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A brief mindfulness intervention: Effects on trait mindfulness, stress and emotion regulation within a sample of working adults.

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ABSTRACT

Due to increasing demands within employment, the prevalence of work-related stress is becoming more common. Work-related stress has detrimental effects for the individual suffering and their employer, indicating a need for interventions to reduce stress. Previous research has found mindfulness to offer promising results. However, the commitment required and the duration of a typical mindfulness course could be considered impractical due to busy work schedules.

This study was therefore interested in the effectiveness of a brief mindfulness intervention, delivered via a mobile phone-based application. Forty-seven employees were allocated randomly to either a mindfulness group ($n = 24$) or an active control group ($n = 23$). The study investigated if a brief ten-day mindfulness intervention could increase trait mindfulness, decrease stress and decrease difficulties in emotion regulation within a sample of working adults.

From pre to post-intervention, significant increases in self-reported trait mindfulness were identified within the mindfulness group and also significant decreases in self-reported stress and difficulties in emotion regulation. The control group displayed non-significant changes from pre to post control group activities for all the tested variables. This study adds to the little research conducted on mobile phone interventions and also addresses real life implications and directions for future research.

KEY WORDS:	TRAIT MINDFULNESS	STRESS	EMOTION REGULATION	BRIEF INTERVENTION	WORKING ADULT WELL- BEING
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Introduction

Mindfulness originates from Asian Buddhist traditions from over two millennia ago (Kerr et al, 2013). Mindfulness is commonly defined as an awareness that is created when an individual pays attention in a particular way, on purpose and non-judgementally to the present moment (Kabat-Zinn, 2003). Some researchers view mindfulness as a single component, that is to be aware and directing attention towards the present moment experience (Brown and Ryan, 2003). However, others view mindfulness as a multifaceted state (Bishop et al, 2004). Mindfulness has also been described as both a state and a trait. State mindfulness views mindfulness as a skill, an individual can only maintain a mindful state when it is cultivated intentionally (Mahmood et al, 2016). Whereas trait mindfulness refers to an enduring element of one's personality that differs between individuals (Cosme and Wiens, 2015). Although separate concepts, evidence has shown both state and trait mindfulness to have positive effects upon psychological well-being (Brown and Ryan, 2003; Allen and Kiburz, 2012; Olafsen, 2017). Despite this, research suggests the two concepts should be viewed as separate and investigated individually as no significant relationship has been found to exist between state and trait mindfulness (Thompson and Waltz, 2007).

In correspondence to the differing views on what mindfulness actually is, several self-report mindfulness questionnaires have been constructed and are frequently used within psychological research (Bergomi et al, 2013). Some examples are the Mindfulness Attention Awareness Scale (Brown and Ryan, 2003), the Five Facet Mindfulness Questionnaire (Baer et al, 2006) and the Philadelphia Mindfulness Scale (Cardaciotto et al, 2008), each designed to measure trait mindfulness. To measure state mindfulness, Lau et al (2006) developed the Toronto Mindfulness Scale. The use of self-report questionnaires within mindfulness research provides a convenient, time and cost effective methodology (Sauer et al, 2013). However, Grossman (2008) argues that simplistic definitions of an originally Buddhist psychological construct of mindfulness in order to quantify it in a way it can be measured may undervalue the concept and alter its original meaning. This may lead to inadequate content validity of measures as well as a lack of convergent validity among different scales (Grossman, 2011). Another concern regarding the use of self-report questionnaires is that of response bias (Paulhus and Vazire, 2007). Qualitative methods, such as interviews, overcome the limitation of response bias and have been found to be successful in measuring mindfulness (Teasdale et al, 2002). However, they are often more time consuming and less cost-effective.

Despite the limitations of the use of self-reports, research does suggest individuals who measure high for trait mindfulness demonstrate less stress reactivity and distress (Bullis et al, 2014). This finding is said to be due to the factors that are associated with trait mindfulness (Baer et al, 2004). Bishop et al (2004) claims that it is the teachings of mindfulness, for example the awareness and non-judgemental acceptance of the present moment, that decrease the cognitive vulnerabilities which are thought to be responsible for maladaptive behaviours. The awareness and non-judgemental acceptance of moment to moment experiences are said to counteract everyday forms of psychological distress (Keng et al, 2011). This idea is supported by research that has demonstrated that through mindfulness practice, trait mindfulness increases and has positive impacts upon psychological well-being (Carmody and Baer, 2008; Shapiro et al, 2011; Evans et al, 2011; Campbell et al,

2012). Due to research indicating the benefits of mindfulness it has recently become one of the most popular concepts within psychotherapy, with an influence that exceeds any other modern psychotherapeutic approach (Škodlar, 2016).

Mindfulness-based stress reduction (MBSR) is perhaps the most well-known mindfulness related psychotherapy (Creswell, 2017). MBSR was founded by Jon Kabat-Zinn (1982) who adapted the Buddhist traditions of mindfulness and applied it to scientific frameworks and Western psychology. A typical MBSR intervention uses a group meeting format, with each meeting lasting approximately two and a half hours in duration for eight consecutive weeks (Kabat-Zinn, 1990). MBSR employs both formal and informal meditations, with the formal practices including body scans, meditation and yoga whilst the informal practice refers to increased awareness of daily experiences for example, when eating dinner or taking a walk (Evans et al, 2011). MBSR has been applied to various populations and has demonstrated beneficial outcomes (Birnie et al, 2010). For example, a meta-analysis conducted by Chiesa and Serretti (2009) found MBSR demonstrated a non-specific effect on stress compared to an inactive control group. Furthermore, research that has investigated the efficacy of MBSR and also employed an active control group has suggested that MBSR may have a specific effect on stress (Shapiro et al, 2007).

Within the workplace, stress is a widespread and costly problem as work-related stress is a major public health issue due to the negative effects it has on an individual's mental health (Lee et al, 2013). The demand control-model (Karasek and Theorell, 1990) suggests work-related stress occurs when workers have high demands placed upon them and have low control over decision-making within their job role (De Jonge et al, 2010). Statistics show that for the year 2016/17 there were 526,000 cases of work-related stress, depression and anxiety. Consequently, 12.5 million working days were lost with stress accounting for 40% of work-related ill health and 49% of working days lost due to ill health (HSE, 2017). Therefore, tackling work-related stress should be high on the agenda for employers (Kinnunen-Amoroso and Liira, 2016). Mindfulness has been identified as an effective method of managing stress and improving performance within workers (Leung et al, 2016). Mindfulness is said to help people to cope better with stress as it teaches them how to view the world without judgement and negative feelings, bringing about a more peaceful and happier life (Körükcü and Kukulcu, 2015). However, a lot of the research that has investigated the efficacy of mindfulness-based interventions has been conducted on clinical or student samples (e.g. Fjorback et al, 2011; Bennett and Dorjee, 2016) and therefore little research has been carried out on non-clinical populations, especially working adults. The few studies that have been conducted on non-clinical samples such as healthy people suffering from stress (Chiesa and Serretti, 2009) and health care professionals suffering from work-related stress (Irving et al, 2009) have indicated that MBSR can have significant positive effects on stress. Research has also suggested MBSR is a good way of improving the ability to cope with stress within a sample of nurses (Smith, 2014).

Despite research demonstrating the positive effects MBSR can have upon well-being, the duration and cost of a traditional MBSR course means it is not accessible for everyone and an alternative needs to be available (Dobkin et al, 2014). Malarkey et al (2013) introduced a shortened MBSR into the workplace where the sessions were conducted onsite during the working day to overcome common barriers that prevent participation in MBSR. However, rather than measuring self-reported stress,

this study measured participant's cortisol levels and only found a non-significant reduction in the mindfulness condition compared to a control group. Josefsson et al (2014) suggests shortened mindfulness programs may not significantly increase mindfulness as they are not long enough to enhance mindfulness. In contrast to this, MacKenzie et al (2006) found a shortened MBSR intervention that was tested on a population of nurses decreased emotional exhaustion, that was said to be due to stress, compared to controls. This indicates a need for more research to be conducted on shortened MBSR interventions that can fit around the working day and produce beneficial outcomes.

More recently, online mindfulness training programs and mobile phone-based mindfulness applications have been created and found to be effective (Morledge et al, 2013). However, research regarding interventions of this kind is lacking and it is argued that more needs to be done within this area (Mohr et al, 2013; Chittaro and Vianello, 2016; Van Emmerick et al, 2018). Plaza et al (2013) conducted a meta-analysis relating to mindfulness-based mobile applications and found that while they were of interest to people, there was no evidence to support their usefulness or effectiveness. More recent research supports the use of mindfulness-based mobile applications as they were found to improve participant's well-being (Howells et al, 2016). However, the participants in this study were aware of what was being measured and this may have produced a biased outcome and therefore the findings are questionable.

Furthermore, due to the emotional reactions that stress can cause, stress is said to impair an individual's ability to regulate their emotions (Wang and Saudino, 2011). For workers, particularly those who work in customer service, emotion regulation is considered one of the most exhausting tasks (Beal et al, 2013). Emotion regulation is defined as a 'process by which individuals influence which emotions they have, when they have them, and how they experience and express [them]' (Gross, 1998: 275). Emotion regulation can be adaptive but also maladaptive, dependent upon which emotion regulation strategies are employed and the context in which they are utilised (Gross, 1998). Maladaptive emotion regulation strategies correlate significantly with various psychological disorders (Aldao et al, 2010; Schäfer et al, 2017) and have been found to be central to the development and maintenance of psychological disorders (Berking et al, 2008). Research indicates that mindfulness-based interventions can decrease difficulties in emotion regulation (Roemer, 2015). Mindfulness aids with emotion regulation as individuals learn to accept all of the thoughts, feelings and emotions they experience without judgement, leading to a healthy engagement with emotions (Chambers et al, 2009). Mindful individuals therefore come to understand that distressing thoughts that they currently hold are not true representations of reality (Coffey and Hartman, 2008), helping to prevent habitual reactions and avoidance strategies and instead promotes more adaptive strategies. Using a student sample, Arch and Craske (2006) supported this idea as they found participants who took part in a mindfulness-based breathing exercise were more open to viewing optional negative picture slides than participants in worrying and unfocussed attention conditions. This implies that the participants in the mindfulness condition were able to view the picture slides as just pictures, in a non-judgemental and non-reactive way. This is theorised to be one of the ways that mindfulness can decrease difficulties in emotion regulation (Shapiro et al, 2006).

However, most of the research investigating mindfulness and emotion regulation has been conducted on clinical samples (e.g. Kumar et al, 2008; Goldin and Gross, 2010; Desrosiers et al, 2013) and therefore research supporting the assumption that mindfulness can decrease difficulties in emotion regulation in non-clinical samples is lacking. A further disadvantage of some of the research in this area is the lack of a control group. For example, in the Goldin and Gross (2010) study it was found that providing MBSR to patients suffering from social anxiety disorder enhanced their ability to successfully regulate their emotions. However, Davidson (2010) argues a lack of control group within this type of research would mean it cannot be concluded the changes observed were due to mindfulness, as opposed to non-specific factors such as positive expectations.

The Present Study

The present study investigated the effects of a brief ten-day mindfulness intervention upon psychological well-being within a working adult sample who are in need of short-term, accessible interventions that can fit around the working day. Trait mindfulness, stress and difficulties in emotion regulation were all measured via self-report questionnaires in all participants at both pre and post-intervention so that any changes could be identified. An active control group was employed to counter any non-specific effects that may cause any changes (Davidson, 2010) and the participants were allocated randomly to the mindfulness condition or active control group. Unlike a traditional MBSR intervention, this study delivered the intervention through a mobile phone-based applications as research exploring this type of intervention is lacking (Plaza et al, 2013; Mohr et al, 2013; Chittaro and Vianello, 2016; Van Emmerick et al, 2018). All of the data was interrogated in order to identify changes that may have occurred as a result of the mindfulness intervention.

Research Hypotheses

It was firstly hypothesised that from pre to post-intervention, significant increases of trait mindfulness would be reported by the mindfulness group, whilst the control group would report no significant increase. It was secondly hypothesised that from pre to post-intervention, significant decreases of stress would be reported by the mindfulness group, whilst the control group would report no significant decrease. Finally, it was hypothesised that from pre to post-intervention, significant decreases of difficulties in emotion regulation would be reported by the mindfulness group, whilst the control group would report no significant decrease.

Method

Design

This study employed a 2 x 2 mixed factorial design. Assessment time (pre-intervention vs. post-intervention) was the within-subjects independent variable and the group in which participants were allocated to (mindfulness vs. control) was the between-subjects independent variable. The study was comprised of three dependent variables: trait mindfulness, stress and emotion regulation, all measured using self-report questionnaires. This allowed the data to be collected in both a time and cost efficient way (Sauer et al, 2013).

Participants

A power analysis was conducted using G*Power 3.1¹ (Faul et al, 2007) in order to determine how many participants would be required to take part. The analysis suggested a minimum of 28 participants would need to be recruited for this study. The study recruited a sample of 47 participants in total. Participants were allocated randomly to the mindfulness group or the control group. Twenty-four of the participants were involved in the mindfulness group ($n = 24$) and twenty-three of the participants were involved in the control group ($n = 23$).

Inclusion criteria for this study required that participants were currently employed. Participants were recruited via an opportunity sample on a voluntary basis from various areas of work. Invitations were sent via email to multiple organisations to ask if they would be willing to advertise the research. An advertisement poster was used, providing potential participants with a brief outline of what the research would require and how to contact the researcher if they wished to take part. Those who then contacted the researcher with an expression of interest were provided with an information sheet. The sheet outlined what the research would entail in more detail and allowed informed decisions about participation to be made. Any information regarding participants being split into two different groups and the true purpose of this study were withheld at this stage to prevent any demand characteristics.

This study was focussed on measuring any changes that occurred from pre to post-intervention, regardless of pre-intervention scores. Therefore, participant's scores were not matched pre-intervention for any of the measures. Also, it would have been difficult to match participant's scores across three different variables.

Measures/Materials

Self-Report Questionnaires

Each of the measures listed below are free to access and use and are within the public domain. The obtaining of permission to use any of the measures was therefore unnecessary.

This study used the 15-item Mindful Attention Awareness Scale (MAAS; Brown and Ryan, 2003) to measure trait mindfulness. This scale was designed to explicitly capture attention and awareness in daily life and is considered one of the most popular measures of mindfulness (Ruiz et al, 2016) with research broadly supporting its validity (MacKillop and Anderson, 2007; De Bruin et al, 2011). The scale uses a 6-point Likert scale to rate each of the 15-items (1 = 'Almost Always, to 6 = Almost Never). To score the scale, a mean is calculated for all items. The highest score on this scale is 90 and the lowest 15. A higher mean score indicates higher levels of trait mindfulness. Brown and Ryan (2003) found the MASS to have an alpha level of .82. As the acceptable level of internal consistency is 0.7 (Nunnally, 1978), this suggests the MAAS has good overall internal consistency. Other research has found the MAAS also exhibits high test-retest reliability and convergent and discriminant reliability (Black et al, 2012).

To measure stress, this study used the 42-item 'Depression Anxiety Stress Scale' (DASS; Lovibond and Lovibond, 1995). The original questionnaire was made up of three subscales that measured depression, anxiety and stress. According to the

¹ Calculated using a significance level of .05, power of .8 and a small effect size (Cohen's $d = .25$).

authors (Lovibond and Lovibond, 1995) it is acceptable to use their subscales as individual measures. Therefore, for the requirements of the current study only the 14-item stress subscale was used. A 4-point Likert scale from 0 to 3 (0 = Did not apply to me at all, to 3 = Applied to me very much) is used to respond. The highest score on this scale is 42 and the lowest 0, high scores indicate higher severity of participant stress. Lovibond and Lovibond (1995) evaluated the psychometric properties of the DASS and found a high internal consistency of the stress scale with a Cronbach's alpha of .89.

This study employed the 36-item 'Difficulties in Emotion Regulation Scale' (DERS; Gratz and Roemer, 2004) to measure difficulties in emotion regulation. This scale was created to measure various aspects of emotion regulation and dysregulation using six distinct subscales: non-acceptance of emotional responses, difficulty engaging goal-directed behaviour, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies and lack of emotional clarity. A 5-point Likert scale ranging from 1 to 5 (1 = Almost Never, to 5 = Almost Always) is used to rate each item. The total score on this scale equals the sum of all subscales. The highest score on this scale is 180 and the lowest 36, with higher scores indicating considerable problems with emotion regulation. In Gratz and Roemer's (2004) assessment of the DERS, they found a high internal consistency with a Cronbach's alpha level of .93. Additionally, each of the DERS subscales has adequate internal consistency, with Cronbach's alpha exceeding .80 for all six subscales.

Interventions and Podcasts

Participants who were allocated to the mindfulness group were asked to complete one ten-minute, audio-guided, mindfulness meditation once a day for a ten-day duration. To do this, participants used the mobile phone-based application Headspace, which is free to download. Permission for use was gained from the developers of Headspace. The applications integrated buddy system was used to monitor participant engagement with the required task. Participants completed the 'Basics' section on the application which introduced them to mindfulness techniques such as breathing exercises and body scans.

This application was chosen based on its ability to fit around variation within workers schedules. Additionally, research into interventions that are mobile phone-based is lacking (Plaza et al, 2013; Mani et al, 2015).

The control group were asked to listen to a set podcast each day, for ten days. The podcasts involved TED Talks and participants were asked to answer a question in relation to the content within the talk to ensure they engaged with the task. Each talk was as similar in duration as possible to the mindfulness activities to minimise extraneous variables between the two conditions. To prevent non-specific effects from influencing the control group's participant scores, all tasks set were unrelated to mindfulness or any other relaxation technique (Chiesa and Seretti, 2009).

Procedure

Once consent was gained, all participants completed the same questionnaire assessing mindfulness, stress and emotion regulation. Upon the completion of the questionnaires, participants were allocated randomly to either the mindfulness or

control condition. All participants were told that the research was interested in finding out if daily mobile phone activities could enhance well-being and were unaware of the separation into two groups.

Following this, the mindfulness group were provided with details of how to access the Headspace application via email, which they would be using to complete ten minutes of mindfulness each day for the next ten days. The control group were provided with a set list of ten Ted Talks, also sent via email, that varied in content but were unrelated to mindfulness or any other meditation relaxation techniques. Control participants were asked to answer a question that concerned the content within the talk to ensure they were engaging with the task.

Finally and once all activities had been completed, both groups of participants completed the original questionnaire once again in order to be able to identify any changes that may have taken place during the ten-day intervention period.

Ethical Considerations

This research followed the BPS code of ethics and conducted guidelines (BPS, 2009). All ethical issues this research concerned were taken into consideration and the correct process was followed in order to gain approval for this study. This study was only conducted once the researcher had completed the procedure for ethical approval and the study had been approved by the research supervisor.

Consent was gained from all participants before the completion of any questionnaires or activities. Each participant received an information sheet providing them with further information about what they would be required to do during this study. All participants were debriefed once they had completed their data collection. Additionally, anonymity was ensured throughout as participants were required to create a unique code and all data was stored securely.

However, a major ethical issue of this research is those participants who were part of the control group were completing a task that was hypothesised to have no positive impact on their well-being. This was while the mindfulness group were receiving a potentially beneficial intervention. To overcome this issue, the control group were provided with information of how to access Headspace during the debrief procedure.

Results

All raw data collected from both sets of participants, mindfulness ($n = 24$) and control ($n = 23$) were inputted into IBM SPSS Statistics 24.0 (SPSS, 2016) and prepared for analysis.

Preparation of Data

As recommended by the authors of the DERS (Gratz and Roemer, 2004), reverse item questions, items: 1, 2, 6, 7, 8, 10, 17, 20, 22, 24 and 34, were reversed for scoring. The score totals for each scale were then calculated for the mindfulness and control group at pre and post-intervention. To check the internal consistency reliability of all scales used, Cronbach's alpha coefficients were calculated. All scales were significantly above 0.7, which is the acceptable alpha (α) level according to Nunnally (1978) demonstrating each scale's internal consistency reliability. Table 1 displays this information.

Hypothesis One

In order to establish if, from pre to post-intervention, trait mindfulness significantly increased, both the mindfulness and control group scores of trait mindfulness were measured using the MASS at pre and post-intervention. The mindfulness and control groups' pre and post-intervention means (*M*) and standard deviations (*SD*) for MAAS scores are displayed in Table 2.

Table 1
The Internal Consistency Reliability, Conducted Using Cronbach's Alpha, of all Scales Used

Measure	Number of Items in Measure	Cronbach's alpha (α)	95% Confidence Interval for Alpha	
			Lower	Upper
Pre MAAS	15	.90*	.85	.94
Post MAAS	15	.93*	.89	.95
Pre DERS	36	.91*	.87	.95
Post DERS	36	.94*	.92	.96
Pre DASS-S	14	.96*	.94	.98
Post DASS-S	14	.95*	.92	.97

Note: * indicates $p < .001$; MASS = Mindful Attention Awareness Scale; DERS = Difficulties in Emotion Regulation Scale; DASS-S = Depression Anxiety Stress Scale (Stress Subscale).

Table 2
Descriptive Statistics of Pre and Post-Intervention MAAS Scores

Assessment Time	Participant Group					
	Mindfulness ($n = 24$)		Control ($n = 23$)		All ($N = 47$)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pre MAAS	51.46	14.61	57.43	13.10	54.38	14.07
Post MAAS	65.38	16.68	61.09	11.13	63.28	14.25

Note: MAAS = Mindfulness Attention Awareness Scale

A 2 x 2 mixed factorial ANOVA was carried out, with group (mindfulness vs. control) as the between-subjects independent variable and assessment time (pre-

intervention vs. post-intervention) as the within-subjects variable. The dependent variable was the scores of trait mindfulness recorded from participants MAAS responses. A significant main effect was found for assessment time, $F(1, 45) = 16.59, p < .001, \eta_p^2 = .269$. Also, a non-significant main effect was found for group, $F(1, 45) = .058, p = .810, \eta_p^2 = .001$. Finally, a significant interaction was found between assessment time and group $F(1, 45) = 5.66, p = .022, \eta_p^2 = .112$. The significant interactions are displayed in Figure 1.

Post-hoc Test

To interpret the significant interaction between assessment time and group for scores on the MAAS, post-hoc tests were conducted using two, paired sample t-tests, in order to determine where the significant differences lay. To control for type 1 errors, a Bonferroni correction ($.05 \div 2 = .025$) was applied. A paired sample t-test was conducted on both groups separately (mindfulness and control). Assessment time (pre-intervention vs. post intervention) was the independent variable and the participants' MAAS scores was the dependent variable. From pre ($M = 51.46, SD = 14.61$) to post ($M = 65.38, SD = 16.68$) mindfulness intervention a significant increase in MAAS scores was found for the mindfulness group, $t(23) = 4.25, p < .001, d^2 = 0.87, 95\% CI [0.41, 1.32]$ showing a large effect size. The MAAS scores in the control group did not significantly increase from pre ($M = 57.43, SD = 13.10$) to post ($M = 61.09, SD = 11.13$) intervention, $t(22) = 1.32, p = .202, d = 0.29, 95\% CI [-0.16, 0.75]$, showing a small effect size.

Hypothesis Two

In order to establish if, from pre to post-intervention, stress significantly decreased, both the mindfulness and control group scores of stress were measured using the DASS at pre and post-intervention. The mindfulness and control groups' pre and post-intervention means (M) and standard deviations (SD) for DASS scores are displayed in Table 3.

² All effect sizes were calculated using CLiCals (Rowley, 2015) (Appendix 13), using Cohen's d and interpreted based on Cohen's 1988 conventions of .02 = small effect size, .05 = medium effect size and .08 = large effect size.

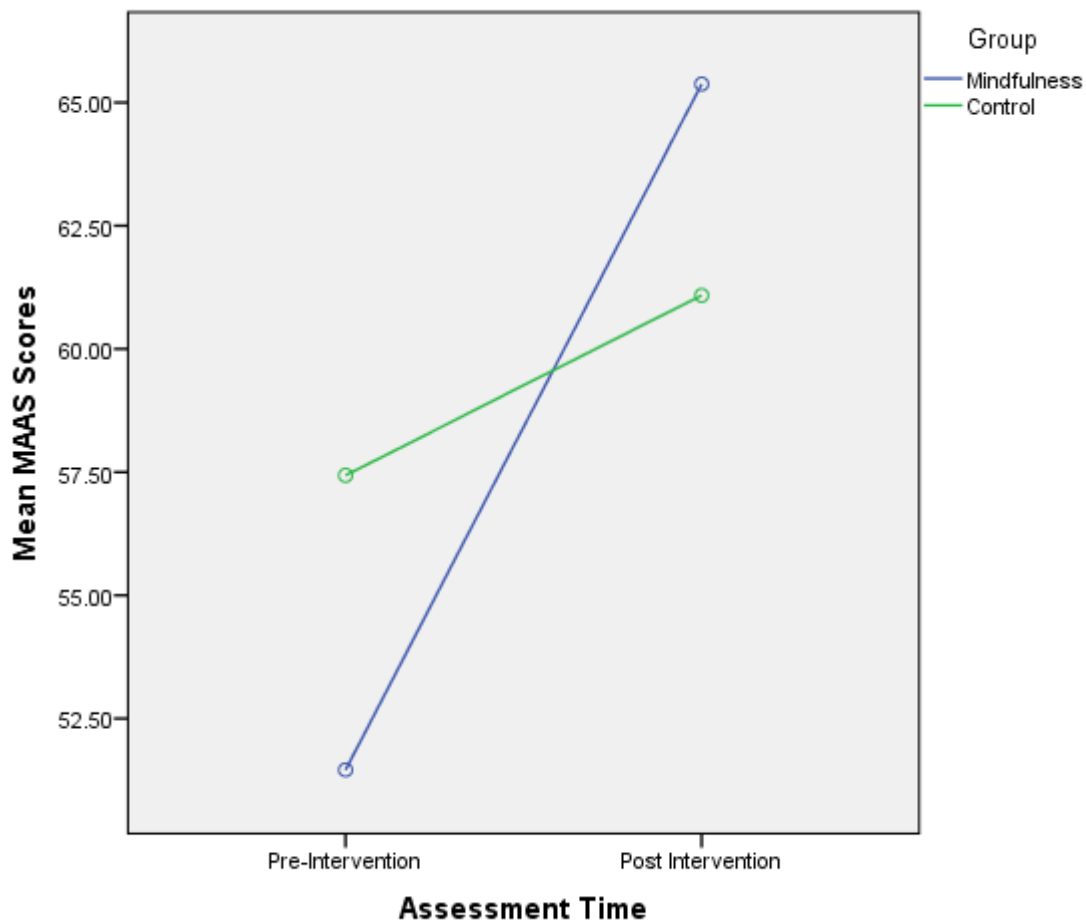


Figure 1. A plot to demonstrate the significant interaction between assessment time (pre-intervention vs. post-intervention) and group (mindfulness vs. control) for scores on the MAAS.

**Table 3
Descriptive Statistics of Pre and Post Intervention DASS-S Scores**

Assessment Time	Mindfulness (<i>n</i> = 24)		Control (<i>n</i> = 23)		All (<i>N</i> = 47)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pre DASS-S	31.25	12.53	27.26	10.53	29.30	11.64
Post DASS-S	23.50	9.72	25.43	8.36	34.45	9.03

Note: DASS-S = Depression Anxiety Stress Scale (Stress Subscale)

A 2 x 2 mixed factorial ANOVA was carried out, with group (mindfulness vs. control) as the between-subjects independent variable and assessment time (pre-intervention vs. post-intervention) as the within-subjects variable. The dependent variable was the stress scores recorded from participants DASS responses. A significant main effect was found for assessment time, $F(1, 45) = 11.00$, $p = .002$, $\eta_p^2 = .196$. Also, a non-significant main effect was found for group, $F(1, 45) = 403.92$, $p = .703$, $\eta_p^2 = .003$. Finally, a significant interaction was found between assessment time and group, $F(1, 45) = 4.21$, $p = .046$, $\eta_p^2 = .086$. The significant interactions are displayed in Figure 2.

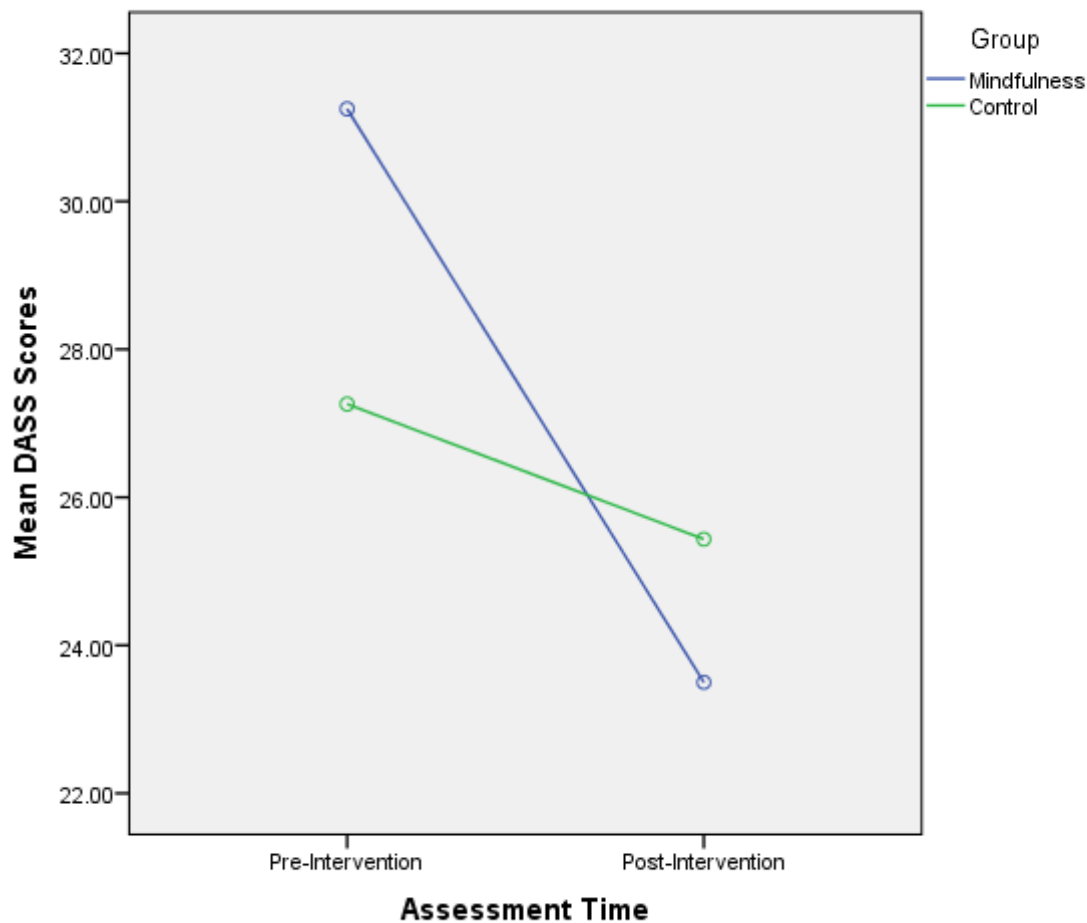


Figure 2. A plot to demonstrate the significant interaction between assessment time (pre-intervention vs. post-intervention) and group (mindfulness vs. control) for scores on the DASS.

Post-hoc Test

To interpret the significant interaction between assessment time and group for scores on the DASS, post-hoc tests were conducted using two, paired sample t-tests, in order to determine where the significant differences lay. To control for type 1 errors, a Bonferroni correction ($.05 \div 2 = .025$) was applied. A paired sample t-test was conducted on both groups separately (mindfulness and control). Assessment

time (pre-intervention vs. post-intervention) was the independent variable and participant's DASS scores was the dependent variable. From pre ($M = 31.25$, $SD = 12.53$) to post ($M = 23.50$, $SD = 9.72$) mindfulness intervention a significant decrease in DASS scores was found for the mindfulness group, $t(23) = 3.17$, $p = .004$, $d = 0.68$, 95% CI [0.22, 1.13] showing a medium to large effect size. The DASS scores in the control group did not significantly decrease from pre ($M = 27.26$, $SD = 10.53$) to post ($M = 25.43$, $SD = 8.36$) intervention, $t(22) = 1.23$, $p = .230$, $d = 0.19$, 95% CI [-0.12, 0.50].

Hypothesis Three

In order to establish if, from pre to post-intervention, difficulties in emotion regulation significantly decreased, both the mindfulness and control group scores of trait mindfulness were measured using the DERS at pre and post-intervention. The mindfulness and control groups' pre and post-intervention means (M) and standard deviations (SD) for DERS scores are displayed in Table 4.

Table 4
Descriptive Statistics of Pre and Post Intervention DERS Scores

Assessment Time	Participant Group					
	Mindfulness ($n = 24$)		Control ($n = 23$)		All ($N = 47$)	
	M	SD	M	SD	M	SD
Pre DERS	89.83	22.59	81.61	18.59	85.81	20.92
Post DERS	69.75	21.84	83.30	21.99	76.38	22.73

Note: DERS = Difficulties in Emotion Regulation Scale

A 2 x 2 mixed factorial ANOVA was carried out, with group (mindfulness vs. control) as the between-subjects independent variable and assessment time (pre-intervention vs. post-intervention) as the within-subjects variable. The dependent variable was the scores of difficulties in emotion regulation recorded from participants DERS responses. A significant main effect was found for assessment time, $F(1, 45) = 9.64$, $p = .003$, $\eta_p^2 = .176$. Also, a non-significant main effect was found for group, $F(1, 45) = 878.00$, $p = .629$, $\eta_p^2 = .005$. Finally, a significant interaction was found between assessment time and group, $F(1, 45) = 13.53$, $p = .001$, $\eta_p^2 = .231$. The significant interactions are displayed in Figure 3.

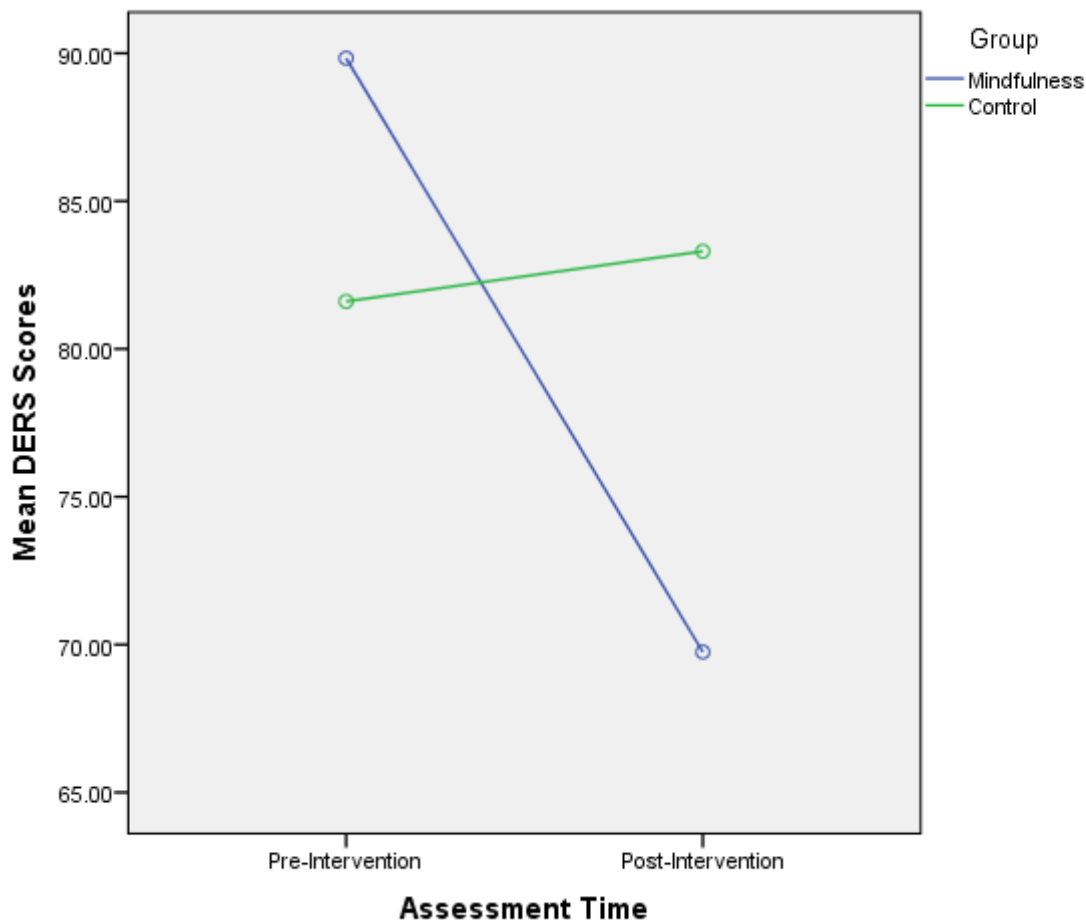


Figure 3. A plot to demonstrate the significant interaction between assessment time (pre-intervention vs. post-intervention) and group (mindfulness vs. control) for scores on the DERS.

Post-hoc Test

To interpret the significant interaction between assessment time and group for the DERS scores, post-hoc tests were conducted using a two, paired sample t-tests, in order to determine where the significant differences lay. To control for type 1 errors, a Bonferroni correction ($.05 \div 2 = .025$) was applied. A paired sample t-test was conducted on both groups separately (mindfulness and control). Assessment time (pre-intervention vs. post-intervention) was the independent variable and participants' DERS scores was the dependent variable. From pre ($M = 89.83$, $SD = 22.59$) to post ($M = 69.75$, $SD = 21.84$) mindfulness intervention a significant decrease of DERS scores was found for the mindfulness group, $t(23) = 4.56$, $p < .001$, $d = 0.88$, 95% CI [0.45, 1.32] showing a large effect size. There was no significant decrease of DERS scores from pre ($M = 81.61$, $SD = 18.59$) to post ($M = 83.30$, $SD = 21.99$) intervention in the control group, $t(22) = .43$, $p = .671$, $d = 0.08$, 95% CI [-0.30, 0.46].

Discussion

This research assessed the effectiveness of a brief ten-day mindfulness intervention, delivered via a mobile phone-based application, on working adult's trait mindfulness, stress and emotion regulation in comparison to an active control group. The results found supported all of the original the hypotheses for trait mindfulness, stress and emotion regulation for both the mindfulness and control group.

Hypothesis One: Trait Mindfulness

As hypothesised, the mindfulness group's scores of trait mindfulness, as assessed by MAAS responses, were found to significantly increase from pre to post-intervention. Within the control group, a non-significant finding was observed for trait mindfulness scores from pre to post control group activities, implying that listening to podcasts has no significant influence upon increasing trait mindfulness.

This finding supports previous research that has identified increases in trait mindfulness as a result of mindfulness practice (Carmody and Baer, 2008; Shapiro et al, 2011; Evans et al, 2011; Campbell et al, 2012). Furthermore, Birnie et al (2010) observed increases in mindfulness after a standard eight week MBSR course. The present study implies a brief mindfulness intervention can also lead to significant increases in trait mindfulness.

Furthermore, this study utilised the buddy system that is integrated within the Headspace application. This was done to ensure participants within the mindfulness condition were complying with the daily mindfulness activities they were required to complete. It can therefore be suggested the significant increase in trait mindfulness within the mindfulness group from pre to post-intervention is a result of the mindfulness intervention.

Hypothesis Two: Stress

As hypothesised, the mindfulness group's stress scores, as assessed by the DASS, were found to significantly decrease from pre to post-intervention. Within the control group, from pre to post control group activities, a non-significant finding was observed for stress scores.

The findings within the mindfulness group support previous research that suggests mindfulness-based interventions can have positive effects upon people subjected to work-related stress (MacKenzie et al, 2006; Irving et al, 2009; Smith, 2014). Furthermore, findings support previous research that has indicated mindfulness-based interventions delivered via mobile phone-based applications can positively impact well-being (Howells et al, 2016). However, participants within the study conducted by Howells et al (2016) were aware of what was being measured and consequently a biased outcome may have been produced. The participants within the present study were not aware of what was being measured, or that they were split into two separate groups. Therefore, findings provide stronger support for the assumption that the mindfulness intervention caused participant's self-reported stress to decrease as they were unaware that this was what the study was measuring. As a result, participants would have been likely to demonstrate less bias in their responses.

Also, the study supports using a brief mindfulness intervention to reduce self-reported stress within working adults. Brief mindfulness-based interventions provide an alternative to groups of people who cannot commit to a more traditional form of

MBSR due to its duration (Dobkin et al, 2014). Interventions of this kind may reduce the number of cases of work-related stress and working days lost due to stress as reported by the Health and Safety Executive (2017).

Hypothesis Three: Emotion Regulation

As hypothesised, from pre to post-intervention, the mindfulness group's scores of difficulties in emotion regulation, as assessed by the DERS, were found to significantly decrease. Within the control group, from pre to post control group activities, a non-significant finding was observed for difficulties in emotion regulation.

This provides support for Roemer et al's (2015) suggestion that mindfulness-based interventions decrease emotion regulation difficulties. The current finding also provides support for Goldin and Gross (2010) who found a significant interaction between emotion regulation and mindfulness. However, as this study employed an active control group unlike that of Goldin and Gross (2010) it provides stronger support for the significant interaction between the two variables.

However, further research is needed to clarify whether the significant decrease in difficulties of emotion regulation that has been identified is a result of increases in an individual's trait mindfulness or a reduction of stress. This is due to previous research indicating that stress is linked to a person's ability to successfully regulate their emotions (Weng and Saudino, 2011) and therefore implying that a decrease in stress should decrease difficulties in emotion regulation.

Strengths and Limitations

An important strength of the present study is the use of the buddy system, which is integrated within the Headspace application, which allowed participant engagement to be checked upon to ensure all findings were valid. Due to the variation in participant's work schedules, a brief intervention that was accessible and could fit around such variations was vital for this research. Use of the buddy system indicated that participants successfully engaged with the intervention and this resulted in significant increases to their well-being.

A second strength of this research is it employed an active control group. The active control group were required to complete tasks of a similar structure to the mindfulness group, however all tasks were unrelated to mindfulness or relaxation. Therefore, this study was able to control for non-specific effects that may have influenced participant scores (Chiesa and Seretti, 2009; Davidson, 2010). This provides stronger support for the suggestion that the changes identified, within the mindfulness group, from pre to post-intervention were due to the mindfulness intervention.

However, this study also has its limitations. While the use of self-report measures to assess variables is practical, they are often unreliable. People often demonstrate response bias, which is responding to questions in a way they wish to be rather than the way they are (Paulhus and Vazire, 2007). Qualitative methods, for example interviews, have been shown to be a successful method of measuring mindfulness (Teasdale et al, 2002) and overcome the issue of response bias, future research should consider this.

Furthermore, this research could have done more to understand the cause behind participant's decreased difficulty in emotion regulation. As previous research

suggests emotion regulation mediates stress and mindfulness (Wang and Saudino, 2011) it is unknown as to whether it was the mindfulness intervention or decreases in stress that caused decreases in emotion regulation difficulties. Consequently, it cannot be concluded that mindfulness decreases difficulties in emotion regulation.

Implications and Future Research

Whilst there has been a growth in research exploring the effectiveness of mindfulness-based interventions over recent years, there is still a lack of research exploring the efficacy of mindfulness interventions delivered through mobile phone-based applications. This study supports the efficacy of a more practical MBSR, a brief ten-day intervention for ten minutes per day, which can increase trait mindfulness and also decrease stress and difficulties in emotion regulation within a sample of working adults.

With evidence to support the use of this type of intervention, businesses may be more inclined to subscribe in order to improve the well-being of their staff. With this implemented it has the potential to decrease the number of work-related illnesses and workdays lost as reported by the Health and Safety Executive (2017).

Mindfulness has also been found to improve the performance of workers (Leung et al, 2016) suggesting that interventions of this kind may benefit businesses in various ways. However, future study is required in order to establish if the positive effects of this intervention last longer term.

Conclusion

The present study adds to the lack of existing literature on mobile phone-based mindfulness interventions. The study supports the efficacy of interventions of this kind, within a sample of working adults, as increases in trait mindfulness, decreases in stress and decreases in difficulties in emotion regulation were all found within the mindfulness group. Interventions of this kind provide an alternative for workers with busy and stressful occupations as it is more flexible to suit their working day. In summary, as the findings observed demonstrate increased mindfulness, reductions in emotion regulation difficulties and stress, it supports employers implementing such interventions within their businesses as a way of improving the well-being of their workers with a time and cost effective method.

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