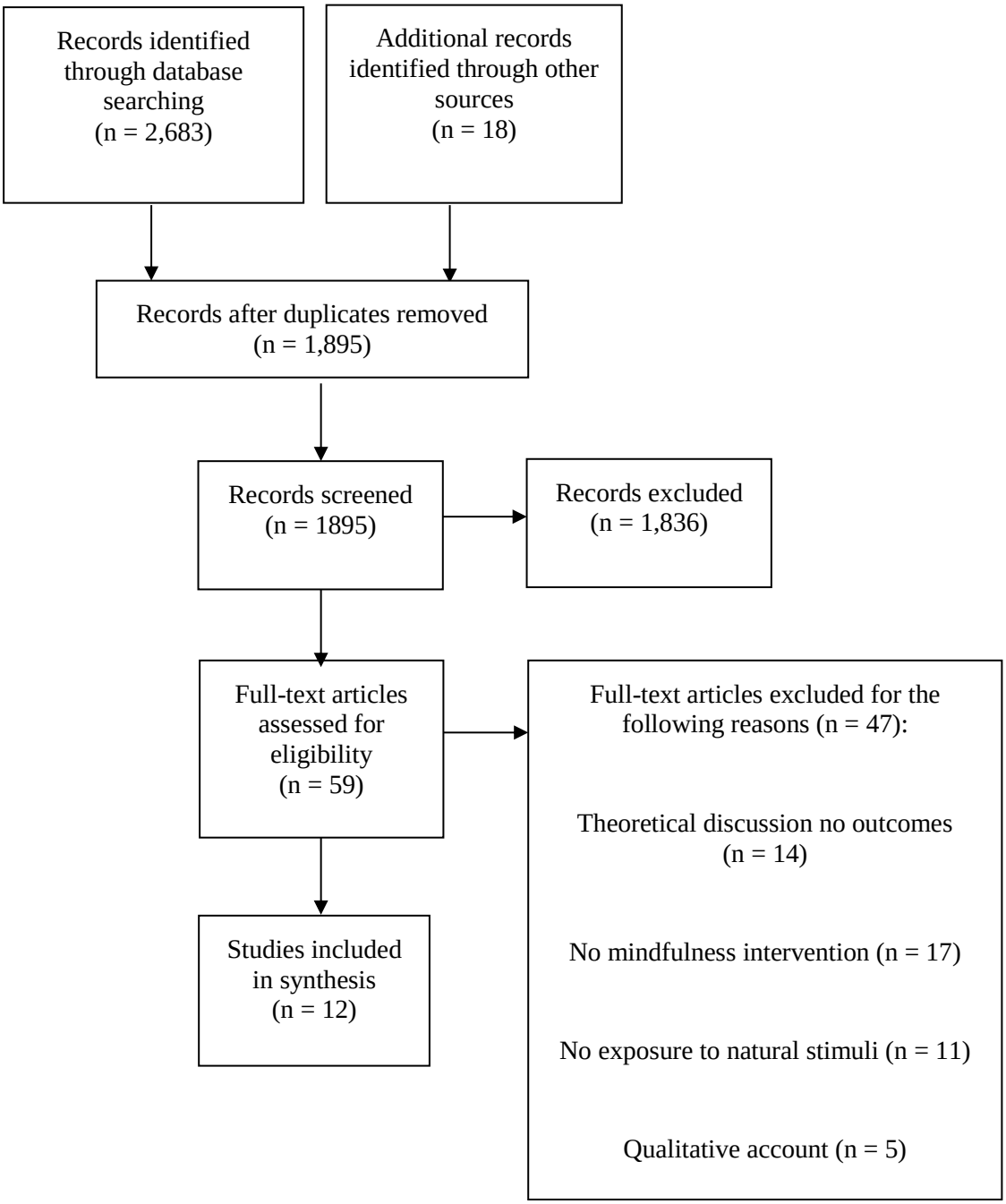

Figure 1. Study Selection Flow Chart

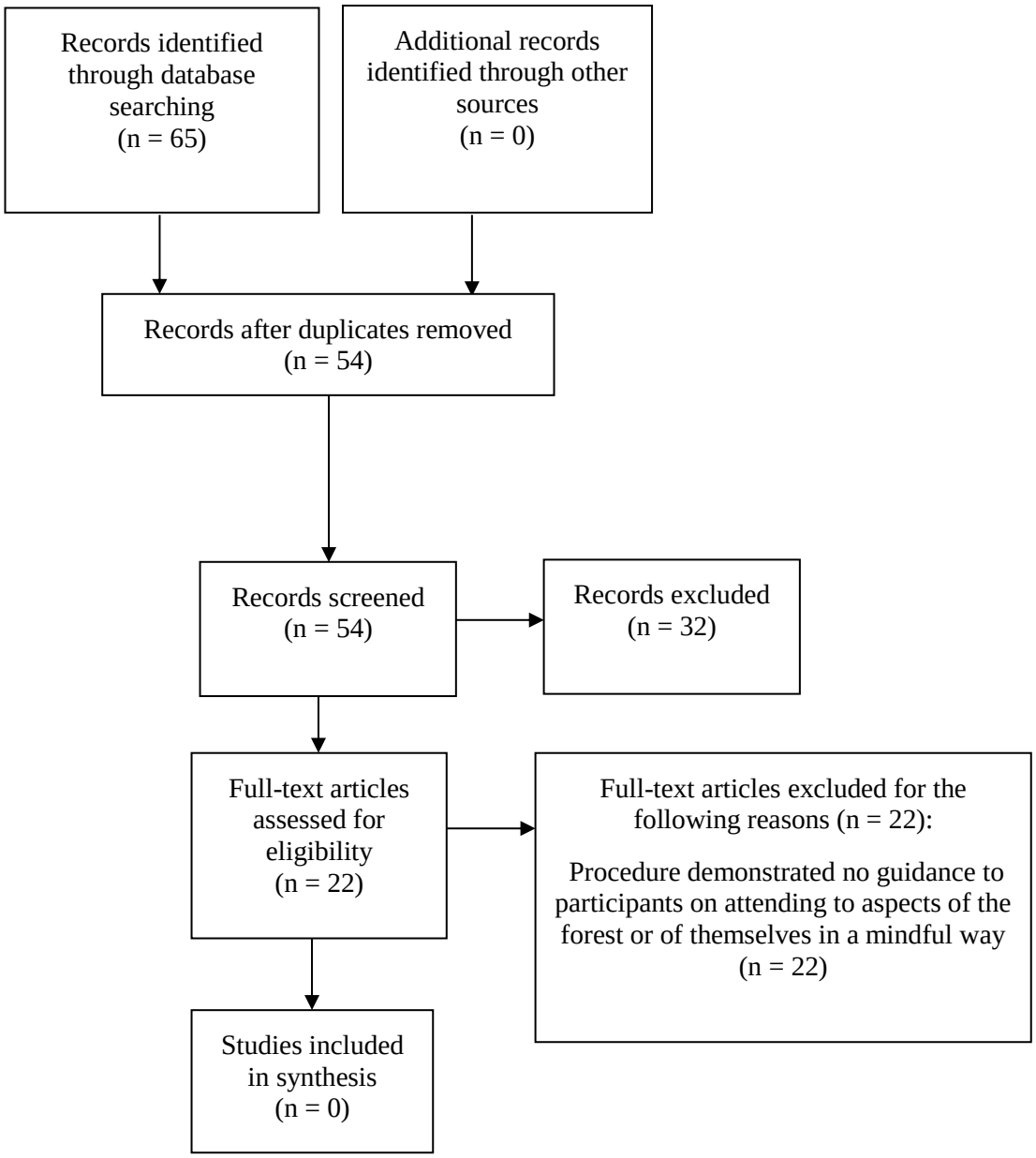

Figure 2. Study Selection Flow Chart of Shinrin-yoku

1.3 Results

Due to the diversity of outcome measures and interventions in the included studies, meta-analysis was deemed an inappropriate method of analysing data. Narrative synthesis allows for exploration of how studies address different aspects of the same phenomena, from which a narrative is developed in order to highlight the overall view (Booth, Sutton, & Papaioannou, 2016). This allows for exploration of the original research question without being constricted to intervention effectiveness only (Popay et al., 2006). Due to the diversity of methodologies, interventions and outcomes of the included studies, narrative synthesis was considered the most appropriate analysis. Findings from the review were tabulated (Table 1) displaying the key characteristics of the 12 included studies. Parenthesis in the following paragraphs details which study is being described based on the study number in Table 1.

Study quality (as detailed in section 1.2.3, Appendix B) varied between included studies, with general quality deemed appropriate using the quality appraisal tool and cut-off criteria. The QualSyst demonstrated that studies typically were well designed to explore the research question, detailed subject characteristics, used appropriate analyses and reported results in sufficient detail. However, studies varied in quality regarding blinding of conditions to experimenter and/or participants. Some papers were able to implement experimenter blinding however we did not implement this, allowing for possibility of experimenter bias (2,6,7,8,10,11). The majority of papers were unable to apply participant blinding and therefore this component is recorded as N/A in the QualSyst, and scoring procedure is adjusted to account for this (see Appendix B).

1.3.1 Study design.

The studies varied largely in many aspects of methodology employed. 10 studies used a cross-sectional experimental design, one study (9) did not have a comparison group and a further study had comparisons of similar interventions in different countries utilising a survey design (4). Of the 10 cross-sectional studies, four compared MNAT experimental conditions to a single active control condition (e.g. treatment as usual, non-meditation in nature; 2, 5, 11, 12), and six compared the MNAT condition to two conditions; two active controls (3, 6, 8, 10) or one active control and one no-intervention control (1, 7). Authors' rationale for design employed was omitted with the exception of the two included theses (7, 8). All studies identified aims and objectives of the research and most employed design and analysis adequately in order to explore the research questions.

Study design is an important factor when drawing conclusions from research. The 10 papers with control comparisons are able to compare the efficacy of MNAT conditions to non-MNAT and provide evidence to support, or argue against, theoretical and clinical findings. Three studies are unable to attribute interventions as being the cause of outcomes as they are either

uncontrolled (4, 9), or did not take baseline characteristics (8). This suggests methodological issues that could be rectified.

Table 1.

Key Characteristics of Studies Included in the Current Review

Author (year)	Country	Design/Sample	Interventions/Groups	Outcome Measures	Findings
de Bloom et al. (2017). Study 1	Finland	2 x RCT *N* = 153; non-clinical sample of workers within Finish companies; split across 2 studies; Spring (*N* = 83), Autumn (*N* = 70)	Park walking (*n* = 51; relaxation exercises, (*n* = 46); no intervention control (*n* = 56)	Single item measures of recovery experiences (relaxation, psychological detachment, enjoyment) and wellbeing (restoration, fatigue, job satisfaction). All measures rate agreement on 5 point scale.	During Spring intervention all groups demonstrated improvement in fatigue and restoration. Largest effect in control group (*d* = .42). By afternoon the relaxation group was more satisfied with their work than before the intervention (*d* = .65) and by evening they were significantly less restored (*d* = -.54). Autumn study showed significant intervention X time interaction for detachment, enjoyment during intervention and fatigue by end of intervention. During intervention, park walking group showed significant increase in relaxation (*d* = .66), detachment (*d* = .61), and enjoyment (*d* = .47) compared to baseline and control group. Relaxation group showed significant increase in relaxation (*d* =.61) compared to baseline and control. By afternoon, park walking group felt significantly less fatigued than baseline (*d* = -.54). The relaxation group were significantly more satisfied with their job by afternoon (*d* = .52). Post intervention showed significant improvement in fatigue for park walking group (*d* = .29) and significant decrease in restoration for relaxation group (*d* = -.27) compared to baseline.
Duvall (2011). Study 2	USA	RCT *N* = 117; non-clinical sample of adults	Standard care including personalized walking plan (*n* = 58); engagement group with awareness plan given to engage and interact with environment (*n* = 59)	Total time spent walking (recorded with accelerometer); satisfaction with walking environment (measured by 4 distinct categories; amount and variety of nature, shade trees, sense of security; walking paths. Assessed using 14 statements related to satisfaction of walking environment measured on 5 point scale)	Significant overall increase in total walking time for both engagement (*d* = .55) and standard care (*d* = .52), no difference between groups. This increase was significant from start of study to follow up for engagement (*d* = .19) and standard care (*d* = .17) in spite of significant decline from end of study to follow up for both engagement (*d* = .36) and standard care (*d* =.35). During treatment period, the engagement group demonstrated significant increased satisfaction with the amount and variety of nature (*d* = .50), shade trees (*d* = .35), and walking paths (*d* = .37). Only satisfaction with shade trees (*d* = .38), and walking paths (*d* = .40) remained improved from start-of-treatment to follow up. There were no changes to satisfaction levels of standard care group.

Author	Country	Design/Sample	Interventions/Groups	Outcome Measures	Findings
Kim, Lim, Chung, & Woo (2009). Study 3	South Korea	Cross-sectional Experimental *N* = 63; clinical sample diagnosed with MDD under pharmacotherapy	CBT group in forest including mindfulness of internal experiences and forest stimuli (*n* = 23); CBT group in hospital including mindfulness of internal experiences and hospital based stimuli (*n* = 19); outpatient control TAU (*n* = 21)	HRDS; MADRS; BDI; Remission induction rates (assessed by scores of HRDS below 7); SF-36; HRV (measured by SDNN, RMSSD, Trianular index, TP, LF power, HF power, LF/HF ratio, Norm. LF power, Norm. HF power); SCS	Significant decreases in HRSD over time. CBT forest condition scored significantly lower on the HRDS than TAU, but not the CBT hospital group. Significant decreases in MADRS for over time. CBT forest condition scored significantly lower on the MADRS than TAU and CBT hospital group. Time dependent improvement of BDI scores but no group effect found. CBT forest group more effective at reducing remission compared to CBT hospital group. Significant increase in aspects of HRV in CBT forest group as demonstrated by increased SDNN, RMSD and TP and some increases in parasympathetic tone measured by HF and the Norm. Only changes to HF in hospital group, no changes in TAU group. Only CBT forest demonstrated a significant decrease in cortisol levels and increase in well-being and overall estimation of health measured by SF-36.
Korpela, Savonen, Anttila, Pasanen, & Ratcliffe, (2017). Study 4	Finland/ France/ Luxemburg/ Sweden	Cross-sectional Survey Study *N* = 299; non-clinical sample.	Forest trail groups across four countries (Finland *n* = 164, Sweden *n* = 54, Luxemburg *n* = 65, France *n* = 16). France data removed due to small sample size.	Single item measures of mood enhancement, willingness to revisit, willingness to refer trail to friends; aspects of nature connectedness and satisfaction were measured through 3 single item measures; restorative change was measured through 4 items. All item measures rate agreement on 5 point scale.	Participants demonstrated increased changes in restorative experience, satisfaction with signposts (with mindful based instructions), overall satisfaction and willingness to recommend trail to a friend. Participants were more satisfied with the trails in Sweden and Luxemburg than in Finland. Participants from Finland and Luxemburg were satisfied with number of signposts but participants from Sweden differed significantly, inclined toward smaller number of signposts. There were significant positive correlations between all items (*r* = .14 to 76) except with satisfaction with number of signposts which was not correlated with other items. Moderation analysis showed satisfaction with signpost content was significantly connected to positive restorative change and mood enhancement across countries.

Author	Country	Design/Sample	Interventions/Groups	Outcome Measures	Findings
Kwon et al. (n.d.). Study 5	South Korea	Cross-sectional Experimental *N* = 22; clinical sample of breast cancer patients	Forest bathing (*n* = 11); Forest bathing with modified MBSR (*n* = 11)	Levels of $CD4^+$T helper cells and $CD56^+$NK cells in lymphocytes; WHOQOL-BREF Korean version	Both conditions significantly increased $CD56^+$NK cells from pre to post intervention and demonstrated significant increase in domains of WHOQOL-BREF. All increases were significantly higher for the MBSR group compared to forest bathing alone.
Lymeus, Lumdgren, & Hartig (2017). Study 6	Sweden	RCT *N* = 41; non-clinical university students	Mindfulness only (*n* = 12); Mindfulness with nature images (*n* = 15); controls rested and viewed natural images (*n* = 14)	DASS: LDST	Main effects of time showed significant improvements in anxiety (η_p^2 = .24), stress (η_p^2 = .28), and LDST performance (η_p^2 = .46) over the duration of the course. There were no differences between the control and combined mindfulness conditions across these linear trends. Comparing the three conditions over the full duration of the study there was a significant effect of group on session change performance on LDST (η_p^2 = .29). Mindfulness nature and control showed increasing performance on LDST whereas mindfulness only fared worse.
Okvat (2012). Study 7	USA	Cross-sectional Experimental *N* = 50; non-clinical older adults (age 55-79)	Mindful community gardening (MCG; *n* = 17); traditional community gardening (TCG; *n* = 17); wait list control (*n* = 16)	SWB (assessed with PANAS; Q-LES-Q-SF; Vitality (measured with sub-scale of MOS Short Form health Survey); social support (measured with sub-scale of MOS Social Support Scale); attention (measured with Digit Span Backward); MAAS; KIMS (observe sub-scale); CNS	TCG and MCG did not significantly enhance social support or attention, or predict any measure of SWB. TCG was positively associated with mindfulness measured by KIMS observe scale compared to control (β = .39) but the MCG group did not show significant association to this sub-scale when compared to control. TCG enhanced KIMS observation more than MCG (β = -30). MCG predicted greater mindfulness scores of the MAAS (β = .25) than controls. This effect diminished when analysing only randomised participants. Neither experimental condition enhanced CNS scores. Dose (total time in garden) was a significant predictor of Q-LES-Q-SF scores for both MCG and TCG (β = .34)

Author	Country	Design/Sample	Interventions/Groups	Outcome Measures	Findings
Sato (2016). Study 8	New Zealand	RCT *N* = 45; non-clinical university students	Participants walked around a botanical garden in mindful condition (*n* = 15); past experience focus condition (*n* = 15); control/no instruction (*n* = 15)	Fascination (8-item checklist from the PRS. Item measurement rated agreement on 7 point scale); PA (measured with 3 items. All item measures rate agreement on 5 point scale); NA (measured with 3 items. All item measures rate agreement on 5 point scale); MAAS	Participants in the mindful condition showed significantly higher MAAS scores than the past experience condition however there was no difference between the mindful condition and control group. There was no significant difference in fascination scores between conditions, however fascination was correlated with MAAS scores (*r* = .30). There was no difference of PA or NA between conditions.
Schramm, Hediger, & Lang (2015). Study 9	Germany	Cross-sectional quasi-experimental *N* = 6; clinical sample with MDD in psychiatric care	NAMT (*n* = 6)	BDI-II; RSQ; KIMS-D; FMI	There was no significant change in the BDI-II from pre to post intervention. Participant scores of RSQ significantly decreased on rumination (ϕ = .83) and negative thoughts about yourself (ϕ = .83) sub-scales. Participant total scores of KIMS-D significantly increased (ϕ = .83), and for the observing (ϕ = .83) and acting with awareness (ϕ = .83) sub-scales. Participant total scores for the FMI significantly increased (ϕ = .90).
Shin et al. (2012). Study 10	South Korea	Cross-sectional Experimental *N* = 139; non-clinical university students	Athletic walking in gymnasium (AG; *n* = 36); Athletic walking in forest (AF; *n* = 34); Mindful walking in gymnasium (MG; *n* = 31); Mindful walking in forest (MF; *n* = 38)	STAI-X1; RSE; HI-K	Anxiety scores decreased a significantly greater degree for MG than AG participants, and decreased a significantly greater degree for MF than AF participants. There was no significant difference between AF and AG, or MF and MG. Self-esteem increased a significantly greater degree for MG than AG participants, and increased a significantly greater degree for MF than AF participants. There was no significant difference between AF and AG, or MF and MG. Happiness increased a significantly greater degree for MG than AG participants, and increased a significantly greater degree for MF than AF participants. There was also a significantly greater increase in happiness for AF than AG, and MF than MG participants. MF was significantly greater at increasing happiness compared to all conditions.

Author	Country	Design/Sample	Interventions/Groups	Outcome Measures	Findings
Sung, Woo, Kim, Lim, & Chung, (2012). Study 11	South Korea	Cross-sectional Experimental *N* = 56; patients in stage 1 hypertension	Forest Therapy Program (FTP; *n* = 28); self-monitoring control group (*n* = 28)	SBP; Salivary Cortisol Levels; QoL measure for patients with hypertension	There was a marginally significant decrease in SBP in FTP compared to control from initial measurement to directly after program completion. Both groups demonstrated lower SBP over time, with the FTP showing reduction immediately after program, the change in control participants was more gradual. Longitudinal SBP changes were not significantly different. Cortisol level reduction was significantly larger for FTP than control from start to follow up. QoL was significantly higher for FTP than control from start to follow up. The FTP group showed significant improvements in MD, HTN, GH and SD domains of the QoL scale.
Unsworth, Palicki, & Lustig (2016). Study 12	USA	RCT *N* = 71; non-clinical university students	Meditation in nature (*n* = 39); non-meditation in nature control (*n* = 32)	INS; FMI; Memory task (participants had to name their favourite memory from the experience)	Significant increases in INS scores for meditation but not for control condition between pre and post nature trip. Participants in the meditation group were significantly more likely to foreground memories of nature than controls. No significant changes in FMI scores across conditions, although there was a positive correlation between FMI difference scores (change from pre to post program) and INS difference scores (*r* = .27), and trip enjoyment (*r* = .29).

Note: RCT = Randomized Controlled Trial; MDD = Major Depressive Disorder; CBT = Cognitive Behavioural Therapy; TAU = Treatment as Usual; HRDS = Hamilton Rating Scale for Depression; MADRS = Montgomery-Asberg Depression Rating Scales; BDI = Beck Depression Inventory; SF-36 = Short Form Health Survey Questionnaire; HRV = Heart Rate Variability; SDNN = Standard Deviation of Normal RR Interval; RMSSD = Root Mean Successive Squared Difference; TP = Total Power; LF = Low Frequency; HF = High Frequency; Norm. = Normalized; SCS = Salivary Cortisol Concentration; MBSR = Mindfulness Based Stress reduction; $CD4^{+}T$ = Cluster of Differentiation 4 T Helper Cells; $CD56^{+}NK$ = Cluster of Differentiation 54 Natural Killer Cells; WHOQOL-BREF = World Health Organization Quality of Life Assessment; DASS = Depression Anxiety Stress Scale; LDST = Letter-Digit Substitution Test; MCG = Mindful Community Gardening; TCG = Traditional Community Gardening; SWB = Subjective Well-Being; PANAS = Positive and Negative Affect Scales; Q-LES-Q-SF = Quality of Life, Enjoyment, and Satisfaction Questionnaire Short Form; MOS = Medical Outcomes Survey; MAAS = Mindfulness Attention Awareness Scale; KIMS = Kentucky Inventory of Mindfulness; CNS = Connectedness to Nature Scale; PRS = Perceived Restoration Scale; PA = Positive Affect; NA = Negative Affect; NAMT = Nature and Animal-Assisted Mindfulness Training; BDI-II = Beck Depression Inventory-II; RSQ = Response Style Questionnaire; KIMS-D = Kentucky Inventory of Mindfulness German Version; FMI = Freiburg Mindfulness Questionnaire; STAI-X1 = Speilberger State-Trait Anxiety Inventory Form X, State Sub-scale; RSE = Rosenberg Self-Esteem Scale; HI-K = Happiness Index for Koreans; BP = Blood Pressure; QoL = Quality of Life; SBP = Systolic Blood Pressure; MD = Mental Dimension; HTN = Hypertension-related Dimension; GH = General Health; SD = Social Dimension; INS = Inclusion of Nature in the Self

1.3.2 Sample characteristics.

Populations and recruitment methods varied across studies. Three studies utilised opportunity sampling methods for university students (6, 8, 10). Four studies recruited working age adults (1, 2, 4, 12) one of which targeted specific companies in order to recruit participants (1), another recruited from the local area with fliers and newspaper advertisements (2), one set up data collection and recruitment points at the start of outdoor walking trails across four countries (4), one recruited from people attending a wilderness program (12). One recruited older adults (7) and detailed the sampling procedure which involved posters at 55 locations, newspaper advertisements and was discussed within talks at relevant social groups. Four studies included clinical samples; MDD (3, 9), Breast cancer (5), hypertension (11). The studies were conducted in a range of countries; four in South Korea (3, 5, 10, 11), three in the U.S.A. (2, 7, 12), one in New Zealand (8), one in Germany (9), one in Sweden (6), one in Finland (1) and one applied across Finland, Sweden, France and Luxemburg (4).

This suggests heterogeneity between the samples in the studies. However, each study itself is homogenous in nature, for example all female (5, 10), all students (6, 8, 10), older people only (7) or specific clinical samples (3, 5, 9, 11) recruiting from a single country (except study 4). This makes it difficult to generalise the studies' reported findings to wider populations.

Generally the recruitment of participants within the study was based on opportunity sampling. The use of posters and fliers (1, 2, 4, 6, 7, 8, 10, 12) could have led to selection bias; individuals may have been motivated to engage in interventions and therefore may not reflect the population. Of these studies, one set up recruitment information at the start of nature trails (4), another at the beginning of nature wilderness trip (12), and one study visited local gardening groups as part of their recruitment (7). This suggests individuals were already motivated to interact with nature which may have impacted on any reported results. The four studies with clinical samples (3, 5, 9, 11) do not describe the recruitment process. This lack of transparency in recruitment methods would be simple to rectify and enable a clearer understanding of the complete procedure, and would help to establish any pre-existing motivation of the participants to engage with the interventions.

There were some noted similarities and differences of the sample characteristics. Most samples were small however a few had well powered studies (1, 2, 4, 10), and sample sizes ranged from N=6 to N=299 (M=85.5, SD=82.74), with authors often describing small samples as a limitation of their respective studies. Only two studies described power calculations with one study (4) reporting a sufficiently powered study, and another reporting an underpowered study (7). Notably, studies with mixed gender samples (1, 2, 3, 4, 6, 7, 8, 11, 12) contained larger proportions of female participants ranging from 56% to 90% (M=74.63%, SD=12.12). It is unclear as to why there was a larger female proportion of samples, and authors should have noted this and ensured

equal split of gender where possible. One study (9) did not report gender of participants and two studies (5, 10) included only female participants. For these two studies the authors provided an acceptable rationale for justification of inclusion of female participants only; clinical sample of breast cancer patients (5) and effects of exercise differ according to sex and age so homogenous sample used (10). Potential gender differences were not explored in many studies. Notably study 12 had a much larger ratio of females to males in the MNAT condition (25 females, 14 males) compared to control condition (17 females, 15 males). The study reports findings indicating MNAT conditions increased connectedness to nature and foregrounding of nature memories, however this may present a gender effect rather than intervention effect. Some studies described no difference between genders for outcomes (4, 7, 8, 12) and the current reviewer suggests this should be applied as standard practice in reporting of results. Without analysis one cannot be sure gender differences were not a confounding factor when there are unequal genders within a sample.

1.3.3 Mindful interventions.

The broadness of the review allowed for mindfulness *of*, and *in*, nature to be included. This distinction reflects the different mindfulness practices of paying attention to one's own internal states, *in*, (breath, body scan, emotions, thoughts, sensations) while presented with natural stimuli or paying attention to the external stimuli, *of*, (sounds, sights, touch, smell). In some respects this distinction is arbitrary as although when being mindful we are applying attention to a specific area of focus, the aim is to be aware and acknowledge all thoughts, feelings and sensations that arise in the present moment. For instance, one may be paying mindful attention to a flower, but would also acknowledge when and where the mind wanders, before bringing attention back to the flower.

Across reviewed studies, the delivery of the mindfulness intervention varied. Four studies detailed interventions that facilitated focus on external aspects of nature (1, 2, 4, 8), two detailed interventions focusing on internal aspects of the participant (10, 12), and six studies detailed interventions of both internal and external aspects (3, 5, 6, 7, 9, 11). This demonstrates procedural differences between interventions.

The rationale for why specific MNAT interventions were employed were not discussed however studies applying both internal and external focus practices were rooted in larger therapeutic models; CBT, MBSR, MBCT. Although the main focus in these therapeutic modalities is formal practice, to engage in introspection, there are often practices focusing on external stimuli as a means to teach the skill of mindfulness.

As noted, definitions of mindfulness vary within the literature. Therefore it would be helpful if authors reported their definitions of mindfulness in order to clarify their orientation, especially as there is no documented and empirically tested model for applying MNAT approaches. One suggestion has been described by McGeeny (2016) which states a 5 stage model that moves

from internal focus to wider attentional focus of natural stimuli. This is similar to the previous description of therapeutic modalities that may use mindful practice of external stimuli early to teach the skill before moving to more formal mediations; e.g. the raisin exercise initially in MBSR/MBCT followed by internal focused, formal practices later. This model would therefore sit with the studies detailing mixed interventions (3, 5, 6, 7, 9, 11). Again this highlights a lack of consensus within the literature of how to deliver MNAT interventions. With reviews such as this, future researchers may explore aspects of MNAT interventions leading to a standardised delivery protocol, regardless of therapeutic framework.

In terms of outcomes, and external or internal practices, the external focus interventions demonstrated moderately positive outcomes (1, 2, 4), or non-existent effects of MNAT (8), compared to the other studies which typically reported stronger effects of MNAT. This demonstrates that how mindfulness is employed may effect the impact it has on the individual, although could reflect the procedural differences of delivering the intervention rather than the *in* or *of* distinction. For instance, external focus studies (1, 2, 4, 8) employed written instructions with only study 1 providing any pre intervention training with instructor. Furthermore in these studies, when conducting the intervention, the participants were alone without any facilitator, therefore it is difficult to identify if there were any problems engaging with the procedure. All other studies utilised instructors who were present to facilitate interventions. Therefore it is difficult to determine if the lowered effect in mindfulness *of* nature studies is due to applying practice to external stimuli or if it is due to the procedure, and lack of instructor. Furthermore, an integral part in the clinical delivery of mindfulness is feedback, or inquiry, which allows for a deepening learning following mindful practice; considered a transformative aspect of the practice (McCown, 2016; Segal et al., 2012; Wolf & Serpa, 2015). This is a fundamental component of formal practices within MBSR and MBCT, however the studies adapting such programmes, and all papers generally, did not explicitly discuss any inquiry following practice. If the inquiry was delivered in the studies that adapted therapeutic modalities then this may be the reason for increased benefits compared to non-therapeutically aligned mindfulness practices rather than this difference between internal and external focus of mindfulness. Therefore it is unclear as to how the intervention was delivered even when protocols of interventions were provided – session by session accounts detail the main *content* of sessions, but not the *process*.

Of the 12 studies, nine used the term ‘mindfulness’ as part of the intervention, the other three described guided attention (1) and awareness plans (2, 4). Of the nine studies that detailed mindfulness there was variation in delivery protocol; three studies described brief guided instructions of mindful awareness to either internal aspects (10) or aspects of nature (8) or both (7), two studies incorporated mindfulness into a CBT program (3, 11), two were an adapted MBSR program (5, 6), one detailed mindful community gardening (7), and one described an adapted MBCT program (10). Of the three studies that did not use the term ‘mindfulness’ to describe their

intervention, inclusion was deemed appropriate as they described paying attention to their surroundings without talking to a partner (1) or use of detailed awareness plans (2, 4) which facilitated engagement by encouraging the participant to conduct careful investigation of the setting, adopting a playful, curious perspective toward the environment. Such definitions are consistent with previously described Western operationalisations of mindfulness.

Studies also differed in the amount of time mindfulness interventions were applied. This ranged from a single 30 minute occasion following a single instruction (8) to nine weekly sessions of 2.5 hours guided by a practitioner (7). Study 4 does not include any timing of intervention, as following the reading of written instructions participants walked at their own pace without being observed by an experimenter, and study 11 describes a three day course but does not include timings. In total, occasions (how many times) of intervention being delivered per study ranged from 1 to 9 (M=4.5, SD=2.94). Similarly total time of intervention (after removal of study 4 and study 11 where times were unreported) ranged from 30 minutes to 22.5 hours (M=489 minutes, SD=490.72).

Delivery of the interventions ranged from practitioner guided interventions to brief written instructions, again demonstrating the variability of intervention delivery. Total time dedicated to intervention is displayed in Figure 3 which highlights differences between adaptation of therapeutic modalities and standalone interventions. Due to the varied findings of the studies it is unclear if increased intervention times are related to increased outcomes. The three shorter duration studies employing intervention times of 30-70 minutes (8, 10, 12) detail only partial support for benefits of MNAT; study 8 found no differences in affect between conditions and reported similar mindfulness scores compared to controls, study 10 demonstrated higher levels of happiness compared to non-MNAT conditions, and study 12 reported increased connectedness to nature in MNAT condition. Of the studies that employed longer timings of intervention there were consistently higher beneficial outcomes with the exception of study 7. However with the lack of reported effect sizes it is unclear the full impact of intervention time on outcome. This opens a potential avenue for future research in the area of MNAT.

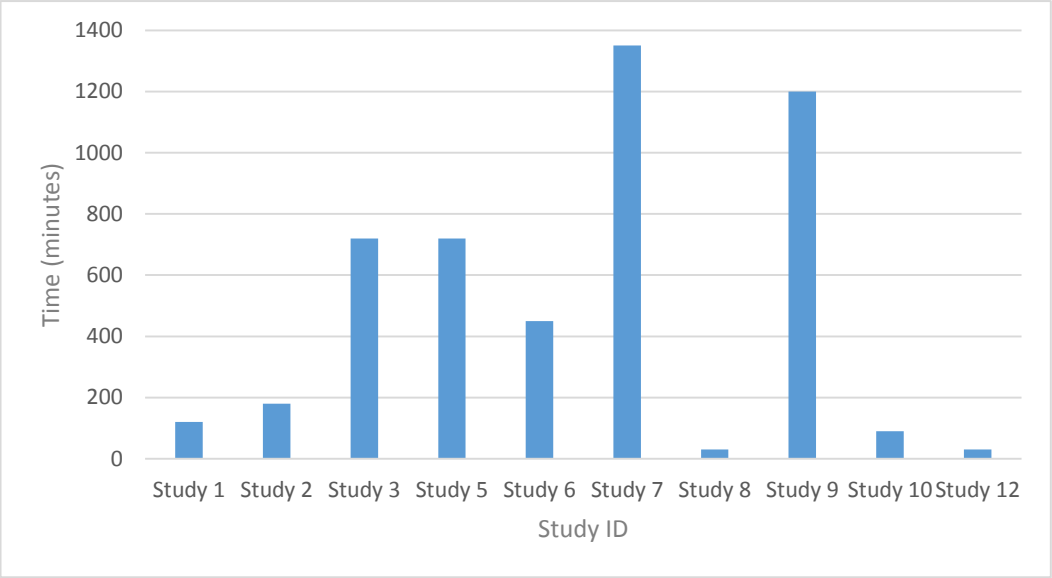

Figure 3. Chart demonstrating total time of interventions used in reviewed studies.

1.3.4 Natural stimuli.

There were both similarities and differences between types of nature exposure. As described in the introduction, beneficial effects of nature have been found across a variety of real world and mediated natural stimuli (e.g. photographs, videos, virtual reality) however stronger are effects found in real world natural environments (Kjellgren & Buhrkall, 2010; McMahan & Estes, 2015). Often use of mediated nature is used in experimental research as it allows for research conducted in controlled, standardised, laboratory settings.

Of the included studies, four used forest environments (3, 5, 10, 11), three used rural areas (4, 9, 12; 12 also included sheep), two used gardens; community (7) and botanical (8), one used parks (1) and one used mediated nature by means of photographs of rural landscapes (6). During review of articles it was noted study 2 reported no explicit manipulation of natural environments; however, as part of their results the authors include nature in their satisfaction measures. Due to the sparsity of literature in the field of MNAT all studies that present quantitative results and provide theoretical or clinical implications were considered in the current review. The different presentations of natural stimuli did not appear to impact on outcomes with the exception of the use of gardens (7, 8). These studies employed different procedures, however, both used gardens and were the only papers to demonstrate minimal or no impact of MNAT conditions. These were the two theses included in the review and include more detail than other papers reviewed. These poorer outcomes seem to reflect methodological and procedural issues rather than quality of environment. For instance, study 7 had a homogenous sample of older people with high levels of psychosocial health, already actively engaged in gardening and therefore the gardening interventions were not particularly novel. Study 8 used a very limited set of instructions to deliver the mindfulness intervention “We want you to focus your attention on your current walking experience—what you

are experiencing in the here and now." (Sato, 2016, p. 72). Although not alone in employing brief mindfulness interventions, this study did not include any other additional training or discussion about how to attend in a mindful manner.

1.3.5 Outcome measures.

Outcome measurement varied across studies. Most studies included validated standardised self-report scales (3, 5, 6, 7, 8, 9, 10, 11, 12) but only five studies reported the psychometric properties of such scales used (4, 6, 7, 8, 10). Study 4 developed their own brief 3-item nature connectedness scale and reported Cronbach's alphas in Finland as .80, Sweden as .71 and Luxemburg as .55. Study 6 reported good internal consistency across all subscales of the DASS with Cronbach's alphas >.7 across groups and measurement times. Only the anxiety subscale demonstrated Cronbach's alpha of <.7 for the mindfulness group across measurement times and were explained due to floor effects with low variance in several anxiety items. Study 7 demonstrated alpha composite scores of .88-.90 for scales of SWB, .82-.86 for mindful measures and .93 for social support scale. Study 8 reports reliability estimates which demonstrated the item reliabilities were more consistent at the between-person level, ranging from .82 to .97 and were lower but still acceptable at the within-person level, ranging from .56 to .81for scales reflecting subjective accounts of the environment and affect. Study 10 reported Cronbach's alphas for the STAI-X as .87, the RSE as .83 and the HI-K as .83. These figures demonstrate acceptable levels of reliability of scales used with the exception of study 4 in which the author's newly developed questionnaire did not present as a reliable measure for participants in Luxemburg. The authors do not comment on this further than reporting Cronbach's alpha.

Use of mindfulness outcome measures raises two points; firstly it is important to measure levels of mindfulness when delivering any mindful intervention in order to assess if the intervention has increased mindfulness levels in participants, secondly the use of different measures could reflect the authors' different operationalisations of mindfulness. All mindfulness scales used in the reviewed studies were measures of trait mindfulness, however, scales conceptualise trait mindfulness differently. For instance the MAAS (Brown & Ryan, 2003) conceptualises mindfulness as having two components of consciousness; attention and awareness (7, 8). The KIMS (Baer, Smith, & Allen, 2004) similarly explores aspects of attention but conceptualises mindfulness as a set of skills; observing, describing, acting with awareness, and accepting without judgment (7, 9). The FMI (Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006) is developed more from traditional Buddhist orientations towards mindfulness, assessing attention and aspects of curiosity and openness to an experience (9, 12). The remaining studies did not include measures of mindfulness which is a limitation when exploring the impact of novel mindfulness interventions.

Three studies employed single item measures (1, 4, 12) and minimally discuss issues of reliability using novel single item measurements. Study 2 also employed newly developed scales to detail participant experiences of walking environments but discuss factor analysis in order to explain inclusion of items, reporting 4 factors; presence of nature, presence of shade and tree cover, sense of security, condition of walking paths. The authors report factor structure was based on item loadings of at least .45, Eigen values greater than 1.0 and alpha coefficients of at least .65, with items loading on more than one factor above the .45 level excluded.

Generally the psychometric data reported is incomplete. Although some papers reported data on reliability and a rationale for measure selection, the remaining studies have not addressed the psychometrics of the measures used. This provides the reviewer with no understanding as to why authors selected certain measures and therefore if the measure is suitable for the study design and objectives.

Four studies also utilised physiological readings including walking time (2), Heart Rate Variability (HRV; 3), T-helper and natural killer cells (5), blood pressure (BP) and cortisol levels (11). Two studies assessed task performance; attention (6), and memory (7). This variation in outcomes was important in light of the review's aim to determine what the research on MNAT has evaluated. Essentially as the literature in MNAT is still in infancy it is to be expected there will be variation of outcomes and this in fact may provide a wider picture of the potential effects of MNAT interventions.

Only two studies included longitudinal follow-up data (2, 11). The majority of papers examined immediate impact of MNAT interventions typically employing a pre-post methodology. In study 2, four weeks after the intervention was completed, participants were mailed the same surveys used at pre and post intervention time points, with a return rate of 60% for the engagement (MNAT) condition and 68% for the standard care condition. Follow up data suggested a similar significant decline in both the groups for reported total time spent walking compared to the end of treatment. Participants in the standard treatment group rated no significant difference in satisfaction with walking environment between pre-treatment, end of treatment and follow-up. The engagement group reported a significant increase in satisfaction of presence of nature, presence of shade trees and walking paths from pre-treatment to the end of intervention. At follow-up the engagement groups satisfaction with nature returned to baseline levels however satisfaction with shade trees and walking paths did not change from end of treatment to follow-up resulting in a significant overall increase in satisfaction from start of treatment to follow-up. This data suggests MNAT interventions have some impact on satisfaction of surroundings even after completion of intervention when compared to non-MNAT.

Study 11 employed a three day forest therapy program (MNAT condition) compared to self-monitoring control group, taking BP readings at baseline, day 3 (straight after intervention), 1,

4, and 8 weeks from baseline. Findings demonstrated significant decrease in systolic BP for MNAT condition compared to control, immediately after the three day intervention and at 8 week time point. Measures of quality of life (QoL) and salivary cortisol levels were taken at baseline and 8 weeks later. This demonstrated a significant increase in QoL scores for both groups from baseline to week 8, however the MNAT group scored significantly higher on QoL, and showed significantly decreased cortisol levels compared to control condition at week 8. This suggests longer term impact of the MNAT condition.

These findings demonstrate the importance of conducting follow-up data collection when employing such interventions as detailed in the reviewed studies. It is a fundamental limitation of the studies to have not included such data in order to explore long term effects of the intervention rather than just immediate effects.

1.4 Discussion

The aim of this review was to explore mindfulness practices applied to and within natural stimuli. Due to the limited evidence around this integration, a broad research question was put forward in order to capture all populations, interventions and outcomes. Despite this broadness a limited number of studies were included in the current review. Furthermore each intervention is qualitatively and quantitatively different between studies. There were varying study designs employed. Many of the papers were brief in their description of methodology and often the rationale for choices made were not provided. Without a rationale one cannot be sure of the researchers' reasons for decisions, a significant limitation of the literature.

All studies examined the effect of an intervention on various outcomes, suggesting a cross-sectional design would be most appropriate in order to make causal connections between variables; however, this was not always the case. For instance, study 9 did not have any controlled comparison therefore it is impossible to determine if the mindfulness intervention resulted in changes of outcomes rather than simply meeting with staff/experimenters for example. However it is important to note this was a feasibility study and demonstrated the program was acceptable and feasible to implement – thus being clinically useful, more so than theoretically. Two studies (4, 8) had no baseline measures prior to intervention and therefore one cannot assume any attribution of intervention on outcomes – these outcomes may have occurred regardless of intervention or in fact the intervention could have had detrimental, rather than beneficial, effects. Furthermore seven studies described random allocation of participants to conditions; however, study 3 utilised a sequential allocation, study 7 had to reallocate participants due to sample size which negated the randomisation, and study 11 described convenient sampling and suggested participants had been allocated to intervention conditions based on preference. The authors describe that perhaps the forest intervention group were more motivated, which, in itself, may be the mechanism for change rather than intervention. If this was the case then the researchers could have completed a similar design and measured levels of motivation (see Touré-Tillery & Fishbach, 2014) in order to control for this cofounding variable. This suggests some methodological limitations to the studies which may affect generalisation of results. A further noteworthy point is that many studies did not include effect sizes within their results (3, 5, 9, 10, 11) and therefore, although hypotheses were statistically significant, the strength of such outcomes were not provided. This demonstrates a lack of full reporting of analyses and, therefore, a lack of complete explanation of study outcomes.

During the current review, it was observed that some papers did not report to highest quality standards. Although the included papers met sufficient standards suggested by the QualSyst, many papers did not fully report study design, sampling methods, procedural aspects, and analyses that would allow replication. This appears a general limitation of the literature and may be a reflection of the journal review process in which they were published. As the review

aimed to capture as much literature as possible not all initial articles were peer reviewed or published in academic journals. Indeed study 5 was not indicated as being published in any journal and was funded by the Korea Forest Research Institute[1].

Recruitment methods varied greatly and it is important to assess participants' motivation when recruited with posters. Motivation of these samples needs to be taken into account when generalizing findings to the wider population. For instance in studies 4 and 12 participants were already motivated to engage in nature by attending outdoor walking trails or a wilderness program therefore this may have suggested an already increased connection with nature. Connectedness to nature can be described as "one's subjective sense of connection to the natural world" (Capaldi, Passmore, Nisbet, Zelenski, & Dopko, 2015, p.2). In the remaining 10 studies only one included a connectedness to nature scale (7) and therefore little is known of where samples sit on this spectrum. The importance of assessing connectedness to nature is made clear by empirical evidence demonstrating an association between connectedness to nature and aspects of mindfulness (Barbaro & Pickett, 2015; Howell, Dopko, Passmore, & Buro, 2011; Wolsko & Lindberg, 2013). Connectedness to nature may act as the mediating variable in applying mindfulness within natural stimuli. Furthermore connectedness to nature has been demonstrated to be linked to increased psychological and social well-being, PA and ability to reflect on life problems, vitality, life satisfaction and happiness (Capaldi, Dopko, & Zelenski, 2014; Haluza, Simic, Hoeltge, Cervinka, & Moshammer, 2014; Howell et al., 2011; Mayer & Frantz, 2004; Zelenski & Nisbet, 2014). Therefore it is important to measure this variable in conjunction with health outcomes. The current studies increase nature contact of the participants, but this contact could have different implications for the individual based on their dispositional connectedness to nature. Although contact with nature can indeed increase one's connection with nature (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2008), connectedness to nature is described as a dispositional trait (Kals, Schumacher, & Montada, 1999; Mayer & Frantz, 2004). Therefore studies around MNAT must include measurement of this dispositional connection to the natural world which may mediate effects of mindful intervention within nature.

Sample characteristics ranged from students, working age adults, older adults and both physical and mental health patients from a range of countries. This makes generalization difficult (alongside the diversity of interventions), but does suggest that beneficial effects found in the majority of studies are present across nationalities, ages and clinical diagnoses. The internationality of the papers suggests diversity between samples but highlights this new area of research is receiving interest globally rather than heavily directed by one country alone. This also makes cultural differences worthy of consideration; for instance Shinrin-yoko is an established approach in Eastern countries and, in many respects, corresponds with other ecotherapeutic programs that

[1] The authors and the Korean Forest Research Institute were contacted to discuss the study but did not respond.

aim to increase interaction between the individual and natural environments. Therefore there may be some bias in that Eastern participants are more familiar with the potential benefits of interacting with nature than Western participants. In Western society, ecotherapeutic practice may be noted as a more alternative therapeutic approach.

Sample sizes varied, although many were small and this was a commonly reported limitation across studies. This may have led to an increase in Type II errors; however, this is often a limitation of early studies within a novel field. Furthermore, gender differences were not often explored thoroughly even though the samples often had a majority of female participants. One study did not report the gender information of its participants (9), and two had 100% female samples (5, 10). Of the remaining nine studies only four studies (4, 7, 8, 11) commented on gender differences noting only the following differences; study 4 reported gender had no impact on findings, study 7 reported there was a notable negative correlation for females and connectedness to nature; however, this was not significant and therefore it is unclear why this was reported. In a second experiment of study 8, the author reported that women felt less negative on days when they spent more (non-mindful) time in nature whereas men showed no relationship between NA and nature experience. Study 11 reported marginal significant differences in that increases in measures of mindfulness were greater for males than females pre and post trip. These would appear somewhat contradictory findings and demonstrate the need to examine gender differences within an MNAT framework worthy of investigation.

The aspect that makes synthesis and analysis of findings most complex is the diversity of the procedure of mindfulness interventions employed. In essence, all studies employed some intervention that required participants to engage in focused attention and awareness to either their internal states, external stimuli, or both, within natural settings or when presented with natural stimuli. However, the level of detail and guidance regarding the focusing of attention in a mindful way varied. Interventions ranged from brief instructions encouraging attention and awareness to incorporating mindfulness of nature within the semi-protocoled therapeutic approach of MBCT, CBT or MBSR. Similarly there were single intervention points versus multiple time points. The levels of discrepancy between interventions makes comparison of efficacy difficult (see section 1.3.3). The variability in interventions included in this current review make it impossible to suggest MNAT interventions may generalise across populations to produce similar effects to those reported herein. It may in fact be the design of the specific intervention that has caused observable outcomes rather than simply the integration of mindfulness applied to nature. Additionally without the inclusion of effect sizes it is unclear as to whether time or type of intervention has a direct effect on magnitude of outcomes.

Due to the variability of interventions and outcomes across studies one has to examine the individual studies in order to see the overall picture. Across the studies, the majority of the

evidence presented describes widely the beneficial effect of interventions across outcomes. A single session of 30 minutes walking within a botanical garden following a one sentence description of attending to nature (8) showed no significant effect of intervention compared to control. The findings demonstrated when participants received instructions to focus on past events their mindfulness levels were significantly lower than control or MNAT condition. The authors conclude mindful instruction did not elicit greater levels of mindfulness due to the argument that nature evokes an automatic mindful state. This finding is consistent with another study (7) which showed no differences between conditions but noted mindfulness levels increased similarly for both groups conducting gardening regardless of whether mindful instructions were given or not. Sato (2016) concludes that characteristics of nature can support meditative practices (8), as previously proposed by Kaplan (2001). However methodological issues with study 8 may have introduced confounding factors. For instance, the intervention was delivered via a single verbal instruction and facilitators were not present during the 30 minute walk around the garden. Secondly there were no baseline measures taken, therefore although condition allocation was randomised there may have been group differences already present; i.e. MNAT and control group had higher baseline mindfulness. Similarly other studies did not include direct facilitation from an instructor following initial written and verbal instructions (1, 2, 4) and one did not report sufficient amount of detail how the single 90 minute intervention was delivered (10). However, this study noted greater increase in happiness in the MNAT condition compared to comparisons of other mindfulness conditions and non-mindful natural conditions. Likewise other brief instructions were related to beneficial outcomes for MNAT conditions; significant reduction in fatigue (1), increased satisfaction of walking (2, 4) and self-reported restoration (4). This provides some evidence that brief instructions and interventions may promote beneficial outcomes as supported by the literature (Shearer et al., 2016; Zeidan et al., 2010).

Some studies used adapted therapeutic programs facilitated by instructors that ran over a longer period of time and greater number of occasions (3, 5, 6, 7, 9). In these studies MNAT conditions reported greater beneficial effects compared to controlled comparisons, when comparisons were present (3, 4, 6, 7) with the exception of study 7 which found no difference between mindful gardening and traditional gardening. Taken as a whole these findings suggest integrating mindfulness practice with nature generally increases beneficial outcomes for the individual however there appears no consistency on how the intervention is delivered in terms of predicting the size of such effect. One assumption could be the added support and facilitation of having an instructor present during intervention may help maintain adherence to completing the intervention. Likewise the use of inquiry may be an integral component on beneficial outcomes, however no study reports this process within its procedural description.

The current review documents multiple methods of how the intervention is delivered, ranging from part of a larger therapeutic program to a standalone attentional and awareness task,

and in amount of overall times and occasions of practice. This mirrors the variations of current clinical delivery of mindfulness, independent from nature, and although makes comparisons difficult for this current review, represents a fair account of clinical practice. Therefore the results across these varied studies, using a range of intervention techniques, on the whole provide support for the benefits of MNAT across outcomes.

Similar to the variety of interventions reported in this review, there was also wide variation in the outcome measures utilised across studies. Although this complicates unification of the findings due to variance in intervention and outcomes assessed, this does provide a more general impression of MNAT literature. The studies demonstrated MNAT is related to increased satisfaction of the environment (2, 4) and taken in conjunction with the other health benefits (see below) this is an important clinical findings as this satisfaction may lead to increased motivation to engage in intervention. In terms of restoration, MNAT conditions were found to be significantly related to aspects of lesser fatigue, increased relaxation, energy, cognitive and attentional restoration (1, 4). Furthermore, in an attentional task it was demonstrated beginners to mindfulness often found learning mindfulness required additional attentional effort thus lowering performance on attentional tasks, however this attentional effort is offset with the introduction of an MNAT condition utilising photographs (6). These findings align with ART and suggest additional restoration of adding mindfulness to nature, however only studies 1 and 6 had comparison groups in non-mindful and non-nature conditions.

Empirically, mindfulness is connected with a positive impact on anxiety and depression (Hofmann et al., 2010) and the review noted improvements following MNAT in self-reports of depressive symptoms (3, 9) and in remission rates (3). Similarly, increases in a wider domain of QoL indices were found in MNAT conditions compared to controls (3, 5, 12); likewise, there was evidence of MNAT conditions having a greater impact on increased happiness compared to active controls (10). However, it should be noted there was no difference in decline of depression or subjective well-being measures in two of the studies with control comparisons (6, 7). This provides some support for the effect of MNAT on mood, anxiety and QoL.

In line with SRT, studies noted physiological impacts of MNAT on participants. HRV, BP and salivary cortisol levels are indicated as biological measures of stress, and MNAT conditions demonstrated beneficial improvements compared to controls (3, 11). Similarly there was improved immune functioning in cancer patients in MNAT condition compared to forest bathing alone (5). These studies were adapted therapeutic programs and employed over a longer period of time. These findings are interesting as outcomes are not dependent on self-report or performance of a task.

The current review demonstrates some support for the integration of mindfulness practices within an ecotherapeutic context. Consistent with ART, findings support the hypothesis that exposure to nature has a beneficial effect on restoration and attentional performance, with some

evidence that MNAT interventions increase these restorative effects compared to non-mindful conditions. The variation between interventions and outcomes described in the current review complicates providing a definitive argument for the use of MNAT interventions, however, generally, evidence demonstrated increased benefits from the integration of mindfulness and nature. In terms of clinical practice, if a service were delivering a mindfulness based intervention, the inclusion of natural stimuli would not be a complicated matter to add. Similarly the incorporation of brief mindfulness and natural stimuli would not present a significant drain on funding and resources of health services.

1.4.1 Limitations of studies.

The current review applied a broad approach and thus included some studies without control comparisons, without complete reporting of procedure, analyses employed and without peer review. This may have compromised the robustness of findings. Although quality assessment was completed only a small number of studies were reviewed, some of which do not provide full transparency. Mindfulness interventions varied and some studies included minimal description of the intervention, therefore it is not clear how mindfulness was delivered which may have impacted on results. Methodologically, most papers reported randomisation; however, upon inspection there was evidence of sequential allocation, experimenter employed allocation and participant preference and therefore some findings may be due to sampling bias. Similarly, samples were mainly female majorities and often authors did not provide details of gender differences. Additionally some studies utilised small sample sizes increasing likelihood of Type II errors.

Study 5 was found through discussion with experts in the field; however, this is not a peer reviewed paper. Having contacted the authors and funding body the current reviewer found little information on its origin and subsequent publication and/or dissemination. Typically in a systematic review such a paper would be excluded; however, due to the sparseness of relevant papers the study was included.

In terms of the interventions delivered, as stated, often full procedural methods were not described. Additionally it was not clear if there were between occasion home practice tasks for individuals as is common in CBT, MBCT and MBSR. Furthermore, studies that include control comparisons provide evidence of the additional effects of adding a mindful component to nature however studies with no comparison make it impossible to attribute causal relations between MNAT and positive outcomes although they are often reported as such. Furthermore most studies explored the immediate effect of interventions and there was limited evidence of longitudinal impacts of MNAT interventions. Conducting follow up data collection would help build a clearer picture of the impact of MNAT interventions.

Research in the field of MNAT must ensure stringent methods are utilised and described thoroughly, including psychometric assessment of measurement scales used. Likewise authors of MNAT papers should present their understanding of mindfulness and link any practice or treatment protocol to a conceptual definition of mindfulness so readers are able to understand the theoretical background of the research. Lack of consideration to theory remains a critique of the majority of research included in the present review. The current findings demonstrate some interesting and positive applications of MNAT; however, replication with larger samples, control comparisons and an emphasis on transparency and detailed procedure is a matter of importance.

1.4.2 Limitations of the review.

Although detailed search criteria is important in a systematic review, studies may have been missed if not including the keyword 'mindfulness'. MNAT research falls under a number of disciplines and therefore more databases could have been included.

No formal risk of bias tool (see Booth et al., 2016) was utilised in this review to explore internal reliability of included studies. Although the use of the QualSyst was employed, the use of summary scores to identify high quality studies can, in itself, introduce bias into a systematic review. Furthermore it is widely known that research reporting positive and significant results are more likely to be published than those with negative and/or non-significant results; therefore this publication bias may have impacted on the current review.

Exclusively qualitative studies were not included within the current review as direct measureable outcomes were an important factor for inclusion. However, qualitative data may have provided narrative of how change may occur, and detailed the process of change in a richer manner than the current review presents.

1.4.3 Conclusion.

The current review is an attempt to explore the literature of applying mindfulness in the context of nature. Even with broad aims there was limited literature with 12 studies meeting the criteria for inclusion. The reviewed papers varied in quality and transparency. The included studies detail beneficial effects of the integration of mindfulness based approaches within, and of, nature; however, they cannot be taken as a whole due to the variations of interventions described. Individually the studies do suggest positive effects and this is often compared to control conditions. The review demonstrates emerging evidence across contexts of population and intervention characteristics which warrant further investigation into MNAT interventions.

The review identifies the need for more robust and transparent reporting of controlled experimental studies to compare baseline characteristics and outcomes, and highlighted the methodological concerns, small sample sizes, and homogenous sample characteristics of current

literature. The review has implications for research and clinical practices and indicates a need to ensure stringent, controlled and transparent studies are conducted and reported, in which authors detail their theoretical and operationalisation of mindfulness and restoration.

Chapter 2: Empirical Paper: Mindfulness and Virtual Environments - The Impact of Mediated Nature on Anxiety, Affect, Worry and Levels of Mindfulness

2.1 Introduction

This paper focuses on the integration of mindfulness practice within natural stimuli presented via virtual reality (VR). This is compared with mindfulness applied to neutral VR stimuli, and progressive muscle relaxation (PMR) used in conjunction with natural VR stimuli. The study experimentally evaluates effects of applying mindfulness and nature VR on levels of mindfulness, anxiety, worry, mind wandering and affect.

2.1.1 What is mindfulness?

Although origins of mindfulness lay with Eastern meditation practices delivered within religious contexts of Buddhism and Hinduism (Kabat-Zinn, 1982; Wallace & Shapiro, 2006) it has been developed and taught within a secular manner (Langer, 1989). Within Buddhist traditions, mindfulness is described as "bare attention", a process of sustained attention in which the individual does not react or evaluate non-discursive registering of events in the present moment (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Thera, 1972). Therefore, mindfulness within the Buddhist tradition is the process of specific awareness, culminating in sustained attention to present moment stimuli in a non-judgemental manner.

This is similar to Western definitions, taught independent of religious connotations. The term mindfulness "refers to a set of techniques in which one gives deliberate sustained attention to presently occurring ambient, somatic or subjective phenomena" (Brazier, 2013, p.117). Kabat-Zinn presents a working definition of mindfulness as "paying attention in a particular way: on purpose, in the present moment and non-judgementally" (Kabat-Zinn, 1994, p. 4). Such definitions suggest mindfulness is anchored in activities of consciousness, namely attention and awareness (Brown, Ryan, & Creswell, 2007).

Similarities exist between original Buddhist teachings and current Western understanding of mindfulness, but also some differences, demonstrating a lack of a consensual operational definition (Bishop, 2002). Lack of a consensually agreed definition of mindfulness complicates research design and evaluation. Bishop and colleagues (2004) operationalise mindfulness, drawing from both Eastern and Western perspectives, as a two-component process with attention maintained on immediate experience, within an orientation characterised by openness, curiosity and acceptance. Mindfulness is considered in both state and trait forms defined as intentional mindfulness meditation or intrinsic, dispositional mindfulness respectively (Wheeler, Arnkoff, & Glass, 2016). Increasing state mindfulness, following repeated mindfulness-based interventions, is

linked to heightened trait mindfulness however individual's trajectories of change may vary (Kiken et al., 2015).

2.1.2 The effects of mindfulness.

Mindfulness is utilised clinically as an approach to increase awareness and respond skilfully to mental events that cause distress and problematic behaviour (Bishop et al., 2004). Coffey, Hartmann and Fredrikson (2010) report that mindfulness contributes to clarity about one's experience which in turn increases the ability to manage negative emotions. Through exploratory and confirmatory factor analysis, mindfulness measures have been linked with emotional regulation measures and assess overlapping factors; present moment attention, acceptance of experience, clarity of internal experiences, ability to manage negative emotions (Coffey et al., 2010). Holzel et al., (2011) examined components of mindfulness including attention regulation, body awareness, emotion regulation and perspectives of the self, detailing support both conceptually and neuroscientifically to suggest these mechanisms as active components in mindfulness meditation which affect change. Mindfulness allows us to be less reactive to present moment experiences by adjusting how we relate to all experiences in the moment, rather than being caught up *in* those experiences (Germer et al., 2005).

Mindfulness is a core process applied within 'third-wave' therapeutic models which aim to change the relationship to cognitions and emotions rather than their content (Hayes, 2004). Third-wave therapies such as MBSR, MBCT, DBT, CFT and ACT have been reviewed extensively (see Chapter 1). Within these modalities, mindful practices differ between longer formal meditative practices, requiring sustained introspection and informal practice delivered as shorter practices, applying mindfulness to alert the individual to the present moment, with acceptance, to everyday life (Germer et al., 2005; see section 1.1.1).

Efficacy of brief standalone mindfulness interventions, independent from therapeutic modality, have been explored. For example, 7 minute pre-recorded audio instructions have been utilised to evoke present moment attention and awareness which demonstrated better tolerance of distress in nicotine deprived smokers following a distress task compared to non-treatment control (Paz et al., 2017). Tan et al. (2014) employed internal focused practice, instructing participants to spend 5 minutes redirecting attention to their breath whilst noticing distractions. Following this brief practice, participants demonstrated increased empathic concern compared to controls.

Meta-analyses demonstrate the positive impact of mindfulness-based interventions on measures of self-report anxiety in non-clinical (Chen et al., 2012), and clinical samples (Hofmann et al., 2010). However these reviews focus on formal practice as found in MBSR/MBCT rather than brief standalone interventions. Behaviourally related to anxiety, worry was found to significantly improve for generalized anxiety disordered patients following MBCT (Evans et al.,

2008) and for older adults with worry symptoms and cognitive dysfunction following an MBSR programme (Lenze et al., 2014). However, in a study exploring the effects of mindfulness compared to relaxation controls, in a chronic worry student sample, findings suggest equal changes to self-report worry scores although significantly greater improvement in emotional comprehension and physiological regulatory mechanisms contrary to worry (measured by indices of somatic and autonomic regulation) in mindfulness condition (Delgado et al., 2010). Although not following a protocoled therapy, this included 10 hours of instructed mindfulness practice. Furthermore trait mindfulness is associated with decreased mind wandering (Deng, Li, & Tang, 2014), and evidence reports greater reduction in mind wandering following eight minutes of mindful breathing compared to active controls (Mrazek, Smallwood, & Schooler, 2012). Intensive 10 day mindfulness intervention with a non-clinical sample demonstrated that participants in the mindfulness condition showed improvements in self-reported mindfulness, depressive symptoms, rumination, working memory and sustained attention compared to control participants (Chambers, Lo, & Allen, 2008).

2.1.3 Ecotherapy.

Ecotherapy is the term given to therapeutic approaches that include the natural world (Buzzell & Chalquist, 2009; Chalquist, 2009). There are three major underlying theories describing why connecting with nature is beneficial for wellbeing; Biophilia, ART and SRT. The Biophilia hypothesis states human evolution occurred in natural environments, and therefore we have an unconscious, innate connection and affiliation with nature (Kellert & Wilson, 1993). Biophilia suggests through evolution we are hard-wired to hold a psychological and emotional attachment to nature. Evidence suggests people have a subjective preference for nature scenes over built environments (Dopko, Zelenski, & Nisbet, 2014), across cultures (Newell, 1997) and from young ages (Kahn, 1997).

ART (Kaplan, 1995; Kaplan & Kaplan, 1989) purports natural environments have a restorative effect on attention which occurs via cognitive pathways. ART suggests a separation of attention; involuntary and directed attention. Involuntary attention describes the process in which one's attention is automatically captured by inherently intriguing or important stimuli. Directed attention, conversely, requires effort in applying cognitive-control processes – the first is automatic and effortless the second is effortful (James, 1892). ART states directed attention is the cognitive mechanism restored by interactions with nature (Berman, Jonides, & Kaplan, 2008). Environments rich with intricate natural stimuli draw upon involuntary attention, allowing directed attention mechanisms to replenish (Kaplan, 1995). Within such natural settings the requirement for directed attention is minimal and the environment is captured in a bottom-up manner (Berman et al., 2008). Evidence supports the theory that natural environments provide attentional restoration over non-natural environments. Increased attentional performance following a mental fatigue task was found in participants shown images of natural landscapes compared to neutral and urban/non-restorative

landscapes (Berto, 2005). Similarly, increased executive attention was observed in older adults following exposure to images of nature compared to urban images (Gamble, Jr, & Howard, 2014).

A third theory, the SRT (Ulrich, 1983; Ulrich et al., 1991), suggests natural environments promote not only attentional restoration but also physiological stress recovery and PA. Similar to ART, SRT also builds on the Biophilia hypothesis suggesting humans are hardwired to process natural stimuli more efficiently than urban environments due to having evolved in natural environments. SRT concurs with a bottom-up style processing of natural environments as ART also indicates, which encourages restoration. A fundamental difference, however, is SRT suggests an initial affective response to natural environments which drives physiological restoration (Ulrich, 1983) in contrast to the cognitive pathway indicated by ART. Evidence supports that natural environments promote recovery from stress, greater than urban environments. In a seminal study, patients hospitalised for cholecystectomy in rooms with natural views demonstrated shorter hospital stays, fewer negative evaluative comments from medical staff and took fewer analgesics compared to those whose view consisted of a brick wall (Ulrich, 1984). In another study, following stress induction, participants who viewed videos of natural settings demonstrated significantly more positive physiological measures assessing heart period, muscle tension, skin conductance and correlates of systolic blood pressure than those who viewed urban settings (Ulrich et al., 1991). In essence these theories overlap; they suggest an innate connection with nature that promotes restoration either through cognitive or affective pathways.

2.1.4 The effects of nature.

Empirical evidence suggests natural stimuli have a restorative effect on the individual. One meta-analysis reports a moderate increase in PA and, smaller, decrease in NA after exposure to natural environments compared to controls (McMahan & Estes, 2015), however the authors comment on the heterogeneity of samples and interventions. Similarly Bowler et al. (2010) conducted another meta-analysis highlighting positive changes to well-being after exposure to natural stimuli. Findings suggested exposure to natural stimuli had the biggest impact on decreasing negative emotions such as anger and sadness, with some support natural environments promoted greater attention compared to synthetic environments.

The majority of empirical evidence does not explore exposure to real world outdoor environments, rather the use of mediated nature by means of photographs and videos are common. Although beneficial effects may be greater in outdoor nature compared to simulated environments, both display beneficial changes to individuals (Kjellgren & Buhrkall, 2010). Exposure to natural settings demonstrates increase in PA and decrease in NA in both real nature and lab-based simulated nature experiments (McMahan & Estes, 2015). Exposure to natural scenes is related to decrease of physiological measures of stress compared to non-natural scenes (Ulrich, 1981; Ulrich et al., 1991). A systematic review demonstrates the impact of natural environments in lowering

self-report levels of anxiety, anger and sadness (Bowler et al., 2010). Findings using self-report measures may be subject to presentation bias; however, they are less intrusive than physiological methods and are sometimes the only method used to measure emotion-based outcomes.

As technology progresses, new ways to present mediated nature are being tested which may provide more immersive experiences than using photographs or videos. VR is a new and under-researched area. Evidence demonstrates that following a stressor task, student participants randomised into a VR condition of photo-real nature settings where they could explore for 10 minutes, exhibited increased PA and decreased physiological measures of stress compared to active controls viewing a nature VR slide show (Valtchanov, Barton, & Ellard, 2010) or urban VR environment (Valtchanov, 2010). Similar studies have demonstrated higher rates of relaxation and increased PA following a stressor task for student participants viewing 15 minute VR of nature compared to indoor environments (Anderson et al., 2017). However, such studies that demonstrate positive results however are underpowered and utilise optimal VR equipment which is not accessible to the majority of the population. The use of VR is employed in the current study as it allows an immersive way to present natural stimuli in lieu of being physically present in natural environments. VR allows for the inclusion of sounds, limits visual distraction through use of specialised headwear, and allows participants to scan the scene. Although the current study aims to use a non-clinical sample to establish initial evidence of integrating mindfulness and nature with VR, the applications of VR may enable people to access immersive natural stimuli even if physically unable to do so; physical disability, incarceration, under mental health section, living in urban environments without easy access to natural settings.

The evidence indicates natural environments have a restorative effect on not only cognitive abilities, namely attention, but also on affect, stress recovery and subjective well-being. ART proposes that the mechanisms of these effects are due to attentional restoration following exposure to natural environments. Exposure to outdoor environments is not necessary to invoke restoration, this can be accomplished with the use of photographs, video footage and VR.

2.1.5 Integration of mindfulness as applied to ecotherapeutic practice.

Historical and current understandings of how mindfulness effects change highlights that focused attention, applied in an effortful way, to present moment experiences in a sphere of curiosity, openness and without judgement leads to benefits in a variety of outcomes. Ecotherapeutic theory, dominated by ART and SRT, suggests restoration, and therefore benefits to the individual, occur through affective and cognitive pathways due to our innate connection with nature. The author of ART has indicated a comparison between ART and mindfulness and suggests a synthesis of the two would provide a means to improve wellbeing (Kaplan, 2001). Kaplan suggests experiences in nature provide facilitation of meditative practice, and in turn that mindfulness allows for a deeper engagement with the natural environment. Therefore, if we apply

mindfully focused attentional awareness to natural stimuli this may increase the benefits of both interventions; the cognitive effort of applying mindful attention is lessened due to the involuntary way in which we process natural stimuli. This is highlighted empirically in beginner mindfulness students whose attentional demands to learning mindfulness were offset with images of nature (Lymeus et al., 2017). Natural environments are suggested to evoke a mindful state independent of effort on the part of the individual due to such settings creating an "uncomplicated state of mind similar to mindfulness" (Richardson & Hallam, 2013, p.5), with partial empirical support (Okvat, 2012; see section 1.4). Mindful engagement with nature may increase the beneficial restorative properties of such an environment due to a directed focus upon natural stimuli. The use of mindfulness may promote one's connection with nature and correlational analysis supports the link between mindfulness and nature connectedness (Barbaro & Pickett, 2015; Howell et al., 2011).

Although the theoretical underpinnings of MNAT have been discussed in the literature there remains limited evidence into its application (see Chapter 1). The only known model of MNAT is briefly discussed by McGeeny (2016) as his 'mindfulness of nature' checklist (Figure 4). The model suggests "a way to get a deeper connection with nature and ourselves" (McGeeny, 2016, p. 71). The model states one moves from 'ego' to eco' through 5 stages with initial internal focused mindfulness practice preceding mindfulness of natural environments.

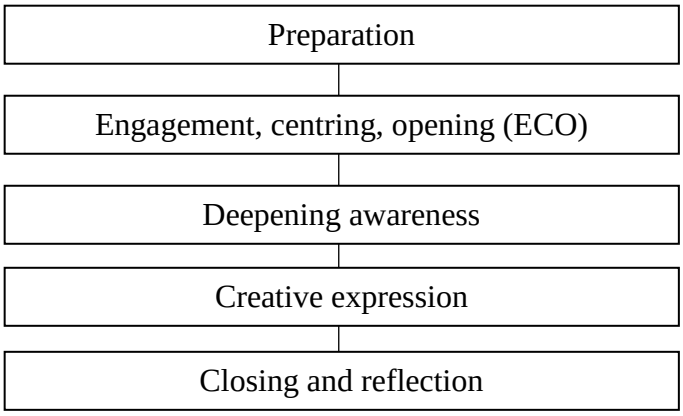

Figure 4. The mindfulness in nature model

2.1.6 Study rationale.

As described, theoretical models such as ART propose nature can facilitate meditative practice, which then allows for deeper engagement with the environment. Although there exists some emerging research in the area, these are often uncontrolled studies or include no active controls (see Chapter 1). The limited data does suggest MNAT may be more beneficial than mindfulness practice, or exposure to natural stimuli, alone. There is a need to explore this using robust methodology and employing active control comparisons.

With the continuing availability and accessibility of technology it is worthwhile exploring if potential benefits can be delivered with the use of VR to provide an immersive experience for people who may be unable to actively engage with restorative environments. Furthermore the delivery of brief standalone mindfulness practice requires little time, effort and training from the practitioner. Likewise, therapeutically interacting with nature provides little drain on resources or training on the part of the clinician. Therefore, if the current study provides support for the principle of combining mindfulness and nature in order to enhance beneficial effects of both then future research may be directed at delivering interventions within clinical contexts.

2.1.7 Research aims and hypotheses.

The current research aims to evaluate the effects of brief mindfulness within a VR natural environment, comparing this to mindfulness of a VR neutral environment and non-mindful engagement of a VR natural environment. Drawing on research of mindfulness and Ecotherapeutic literature the current author expects there will be greater benefits of MNAT conditions compared to non-MNAT conditions in regards to outcomes of affect, anxiety and behaviours related to anxiety such as worry and mind wandering. Furthermore, mindfulness definitions explored herein describe the cultivation of both awareness and acceptance of one's events and therefore there is an expectation these constructs, along with measureable levels of overall mindfulness, will also increase following intervention. Outcomes are recorded using self-report measures[2]; immediate affective states (PANAS), depressive mood (PHQ-9), current anxiety (STAI-6), general level of anxiety (GAD-7), mind-wandering (MEWS), worry (PSWQ), state mindfulness (SMS) and dispositional mindfulness (PHLMS) including mindful awareness (PHLMS-Awareness subscale) and mindful acceptance (PHLMS-Acceptance subscale). The hypotheses tested are:

H1: Anxiety, worry, NA, depressed mood and mind wandering, will reduce over the course of the intervention as measured by and STAI-6, GAD-7, PSWQ, PANAS-NA, PHQ-9, and MEWS; this reduction will be greater for MNAT condition, compared to mindfulness and non-nature, or relaxation and nature conditions.

H2: Levels of mindfulness and PA will increase over the course of the intervention as measured by the PHLMS, SMS, and PANAS-PA; this increase will be greater for MNAT condition, compared to mindfulness and non-nature, or relaxation and nature conditions.

H3: Mindful awareness and acceptance will increase over the course of the intervention measured by the PHLMS-Acceptance and PHLMS-Awareness subscales; this increase will be greater for MNAT condition, compared to mindfulness and non-nature, or relaxation and nature conditions.

[2] Full description of outcome measures used in the current paper are described in detail in section 2.2.4.

2.2 Method

Ethical approval was obtained from the School of Psychology Ethics Committee at the University of Southampton (Appendix C).

2.2.1 Design.

This cross-sectional experimental study employed a mixed design with one within-subject variable of time; 2 levels (baseline and post-intervention) for trait measures and 6 levels (baseline, T2, T3, T4, T5, post-intervention) for state measures, and one between-subject variable of condition; 3 levels (MNAT, mindfulness of neutral (MNEU), progressive muscle relaxation and nature (PMRNAT)). The dependent variables were measures of state and trait anxiety, mind wandering, worry, affect and mindfulness.

2.2.2 Participants.

Participants were undergraduate students, and non-students from the general population. Participants were recruited through an online university study website (Appendix D) and posters placed in locations across the University of Southampton (Appendix E). Upon completion, participants received either course credit or payment of £12. There was no screening stage as the study was open to all participants. A total of 70 participants completed day 1 of the intervention (baseline, T2). Participants were then sent email and text message prompts every 48 hours to undertake a further 4 sessions at home (T3, T4, T5, post-intervention). Therefore day 1 procedures were completed in the lab (baseline, T2) and day 3, 5, 7, 9 were completed at home (T3, T4, T5, post-intervention). A total of 61 participants completed the study. Participants comprised of 40 females and 21 males aged between 18 and 40 (M=26.92, SD=6.07). There were 23 full time students, and 38 non-students.

2.2.3 Procedure.

Prior to data collection a pilot study was completed using 5 participants. This identified technical and practical issues with the use of the VR headset and demonstrated the length of the procedure, and materials, used were acceptable and did not overwhelm participants.

The study was hosted online by LifeGuide (University of Southampton web based intervention platform). Participants signed up through the online study database at the University of Southampton or contacted the lead researcher directly after seeing posters or hearing about the study. For each participant, the experiment was conducted across a period of 9 days. Figure 5 visually details procedure of study for each condition.

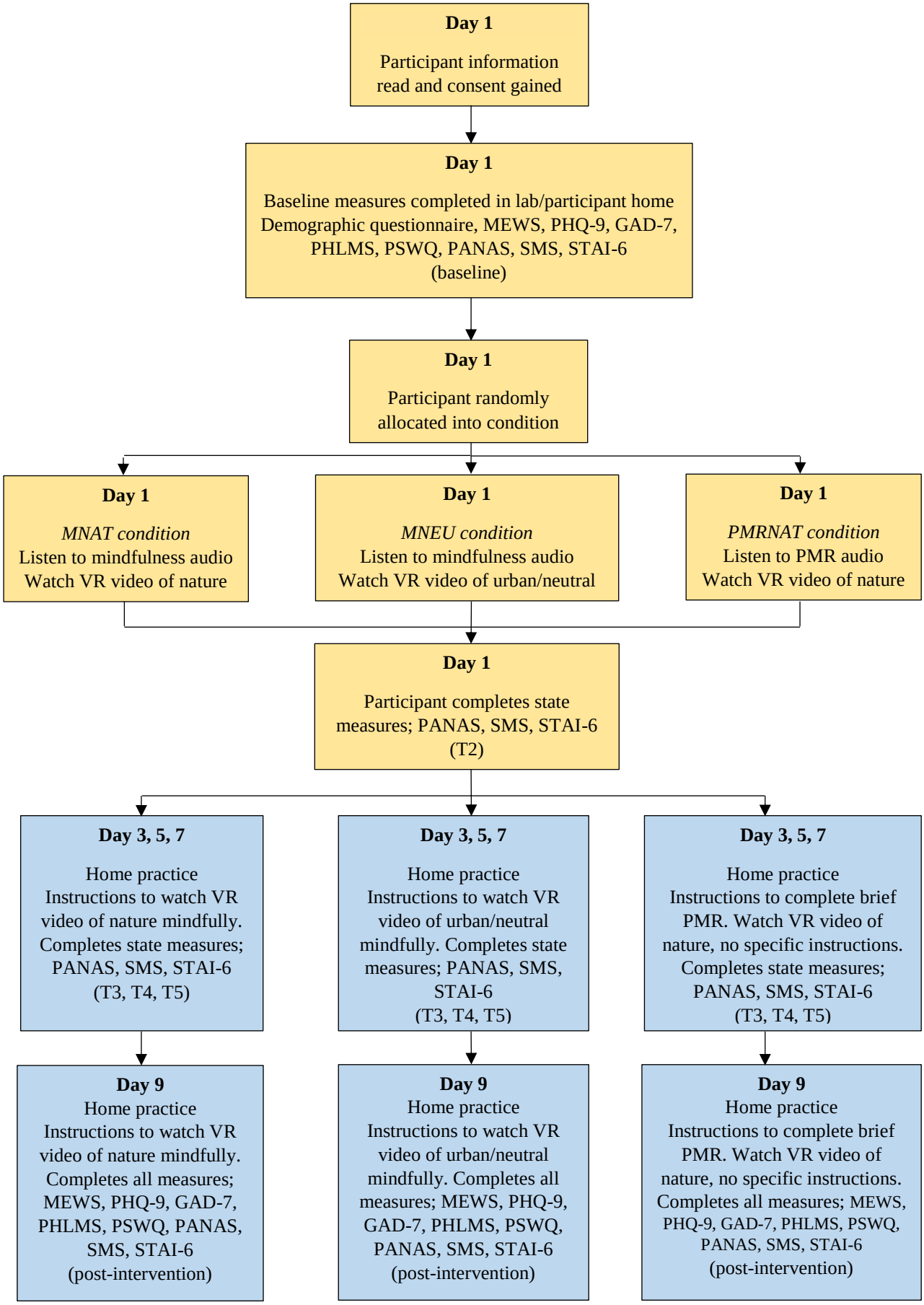

Figure 5. Study Procedure Flow Chart
Note: Equivalent to graph shaded areas in section 2.3.2, Orange shaded boxes= lab based day; Blue shaded boxes = home practice days

For day 1 procedure, participants were invited to the lab or were visited at their home. All home based procedures were as similar to lab protocol as possible. All instructions delivered verbally were scripted to ensure standardisation (Appendix F). 'Initial instructions' were read to all participants detailing the outline of the day and ensuring the participant had a smartphone in order to watch the VR videos. The experimenter left the room whilst the participant registered with LifeGuide, read the information sheet (Appendix G) and recorded consent. Participants completed the demographic questionnaire and all baseline measures; MEWS, PHQ-9, GAD-7, PHLMS, PSWQ, PANAS, SMS, STAI-6.

The experimenter returned to the room with the participant. LifeGuide randomised[3] the participant to a condition and displayed a code on the screen that the experimenter could decipher in order to present the correct procedure for the condition. There were 3 conditions; MNAT, MNEU and PMRNAT. These conditions are described in detail in section 2.2.6. Participants were unaware of the group they were assigned to. Participants were then requested to listen to an audio file based on their group allocation (Appendix H; Figure 5). 'Audio task' instructions were read to all participants (Appendix F). The experimenter left the room. Participants in the MNAT and MNEU conditions listened to a recorded guided mindfulness practice, participants in the PMRNAT condition listened to a recorded guided PMR exercise.

Upon completion the experimenter returned to the room with the participant. The experimenter used the participant's phone and played a small practice VR clip, placing the phone in a cardboard VR viewer that allows videos to be displayed in VR. 'Practice video instructions' were read to all participants (Appendix F). The participant was able to adjust the head strap and find optimum viewing condition. Once the participant was able to use the viewer the experimenter prepared the experimental video based on the allocated condition; MNAT and PMRNAT viewed a video of natural scenery, MNEU viewed a video of an urban scene (Appendix H; Figure 5). The experimenter then read standardised instructions based on the allocated condition; MNAT and MNEU to watch the video in a mindful manner, ('Instructions for video group 1 or 2', Appendix F) and PMRNAT no specific instructions ('Instructions for video group 3', Appendix F). All participants were instructed to remain seated and to look around during viewing.

After completion the experimenter returned to the room and entered a predetermined code into LifeGuide to allow continuation, reading the 'last measures' script (Appendix F) and left the room in order for the participant to complete the state measures for a second time (T2); PANAS, SMS, STAI-6. The experimenter then returned to the room and read a standardised script, 'Ending',

[3] Pure randomization was employed for the first 56 participants. Review of randomization indicated a higher number of participants in one active control condition (MNEU) compared to other conditions. LifeGuide was updated to randomise the final 5 participants into only the two conditions with fewer participants (MNAT, PMRNAT). Participants remained blinded to the condition they were in at all stages.

detailing the next aspects of the study before thanking them for their time and giving them a VR headset to take home (Appendix F). This concluded day 1, lab based data collection.

Following the lab based day 1, participants continued with the experiment at home (days 3, 5, 7, 9). Participants received a standardised automated email (Appendix I) and text message (Appendix J) 48 hours after they completed the intervention on day 1, prompting them to login to LifeGuide and complete the task for the day. This consisted of viewing the same VR video they watched on day 1 followed by completing state measures. MNAT and MNEU conditions were given instructions to watch the VR video mindfully (Appendix K), PMRNAT condition were given a short written PMR exercise to follow (Appendix L) before watching the VR video without being given any specific viewing instruction prior. Following this participants again completed state measures; PANAS, SMS, STAI-6. The next email/text was then triggered 48 hours from the last email/text. The home task was identical for days 3, 5, and 7 (T3, T4, T5).

On the final day, day 9 (post-intervention), the procedure was again identical however the participant also completed all trait measures alongside the state measures; MEWS, PHQ-9, GAD-7, PHLMS, PSWQ, PANAS, SMS, STAI-6. The participant was then presented with the debrief document (Appendix M) before selecting payment method.

2.2.4 Measures.

The current study employed the use of 8 measures. Trait measures were administered at baseline and following final experimental session; baseline, post-intervention. State measures were administered at baseline and following each of the 5 intervention occasions; baseline, T2, T3, T4, T5, post-intervention. All measures demonstrated satisfactory reliability as calculated by Cronbach's alpha values; minimum $\alpha = .55$. The majority of scales demonstrated $\alpha > .7$, suggesting good reliability (Kline, 1999; Appendix N).

Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001). The PHQ-9 is a 9-item self-report scale assessing depressive symptoms drawn from the DSM-IV diagnostic criteria (Appendix O). Respondents indicate how often they have experienced symptoms of depression over the past two weeks on a scale ranging from 0 (not at all) to 3 (nearly every day). The total range of scores is 0-27 and cut off scores of 5, 10, 15, and 20 are used to indicate mild, moderate, moderately severe, and severe depression respectively. It is a valid and reliable measure of depression severity (Kroenke et al., 2001). This measure was employed to assess depressive mood at baseline and post-intervention.

Generalised Anxiety Disorder Assessment (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). The GAD-7 is a 7-item self-report scale used as a screening tool and severity measure for generalised anxiety (Appendix P). Respondents indicate how often they have experienced symptoms of anxiety over the past two weeks on a scale ranging from 0 (not at all) to 3 (nearly

every day). The total score can range from 0-21 and cut off scores of 5, 10, and 15 are used to indicate mild, moderate, and severe levels of anxiety respectively. It is a valid and reliable measure of anxiety severity in clinical (Spitzer et al., 2006) and non-clinical populations (Löwe et al., 2008). This measure was employed to assess general anxiety at baseline and post-intervention.

The Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008). The PHLMS is a 20-item self-report measure of trait mindfulness with 2 subscales; present-moment awareness and acceptance (Appendix Q). Respondents indicate how often they have experienced each statement within the past week related to present-moment awareness and acceptance on a scale ranging from 1 (never) to 5 (very often). Total scores can be calculated for both the subscales ranging from 10-50, and overall scores of dispositional mindfulness from 20-100. It is a valid and reliable measure of trait mindfulness (Cardaciotto et al., 2008). This measure was employed to assess trait mindfulness at baseline and post-intervention.

Mind Excessively Wandering Scale (MEWS; Mowlem et al., 2016). The MEWS is a 15-item self-report measure of mind wandering (Appendix R). Respondents indicate how much each statement describes their experiences generally on a scale ranging from 0 (not at all or rarely) to 3 (nearly all of the time or constantly). Total scores can be calculated ranging from 0 to 45, higher scores indicating greater mind wandering, with a cut-off of 15 indicating underlying disorder. It is a valid and reliable measure of mind wandering (Mowlem et al., 2016). This measure was used to assess mind wandering at baseline and post-intervention.

Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990). The PSWQ is a 16-item self-report measure of trait worry (Appendix S). Respondents indicate how much each statement describes their experience generally on a scale from 1 (not at all typical of me) to 5 (very typical of me). Total scores can be calculated ranging from 16 to 80, with scores of 56 or higher signifying high trait worry (Hirsch, Mathews, Lequertier, Perman, & Hayes, 2013). It is a valid and reliable measure of trait worry (Hirsch et al., 2013; Meyer et al., 1990). This measure was used to assess worry at baseline and post-intervention.

Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS is a 20-item measure of positive and negative affect (Appendix T). Respondents rate the extent to which they feel particular emotions (10 negative and 10 positive) on a scale ranging from 1 (very slightly or not at all) to 5 (extremely). Total scores can be calculated for both the positive subscale and the negative subscale ranging from 10-50. It is a valid and reliable measure of affect (Crawford & Henry, 2004). This measure was employed to assess state affect at baseline and following each of the 5 intervention occasions (baseline, T2, T3, T4, T5, post-intervention).

The Spielberger State-Trait Anxiety Inventory-Short Form (STAI-6; Marteau & Bekker, 1992). The STAI-6 is a 6-item self-report measure of state anxiety (Appendix U). Respondents

indicate how much they feel each statement right now on a scale ranging from 1 (not at all) to 4 (very much). Total scores can be calculated by summing the six scores then multiplying by 20/6, providing a score ranging from 20-80. It is a valid and reliable measure of state anxiety (Marteau & Bekker, 1992; Tluczek, Henriques, & Brown, 2009). This measure was employed to assess state anxiety at baseline and following each of the 5 intervention occasions (baseline, T2, T3, T4, T5, post-intervention).

State Mindfulness Scale (SMS; Tanay & Bernstein, 2013). The SMS is a 21-item self-report measure of state mindfulness with 2 subscales; mental events and bodily sensations (Appendix V). Respondents indicate how much each statement describes their recent experience on a scale ranging from 0 (not at all) to 4 (very well). Total scores can be calculated for both the mental event and bodily sensation subscales ranging from 0-24 and 0-60 respectively, and overall scores of state mindfulness range from 0-84 with higher scores indicating increased mindfulness. It is a valid and reliable measure of state mindfulness (Cox, Ullrich-French, & French, 2016; Tanay & Bernstein, 2013). This measure was employed to assess state mindfulness at baseline and following each of the 5 intervention occasions (baseline, T2, T3, T4, T5, post-intervention).

2.2.5 Materials.

PMR audio. The PMR audio is an 8 minute audio clip used for the PMRNAT active control condition. The audio was downloaded from AnxietyBC. The PMR exercise involved guided instructions to relaxing groups of muscles by tensing and releasing in a systematic way throughout the body. Participants are instructed to tense certain muscles, hold the tension for a brief period of time, then "completely let go and relax" … "noticing the difference between when muscles were tense, and now that they are relaxed".

Mindfulness audio. The mindfulness audio is an 8 minute audio clip used for both the mindfulness conditions (MNAT, MNEU). The audio is downloaded from Finding Peace in Frantic World, based on MBCT. The practice is employed within MBCT and involves guided instructions to bring attention and awareness to the body and breath "to settle and ground yourself in the present moment" ... "to sense how things are in the body, not trying to control anything"… "sooner or later you may find your mind wanders, when this happens there's no need to criticise yourself just notice where the mind wanders and gently bring your attention to the breath". The recording encourages participants to notice changing sensations in the body and the flow of the breath in the present moment, whilst maintaining an awareness of where the mind may wander to (thoughts, memories, associations) and to bring the attention gently back to the area of focus. In this manner the practice allows for development of focused attention and open awareness to all current experiences moment by moment.

Cardboard viewer. The cardboard viewer is a piece of equipment that allows participants to use their smartphones to act as VR devices (Appendix W). The fold-out cardboard viewer is a low-cost system enabling a wider audience and researchers to utilise VR. Apps on the phone split the image into two. The phone is then placed within the viewer projecting one image onto each eye through convex lenses. The viewer is held in place by a Velcro strap that goes around the participant's head.

Nature video. The nature VR video is a 5 minute 360° video with full sound (Appendix X). Using the phone's gyroscope the participant is able to look around the scene. The video is made up of five, 1 minute clips of forest scenes including trees and a water source in each, consistent with Kaplan's description of restorative environments (Kaplan, 1995).

Neutral video. The neutral VR video is a 4 minute 16 second 360° video with full sound (Appendix Y). The video is made up of various clips of Los Angeles including shops and traffic at Beverly Hills, Hollywood Boulevard and Venice beach. All scenes have people walking around as would be expected in any urban setting.

2.2.6 Intervention conditions.

There were 2 audio recordings for the conditions and 2 VR videos. For clarity, the guided mindfulness recording is named 'mindfulness audio' and the guided PMR recording is named 'PMR audio'. The nature video is named 'nature VR' and the urban/neutral video is named 'neutral VR'. Each condition followed the same format with differences of audio presented, VR video presented and instructions prior to VR.

MNAT. On day 1 in the lab, the participant completes baseline measures (baseline) and is then presented with the mindfulness audio. They then view the nature VR following standardised instructions to watch the video mindfully (Appendix F) and afterwards complete set of state measures (T2). When the participant logs in to complete the home task they are presented with the standardised text about watching the nature VR mindfully (Appendix K) and click a link to watch the nature VR, following which they complete state measures (T3, T4, T5). During their final home practice, day 9, the participant completes all measures completed at baseline (post-intervention). The inclusion of internal focused mindfulness practice then external focus of nature VR is in line with McGeeny's (2016) mindfulness in nature model.

MNEU. On day 1 in the lab, the participant completes baseline measures (baseline) and is then presented with the mindfulness audio. They then view the neutral VR following standardised instructions to watch the video mindfully (Appendix F) and afterwards complete set of state measures (T2). When the participant logs in to complete the home task they are presented with the standardised text about watching the neutral VR mindfully (Appendix K) and click a link to watch

the nature VR, following which they complete state measures (T3, T4, T5). During their final home practice, day 9, the participant completes all measures completed at baseline (post-intervention).

PMRNAT. On day 1 in the lab, the participant completes baseline measures (baseline) and is then presented with the PMR audio. They then view the nature VR following no specific instructions (Appendix F) and afterwards complete state measures (T2). When the participant logs in to complete the home task they are presented with the brief PMR task (Appendix L) and click a link to watch the nature VR, following which they complete state measures (T3, T4, T5). During their final home practice, day 9, the participant completes all measures completed at baseline (post-intervention).

2.3 Results

A priori power calculations were performed using G*Power version 3 (Faul, Erdfelder, Lang, & Buchner, 2007). No current research documents effect size of MNAT interventions on the outcomes used in the current study. Therefore, based on achieving an effect size at least as great as Lymeus et al., (2017; n_p^2=24) in regards to self-report of anxiety following a brief MNAT intervention, a target sample of *N*=18, with 95% power and 5% significance level was suggested. Subsequent statistical analyses were conducted using SPSS version 22 (IBM Corp., 2016).

2.3.1 Preliminary analyses.

Group characteristics were examined (Table 2). Groups did not differ on gender, ethnicity, health concerns, or previous mindfulness. A one-way ANOVA demonstrated a significant difference between age across conditions ($F(2,58) = 4.171$, $p = .02$, $\eta_p^2 = .13$). A Bonferroni post-hoc test demonstrated that participants in the PMRNAT condition were significantly younger than the MNEU condition ($p = .022$). Furthermore a Chi-square test for independence indicated a significant association between condition and employment, $\chi^2 (2, n = 61) = .43$, $p = .004$. This reflects the fact that randomization did not equally split participants and demonstrates a younger, student sample in the PMRNAT condition. Variables of current mindfulness and frequency of any current mindfulness practice violated the assumptions of the Chi-square test and are not included in Table 2.

Table 2.

Group Characteristics

	MNAT (*n* = 18)	MNEU (*n* = 24)	PMR (*n* = 19)	Statistic
Mean Age *(SD)*	27.83 *(6.29)*	28.71 *(5.09)*	23.92 *(6.07)*	$F = 4.17^{*}$
Gender				
Female	12	14	14	$\chi^2 = 1.13$
Male	6	10	19	
Ethnicity				
Bangladeshi	1	0	0	
Chinese	0	0	2	
Other Asian	0	2	0	
White British	15	15	13	$\chi^2 = 19.64$
White Irish	0	1	0	
Other White	2	2	4	
Mixed White & Asian	0	2	0	
Other Mixed Background	0	1	0	
Any Other Ethnic Background	0	1	0	
Employment				
Employed	13	19	6	$\chi^2 = 11.30^{*}$
Full Time Student	5	5	13	
Health concern				
Yes	4	5	6	$\chi^2 = .74$
No	14	19	13	
Previous Mindfulness				
Yes	11	12	11	$\chi^2 = .57$
No	7	12	8	

*Note: * = p < .05; n = number of participants; MNAT = Mindfulness of Nature Condition; MNEU = Mindfulness of Neutral Condition; PMRNAT = Progressive Muscle Relaxation with Nature Condition*

Prior to the main analysis, assumptions were explored for data from standardised measures; normality was assessed through the use of histograms, Q-Q plots, Kolmogorov-Smirnov tests and calculating skewness and kurtosis (Appendix N). There were some violations to the data however skew and kurtosis were generally minimal[4]. Some significant Kolmogorov-Smirnov tests were observed however this may be expected due to small *n* per condition (Field, 2009). Furthermore, exploration of z-scores to determine outliers demonstrated majority of values between – 3.29 and 3.29 (Field, 2009) with the exception of single outliers for PHQ-9 baseline and post-intervention,

[4] All data was inspected and concerns were identified for the inclusion of the PANAS-NA subscale in analysis due to the severe violations of assumptions across time points (Appendix N). Transformations were applied to the PANAS-NA subscale, however violations remained. Therefore the PANAS-NA was removed from subsequent analysis in the current section.

and the STAI-6 time 2. Further exploration of this data suggested those results constituted elevated scores within the normal range and were not removed as outliers[5]. There is no consensually agreed non-parametric alternative to mixed ANOVA and due to the robustness of ANOVA against violated assumptions (Glass, Peckham, & Sanders, 1972; Schmider, Ziegler, Danay, Beyer, & Bühner, 2010) it was deemed acceptable to continue with parametric testing[6].

Table 3 displays baseline measures between groups and demonstrates no significant differences for any measure between conditions at the start of the procedure. Appendix Z displays descriptive statistics for all scales between conditions over each time point.

Table 3.

Descriptive Statistics of Standardised Measures at Baseline for Each Group.

	MNAT (*n* = 18)	MNEU (*n* = 24)	PMR (*n* = 19)	
	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*	*F*(2,58)
GAD-7	6.11(4.84)	6.88 (5.41)	8.21 (3.51)	.947
PHQ-9	5.33 (3.74)	6.04 (5.20)	7.63 (3.64)	1.37
PSWQ	51.39 (14.96)	49.08 (14.28)	54.95 (9.86)	1.04
PHLMS	66.50 (8.05)	64.46 (8.60)	64.32 (5.30)	.50
PHLMS-ACCEPTANCE	31.00 (7.05)	29.13 (7.31)	26.79 (5.21)	1.87
PHLMS-AWARENESS	35.50 (5.40)	35.33 (4.29)	37.53 (4.26)	1.38
MEWS	14.17 (7.52)	15.96 (7.84)	19.26 (6.15)	2.37
STAI-6	37.59 (11.19)	36.25 (14.19	39.64 (9.87)	.42
SMS	30.61 (15.57)	31.38 (16.84)	39.26 (16.57)	1.65
PANAS-PA	26.78 (5.08)	28.54 (7.87)	26.26 (8.26)	.58

Table 4 displays correlations between baseline measures for the total sample. Analysis demonstrates positive correlations between the anxiety and depressed mood measures as would be expected, and negative relationships between the general level of mindfulness (PHLMS) and anxiety. However, levels of current mindfulness (as measured by the SMS) and PHLMS demonstrated no significant correlation; r =.03, n = 61, p =.830. The SMS was found to correlate positively with measures of anxiety at baseline (Table 4).

[5] Outliers were removed to explore impact on data however this did not influence parametric assumptions being met and therefore were kept for data analysis.

[6] Non-parametric equivalent tests were completed in order to ensure comprehensive analysis of data (Appendix AA).

Table 4.

Correlations of Baseline Measures for all Participants.

		Scale									
		GAD-7	STAI-6	MEWS	PSWQ	PHLMS	PH-Acc.	PH-Awa.	SMS	PHQ-9	PA
All participants $N = 61$	GAD-7	--	--	--	--	--	--	--	--	--	--
	STAI-6	.50**	--	--	--	--	--	--	--	--	--
	MEWS	.63**	.40**	--	--	--	--	--	--	--	--
	PSWQ	.67**	.42**	.59**	--	--	--	--	--	--	--
	PHLMS	-.34**	-.09	-.51**	-.48**	--	--	--	--	--	--
	PH-Acc.	-.50**	-.09	-.62**	-.49**	.79**	--	--	--	--	--
	PH-Awa.	.17	-.01	.09	-.06	.46**	-.18	--	--	--	--
	SMS	.31*	.32*	.29*	.24	.03	-.25*	.41**	--	--	--
	PHQ-9	.57**	.53**	.56**	.49**	-.41**	-.49**	.05	.26*	--	--
	PA	-.08	-.38**	.07	-.03	.02	-.05	.10	.06	-.34**	--

*Note: PH-Acc. = PHLMS Acceptance subscale; PHLMS Awareness subscale; * = $p < .05$; ** = $p < .01$*

2.3.2 Main analysis.

Mixed ANOVAs were employed to examine effects of interventions across outcomes using scores from standardised measures. Assumptions of sphericity were tested for within-participant factors using the Mauchly's test. Any violation is detailed within the relevant analysis. All 3x2 ANOVAs compare baseline measures with those at post-intervention, all 3x6 ANOVAs compare measures taken at all time points; lab based day 1 (baseline, T2) and following home practice until post intervention (T3, T4, T5, post-intervention; see Figure 5). Outcome changes were then analysed using Pearson correlation to explore relationships between variables.

2.3.2.1 Effect of intervention on anxiety. GAD-7 and STAI-6 scores were explored to examine changes to anxiety. A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of interventions on general level of anxiety (measured by the GAD-7) across two time points (baseline, post-intervention). There was a significant main effect of time on anxiety ($F(1,58) = 17.27$, $p < .001$, $\eta_p^2 = .23$), but no significant effect of group ($F(2,58) = .75$, $p = .478$, $\eta_p^2 = .03$) or interaction between group and time ($F(2,58) = .43$, $p = .654$, $\eta_p^2 = .02$). This suggests general anxiety reduced over the course of the intervention, the reduction was similar for all conditions (Figure 6).

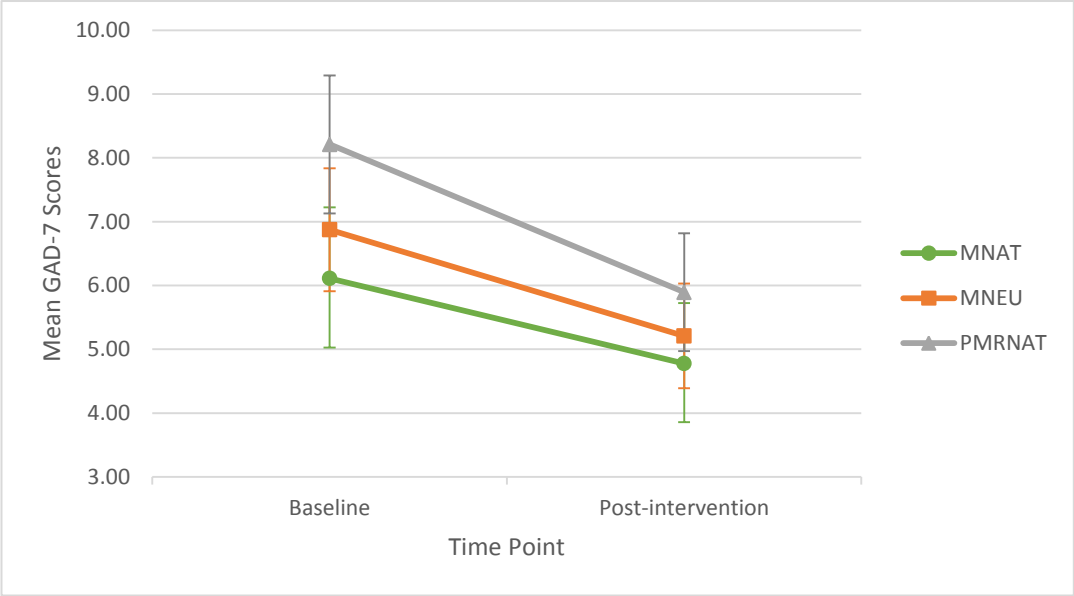

Figure 6. Mean GAD-7 at Baseline and Post-intervention for each group. Error bars = +/-1SEM

A 3 (Group) x 6 (Time) mixed ANOVA assessed the impact of the interventions on current level of anxiety (measured by the STAI-6) across six time points (baseline to post-intervention). For the within-subject measure of time, Mauchly's test suggested assumption of sphericity was violated (χ^2 (14) = 48.16, p <.001). As such, the degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity (ε =.69). There was a significant main effect of time on current anxiety (F(3.448,144.811) = 4.80, p =.002, η_p^2 =.10) but no significant effect of group (F(2,42) =.596, p =.56, η_p^2 =.03), or interaction between group and time (F(6.90,144.811) = 1.49, p =.177, η_p^2 =.07). Findings suggests current anxiety ratings reduced from baseline-T2 then returned to levels comparative with baseline over the course of the intervention, the reduction was similar for all conditions[7] (Figure 7[8]).

[7] There was an observed decrease between baseline and T2 measures of the STAI-6 which reflect day 1 measurements taken prior and post initial intervention which is the only day completed in the lab. Therefore baseline and T2 measures reflect standardised procedure as delivered by the primary experimenter under laboratory conditions whereas T3 to post-intervention were not under such conditions, being practiced at home without research supervision. In order to examine if there were differences in all 3x6 measures (STAI-6, SMS, PANAS-PA) over the laboratory based time points, analysis of day 1 only was completed (Appendix BB).

[8] Note shading of Figure 7, 11 and 16 demonstrates day 1 of the experiment which was conducted in the lab (see Figure 5). Orange shaded for lab based day; Blue shaded boxes for home practice days.

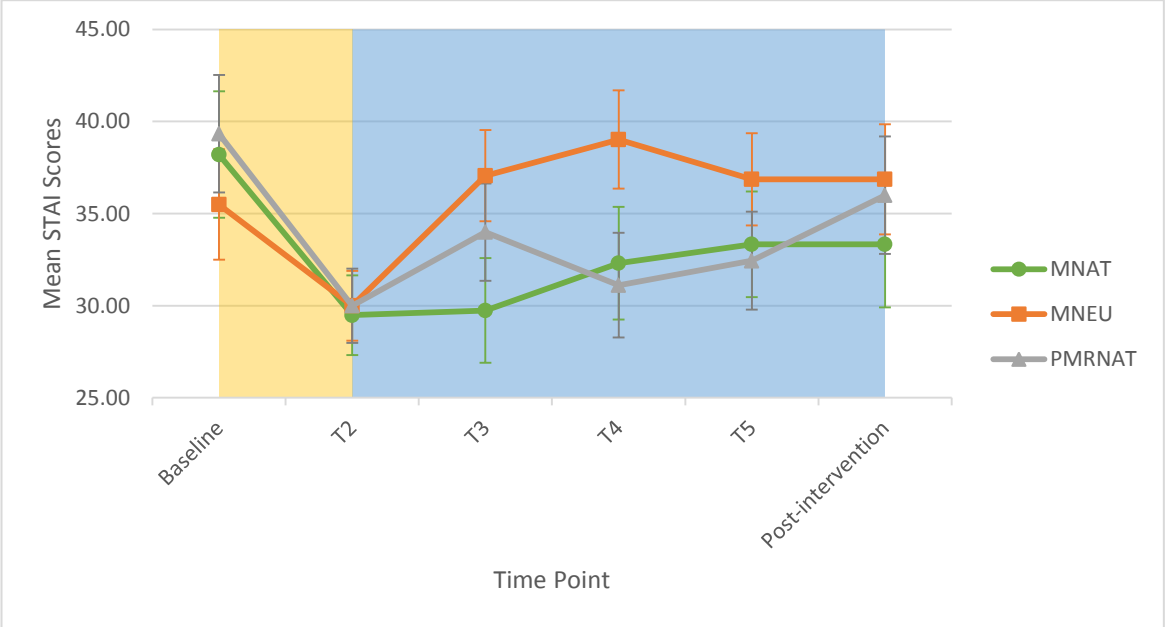

Figure 7. Mean STAI at baseline, T2, T3, T4, T5 and Post-intervention for each group. Error bars = +/-1SEM

2.3.2.2 Effect of intervention on mind wandering. MEWS scores were explored to examine changes to mind wandering. A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on mind wandering across two time points (baseline, post-intervention). There was a significant main effect of time on mind wandering ($F(1,58) = 14.55$, $p < .001$, $\eta_p^2 = .20$), but no significant effect of group ($F(2,58) = 1.80$, $p = .174$, $\eta_p^2 = .06$) or interaction between group and time ($F(2,58) = .47$, $p = .625$, $\eta_p^2 = .02$). This suggests mind wandering reduced over the course of the intervention, the reduction was similar for all conditions (Figure 8).

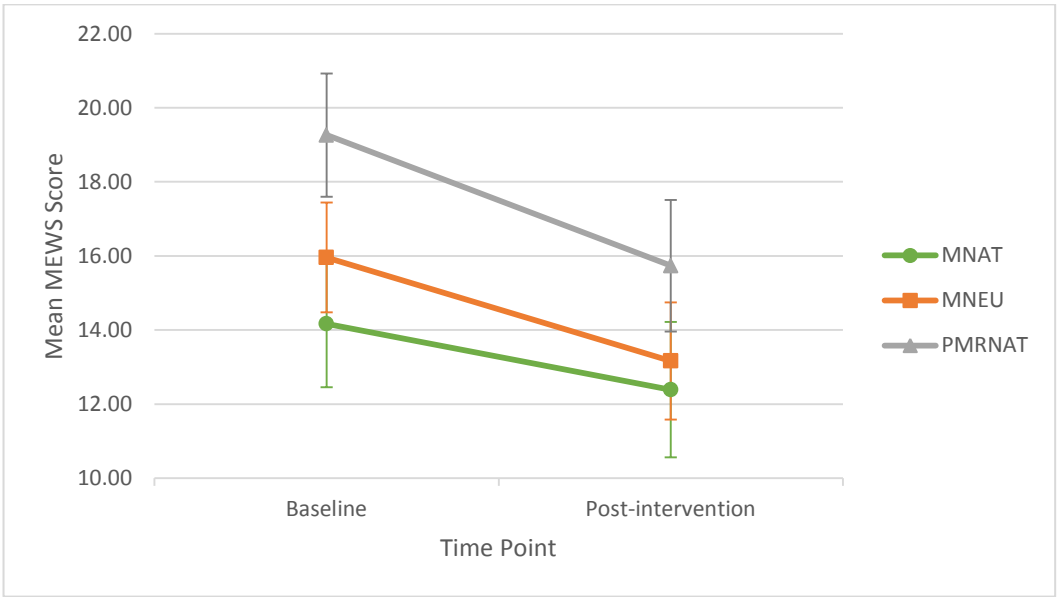

Figure 8. Mean MEWS at Baseline and Post-intervention for each group. Error bars = +/-1SEM

2.3.2.3 Effect of intervention on worry. PSWQ scores were explored to examine changes to worry. A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on worry across two time points (baseline, post-intervention). There was a significant main effect of

time on worry ($F(1,58) = 19.12$, $p < .001$, $\eta_p^2 = .25$), but no significant effect of group ($F(2,58) = .89$, $p = .415$, $\eta_p^2 = .03$) or interaction between group and time ($F(2,58) = .51$, $p = .601$, $\eta_p^2 = .02$). This suggests worry reduced over the course of the intervention, the reduction was similar for all conditions (Figure 9).

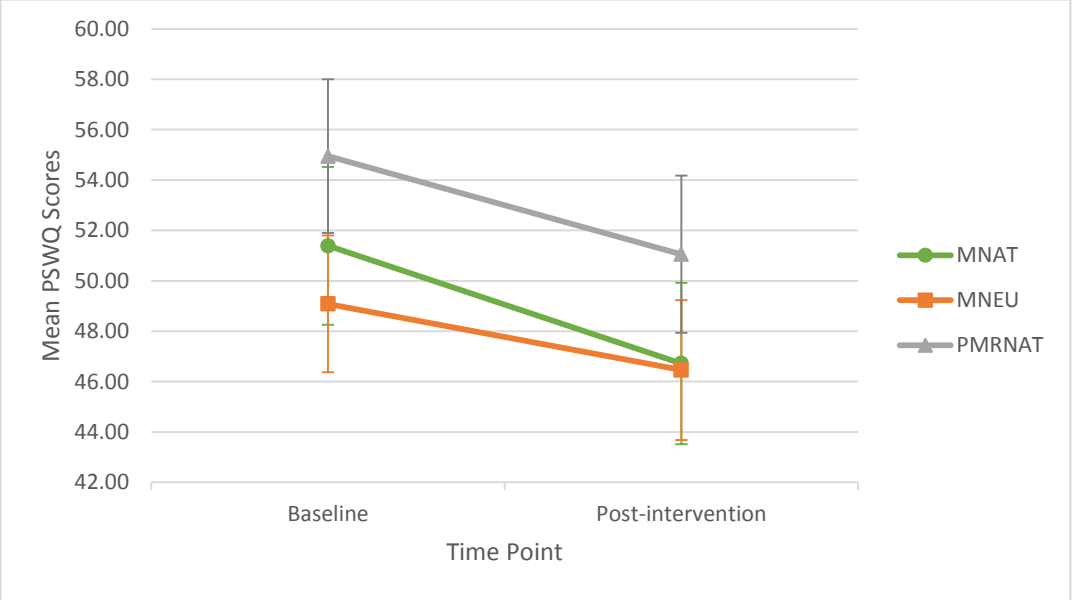

Figure 9. Mean PSWQ at Baseline and Post-intervention for each group. Error bars = +/-1SEM

2.3.2.4 Effect of intervention on affect. PHQ-9 and PANAS-PA scores were explored to examine changes to affect. A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on depressed mood (measured by the PHQ-9) across two time points (baseline, post-intervention). There was a significant main effect of time on level of depressive mood ($F(1,58) = 12.33$, $p = .001$, $\eta_p^2 = .18$), but no significant effect of group ($F(2,58) = 1.35$, $p = .266$, $\eta_p^2 = .05$), or interaction between group and time ($F(2,58) = .08$, $p = .924$, $\eta_p^2 = .003$). This suggests general depressive mood reduced over the course of the intervention, the reduction was similar for all conditions (Figure 10).

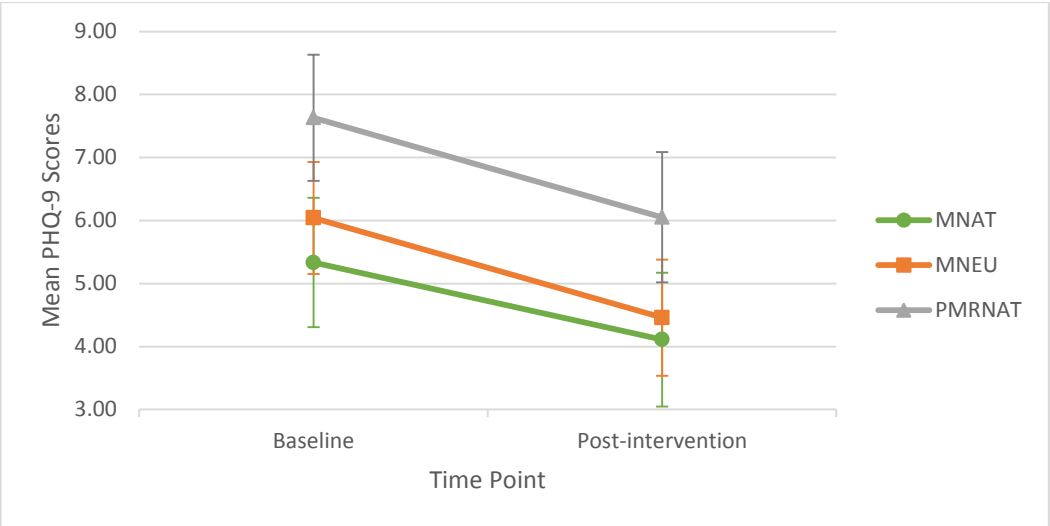

Figure 10. Mean PHQ-9 at Baseline and Post-intervention for each group. Error bars = +/-1SEM

A 3 (Group) x 6 (Time) mixed ANOVA assessed the impact of the interventions on current level of PA (measured by the PANAS-PA) across six time points (baseline to post-intervention). Mauchly's test demonstrated assumption of sphericity was violated for time, therefore corrections were made using Greenhouse-Geisser estimates. There was a significant main effect of time on PA ($F(3.92,164.68) = 6.47$, $p < .001$, $\eta_p^2 = .13$), but no significant effect of group ($F(2,42) = .30$, $p = .742$, $\eta_p^2 = .01$), or interaction between group and time ($F(7.84,164.68) = .56$, $p = .807$, $\eta_p^2 = .03$). This suggests PA reduced over the course of the intervention, the reduction was similar for all conditions (Figure 11).

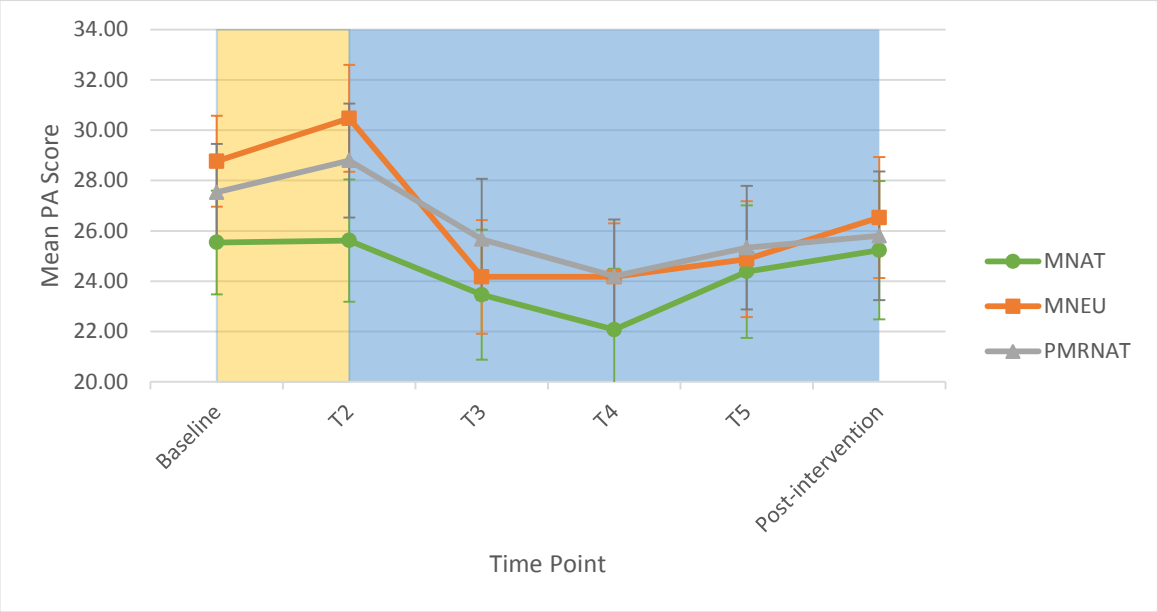

Figure 11. Mean PA at Baseline T2, T3, T4, T5 and Post-intervention for each group. Error bars = +/-1SEM

2.3.2.5 Effect of intervention on levels of mindfulness. PHLMS and SMS scores were explored to examine changes to levels of mindfulness. A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on general mindfulness (measured by the PHLMS) across two time points (baseline, post-intervention). There was no significant main effect of time on level of general mindfulness ($F(1,58) = 2.80$, $p = .099$, $\eta_p^2 = .05$), group ($F(2,58) = 1.06$, $p = .354$, $\eta_p^2 = .04$), or interaction between group and time ($F(2,58) = 1.35$, $p = .267$, $\eta_p^2 = .05$). Although there was a trend for increased general mindfulness for mindfulness-based conditions (MNAT and MNEU), findings suggest no change to general levels of mindfulness over the course of the intervention for all conditions (Figure 12).

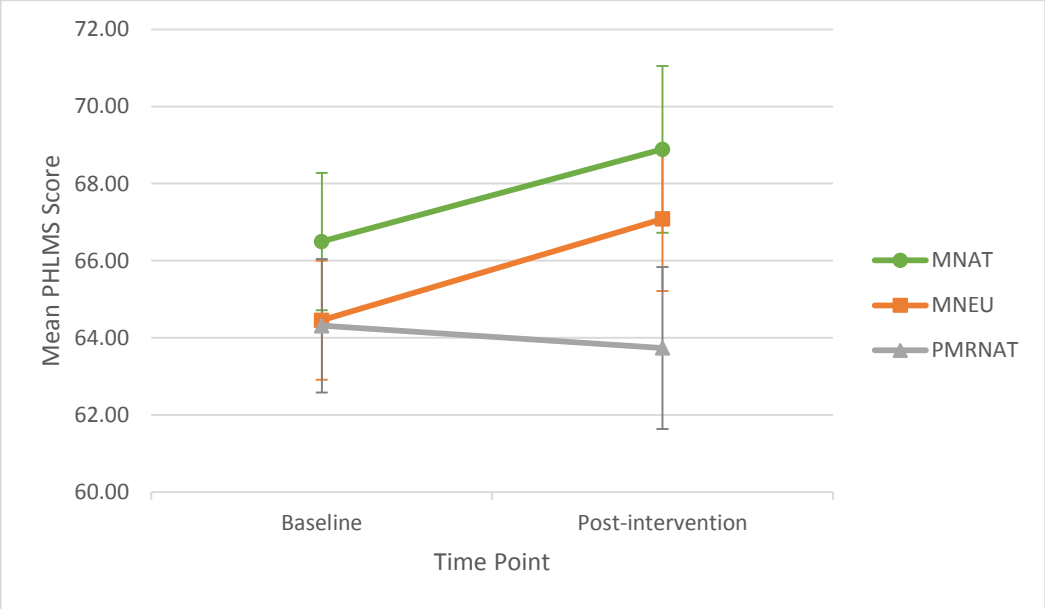

Figure 12. Mean PHLMS at baseline and Post-intervention in each group. Error bars = +/-1SEM

A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on mindful awareness (measured by PHLMS-Awareness subscale) across two time points (baseline, post-intervention). There was no significant main effect of time on mindful awareness ($F(1,58)$ =.11, p =.737, η_p^2 =.002), group ($F(2,58)$ =.87, p =.424, η_p^2 =.03), or interaction between group and time ($F(2,58)$ = .52, p =.595, η_p^2 =.02). This suggests no change to mindful awareness over the course of the intervention for all conditions (Figure 13).

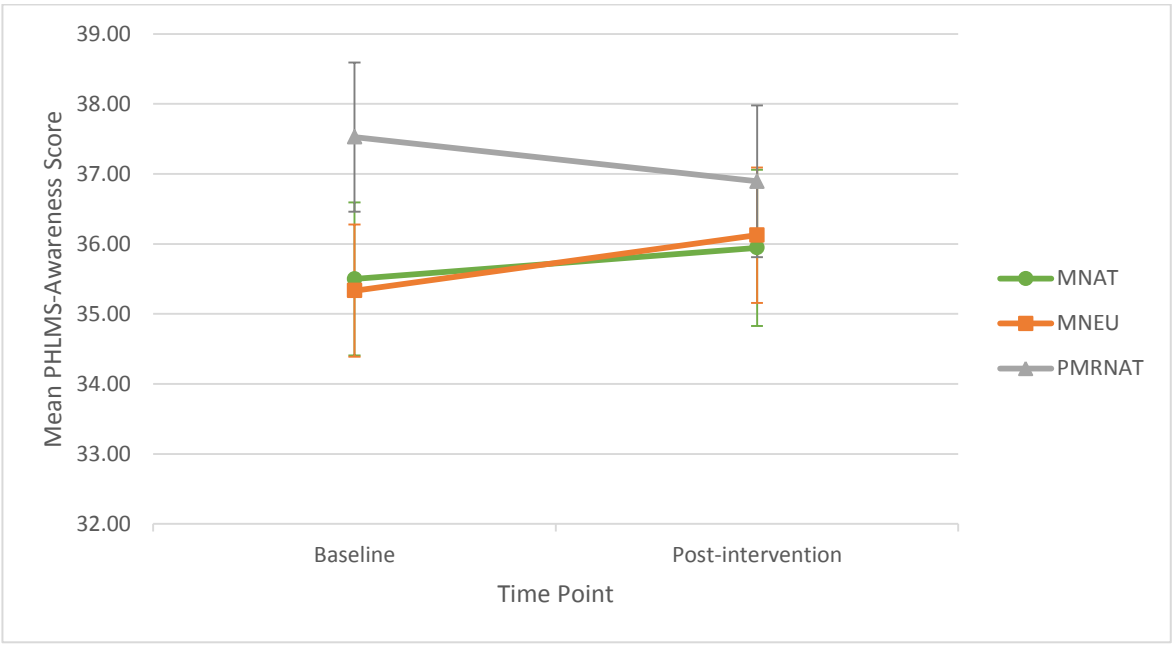

Figure 13. Mean PHLMS-Awareness at baseline and Post-intervention for each group. Error bars = +/-1SEM

A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on mindful acceptance (measured by PHLMS-Acceptance subscale) across two time points (baseline, post-intervention). There was no significant main effect of time on mindful acceptance ($F(1,58)$ =

3.51, p =.066, η_p^2 =.06), but there was a marginally significant effect of group (F(2,58) = 3.16, p =.050, η_p^2 =.10), and no significant interaction between group and time (F(2,58) =.79, p =.460, η_p^2 =.03). Employing the Bonferroni post-hoc test, participants in the MNAT condition had higher acceptance scores than the PMR condition (p =.049). This suggests no change to mindfulness acceptance over time but participants in the MNAT condition had higher levels of mindful acceptance (Figure 14).

Due to the marginally significant effect of group on mindful acceptance (p =.050), further investigation was warranted. Due to non-significant interaction of time and acceptance the data suggests the difference present at baseline is not significantly different to that at post-intervention, however the group difference at post intervention is large enough between MNAT and PMRNAT to demonstrate a significant difference. One Way ANOVAs were completed to explore this effect in more detail. Table 3 details no significant difference between groups for PHLMS-Acceptance at baseline; F(2,58) = 1.87, p =.164, η_p^2= .06

A one way between-participants ANOVA was conducted to explore the impact of condition on mindful acceptance post-intervention. There was a significant difference for the groups; F (2,58) = 3.64, p =.033, η_p^2 =.11. Employing the Bonferroni post-hoc test, participants in the MNAT condition had higher acceptance scores than the PMRNAT condition at post-intervention (p =.033; Figure 15).

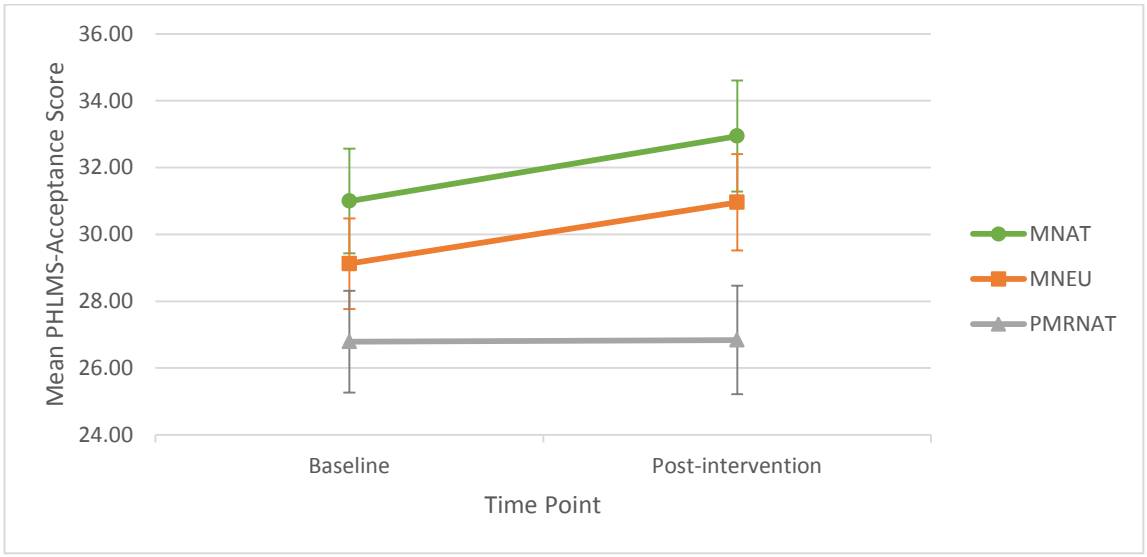

Figure 14. Mean PHLMS-Acceptance at Baseline and Post-intervention for each group. Error bars = +/-1SEM

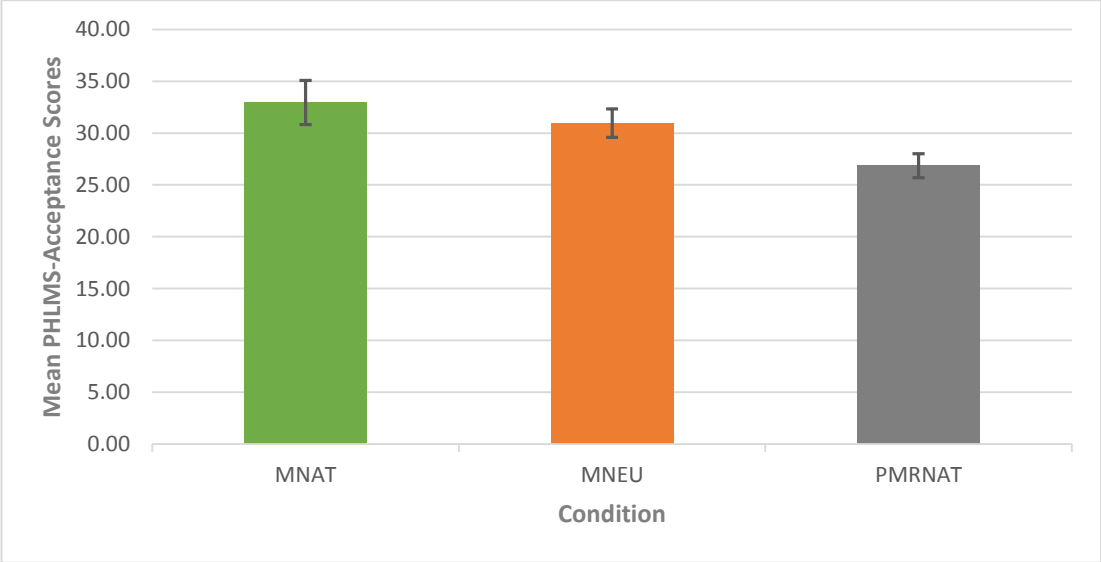

Figure 15. Mean PHLMS-Acceptance at Post-intervention for each group. Error bars = +/-1SEM

A 3 (Group) x 6 (Time) mixed ANOVA assessed the impact of the interventions on current level of mindfulness (measured by the SMS) across six time points (baseline to post-intervention). Mauchly's test demonstrated assumption of sphericity was violated for time, therefore corrections were made using Greenhouse-Geisser estimates. There was a significant main effect of time on current mindfulness ($F(2.82,118.33) = 11.72$, $p < .001$, $\eta_p^2 = .22$), but no significant effect of group ($F(2,42) = 1.6$, $p = .203$, $\eta_p^2 = .07$), or interaction between group and time ($F(5.64,118.33) = 1.13$, $p = .348$, $\eta_p^2 = .05$). This suggests current mindfulness levels increased over the course of the intervention, the increase was similar for all conditions (Figure 16).

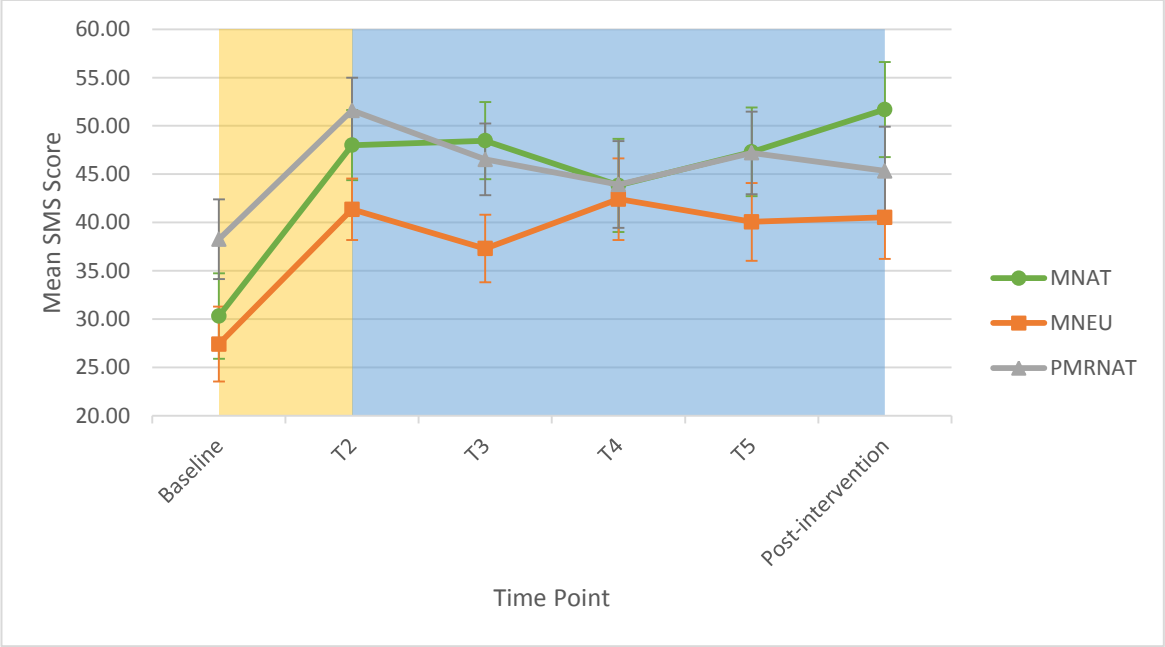

Figure 16. Mean SMS at baseline T2, T3, T4, T5 and Post-intervention for each group. Error bars = +/-1SEM

2.3.3 Correlations.

Table 5 displays correlations between the change scores of measures (final time point – baseline) and variables of age, previous mindfulness, employment and health concerns for the overall sample and by condition. Results demonstrate variability in correlations between the groups, with majority of significant relationships found for the MNAT condition when exploring across groups.

Overall the data presents difficulties for analyses conducted herein. As described there were issues of normality and group differences at baseline. As groups could not be matched by removal of outliers we must approach all results with caution and run supplementary analyses including non-parametric tests. Following investigation of correlations there may be confounding variables to account for, therefore a series of ANCOVAs were considered however as there were variation between groups in terms of age and employment this violates use of ANCOVA (Field, 2009). Furthermore, ANCOVA was deemed inappropriate as this does not provide a means to 'control' for such variables (Field, 2009; Miller & Chapman, 2001).

Table 5.

Correlations of Difference Scores and Age for all Participants, and by Condition.

		Scale									
		GAD	STAI-6	MEWS	PSWQ	PHLMS	PH-Acc.	PH-Awa.	SMS	PHQ-9	PA
All participants *N* = 61	GAD-7	--	--	--	--	--	--	--	--	--	--
	STAI-6	.24	--	--	--	--	--	--	--	--	--
	MEWS	.35**	.20	--	--	--	--	--	--	--	--
	PSWQ	.14	.36**	.45**	--	--	--	--	--	--	--
	PHLMS	-.16	-.09	-.42**	-.31*	--	--	--	--	--	--
	PH-Acc.	-.17	-.01	-.46**	-.23	.74**	--	--	--	--	--
	PH-Awa.	-.05	-.12	-.10	-.20	.65**	-.03	--	--	--	--
	SMS	-.07	.03	.04	-.13	.29*	.01	.42**	--	--	--
	PHQ-9	.28*	.32*	.58**	.53**	-.18	-.25	.02	.11	--	--
	PA	-.32*	-.43**	-.30*	-.27*	.27*	.16	.23	.35**	-.22	--
	Age	-.09	.07	-.18	.18	.25*	.36**	-.03	.16	-.03	.12
MNAT *n* = 18	GAD-7	--	--	--	--	--	--	--	--	--	--
	STAI-6	.70**	--	--	--	--	--	--	--	--	--
	MEWS	.77**	.61**	--	--	--	--	--	--	--	--
	PSWQ	.58*	.49*	.48*	--	--	--	--	--	--	--
	PHLMS	-.12	-.27	-.43	-.31	--	--	--	--	--	--
	PH-Acc.	-.08	-.07	-.51*	-.11	.84**	--	--	--	--	--
	PH-Awa.	-.10	-.37	.05	-.39	.47*	-.09	--	--	--	--
	SMS	-.03	-.004	-.05	-.13	.14	-.16	.52*	--	--	--
	PHQ-9	.56*	.37	.60**	.71**	-.30	-.27	-.12	-.06	--	--
	PA	-.55*	-.60**	-.70**	-.43	.58*	.43	.35	.28	-.39	--
	Age	-.01	-.11	-.34	.11	.51*	.59**	-.03	.14	-.25	.33
MNEU *n* = 24	GAD-7	--	--	--	--	--	--	--	--	--	--
	STAI-6	.01	--	--	--	--	--	--	--	--	--
	MEWS	.20	.002	--	--	--	--	--	--	--	--
	PSWQ	-.06	.32	.18	--	--	--	--	--	--	--
	PHLMS	-.45*	.01	-.19	-.24	--	--	--	--	--	--
	PH-Acc.	-.38	.08	-.19	-.08	.69**	--	--	--	--	--
	PH-Awa.	-.27	.01	-.09	-.26	.74**	.02	--	--	--	--
	SMS	-.09	.12	-.03	-.18	.58**	.30	.52**	--	--	--
	PHQ-9	-.10	.24	.52*	.41*	.15	-.02	.23	.25	--	--
	PA	-.06	-.41*	-.05	-.26	-.01	-.36	.33	.37	.03	--
	Age	.07	.29	-.02	.53**	.04	.01	.04	.27	.54*	-.02
PMR *n* = 19	GAD-7	--	--	--	--	--	--	--	--	--	--
	STAI-6	.07	--	--	--	--	--	--	--	--	--
	MEWS	.16	.01	--	--	--	--	--	--	--	--
	PSWQ	-.003	.21	.74**	--	--	--	--	--	--	--
	PHLMS	-.05	-.13	-.70**	-.45	--	--	--	--	--	--
	PH-Acc.	-.18	-.09	-.72**	-.59**	.66**	--	--	--	--	--
	PH-Awa.	.11	-.08	-.25	-.03	.70**	-.08	--	--	--	--
	SMS	-.18	.001	.09	.03	.01	-.23	.24	--	--	--
	PHQ-9	.33	.41	.01	.02	.22	-.43	-.06	.74	--	--
	PA	-.45	-.14	-.17	-.03	-.03	.37	-.06	.48*	-.35	--
	Age	-.38	-.10	-.28	-.15	.01	.26	-.23	-.07	-.27	.002

*Note: * = p < .05; ** = p < .01*

3.1 Discussion

The findings from this study do not support the predictions made that MNAT interventions would lead to greater reduction in anxiety, worry, mind wandering, depressed mood or increased PA and levels of mindfulness. Analyses suggested hypotheses were not supported by the data and are rejected, although there was partial support for H3. Results indicate that self-report scores of anxiety, worry, depressed mood and mind wandering reduced similarly for each condition over the period of the experiment and state mindfulness (measured by SMS) rose over time similarly for each condition, with no change to dispositional mindfulness. This is consistent with literature noting an inverse relationship between anxiety and mindfulness (section 2.1.2).

Current mindfulness levels (measured by SMS) increased similarly for all groups over time. There was a marginally significant main effect of group for mindful acceptance (measured by PHLMS-Acceptance); however, mindful acceptance, general levels of mindfulness (measured by PHLMS) and mindful awareness (measured by PHLMS-Awareness) did not change over time across conditions. Research suggests that increasing state mindfulness through repeated practice is linked to greater trait mindfulness (Kiken et al., 2015), although the current study did not reflect this, perhaps this is due to how the mindfulness interventions were delivered (see below). There was partial support that mindful acceptance was greater for MNAT compared to PMRNAT. As noted, acceptance is a component of mindfulness (Bishop et al., 2004; Germer et al., 2005); however, the MNEU condition did not demonstrate as high acceptance scores as MNAT. Due to no interaction effect with time, this finding was investigated further (section 2.3.2.5) suggesting that differences existed at baseline, although not statistically significant but reached significance at post-intervention, rather than being an effect of the intervention. MNAT acceptance was significantly greater than PMRNAT post-intervention, although MNEU acceptance scores at post-intervention were not significantly different from PMRNAT or MNAT conditions. These results should be interpreted with caution however provide partial support to H3.

There was a decline in PA for all groups over time. This finding was unusual as evidence suggests PA is negatively related to depression (Brown, Chorpita, & Barlow 1998; Watson et al., 1988) we would expect PA to increase as depressive mood decreased which was not found. PA is not reported to be associated with anxiety, although NA is (Brown et al., 1998). In the current study the NA subscale could not be incorporated into analysis due to extreme violations of normality, and therefore relationship to other measures was not completed. Furthermore research has demonstrated a link between PA and natural settings (McMahan & Estes, 2015) which was not replicated in this study. Perhaps participants may have become fatigued and apathetic when asked repeatedly to reflect on mood, as suggested by anecdotal feedback of boredom following repeated home tasks.

Taken together, these results suggest similar changes over time, and that intervention had no impact on outcomes – there was no added benefit of MNAT condition when compared to active

controls. As noted there were some complications with the data; normality (section 2.3.1) and potential confounding factors (section 2.3.3). The latter being related to the problems with the randomisation process (section 2.2.3, footnote 1). Despite having randomisation built into the intervention this was unsuccessful in allocating matched groups. In order to approach analysis appropriately, supplementary analyses were conducted. Non-parametric equivalent tests were conducted due to non-normal distributions (Appendix AA) and demonstrated equal finings to reported ANOVAs. These findings suggest that the current study would be best replicated with evenly balanced groups as the randomisation method completed herein was unsuccessful and therefore led to violated datasets.

Correlations revealed some expected and unexpected relationships between variables. Measures of anxiety and anxious related behaviours were mainly related positively as would be expected. Unexpectedly, current mindfulness levels (measured by SMS) correlated positively with anxiety and depressive mood measures at baseline. This is not consistent with the literature on mindfulness and anxiety, and mindfulness and mood demonstrating an inverse relationship (Brown & Ryan, 2003). This is further complicated by the observation that at baseline SMS did not correlate with PHLMS (Table 4). Following intervention, SMS relationships to other variables changed and was unrelated to anxiety based outcomes and positively related to PHLMS and age. It is unclear what this indicates. During piloting of the procedure a different state mindfulness measure was used, the Toronto Mindfulness Scale (Lau et al., 2006). Feedback suggested that at baseline this was a confusing measure as it was designed to encourage reflection on a recent meditative practice. Therefore the SMS was substituted for this scale which was not dependent on having recently completed a meditation practice. However, although not reflecting on a recent meditative practice, perhaps the SMS was still difficult for participants to reflect on at baseline (the only time point without a prior VR task) but following VR and mindful practice, reflections of experiences were more identifiable.

Previous evidence has demonstrated the effectiveness of MNAT conditions when compared to active controls (see Chapter 1), therefore it is important to explore what aspects of this study impacted on findings herein; no significant additional benefits of MNAT procedures compared to nature alone or mindfulness alone. Firstly, the specification of technology used to present the VR may have impacted upon findings. Of the documented studies employing VR and nature, the authors detail advanced equipment in order to present VR. High specification processors were used to create and run the VR environments rendering photo realistic settings. Participants were able to control movement by use of a wireless mouse (Valtchanov, 2010), and received somatosensory feedback from rumble platforms as they explored the environments (Valtchanov et al., 2010). As a minimum, participants were shown VR environments for 15 minutes using an Oculus Rift (Anderson et al., 2017) rather than cardboard viewers. Therefore we may question the limitations of technology employed in the study. Although piloting and feedback during

experimentation revealed people were able to view the scenes clearly this would have been inferior to the technology used in the reported papers. This should be considered if employing VR research in the future.

Secondly, we may question the fidelity of mindfulness interventions delivered. It has been suggested the facilitators' embodiment of mindfulness in teaching is central to the facilitation of learning (van Aalderen, Breukers, Reuzel, & Speckens, 2014). In clinical practice, especially when initially introducing mindfulness, it is helpful to be guided through the experience by a facilitator. During the initial mindfulness practice in the lab, participants (MNAT and MNEU) did complete a guided meditation based on MBCT. However, prior to all VR experiences participants were given instructions verbally by the experimenter (lab, day 1) or read written instructions to engage mindfully with the video prior to viewing VR (home based days; 3, 5, 7, 9). This means participants may have not been engaged mindfully throughout the duration of the practice. Typically during guided practice facilitators may ask participants to notice mind wandering and to bring attention back to the focus of the practice. Participants new to mindfulness often require prompting to note when they are with their sensory experiences or with their thoughts – this skill develops through practice. Without such guidance it is unclear if participants in the mindfulness conditions were actually employing mindfulness as they viewed the VR or whether their viewing was actually qualitatively similar to the PMRNAT condition. Additionally, in order to facilitate mindfulness practice instructors will conduct inquiry following mindfulness based practice (see Segal et al., 2012). This process enables learning by asking feedback from participants about their experience, encouraging reflection and exploration and linking observations to the theme of the programme (Crane et al., 2015). Without such inquiry, development of the participants' mindfulness practice may have been stilted or halted altogether. The literature exploring brief mindfulness interventions (see Chapter 1) does not always include inquiry, however many studies are unclear whether they have employed an inquiry stage or not as protocols are often lacking.

Thirdly, there were no means to closely monitor home practice. Data collection software enabled the current experimenter to assess if participants had completed measures at each time point. However, there is no way to know if participants engaged in the VR practice before completing measures. Indeed, even if participants did engage in the practice prior to completing measures there is no guarantee they engaged mindfully with the practice or if they were in a distraction free environment. This could have been rectified by completing each practice in the lab rather than allow home practice. Furthermore, the addition of qualitative feedback following the full experiment may have highlighted difficulties presented to participants. Anecdotal feedback suggested some participants were 'bored of the same video' suggesting some resistance or at least negative perceptions of the study. Again, facilitator led practice would support participants noting this 'boredom' in a mindful manner, re-engaging with the task at hand.

Individually all these factors may not have had a large effect on outcomes, however taken as a whole it appears the intervention may have been diluted by the technology employed and the mechanisms of delivering mindfulness. Therefore the findings that MNAT interventions produced no different effects compared to non-MNAT interventions may potentially be due to methodological issues rather than theoretical inaccuracies. As other similar research has noted improved benefits from MNAT conditions, the principle appears sound, however the delivery herein may be at fault.

3.1.1 Limitations.

The study hypotheses (section 2.1.7) were broad in nature as this was a novel design, and previous MNAT literature demonstrated a number of outcomes; however, this meant that the hypotheses became non-specific and did not suggest a primary outcome for interventions. Reflecting on the literature and current research question, it is suggested that a primary outcome measure of either state anxiety or levels of state mindfulness would have been appropriate. These measures would be selected as beneficial changes in state anxiety is indicated in research exploring mindfulness and/or Ecotherapeutic interventions. State mindfulness would be worthy of being primary outcome due to the theoretical discussion that nature can facilitate mindful states which in turn can lead to greater connection with natural, restorative environments.

As noted in Table 2, there were significant participant differences between randomised conditions. This suggests the randomisation procedure was not effective in reducing sample bias. This was due to the ‘pure randomisation’ method used in which software randomly allocated each new participant at a 33.33% chance of allocation to each condition. As noted, initially there was increased allocation to the MNEU condition, as such this was closed as a potential allocation for the final 5 participants. In future research ensuring robust, stratified randomisation techniques is important.

The use of accessible, affordable and easy to use VR viewers may have compromised the immersive effect of more technologically advanced equipment. At the time of planning the current study, use of cardboard VR viewers was an innovative and affordable means to deliver VR interventions, however, recent technological developments mean better technology could have been utilised to deliver the VR. This should inform future researchers to be conscious of decisions around selecting equipment. Furthermore, although the nature VR matched closely to Kaplan’s criteria of restorative environments, there may have been confounding factors within the neutral VR. Although it is common to use urban environments when exploring effects against natural environments, the current neutral VR included presence of people which is uncommon in the literature. Therefore, this may have elicited greater attentional load than an empty urban environment. Additionally, if people had visited Los Angeles there may be associations, positive or negative, from such experiences which could impact upon outcome measures. Future research

employing urban environments for comparison should control for addition of people, especially if they are not present in the natural environment conditions.

Although piloting suggested the number of measures used was suitable and acceptable, anecdotal feedback from some participants following the study suggested 'boredom' with completing regular outcome measures. This may have also impacted upon post-intervention data in which all eight measures were completed. Furthermore, it is now considered that a scale measuring connectedness to nature should have been utilised in the study (see Chapter 1). Such self-report scales exist which have been well validated such as the connectedness to nature scale (CNS; Mayer & Frantz, 2004). Connectedness to nature should have been assessed at baseline as it is unclear where participants sit upon this spectrum. Connectedness to nature is linked to trait mindfulness (Wolsko & Lindberg, 2013) therefore when employing any MNAT based procedure this factor should be measured in order to explore mediating effects of the construct on outcomes.

3.1.2 Future research.

It is proposed that future research into MNAT is worthwhile, however procedures should be methodologically sound. Detailed protocols of MNAT procedures would aid transparency of how interventions are delivered, and to ascertain whether the presence of an instructor, facilitating practice and an inquiry process, is a necessary factor in such an approach. Furthermore it is felt the use of cardboard VR viewers may still be beneficial however this should be lab based in order to ensure practice is completed regularly and consistently.

The current researcher believes the first step in future research should be to develop and test a brief intervention comparing MNAT to MNEU and PMRNAT conditions without the use of VR. A robust intervention, that replicates effects found in MNAT empirical literature, should be developed in order to have a meaningful structure to inform future MNAT intervention delivery. Following this initial research, moving onto the addition of VR would be worthwhile. If findings then support the hypotheses proposed herein, research may only then move to applying such interventions with clinical populations of affective and anxiety disorders.

3.1.3 Conclusion.

The findings from this study do not differentiate any effects from the experimental condition (MNAT) compared to active controls (MNEU and PMRNAT). Results indicate a similar pattern of change across outcomes regardless of intervention which did not provide support for the hypotheses. Methodological and procedural issues may have impacted on results and therefore recommendations for future MNAT research are suggested such as employing stratified randomisation to provide balanced groups and to employ protocoled mindfulness interventions potentially guided by a facilitator.

APPENDIX A: Authors Contacted

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Chan Woo Park - Korea Forest Research Institute (Korea)

Dr Miles Richardson – University of Derby (UK)

Keong Sub Shin - Sam Medical Center (Korea)

Dr Paul Stevens – Journal of Ecopsychology (UK)

Beom Seok Yang - Korea Institute of Science and Technology (Korea)

APPENDIX B: QualSyst Checklist

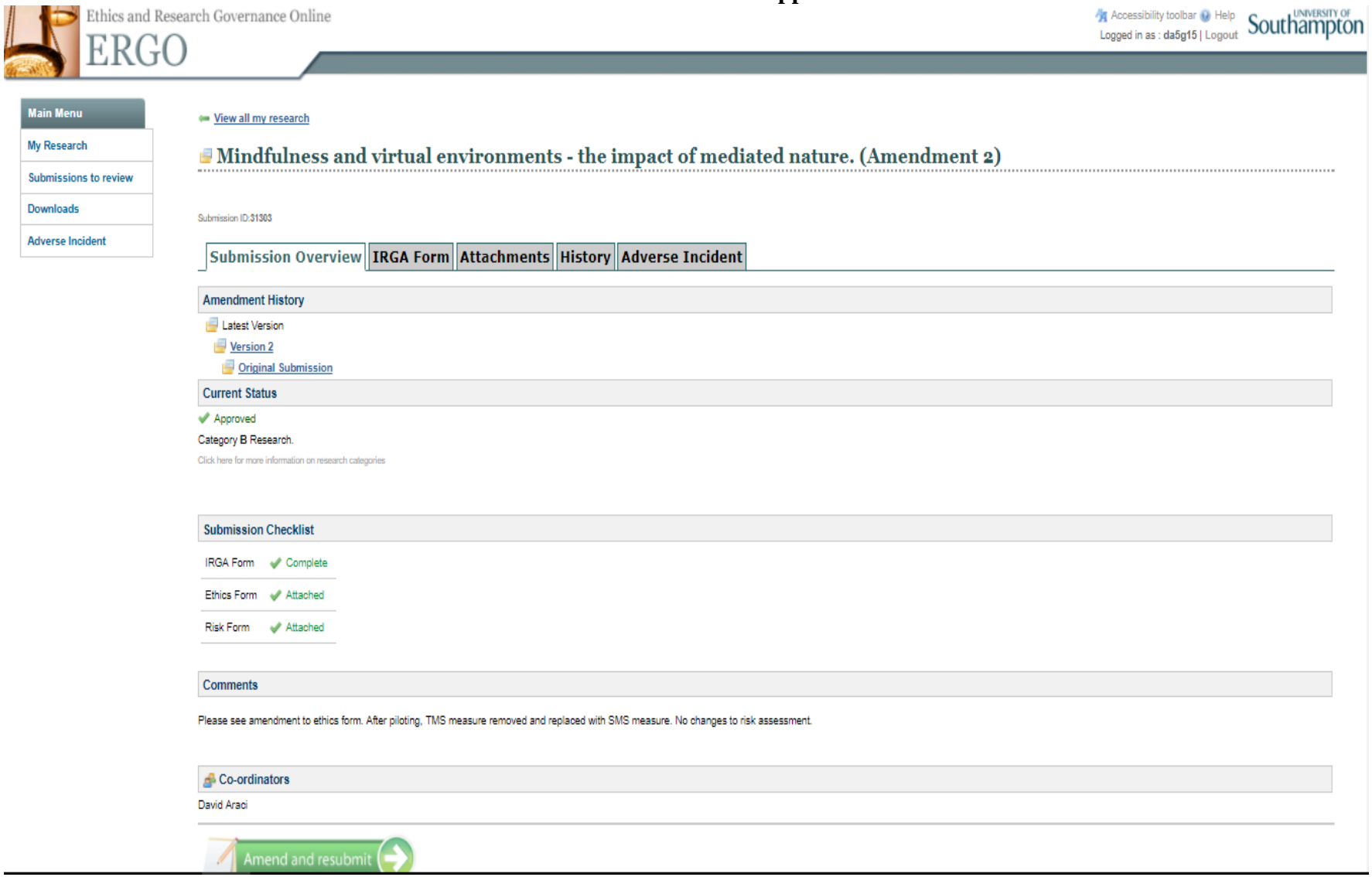
	Objective sufficiently described	Design evident and appropriate?	Method of subject selection is described and appropriate.	Subject characteristics or sufficiently described?	Random allocation to treatment group was described?	Interventional and blinding of investigators to intervention is reported?	Interventional and blinding of subjects to intervention was reported?	Outcome measures well defined and robust to measurement bias?	Sample size appropriate?	Analysis described and appropriate?	Some estimate of variance is reported for the main results/outcomes?	Controlled for confounding?	Results reported in sufficient detail?	Do the results support the conclusions?	Total score (%)
de Bloom et al. (2017)	2	2	1	2	1	N/A	N/A	1	1	2	1	2	2	2	79.2
Duvall (2011)	1	2	2	2	2	0	N/A	2	1	2	2	1	2	2	80.8
Kim, Lim, Chung, & Woo (2009)	2	2	1	1	1	N/A	N/A	2	1	2	1	1	2	2	75
Korpela, Savonen, Anttila, Pasanen, & Ratcliffe, (2017)	1	2	1	2	N/A	N/A	N/A	2	2	2	1	1	2	2	81.8
Kwon et al. (n.d.)	2	2	2	2	1	N/A	0	2	1	2	2	1	2	1	76.9
Lymeus, Lumdgren, & Hartig (2017)	2	2	1	2	1	0	N/A	2	1	2	2	2	2	2	80.8

Note: 14 items (Appendix B) were scored depending on the degree to which the specific criteria were met ("yes" = 2, "partial" = 1, "no" = 0). Items not applicable to a particular study design were marked "n/a" and were excluded from the calculation of the summary score. A summary score was calculated for each paper by summing the total score obtained across relevant items and dividing by the total possible score (i.e.: 28 – (number of "n/a" x 2))

APPENDIX B: QualSyst Checklist (Cont.)

	Objective sufficiently described	Design evident and appropriate?	Method of subject selection is described and appropriate.	Subject characteristics or sufficiently described?	Random allocation to treatment group was described?	Interventional and blinding of investigators to intervention is reported?	Interventional and blinding of subjects to intervention was reported?	Outcome measures well defined and robust to measurement bias?	Sample size appropriate?	Analysis described and appropriate?	Some estimate of variance is reported for the main results/outcomes?	Controlled for confounding?	Results reported in sufficient detail?	Do the results support the conclusions?	Total score (%)
Okvat (2012)	2	2	1	2	1	0	0	2	0	2	2	2	2	1	67.9
Sato (2016)	2	2	2	2	1	0	N/A	1	1	2	1	2	2	2	76.9
Schramm, Hediger, & Lang (2015)	2	2	2	1	N/A	N/A	N/A	2	0	2	2	0	2	2	77.3
Shin et al. (2012)	2	2	1	2	1	0	N/A	2	2	2	1	2	2	2	80.8
Sung, Woo, Kim, Lim, & Chung, (2012)	2	2	1	2	1	0	0	2	1	2	1	2	2	2	71.4
Unsworth, Palicki, & Lustig (2016)	2	2	1	2	1	N/A	N/A	1	1	2	1	2	2	2	79.2

APPENDIX C: Ethical Approval



APPENDIX D: Online Advert

Researcher: David Araci (Trainee Clinical Psychologist)

Would you like to learn techniques that might help reduce worry and increase your well-being? If so, we would like to invite you take part in a new research project using virtual reality that will test whether different psychological excercises can help.

The first part of the experiment will take about 1 hour to complete. After this you will be asked to do some home practice of the techniques taught (only 7 minutes a day for 4 days!) and then answer some questionnaires.

Participants must own their own smartphone to take part in the study and bring it with them to the experiment.

Participants will get a free cardboard Virtual Reality headset.

Participants will also receive £12 (Psychology students at the University of Southampton can request 20 research credits instead).

If you are interested in finding out more please email David Araci (da5g15@soton.ac.uk) or logon to Psychobook to book a slot.

APPENDIX E: Poster Advert

UNIVERSITY OF Southampton

ERGO Study ID: 25231 Recruitment dates: 01/09/2017 – 09/04/18

Researcher: David Araci (Trainee Clinical Psychologist)

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Virtual reality and mood
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APPENDIX F: Day 1 Procedure – Researcher Instructions

Plan for Day 1

- Have LifeGuide ready on computer. Seat participant.
- Read '**Initial Instructions'**. Leave room allowing participant to register and complete measures
- After 5 minutes look through eyehole to check cooperation. Record on Participant Observation Form
- When participant is ready:
- Group number will be presented on screen, prepare videos and audio – see table 1
- Read '**Audio Task'**
- Participants given intervention audio:
    - Group 1 or Group 2 (MNAT or MNEU conditions): Mindfulness - 8mins
    - Group 3 (PMR condition): PMR Audio – PMR 8mins
    - Leave room. After 4 minutes look through eyehole to check cooperation. Record on Participant Observation Form.
- When participant is ready:
- Read **'practice video instructions'**
- Put together Virtual reality viewer showing participant. Open YouTube app and prepare practice video: For all participants search 'Petra 360'.
- Stop autoplay function. Load the video and pause it. Get it ready for headset and then tap the google cardboard button and video will immediately play, secure in viewer and give to participant.
- When participant is ready:

APPENDIX F: Day 1 Procedure – Researcher Instructions (cont.)

- Load the correct video (see below) for group and pause it. Get it ready for headset and then tap the google cardboard button and video will immediately play, secure in viewer and give to participant.
- **If in group 1 or group 2 read 'Instructions for Video group 1 or 2' sheet. If in group 3 read 'Instructions for Video group 3'**
    - Group 1 or 3 (MNAT or PMR condition): search 'back to nature 2 360'
    - Group 2 (MNEU condition): search 'los Angeles highlights 360'
- Leave room and set timer (4 mins for Group 2, 5 mins for Group 1 and 3) . After 2 minutes look through eyehole to check cooperation. Record on Participant Observation Form.
- When participant is ready:
- Read **'Last measures'**
- Input code MNAT for them, do not tell them code. Leave room.
- When participant is ready:
- Read **'Ending'**
- Give headset.

Table 1 - Audio and video conditions

	Audio	Instructions to video	Video
Group 1 (MNAT)	Mindfulness (Group1)	Watch mindfully	Back to nature
Group 2 (MNEU)	Mindfulness (Group2)	Watch mindfully	Los Angeles
Group 3 (PMR)	PMR (Group3)	Normally	Back to nature

APPENDIX F: Day 1 Procedure – Researcher Instructions (cont.)

Initial Instruction

"Thank you for taking part in this study. Today you will be asked to answer some questions, listen to some audio and watch a video. You will need to have a smartphone with the YouTube app installed. The videos used in this study only work through the YouTube app. Today you will spend up to 40 minutes in the lab. After that there will be 4 short home tasks that take around 7 minutes each day to complete. You must complete the study in order to get payment. You will also need to have a Pay Pal account setup if you prefer the £12 instead of 20 credits.

In a moment I will leave the room and ask you to enter some information and answer some questions on the computer. When I leave the room can you please click the new user link to set up your information. You will be asked for an email and mobile number – these will only be used to contact you when the next part of the study is active.

When you have finished the questionnaires the screen will ask you to let the experimenter know. Please knock on the door or come out to let me know. If you want to stop the experiment at any point that is fine, just please let me know you want to end it.

I will wait outside until you knock or come and get me"

Audio Task

"You will now listen to a short practice asking you to focus on parts of your body. Again when you have finished please knock or come and find me."

'Practice Video Instructions'

"In a moment I will ask you to watch a short virtual reality film. To make sure the headset is as best it can be I will stay in the room whilst you look at a one minute video. When I give you the viewer you might want to use the strap or hold it with your hands. Your arms might get tired so it's up to you. The video is not always 100%"

Instructions for video group 1 or 2

"I will now show you a short video using the virtual reality head set. The focus can sometimes be a little blurry. You can choose not to use the head strap but your arms may tire without it.

As you watch the video try to do so mindfully. Pay attention to the sounds and images that you hear and see. Being aware if your mind wanders. Whenever your mind wanders remind yourself that it is ok and bring your attention back to what you are watching.

Your mind may wander lots during the task. That is fine, every time your mind wanders acknowledge where it went and bring your attention to what you are seeing.

Remember, the aim is not to block out thoughts and feelings but to notice them as they arise and redirect your attention to the scene in front of you.

When watching the video feel free to move your head around and look at the scene, please stay in your seat when watching the video. Please do not push the button on the top right corner as it may stop the video. When you are finished please knock or come and find me"

Instructions for Video group 3

"I will now show you a short video using the virtual reality head set. The focus can sometimes be a little blurry. You can choose not to use the head strap but your arms may tire without it.

When watching the video feel free to move your head around and look at the scene, please stay in your seat when watching the video. Please do not push the button on the top right corner as it may stop the video. When you are finished please knock or come and find me"

Last measures

"We are nearly finished for today. There are just 3 more questionnaires to complete. We know it can be repetitive answering lots of questions but please do try to answer the questions as accurately as you can. When you have finished please knock on the door or come and find me"

Ending

"Thank you for taking part today. I will give you a headset to do the home practices. You will be emailed and texted for a total of four home practices. These will take around 7 minutes each time. The final day you will be asked to complete all questionnaires again and let us know your payment preferences. You must complete this part to receive payment.

You will need to have the YouTube app installed on your phone. When you receive an email or text you can login to the study with your phone. If you have an iPhone you may need to turn it to landscape to see the questionnaires properly. If you have an iPhone you will have to go back to Safari – android users should be able to back out of the YouTube app and continue the questionnaires. If you have a chunky phone case you may need to remove it first. We suggest playing around with the viewer and the head strap before the next video so you are ready to use it. When taking off the head strap be careful not to rip the glued Velcro from the side.

If you have any questions you can direct them to David Araci. His contact details will be included in the emails you receive"

APPENDIX G: Participant Information Sheet

(Version 2; 16-10-17)

Study title: Mindfulness and virtual environments - the impact of mediated nature

Researcher's name: David Araci – da5g15@soton.ac.uk

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form. You may withdraw from the study at any point.

All data will be anonymised and your name will never appear with any results or be discussed with anyone.

What is the research about? The research is examining the effects of virtual reality environments on mood and awareness.

Why have I been chosen? You have been contacted because you responded to one of our study adverts.

What do I need? Participants must have their own smartphone that can access the internet. Tablets are not appropriate for the study.

What will happen to me if I take part? You will attend a session at the University of Southampton to fill in some questionnaires and take part in a few tasks. If you are unable to attend the university please contact the research team who may be able to offer a home visit. These will include a short breathing task and you will be given instructions for a 5 minute task in which you will be asked to pay attention to parts of your body. You will then wear a Virtual Reality headset and view a scene for 5 minutes before repeating the questionnaires and final short breathing task. Testing this days will last approximately 1 hour.

After the first test session you will be asked to view the same virtual scene and answer 2 short questions every other day for a total of 5 times. You will receive an email and text prompt at 5pm every other day directing you to a link to complete some online questions. Each time you watch the virtual reality scene you will be asked to answer some short

questions about your mood on that day (total time approx. 7 minutes). On the final day of the study you will be asked to fill in some questionnaires and be debriefed.

Are there any benefits in my taking part?

Participants will get a free cardboard Virtual Reality headset. Participants will also receive £12 (Psychology students at the University of Southampton can request 20 research credits instead). Information gathered by the study may be used to inform further research and/or clinical practice.

Are there any risks involved? There are no expected risks to taking part in this study. If you feel any distress from completing the tasks or completing the questionnaires you may talk through them with the research lead (contact information above).

Will my participation be confidential? This study will comply with the Data Protection Act and relevant University policy. The attached information will be stored on a password protected drive and will not contain your name anywhere.

What happens if I change my mind? You have the right to withdraw at any time. If you wish to withdraw after taking part in the first part of the study please email the researcher who will delete your data.

APPENDIX H: Details of Materials Used Across Conditions

	Audio	Video	Instructions to video
Group 1 (MNAT)	Mindfulness (Group1)	Nature	Watch mindfully
Group 2 (MNEU)	Mindfulness (Group2)	Los Angeles	Watch mindfully
Group 3 (PMR)	PMR (Group3)	Nature	No specific instructions

APPENDIX I: Email Prompt

SUBJECT: Southampton Virtual Reality and Mood Study

Dear participant,

We really appreciate your participation in the Virtual Reality and Mood study, and hope you are finding the psychological exercise useful. You will need to login within 24 hours from this email to continue with the study.

It is necessary to complete the study in order to receive the payment.

Please click the following link to access the study and complete today's home practice.

Please have your VR headset ready and the YouTube app installed on your phone.

https://virtualreality.lifeguidewebsites.org

If you have decided for any reason not to participate further please let me know via email and I will remove your details from the system.

Kind regards

David Araci

Trainee Clinical Psychologist

University of Southampton

email: da5g15@soton.ac.uk

https://virtualreality.lifeguidewebsites.org

Please do NOT click reply to respond to this email. You can reply by writing a new email to da5g15@soton.ac.uk

APPENDIX J: Text Prompt

Number: VR Study

Please login to Lifeguide today to continue your home practice for the Virtual reality and Mood study.

You will need to login within 24 hours of this text.

It is necessary to complete the study in order to receive the payment.

Please have your VR headset ready and the YouTube app installed on your phone.

https://virtualreality.lifeguidewebsites.org

APPENDIX K: Instructions for MNAT and MNEU Home Practice

As you watch the video try to do so mindfully. Pay attention to the sounds and images that you see and hear. Being aware if your mind wanders.

Whenever your mind wanders remind yourself that it is ok and bring your attention back to what you are watching. Your mind may wander lots during the task. That is fine, every time your mind wanders acknowledge where it went and bring your attention to what you are seeing.

Remember, the aim is not to block out thoughts and feelings but to notice them as they arise and redirect your attention to the scene in front of you

APPENDIX L: Instructions for PMRNAT Home Practice

Sit back or lie down in a comfortable position.

Begin by taking a deep breath and noticing the feeling of air filling your lungs and slowly breathing out through your mouth.

Begin to tense your feet by curling your toes and the arch of your foot. Hold onto the tension and notice what it feels like.

(5 second pause)

Release the tension in your foot. Notice the new feeling of relaxation.

Next, begin to focus on your lower leg. Tense the muscles in your calves.

Hold them tightly and pay attention to the feeling of tension.

(5 second pause)

Release the tension from your lower legs. Again, notice the feeling of relaxation. Remember to continue taking deep breaths.

Next, tense the muscles of your upper leg and pelvis. You can do this by tightly squeezing your thighs together.

Make sure you feel tenseness without going to the point of strain.

(5 second pause)

And release. Feel the tension leave your muscles.

Begin to tense your stomach and chest. You can do this by sucking your stomach in. Squeeze harder and hold the tension. A little bit longer

5 second pause)

Release the tension. Allow your body to go limp. Let yourself notice the feeling of relaxation. Continue taking deep breaths.

Next, tense the muscles in your back by bringing your shoulders together behind you.

Hold them tightly. Tense them as hard as you can without straining and keep holding.

(5 second pause)

Release the tension from your back. Feel the tension slowly leaving your body, and the new feeling of relaxation.

Tense your arms all the way from your hands to your shoulders. Make a fist and squeeze all the way up your arm. Hold it.

(5 second pause)

Release the tension from your arms and shoulders.

APPENDIX L: Instructions for PMRNAT Home Practice (cont.)

Move up to your neck and your head. Tense your face and your neck by distorting the muscles around your eyes and mouth.

(5 second pause)

Release the tension

Finally, tense your entire body. Tense your feet, legs, stomach, chest, arms, head, and neck. Tense harder, without straining. Hold the tension.

(5 second pause)

Now release. Allow your whole body to go limp.

When you are ready click continue to proceed.

APPENDIX M: Debriefing Statement

The Impact of Mediated Nature on Mood, Worry and Levels of Mindfulness

Debriefing Statement (Version 1; 20-06-17)

The aim of this research was to look at the effects of being mindfully aware of virtual natural environments, and the impact this may have on mood, anxiety, thought intrusion and mindfulness. Empirical evidence suggests exposure to nature, including virtual environments, has a positive impact on mood, stress and anxiety (McSweeney, Rainham, Johnson, Sherry, & Singleton, 2015). Attention Restoration Theory (Kaplan, 1995; Kaplan & Kaplan, 1989) suggests we innately attend to nature that restores our attentional capacity, in turn having a positive impact on mood and attentional awareness. Mechanisms of mindfulness suggest that attention is a primary component (Hölzel et al., 2011). Therefore the integration of nature and mindfulness may contribute to greater benefits. It is expected that participants who took part in the mindfulness of virtual natural environments condition will experience positive changes in mood, thought intrusion and mindfulness levels compared to people who did mindfulness alone, and those who viewed virtual natural environments non-mindfully.

Your data will help our understanding of the effects of virtual reality and guided mindfulness on changes in mood, anxiety, thought intrusion and levels of mindfulness. Once again, the results of this study will not include your name or any other identifying characteristics.

The experiment did not use deception.

Over the course of the study we asked you to discuss certain aspects of your mental health. If you found any of these questions have caused you concern, there are several sources of advice which are available and which may prove helpful in dealing with your concerns. These include your General Practitioner, NHS direct, and also Student Services or your personal tutor.

You may request a summary of research findings once the project is completed.

If you have any further questions please contact me David Araci at da5g15@soton.ac.uk.

Thank you for your participation in this research.

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

APPENDIX N: Cronbach's Alpha and Normality Testing

Cronbach's alpha and normality testing for all scales across conditions and time points.

	MNAT				MNEU				PMRNAT			
	K-S	Skew	Kurt.	α	K-S	Skew	Kurt.	α	K-S	Skew	Kurt.	α
GAD-7												
Baseline (day 1)	.224*	1.134	.268	.897	.244*	1.135	.188	.908	.115	-.083	-.596	.798
T6 (day 9)	.191	1.170	.801	.907	.160	1.174	1.289	.893	.172	.416	-.676	.828
PHQ-9												
Baseline	.258*	1.086	.274	.785	.170	1.90	5.128	.859	.197	.687	.479	.725
T6	.258*	1.980	4.019	.904	.223*	1.283	.874	.851	.189	1.725	3.841	.888
PSWQ												
Baseline	.141	-.005	-.598	.956	.109	-.004	-.754	.941	.134	-.340	-.459	.870
T6	.111	.048	-.538	.964	.084	.053	-.558	.941	.125	.355	-.1013	.905
PHLMS												
Baseline	.113	-.325	-.333	.779	.156	.193	-.789	.798	.125	-.680	.076	.553
T6	.134	-.157	.028	.861	.152	.526	.441	.898	.147	.593	-.890	.658
PHLMS-Acceptance												
Baseline	.142	.555	1.198	.893	.124	.405	-.435	.878	.171	-.437	.378	.810
T6	.118	-.033	-.883	.952	.098	.34	-.154	.908	.144	-.263	-.700	.779
PHLMS-Awareness												
Baseline	.220*	-.649	-.635	.843	.137	-.279	-.892	.708	.1406	.203	.166	.746
T6	.133	-.214	.032	.662	.101	.484	-.473	.795	.123	.353	.345	.774
MEWS												
Baseline	.123	.550	-.145	.895	.156	.794	.067	.901	.156	-.355	.260	.836
T6	.192	.815	.108	.925	.136	.402	-.828	.931	.095	-.108	-.010	.860
STAI-6												
Baseline	.148	.820	1.291	.898	.126	1.065	1.440	.879	.204*	.358	-1.312	.808
T2	.142	.199	-.566	.590	.221*	1.252	3.594	.728	.175	.907	1.076	.779
T3	.205	1.583	3.368	.871	.120	.442	-.221	.850	.168	.197	-.574	.682
T4	.199	.464	.100	.638	.129	-.159	-1.288	.854	.221*	1.214	1.715	.885
T5	.161	.047	-.829	.782	.227*	.417	-.943	.828	.172	1.004	.219	.828
T6	.152	.779	.325	.778	.252*	.837	-.557	.903	.112	1.112	2.112	.892

*Note: K-S = Kolmogorov Smirnov statistic; *= p <.05; Kurt. = Kurtosis value*

APPENDIX N: Cronbach's Alpha and Normality Testing (cont.)

	MNAT				MNEU				PMRNAT			
	K-S	Skew	Kurt.	α	K-S	Skew	Kurt.	α	K-S	Skew	Kurt.	α
SMS												
Baseline	.167	-.498	-.1.044	.943	.106	.360	-.757	.939	.114	.099	-1.094	.951
T2	.200	-.747	-.385	.928	.076	-.061	-.114	.925	.166	-1.264	3.044	.897
T3	.143	-.634	.024	.929	.134	-.302	-.161	.942	.165	-.633	-.750	.952
T4	.172	-.086	-.39	.915	.118	.178	.152	.961	.091	-.037	-.557	.959
T5	.212	-.682	.279	.956	.173	-.182	-1.055	.941	.107	-.015	-.790	.962
T6	.168	-.814	.424	.936	.115	.128	-.699	.973	.133	-.339	-.964	.959
PANAS-NA												
Baseline	.225*	1.683	3.148	.788	.240*	2.132	5.312	.807	.228*	1.655	2.455	.760
T2	.454*	2.331	5.037	.565	.270*	2.964	10.906	.794	.344*	1.789	1.862	.781
T3	.293*	2.304	6.227	.856	.252*	2.114	5.193	.853	.230*	1.975	4.570	.804
T4	.314*	3.374	12.457	.903	.225*	2.361	6.819	.818	.265*	2.180	5.521	.768
T5	.365*	1.408	.882	.799	.292*	1.776	2.250	.799	.370*	1.752	2.466	.560
T6	.266*	2.388	6.659	.837	.257*	1.856	2.996	.797	.359*	3.978	16.548	.953
PANAS-PA												
Baseline	.186	-.296	-.775	.805	.089	-.003	-.804	.878	.125	.147	-1.144	.938
T2	.174	.228	-1.551	.920	.114	-.098	-1.007	.915	.151	.173	-1.256	.951
T3	.151	.523	.057	.936	.124	.67	-1.117	.945	.204	.383	-1.322	.965
T4	.106	.325	-.168	.948	.160	.683	-.473	.954	.186	.364	-1.386	.970
T5	.155	-.096	-.825	.940	.091	.67	1.137	.939	.166	.340	-1.343	.956
T6	.116	.238	-1.057	.962	.200*	.465	-.799	.940	.163	.484	-1.047	.961

*Note: K-S = Kolmogorov Smirnov statistic; *= p <.05; Kurt. = Kurtosis value*

APPENDIX O: Patient Health Questionnaire

PHQ-9				
Over the last 2 weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	0	1	2	3
Feeling down, depressed, or hopeless	0	1	2	3
Trouble falling/staying asleep, sleeping too much	0	1	2	3
Feeling tired or having little energy	0	1	2	3
Poor appetite or overeating	0	1	2	3
Feeling bad about yourself – or that you are a failure or have let yourself or your family down	0	1	2	3
Trouble concentrating on things, such as reading the newspaper or watching television.	0	1	2	3
Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual.	0	1	2	3
Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

APPENDIX P: Generalised Anxiety Disorder Assessment

GAD-7				
Over the last 2 weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
Feeling nervous, anxious or on edge	0	1	2	3
Not being able to stop or control worrying	0	1	2	3
Worrying too much about different things	0	1	2	3
Trouble relaxing	0	1	2	3
Being so restless that it is hard to sit still	0	1	2	3
Becoming easily annoyed or irritable	0	1	2	3
Feeling afraid as if something awful might happen	0	1	2	3

APPENDIX Q: The Philadelphia Mindfulness Scale

Please select how often you experienced each of the following statements within the past week.	**Never**	**Rarely**	**Sometimes**	**Often**	**Very Often**
I am aware of what thoughts are passing through my mind.	☐	☐	☐	☐	☐
I try to distract myself when I feel unpleasant emotions.	☐	☐	☐	☐	☐
When talking with other people, I am aware of their facial and body expressions.	☐	☐	☐	☐	☐
There are aspects of myself I don't want to think about.	☐	☐	☐	☐	☐
When I shower, I am aware of how the water is running over my body.	☐	☐	☐	☐	☐
I try to stay busy to keep thoughts or feelings from coming to mind.	☐	☐	☐	☐	☐
When I am startled, I notice what is going on inside my body.	☐	☐	☐	☐	☐
I wish I could control my emotions more easily.	☐	☐	☐	☐	☐
When I walk outside, I am aware of smells or how the air feels against my face.	☐	☐	☐	☐	☐
I tell myself that I shouldn't have certain thoughts.	☐	☐	☐	☐	☐
When someone asks how I am feeling, I can identify my emotions easily.	☐	☐	☐	☐	☐
There are things I try not to think about.	☐	☐	☐	☐	☐
I am aware of thoughts I'm having when my mood changes.	☐	☐	☐	☐	☐
I tell myself that I shouldn't feel sad.	☐	☐	☐	☐	☐
I notice changes inside my body, like my heart beating faster or my muscles getting tense.	☐	☐	☐	☐	☐

APPENDIX Q: The Philadelphia Mindfulness Scale (cont.)

Please select how often you experienced each of the following statements within the past week.	**Never**	**Rarely**	**Sometimes**	**Often**	**Very Often**
If there is something I don't want to think about, I'll try many things to get it out of my mind.	☐	☐	☐	☐	☐
Whenever my emotions change, I am conscious of them immediately.	☐	☐	☐	☐	☐
I try to put my problems out of mind.	☐	☐	☐	☐	☐
When talking with other people, I am aware of the emotions I am experiencing.	☐	☐	☐	☐	☐
When I have a bad memory, I try to distract myself to make it go away.	☐	☐	☐	☐	☐

APPENDIX R: Mind Excessively Wandering Scale

	not at all or rarely	some of the time	most of the time	nearly all of the time or constantly
1. I have difficulty controlling my thoughts				
2. I find it hard to switch my thoughts off				
3. I have two or more different thoughts going on at the same time				
4. My thoughts are disorganised and 'all over the place'				
5. My thoughts are 'on the go' all the time				
6. Because my mind is 'on the go' at bedtime, I have difficulty falling off to sleep				
7. I experience ceaseless mental activity				
8. I find it difficult to think about one thing without another thought entering my mind				
9. I find my thoughts are distracting and prevent me from focusing on what I am doing				
10. I try to distract myself from my thoughts by doing something else or listening to music				
11. I have difficulty slowing my thoughts down and focusing on one thing at a time				
12. I find it difficult to think clearly, as if my mind is in a fog				
13. I find myself flitting back and forth between different thoughts				
14. I use alcohol or other drugs to slow down my thoughts and stop constant 'mental chatter'				
15 I can only focus my thoughts on one thing at a time with considerable effort				

APPENDIX S: Penn State Worry Questionnaire

Instructions: Rate each of the following statements on a scale of 1 ("not at all typical of me") to 5 ("very typical of me"). Please do not leave any items blank.

	Not at all typical of me				Very typical of me
1. If I do not have enough time to do everything, I do not worry about it.	1	2	3	4	5
2. My worries overwhelm me.	1	2	3	4	5
3. I do not tend to worry about things.	1	2	3	4	5
4. Many situations make me worry.	1	2	3	4	5
5. I know I should not worry about things, but I just cannot help it.	1	2	3	4	5
6. When I am under pressure I worry a lot.	1	2	3	4	5
7. I am always worrying about something.	1	2	3	4	5
8. I find it easy to dismiss worrisome thoughts.	1	2	3	4	5
9. As soon as I finish one task, I start to worry about everything else I have to do.	1	2	3	4	5
10. I never worry about anything.	1	2	3	4	5
11. When there is nothing more I can do about a concern, I do not worry about it anymore.	1	2	3	4	5
12. I have been a worrier all my life.	1	2	3	4	5
13. I notice that I have been worrying about things.	1	2	3	4	5
14. Once I start worrying, I cannot stop.	1	2	3	4	5
15. I worry all the time.	1	2	3	4	5
16. I worry about projects until they are all done.	1	2	3	4	5

APPENDIX T: Positive and Negative Affect Scale

This scale consists of a number of words that describe different feelings and emotions. Read each item and indicate to what extent you feel this way right now by ticking in the appropriate box.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					
Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
Afraid					

APPENDIX U: The Spielberger State-Trait Anxiety Inventory-Short Form

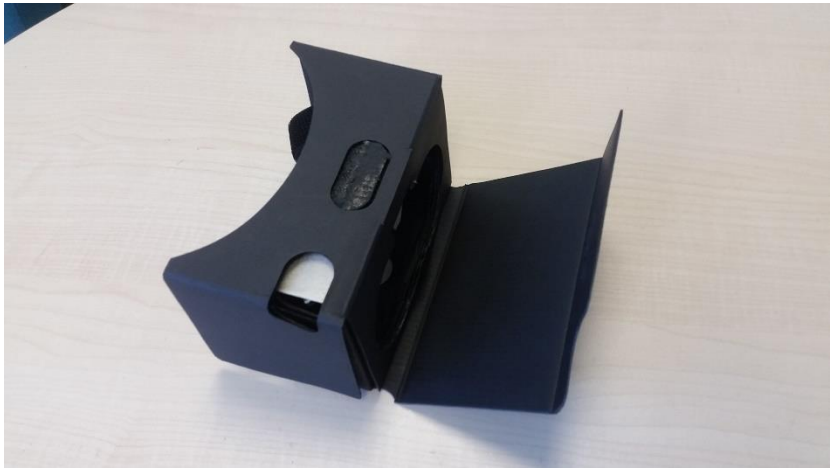
A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate number to the right of the statement to indicate how you ***feel right now, at this moment***. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

STAI 6				
	Not at all	Somewhat	Moderately	Very much
I feel calm……	0	1	2	3
I am tense……	0	1	2	3
I feel upset……...	0	1	2	3
I am relaxed…….	0	1	2	3
I feel content……	0	1	2	3
I am worried……	0	1	2	3

APPENDIX V: State Mindfulness Scale

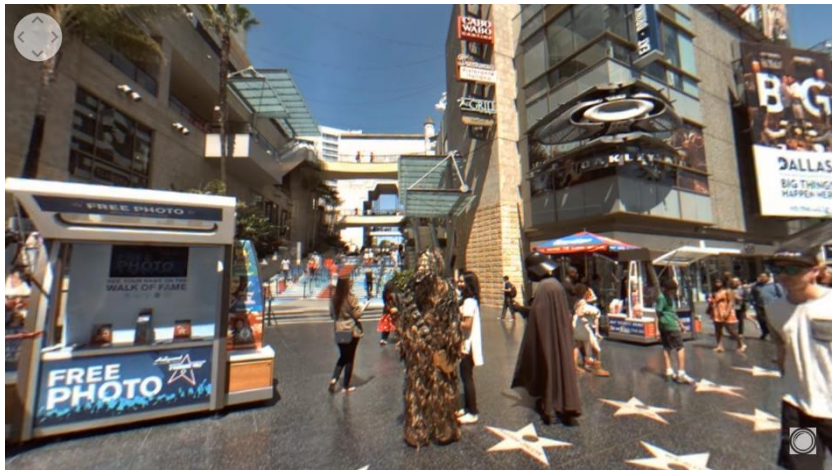
SMS					
Over the past <u>five minutes</u>, how would you best describe your experience?	Not at all				Very well
I was aware of different emotions that arose in me	1	2	3	4	5
I tried to pay attention to pleasant and unpleasant sensations.	1	2	3	4	5
I found some of my experiences interesting.	1	2	3	4	5
I noticed many small details of my experience.	1	2	3	4	5
I felt aware of what was happening inside of me.	1	2	3	4	5
I noticed pleasant and unpleasant emotions.	1	2	3	4	5
I actively explored my experience in the moment.	1	2	3	4	5
I clearly physically felt what was going on in my body	1	2	3	4	5
I changed my body posture and paid attention to the physical process of moving	1	2	3	4	5
I felt that I was experiencing the present moment fully.	1	2	3	4	5
I noticed pleasant and unpleasant thoughts.	1	2	3	4	5
I noticed emotions come and go.	1	2	3	4	5
I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face).	1	2	3	4	5
I noticed physical sensations come and go.	1	2	3	4	5
I had moments when I felt alert and aware.	1	2	3	4	5
I felt closely connected to the present moment.	1	2	3	4	5
I noticed thoughts come and go.	1	2	3	4	5
I felt in contact with my body.	1	2	3	4	5
I was aware of what was going on in my mind.	1	2	3	4	5
It was interesting to see the patterns of my thinking.	1	2	3	4	5
I noticed some pleasant and unpleasant physical sensations	1	2	3	4	5

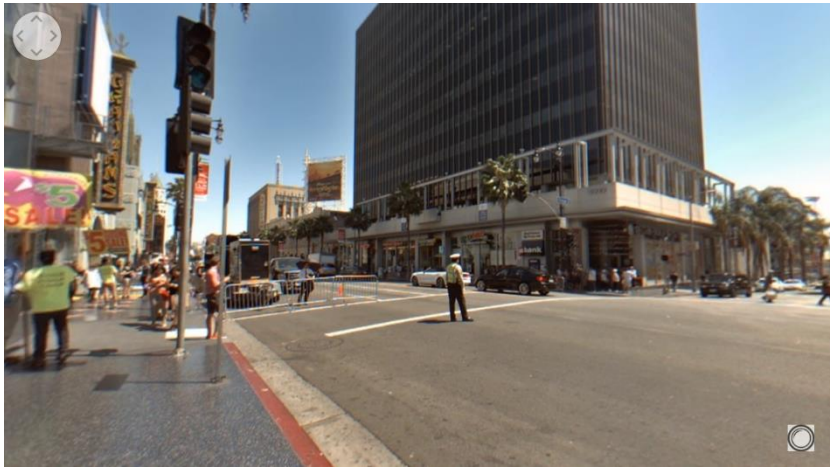
APPENDIX W: VR Cardboard Viewer



APPENDIX X: Screenshots of Nature VR Video

APPENDIX Y: Screenshots of Neutral/Urban VR Video





APPENDIX Z: Descriptive Statistics of Measures at all Time Points for Each Group.

	MNAT (n = 18)	MNEU (n = 24)	PMRNAT (n = 19)	
	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*	F(x,y)
GAD-7 (Baseline)	6.11 (4.84)	6.88 (5.41)	8.21 (3.51)	.95(2,58)
GAD-7 (post-intervention)	4.78 (4.18)	5.21 (4.17)	5.89 (3.65)	.37(2,58)
PHQ-9 (Baseline)	5.33 (3.74)	6.04 (5.20)	7.63 (3.64)	1.37(2,58)
PHQ-9 (post-intervention)	4.11 (4.65)	4.46 (4.09)	6.05 (4.87)	1.01(2,58)
PSWQ (Baseline)	51.39 (14.96)	49.08 (14.28)	54.95 (9.86)	1.04(2,58)
PSWQ (post-intervention)	46.72 (15.20)	46.46 (13.84)	51.05 (9.86)	.713(2,58)
PHLMS (Baseline)	66.50 (8.05)	64.46 (8.60)	64.32 (5.30)	.50(2,58)
PHLMS (post-intervention)	68.89 (9.88)	67.08 (10.47)	63.74 (6.23)	1.52(2,58)
PHLMS-Acc. (Baseline)	31.00 (7.05)	29.13 (7.31)	26.79 (5.21)	1.87(2,58)
PHLMS-Acc. (post-intervention)	32.94 (9.04)	30.96 (6.77)	26.84 (5.03)	3.64(2,58)*
PHLMS-Awa. (Baseline)	35.50 (5.40)	35.33 (4.29)	37.53 (4.26)	1.38(2,58)
PHLMS-Awa. (post-intervention)	35.94 (3.90)	36.13 (5.21)	36.89 (4.79)	.22(2,58)
MEWS (Baseline)	14.17 (7.52)	15.96 (7.84)	19.26 (6.15)	2.37(2,58)
MEWS (post-intervention)	12.39 (8.04)	13.17 (8.44)	15.74 (6.45)	.97(2,58)
STAI-6 (Baseline)	37.59 (11.19)	36.25 (14.19	39.64 (9.87)	.42(2,58)
STAI-6 (T2)	28.70 (5.16)	29.58 (7.31)	30.00 (7.70)	.17(2,58)
STAI-6 (T3)	32.08 (11.08)	36.21 (11.14)	34.71 (8.98)	.72(2,58)
STAI-6 (T4)	31.76 (6.25)	38.03 (11.76)	31.05 (11.60)	2.80(2,58)
STAI-6 (T5)	31.8 (8.34)	35.33 (10.34)	32.35 (11.10)	.65(2,58)
STAI-6 (post-intervention)	33.89 (9.65)	36.39 (14.11)	35.96 (12.15)	.23(2,58)
SMS (Baseline)	30.61 (15.57)	31.38 (16.84)	39.26 (16.57)	1.65(2,58)
SMS (T2)	47.83 (13.87)	44.21 (13.74)	51.26 (12.74)	1.46(2,58)
SMS (T3)	47.44 (12.28)	38.82 (15.02)	45.53 (15.82)	1.89(2,58)
SMS (T4)	43.53 (12.03)	42.50 (18.13)	44.42 (18.18)	.07(2,58)
SMS (T5)	49.38 (15.38)	38.50 (15.33)	47.35 (17.26)	2.42(2,58)
SMS (post-intervention)	52.06 (13.38)	40.96 (20.49)	46.95 (16.58)	2.11(2,58)
PANAS-PA (Baseline)	26.78 (5.08)	28.54 (7.87)	26.26 (8.26)	.58(2,58)
PANAS-PA (T2)	27.11 (7.03)	29.92 (9.03)	27.68 (9.24)	.65(2,58)
PANAS-PA (T3)	23.50 (7.62)	24.23 (8.88)	24.65 (10.28)	.07(2,58)
PANAS-PA (T4)	22.65 (6.96)	24.00 (8.85)	23.89 (9.56)	.14(2,58)
PANAS-PA (T5)	26.19 (8.34)	24.90 (8.81)	25.53 (10.12)	.09(2,58)
PANAS-PA (post-intervention)	26.11 (8.96)	27.00 (9.82)	24.53 (10.06)	.35(2,58)

*Note: * = $p < .05$*

APPENDIX AA: Summary of Non-Parametric Testing

Summary of Freidman test results as non-parametric equivalent tests of ANOVAs. It should be noted that Freidman test does not allow for inclusion of categorical variables, or for exploration of more than one independent variable and therefore acts as an equivalent only of a one-way repeated ANOVA. Therefore Freidman tests were conducted to explore changes to each outcome measure, over time, separately per condition. Additionally, Kruskal-Wallis tests were employed. Kruskal-Wallis act as the non-parametric equivalent of one-way between groups ANOVA. Therefore the results described here detail non-parametric equivalents of one-way between subject ANOVA (Kruskal-Wallis) to explore effect of group on scale difference scores, and non-parametric equivalent of one-way repeated measure ANOVA (Freidman) to changes of scores over time (baseline to post-intervention) for each group separately.

Anxiety

A Kruskal-Wallis test revealed no statistically significant difference on general anxiety (measured by GAD-7 difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) = 1.25$, $p = .536$. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, post-intervention). There was a significant effect of time for the overall sample, $\chi^2 = (1, N = 61) = 20.48$, $p < .0005$, with median scores indicating decrease in general anxiety over time from baseline ($Md = 6$) to post-intervention ($Md = 4$). There was no significant effect of time for MNAT, $\chi^2 = (1, n = 18) = 1.92$, $p = .166$. There was a significant effect of time for both MNEU, $\chi^2 = (1, n = 24) = 13.76$, $p < .005$, and PMRNAT, $\chi^2 = (1, n = 19) = 6.25$, $p = .012$, conditions with median scores indicating decrease in general anxiety over time from baseline to post-intervention. Taken together, these analyses demonstrate a reduction of general anxiety for the MNEU and PMR group over time, however these differences were not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

A Kruskal-Wallis test revealed no statistically significant difference on current anxiety (measured by STAI-6 difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) = 2.09$, $p = .352$. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the six time points (baseline, T2, T3, T4, T5, post-intervention). There was a significant effect of time for the overall sample, $\chi^2 = (5, N = 45) = 17.43$, $p = .004$, with median scores indicating decrease in general anxiety over time from baseline. There was no significant effect of time for MNAT, $\chi^2 = (5, n = 13) = 9.98$, $p = .076$, or PMRNAT, $\chi^2 = (1, n = 19) = 6.25$, $p = .012$, conditions. There was a significant effect of time for MNEU, $\chi^2 = (5, n = 15) = 10.30$, $p = .67$, condition with median scores indicating decrease in current anxiety over time from baseline to post-intervention. Taken together, these analyses demonstrate a reduction of general anxiety for the MNEU group over time, however this difference was not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

APPENDIX AA: Summary of Non-Parametric Testing (cont.)

Mind Wandering

A Kruskal-Wallis test revealed no statistically significant difference on mind wandering (measured by MEWS difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) = .86$, $p = .652$. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, post-intervention). There was a significant effect of time for the overall sample, $\chi^2 = (1, N = 61) = 10.97$, $p = .001$, with median scores indicating decrease in mind wandering over time from baseline to post-intervention. There was no significant effect of time for MNAT, $\chi^2 = (1, n = 18) = 2.25$, $p = .134$. There was a significant effect of time for MNEU, $\chi^2 = (1, n = 24) = 4.17$, $p = .041$, and PMRNAT, $\chi^2 = (1, n = 19) = 4.77$, $p = .029$, conditions with median scores indicating decrease in mind wandering over time from baseline to post-intervention. Taken together, these analyses demonstrate a reduction of general anxiety for the MNEU group over time, however this difference was not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

Worry

A Kruskal-Wallis test revealed no statistically significant difference on worry (measured by PSWQ difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) = .68$, $p = .712$. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, post-intervention). There was a significant effect of time for the overall sample, $\chi^2 = (1, N = 61) = 5.07$, $p = .024$, with median scores indicating decrease in worry over time from baseline to post-intervention. There was no significant effect of time for MNAT, $\chi^2 = (1, n = 18) = 2$, $p = .157$, MNEU, $\chi^2 = (1, n = 24) = 1.19$, $p = .275$ or PMRNAT, $\chi^2 = (1, n = 19) = 2$, $p = .157$, conditions. Taken together, these analyses demonstrate a reduction of worry for the total sample however there was no significant effect of time between each condition with the Kruskal-Wallis test.

Affect

A Kruskal-Wallis test revealed no statistically significant difference on depressed mood (measured by PHQ-9 difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) = .57$, $p = .752$. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, post-intervention). There was a significant effect of time for the overall sample, $\chi^2 = (1, N = 61) = 15.08$, $p < .0005$, with median scores indicating decrease in depressed mood over time from baseline to post-intervention. There was a significant effect of time for MNAT, $\chi^2 = (1, n = 18) = 4$, $p = .046$, MNEU, $\chi^2 = (1, n = 24) = 7.12$, $p = .008$ and PMRNAT, $\chi^2 = (1, n = 19) = 4.26$, $p = .039$, conditions. Taken together, these analyses demonstrate a reduction of depressed mood for all conditions over time.

A Kruskal-Wallis test revealed no statistically significant difference on PA (measured by PANAS-PA difference scores) across the three different intervention conditions, $\chi^2 = (2, n = 61) =$

.12, p = .944. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the six time points (baseline, T2, T3, T4, T5, post-intervention). There was a significant effect of time for the overall sample, χ^2 = (1, N = 45) =22.38, p <.0005, with median scores indicating decrease in PA over time from baseline to post-intervention. There was a significant main effect of time for MNEU, χ^2 = (1, n = 17) = 14.73, p =.012 with median scores indicating decrease in PA over time from baseline (*Md* = 29) to post-intervention (*Md* = 23). and no significant effect of time for MNAT, χ^2 = (1, n = 13) = 5.79, p =.327, or PMRNAT, χ^2 = (1, n = 19) = 4.26, p =.268 conditions. Taken together, these analyses demonstrate a reduction of PA for the MNEU group over time, however this difference was not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

Mindfulness

A Kruskal-Wallis test revealed no statistically significant difference on current mindfulness levels (measured by SMS difference scores) across the three different intervention conditions, χ^2 = (2, n = 61) = 4.29, p = .117. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the six time points (baseline, T2, T3, T4, T5, post-intervention). There was a significant effect of time for the overall sample, χ^2 = (5, N = 45) =28.32, p <.0005, with median scores indicating increase in current mindfulness over time from baseline to post-intervention. There was a significant main effect of time for MNAT, χ^2 = (5, n = 13) = 18.85, p =.002 and marginal effect for PMRNAT, χ^2 = (5, n = 15) = 10.97, p =.052 conditions with median scores indicating increase in current mindfulness over time. There was no significant MNEU, χ^2 = (1, n = 17) = 7.07, p =.215. Taken together, these analyses demonstrate an increase of current mindfulness for the MNAT and PMRNAT group over time, however this difference was not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

A Kruskal-Wallis test revealed no statistically significant difference on general mindfulness levels (measured by PHLMS difference scores) across the three different intervention conditions, χ^2 = (2, n = 61) = 2.09, p = .353. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, T2, T3, T4, T5, post-intervention). There was no significant effect of time for the overall sample, χ^2 = (1, N = 61) = 1.98, p =.159, MNAT, χ^2 = (1, n = 18) = 2, p =.157, MNEU, χ^2 = (1, n = 24) = 1.5, p =.221, or PMRNAT, χ^2 = (1, n = 19) = .053, p =.819. This suggests no changes in general levels of mindfulness over time across all conditions.

A Kruskal-Wallis test revealed no statistically significant difference on mindful acceptance (measured by PHLMS-Acceptance difference scores) across the three different intervention conditions, χ^2 = (2, n = 61) = .85, p = .655. A series of Freidman tests were conducted to see if

there were changes for the overall sample and each condition over the two time points (baseline, T2, T3, T4, T5, post-intervention). There was a significant effect of time for the overall sample, χ^2 = (1, *N* = 61) = 5.79, *p* =*.016*, and MNEU, χ^2 = (1, *n* = 24) = 4.55, *p* =.033, with median scores indicating increase in mindful acceptance over time from baseline to post-intervention. There was no significant effect of time for MNAT, χ^2 = (1, *n* = 18) = 1.47, *p* =.225, or PMRNAT, χ^2 = (1, *n* = 19) = .053, *p* =.8467, conditions. Taken together, these analyses demonstrate an increase mindful acceptance for the MNEU group over time, however this difference was not large enough to detect a significant difference between interventions with the Kruskal-Wallis test.

A Kruskal-Wallis test revealed no statistically significant difference on mindful awareness (measured by PHLMS-Awareness difference scores) across the three different intervention conditions, χ^2 = (2, *n* = 61) = .94, *p* = .624. A series of Freidman tests were conducted to see if there were changes for the overall sample and each condition over the two time points (baseline, T2, T3, T4, T5, post-intervention). There was no significant effect of time for the overall sample, χ^2 = (1, *N* = 61) = .46, *p* =.5, MNAT, χ^2 = (1, *n* = 18) = .25, *p* =.617, MNEU, χ^2 = (1, *n* = 24) = 1.19, *p* =.275, or PMRNAT, χ^2 = (1, *n* = 19) = .22, *p* =.637. This suggests no changes in mindful awareness over time across all conditions.

APPENDIX BB: ANOVAs for Lab Based Data Collection Only

Mixed ANOVA results for Day 1, lab based data collection for scales that had 6 collection time points (baseline, T2, T3, T4, T5, post-intervention) to explore effects of lab based intervention.

A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on current anxiety ratings (measured by the STAI-6) across two time points during day 1 in the lab (baseline, T2). There was a significant main effect of time on current anxiety ($F(1, 58) = 34.81$, $p > .005$, $\eta_p^2 = .38$), but no significant effect of group ($F(2, 58) = .322$, $p = .726$, $\eta_p^2 = .01$), and no significant interaction between group and time ($F(2, 58) = .43$, $p = .65$, $\eta_p^2 = .02$). This suggests current anxiety ratings decreased from baseline to time 2, the reduction was similar for all conditions (Figure 11).

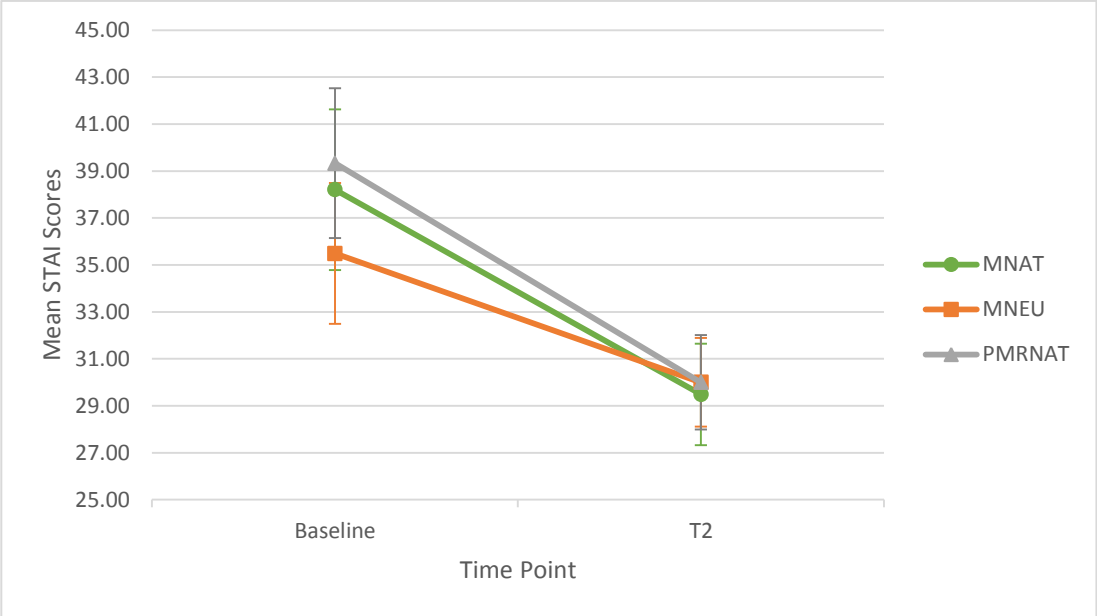


Figure 11. Mean STAI scores at baseline and T2 for lab day only for each group. Error bars = +/-1SEM

A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on current mindfulness ratings (measured by the SMS) across two time points during day 1 in the lab (baseline, T2). There was a significant main effect of time on current levels of mindfulness ($F(1, 58) = 44.82$, $p > .005$, $\eta_p^2 = .44$), but no significant effect of group ($F(2, 58) = 1.98$, $p = .145$, $\eta_p^2 = .06$), and no significant interaction between group and time ($F(2, 58) = .56$, $p = .575$, $\eta_p^2 = .02$). This suggests current mindfulness levels increased from baseline to time 2, the increase was similar for all conditions (Figure 12).

APPENDIX BB: ANOVAs for Lab Based Data Collection Only (cont.)

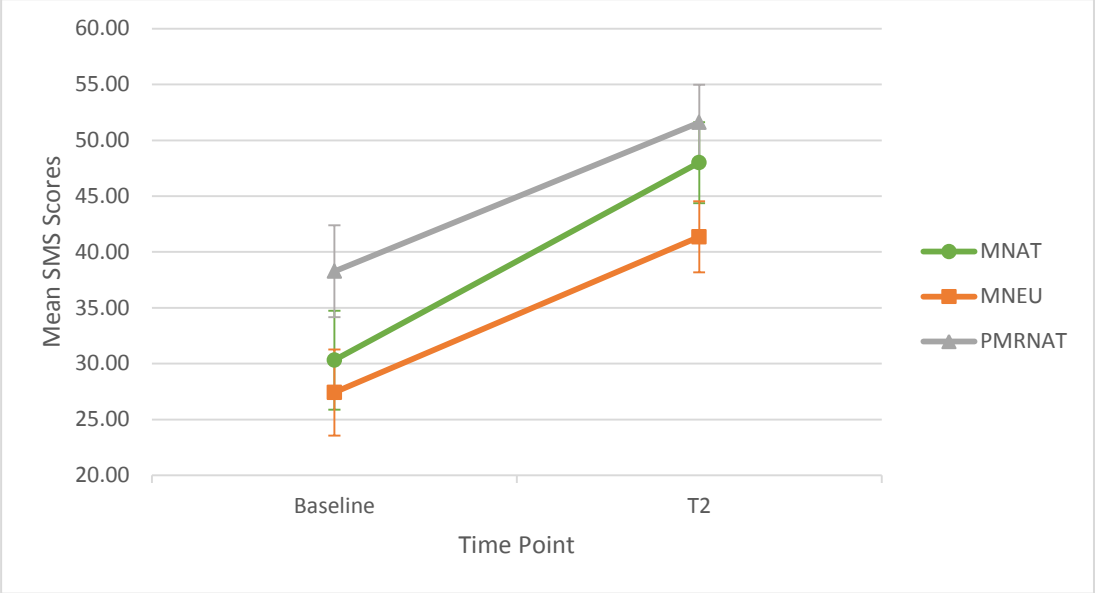


Figure 12. Mean SMS scores at baseline and T2 for lab day only for each group. Error bars = +/-1SEM

A 3 (Group) x 2 (Time) mixed ANOVA assessed the impact of the interventions on current PA (measured by the PANAS-PA) across two time points during day 1 in the lab (baseline, T2). There was no significant main effect of time on PA ($F(1, 58) = 1.66$, $p = .202$, $\eta_p^2 = .03$), or group ($F(2, 58) = .70$, $p = .50$, $\eta_p^2 = .02$), and no significant interaction between group and time ($F(2, 58) = .18$, $p = .83$, $\eta_p^2 = .01$). This suggests PA ratings did not change from baseline to time 2for any condition (Figure 13).

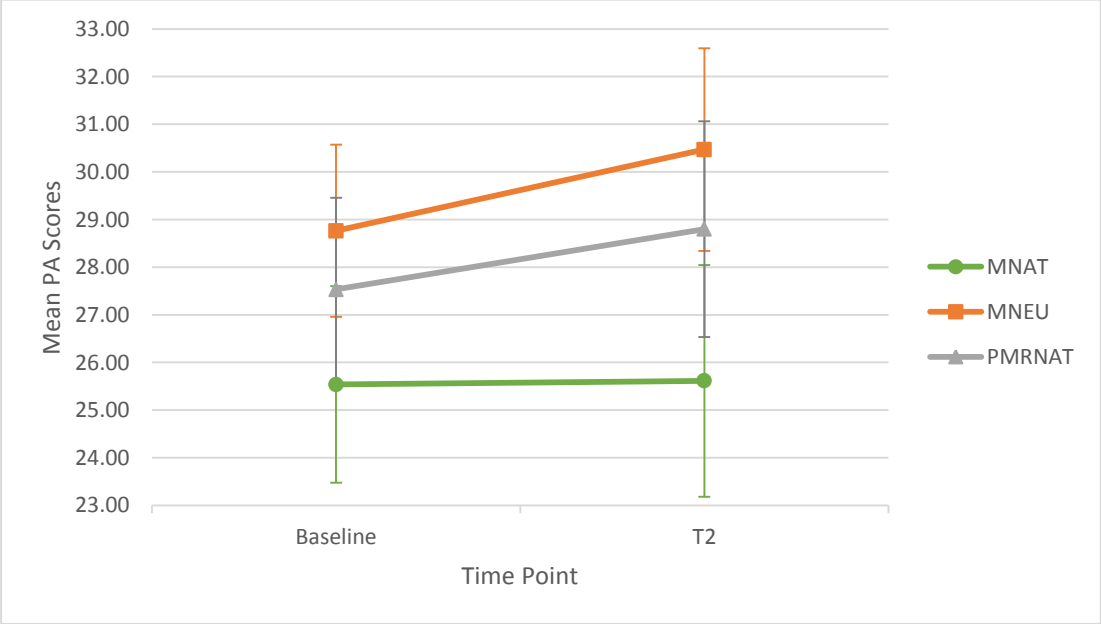


Figure 12. Mean PA scores at baseline and T2 for lab day only for each group. Error bars = +/-1SEM

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