An investigation into the effects of a short-term mindfulness intervention on stress and emotion regulation in undergraduate students: Understanding mechanisms of action

Lauren Armstrong

Supervised by: Elaine Reeves

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ABSTRACT

Stress and poor emotion regulation (ER) strategies are two factors that negatively influence the psychological well-being of students. Mindfulness has been shown to enhance stress and ER in a student population; however the mechanisms by which it exerts its positive effects remain unclear. Thirty-four undergraduate students were randomly assigned to either a mindfulness condition or an active control condition to investigate whether a short-term mindfulness intervention would improve trait mindfulness, stress and ER over a four week period. Despite experiencing no significant changes in stress, the mindfulness condition experienced significant increases in trait mindfulness and significant decreases in difficulties in ER from pre-post intervention. No significant changes in any of the variables were found for the control condition. ER was also found to mediate between mindfulness and stress in the final week, suggesting that ER is one mechanism of action by which mindfulness improves well-being. The current study therefore offers promising theoretical directions, however the efficacy of short-term interventions needs further delineation.

KEY WORDS: TRAIT MINDFULNESS STUDENT WELL-BEING EMOTION REGULATION STRESS SHORT-TERM INTERVENTION
Introduction

Mindfulness is a concept derived from Eastern meditation practice that has been adopted in Western Psychology and utilized in many applications relating to health and well-being. A common definition of mindfulness is that of ‘paying attention in a particular way: on purpose, in the present moment, and non-judgementally’ (Kabat-Zinn, 1994, p.4). Bishop et al. (2004) theorise that mindfulness is a multifaceted state, however Brown & Ryan (2003) posit that mindfulness comprises one component, made up of a receptive attention to and awareness of present events and experience. Here it is also seen as an inherent disposition; a capacity that can be enhanced through practice (Kabat-Zinn, 2003).

Thomson & Waltz (2007) aimed to find out to what extent trait and state mindfulness were correlated, as both have been found to independently improve well-being (Brown & Ryan, 2003). Scores on both state and trait measures of mindfulness after a brief mindfulness-meditation were not significantly related, suggesting that state and trait mindfulness should be investigated as two separate concepts whose relationship is not necessarily linear.

Despite certain conceptual differences one thing that has been unanimously displayed throughout research is that trait mindfulness exerts a positive effect on psychological health (Lykins & Baer, 2009; Moss et al., 2012; Shapiro et al., 2011), and mediates the relationship between mindful practice and changes in well-being and perceived stress (Carmody & Baer, 2008; Josefsson et al., 2011).

Mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) is an eight-week formal intervention that was originally used to reduce chronic pain. Current reviews demonstrate that MBSR can improve a variety of health issues (Grossman et al., 2004; Keng et al., 2011) including anxiety (Anderson et al., 2007) and depression (Grossman et al., 2010), although less research has focused on non-clinical populations, especially in the realm of stress reduction. Chiesa & Serretti (2009) therefore conducted a meta-analysis, and found that overall, MBSR had a significant positive non-specific effect on stress compared to studies with an absence of treatment (Shapiro et al., 1998; Rosenzweig et al., 2003). One study (Shapiro et al., 2007) that used an active control group suggested MBSR may have also had a specific effect.

However, the positive effects of mindfulness practice could be elucidated to the more general effects of taking part in an intervention such as relaxation, which has also been shown to alleviate distress, anxiety and depression (Piazza-Waggoner et al., 2003; Stetter & Kupper, 2002). Jain et al. (2007) and Delgado et al. (2010) found that both mindfulness and relaxation were effective in alleviating distress, suggesting that some changes found after MBSR are not necessarily linked specifically to increased mindfulness. However, in both studies mindfulness was unique in its ability to improve aspects of emotion regulation (ER). This is not surprising, given that mindfulness improves one’s clarity of emotions and leads to better discrimination of thoughts and feelings (Hargus et al., 2010).

Ideally a control condition that is structurally similar to the mindfulness intervention should always be implemented. Thus, non-specific factors that might elicit beneficial effects such as relaxation or group support can be controlled for (Chiesa & Serretti, 2009), allowing any changes to be attributed specifically to mindfulness (Davidson,
2010). There are issues within mindfulness research concerning the use of poorly controlled designs, Grossman et al. (2007) providing a rare example of this ideal level of control.

As MBSR is an eight-week program most studies implementing a mindfulness intervention have followed a similar format. However, MBSR is both lengthy and costly, so it is important to examine the efficacy of short-term interventions. One short-term study by Myint et al. (2011) conducted in a stressful university environment found that mindfulness was effective in alleviating stress in those without exam pressure, but that this was not the case for those meditating throughout the exam period. Zeidan et al. (2010) also demonstrated that a four-day mindfulness intervention improved cognitive abilities, but not mood, indicating that short-term practice was not effective enough to produce any lasting changes in disposition, which perhaps requires more time. Thus it appears the effects of short-term interventions are mixed in terms of the magnitude of benefits they produce, and is clearly an issue that needs investigating further.

Stress is an area that has commanded a huge amount of research and there are several theories, physiological and psychological, associated with it (Krohne, 2001). The transactional theory (Lazarus & Folkman, 1984) sees stress as the product of the interaction between an individual and the environment. It explains how environments that are otherwise the same for everyone elicit individual differences in response, based on events being appraised as taxing or threatening in relation to one’s own coping resources. Mindfulness should be seen to enhance these resources through improved appraisals and enhanced emotional responding that occurs in response to stressors after mindfulness practice (Weinstein et al., 2009).

Students face a massive amount of stress in the form of exams and assignments, and now there is the added pressure of increased tuition fees. Worryingly, the time when individuals enter university is the time that they are most vulnerable to mental health difficulties (Kessler et al., 2005). Not all stress is negative, but above a certain point it becomes associated with mental and physical health problems (Guthrie et al., 1998), and has the potential to impede learning (Timmins & Kaliszer, 2002). Promisingly, mindfulness has been shown to be of great use to student populations (Howell et al., 2008).

Kang et al. (2009) found that mindfulness was successful in reducing stress and anxiety in students, compared to a control group who experienced increases in these measures over the same period. This is in line with other research that suggests mindfulness is an effective way of managing stress in a student population, whose baseline stress measures are often higher than that of their peers in the first place (Warnecke et al., 2011). Lynch et al. (2011) also demonstrated that an eight-week mindfulness program designed for students successfully reduced stress and anxiety compared to a control condition, as well as decreasing negative affect. This could be due to the acceptance component of mindfulness (Kohls et al., 2009) that has been linked to more flexible responding to emotions, as well as more adaptive affect regulation that can buffer against mood disorders and lead to faster recovery from negative states (Jiminez et al., 2010).

Although the positive impact of mindfulness meditation has been well documented, it is less clear by what processes mindfulness exerts its beneficial effects. In terms of
understanding this, research has focused on the beneficial impact of mindfulness on ER (Ortner et al., 2007). ER refers to the ability to monitor, understand and accept emotions, or the ability to reduce or control negative emotions (Kopp, 1989). Developing adaptive ER is important, as negative ER strategies are a major causal factor in psychopathology (Hayes, 2003). Indeed, difficulties in ER have been found in half of Axis I disorders and all Axis II disorders and deficits in this area have been linked to health outcomes in response to stress (Connelly & Denney, 2007), as well as the development of GAD (Roemer et al., 2009).

Many people have difficulty regulating their emotions, experiencing both under and over engagement with them (Feldman et al., 2007). Mindfulness teaches one to accept all feelings, thoughts and emotions without judging or elaborating on them, leading to a healthy engagement with emotions that subsequently facilitates clarity of emotional experience (Chambers et al., 2009). The mindful individual thus learns that any distressing thoughts they may have aren’t accurate representations of reality (Coffey & Hartman, 2008), which in turn stops habitual reactions and automatic avoidance strategies, and promotes adaptive strategies instead.

This is supported by Arch & Craske (2006), where participants who had undergone a mindfulness-based focused breathing exercise were more willing to view optional negative slides than their counterparts in unfocused attention and worry conditions. This suggests that the more mindful participants were capable of viewing the slides as ‘just pictures’ without reacting to them, which is one way that mindfulness is theorised to improve ER (Shapiro et al., 2006).

Few studies have investigated these mechanisms of action further, but a recent study by Erisman & Roemer (2010) examined the relationship between mindfulness and ER by exposing participants to a range of evocative film clips. This mindfulness intervention had a medium-sized effect on ER following an affectively mixed film clip, which included less negative affect immediately after viewing. This supports research that suggests that mindfulness improves well-being by improving emotional responding to distressing events (Eifert & Heffner, 2003), encompassing reduced emotional reactivity to negative stimuli (Campbell-Sills et al., 2006).

Importantly, Coffey & Hartman (2008) demonstrated that ER mediated the relationship between mindfulness and distress, and is supported by neuroimaging evidence that shows mindfulness meditation is associated with greater left-sided anterior brain activation, an area that is linked to adaptive responding to stressful events (Davidson et al., 2003). However, although evidence suggests that the interaction between mindfulness and ER leads to greater psychological well-being (Jermann et al., 2009), there is a lack of experimental research that has forwarded the investigation into this proposed mechanism of action (Hölzel et al., 2011).

The current study therefore aimed to further the investigation into the mechanisms of action by which mindfulness exerts its positive effects in a population of students, who are in need of short-term therapies that can help them cope with university life. A quasi-experimental design was employed with participants randomly assigned to a mindfulness condition or an active control condition. Both took part in three sessions in which self-report measures of mindfulness, stress and ER were used to assess changes from pre-post intervention.
It was firstly hypothesised that participants in the mindfulness condition would experience a significant increase in trait mindfulness from week 1 to week 4. Secondly, it was hypothesised that the mindfulness intervention would significantly reduce stress levels from week 1 to week 4. Thirdly, significant decreases in difficulties in ER were expected from week 1 to week 4 for the mindfulness condition. No significant changes in any of the variables from week 1 to week 4 were predicted for the control condition. Finally, it was expected that ER would mediate the relationship between mindfulness and stress at week 4.

Methodology

Design

A 2 X 2 mixed quasi-experimental design was used where the independent between-subjects variable was group type (mindfulness vs. control) and the independent within-subjects variable was assessment time (week 1 and week 4). The dependent variables were scores in mindfulness, ER and stress as measured by self-report questionnaires.

Participants

Participants were recruited using opportunity sampling around a university campus with the help of informative posters (Appendix A). A power analysis (Appendix B) calculated using G*power 3.1.3 (Faul et al., 2007) determined that a minimum of 24 participants were needed.¹

In total 34 participants took part, (n = 18) for the mindfulness condition and (n = 16) for the control condition, consisting of 61.76 % females, with an age range of 18-28 (M = 22.38, SD = 2.86). Participants were matched for age and gender before being randomly allocated to a condition, with two participants in the control condition unable to complete the study due to work commitments.

Due to practical constraints, participants were not matched for scores on the FFMQ, DERS and DASS before the study began. Therefore, differences in scores between mindfulness intervention and control conditions at week 1 and week 4 were not hypothesised nor examined, as it would not have been possible to make sure that participants had similar levels of all variables before being randomly assigned to a condition. Other studies (Kang et al., 2009; Shapiro et al., 2007) have followed a similar procedure in their design and analysis.

Materials

Self-Report Questionnaires (Appendices C-F)

The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) is a 39 item questionnaire designed to measure trait mindfulness. It comprises five subscales namely observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience. Items are rated on a 5 point Likert-scale (1 = never, 5 = very often), with a high total score representing a high

¹ Calculated using a significance level of .05, power of .08 and a small effect size (Cohen’s d = .25).
level of mindfulness, the highest score being 195 and the lowest 39. For the purposes of this study the scores from the individual subscales were not investigated. The scale shows good overall internal consistency with a Cronbach’s alpha of .92; the individual scales ranging from .75 to .91 (Baer et al., 2006).

The Difficulties in Emotion Regulation Scale (DERS; Gatz & Roemer, 2004) is a 36 item questionnaire designed to measure characteristic patterns of emotion regulation. It comprises six subscales namely non-acceptance of emotional responses, difficulties engaging in goal-directed behaviour, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies and lack of emotional clarity. Responses are scored on a 5 point Likert-scale (1 = almost never, 5 = almost always) and a higher total score indicates greater difficulties in ER. The highest score is 180 and the lowest is 36. For the purposes of this study the scores from the individual subscales were not investigated. The scale shows good overall internal consistency with a Cronbach’s alpha of .93; the six subscales ranging from .80 to .89 (Gatz & Roemer, 2004).

The Depression Anxiety and Stress Scales (DASS; Lovibond & Lovibond, 1995) is a 42 item scale that measures depression, anxiety and stress and comprises three subscales that relate to each of these factors. Items are rated on a 4 point Likert-scale (0 = does not apply, 3 = applies very much) and a higher score represents a higher level of difficulty with these issues. For the purposes of this study only the stress scale comprising 14 items was used, where the highest score is 42 and the lowest score is 0. This is acceptable according to the author’s instructions (Lovibond & Lovibond, 1995). The stress scale has good internal consistency with a Cronbach’s alpha of .90; with depression and anxiety subscales .91 and .84 respectively (Lovibond & Lovibond, 1995).

The Toronto Mindfulness Scale (TMS; Lau et al., 2006) is a 13 item scale used to assess the extent to which participants have been mindful following a period of meditation. It comprises two subscales namely observing and decentering which are rated on a 5 point Likert-scale (0 = not at all, 4 = very much). A higher total score represents a higher level of state mindfulness, the highest score being 52 and the lowest score 0. The scale has a good overall consistency of .91 (Lau et al., 2006), with α coefficients of .93 and .91 for curiosity and decentering respectively. For the purposes of this study the scores for the individual subscales were not investigated.

Permission was obtained for the use of all questionnaires.

**Recordings and podcasts**

The mindfulness condition listened to recordings from two series’ of Jon Kabat-Zinn’s Guided Mindfulness Meditation (Kabat-Zinn, 1990b, 2005b). Week one was Track 1- Breathscape from Series 3, week two was Track 7- Nowscape (Choiceless awareness) from Series 3 and week three was Track 1- Body scan from Series 1 (Appendix H). This intervention was representative of other mindfulness interventions, such as Kang et al. (2009) who used voice recorded files to develop mindful awareness. The recordings also incorporated essential aspects of MBSR, such as sitting meditation and the body scan (Kabat-Zinn, 1982). Permission was obtained prior to the study to use the recordings for experimental purposes.
The control group listened to three podcasts from the Guardian’s Careers Talk series. Week one was ‘A guide to work experience’ (Eustice, Crawford et al., 2011), week two was ‘Maximising your career potential at university’ (Eustice, Cuddon et al., 2011) and week three was ‘Predictions for the graduate job market in 2012’ (Eustice, Taylor et al., 2011) (Appendix I). Educational recordings have been validated by Erisman & Roemer (2010) who used neutral educational information from a public radio broadcast for their control condition.

The overall duration of the mindfulness and control recordings equated to the same length of time. Therefore participants in both conditions underwent approximately 95 minutes of intervention spread over the three week period, which was of a similar length to the intervention used by Zeidan et al. (2010).

**Procedure**

Participants attended three sessions, once a week for three weeks in which they listened to one recording per session. Mindfulness participants were informed they were in group A and control participants were informed they were in group B so they could access the appropriate recordings, and were provided with written instructions for the session (Appendix J).

To make sure any changes could be attributed specifically to the mindfulness intervention, the active control condition took part in a structurally similar intervention. The format of the intervention between conditions was kept the same², and the sessions for each condition were conducted at the same time on the same day each week, in similar controlled environments. Group support has been identified as a variable that needs to be controlled for (Chisea & Serretti, 2009) as it may contribute to the beneficial nature of an intervention. Participants therefore listened to the recordings individually through headphones on a computer, and were instructed not to communicate with each other for the duration of the study.

Baseline measurements of all variables (mindfulness, stress and ER) were assessed pre-intervention at week 1 and again post-intervention at week 4. The variables were assessed from pre-post intervention as the FFMQ has been validated in longer-term trials (Carmody et al., 2009) and stress and ER were expected to change with mindfulness.

Following Erisman & Roemer (2010) the TMS was given to participants after each session as a manipulation check, to make sure the participants were sufficiently engaged with the meditation. The control group received a Likert-scale style questionnaire with questions pertaining to their podcasts to keep the conditions structurally similar (Appendix G).

The first questionnaires were completed at the first session prior to listening to the first recording. The TMS or corresponding control questionnaire was completed immediately after the participants had finished listening to the recording at each session and final measurements were assessed one week after the final session, where participants were also fully debriefed. Appendix K provides a schematic-overview of the study.

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² For example all participants were instructed to pay close attention to the recordings with their eyes closed.
Ethics

Consent was obtained prior to the commencement of the study (Appendix L) and participants were debriefed after the study had ended (Appendix M). One potential ethical issue was that whilst the mindfulness group were receiving an intervention designed to improve psychological well-being, the control group were asked to give up the same amount of time yet were not expected to receive any beneficial changes. However, the recordings were deemed interesting for a student population as they pertained to careers advice for the graduate job market. See appendices N & O for ethics forms EFC and AEAF.

Results

All raw data were entered into IBM SPSS Statistics 19.0 to be analysed, and all data output can be found in Appendix P. After all items from each questionnaire had been entered, the appropriate items were reversed scored (See Appendices C-F) and total scores for each questionnaire at each assessment time (week 1 and week 4) were calculated. To check internal reliability Cronbach’s alpha (α) coefficients were generated for all scales at each assessment time. All scales were found to have an α of at least 0.7, denoting satisfactory reliability (Nunally, 1978), which is demonstrated in Table 1.

Table 1

Internal consistency (reliability) and confidence intervals for all measures at each assessment time

<table>
<thead>
<tr>
<th>Measure</th>
<th>Number of items in measure</th>
<th>Reliability</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>α</td>
<td>Lower level</td>
</tr>
<tr>
<td>FFMQ week 1</td>
<td>39</td>
<td>.86**</td>
<td>.76</td>
</tr>
<tr>
<td>FFMQ week 4</td>
<td>39</td>
<td>.92**</td>
<td>.87</td>
</tr>
<tr>
<td>DERS week 1</td>
<td>36</td>
<td>.94**</td>
<td>.90</td>
</tr>
<tr>
<td>DERS week 4</td>
<td>36</td>
<td>.94**</td>
<td>.91</td>
</tr>
<tr>
<td>DASS week 1</td>
<td>14</td>
<td>.90**</td>
<td>.85</td>
</tr>
<tr>
<td>DASS week 4</td>
<td>14</td>
<td>.92**</td>
<td>.88</td>
</tr>
<tr>
<td>TMS 1</td>
<td>13</td>
<td>.80</td>
<td>.63</td>
</tr>
<tr>
<td>TMS 2</td>
<td>13</td>
<td>.81</td>
<td>.65</td>
</tr>
<tr>
<td>TMS 3</td>
<td>13</td>
<td>.87*</td>
<td>.76</td>
</tr>
</tbody>
</table>

Note: F test with true value = 0.7, * p < .01, ** p < .001

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3 FFMQ= Five Facet Mindfulness Questionnaire, DERS= Difficulties in Emotion Regulation Scale, DASS= Stress subscale of the Depression Anxiety and Stress scales.
Pre-intervention baseline measurements are referred to as week 1 measurements and final post-intervention measurements are referred to as week 4 measurements for the FFMQ, DERS and DASS from here on in.

**Manipulation Check**

Paired sample t-tests were conducted to determine the effectiveness of the TMS as a manipulation check; however none of the t-tests determined any significant increases in scores across the study. Week 2 scores \((M = 28.83, SD = 7.43)\) did not significantly increase from week 1 scores \((M = 28.61, SD = 8.53)\), \(t(17) = .13, p = .899\), and week 3 scores \((M = 30.06, SD = 9.62)\) did not significantly increase from week 2 scores, \(t(17) = .75, p = .466\). Week 3 measurements did not significantly increase from week 1 measurements either, \(t(17) = .94, p = .360\).

To determine whether the participants had been appropriately engaged right from the start, and hence why TMS scores did not increase throughout the study, one sample t-tests were used to see if these values were similar to the TMS score obtained by Erisman & Roemer (2010) who also used the TMS as a manipulation check. Week 1 TMS scores were not significantly different from the Erisman & Roemer (2010) TMS value \((M = 29.13, SD = 4.77)\), \(t(17) = .26, p = .799\). Neither were week 2 scores, \(t(17) = .17, p = .867\) or week 3 scores, \(t(17) = .41, p = .688\). This demonstrates that participants displayed a sufficient level of engagement in the very first session and maintained this consistent level of engagement with the material at each subsequent week.

**Hypothesis One**

In order to determine whether trait mindfulness significantly increased from week 1 to week 4, FFMQ scores were measured from pre-post intervention in both conditions. Table 2 provides the means and standard deviations for the FFMQ for both mindfulness and control conditions at weeks 1 and 4.

**Table 2**
**Descriptive statistics for the FFMQ at week 1 and week 4**

<table>
<thead>
<tr>
<th>Assessment time</th>
<th>Mindfulness ((n = 18))</th>
<th>Control ((n = 16))</th>
<th>Total Sample ((N = 34))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
<td>(M)</td>
</tr>
<tr>
<td>FFMQ week 1</td>
<td>126.50</td>
<td>15.26</td>
<td>126.19</td>
</tr>
<tr>
<td>FFMQ week 4</td>
<td>136.89</td>
<td>20.26</td>
<td>128.06</td>
</tr>
<tr>
<td>Overall</td>
<td>131.69</td>
<td>--</td>
<td>127.13</td>
</tr>
</tbody>
</table>

A 2 X 2 mixed factorial ANOVA was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects independent variable was the condition (mindfulness or control) and the dependent variable was the FFMQ score.\(^4\) A significant main effect for assessment

\(^4\) All significance values reported are two-tailed with an alpha level of .05 unless otherwise stated.
time was observed, $F(1, 32) = 9.48, p = .004^5$ but not for condition, $F(1, 32) = .80, p = .377$. A significant interaction effect was observed, $F(1, 32) = 9.48, p = .040$. Figure 1 illustrates this interaction.

![Figure 1: A plot to illustrate the interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the FFMQ](image)

**Post-hoc tests**

To determine the source of significance within the ANOVA paired-sample t-tests were conducted\(^6\) separately for each condition where the independent variable was assessment time (week 1 and week 4) and the dependent variable was FFMQ score. A significant increase was found for the mindfulness condition from week 1 ($M = 126.50$) to week 4 ($M = 136.89$) with a large effect size\(^7\), $t(17) = 3.40, p = .003, d = .86$, but not for the control group from week 1 ($M = 126.19$) to week 4 ($M = 128.06$), $t(15) = .77, p = .456$. This indicates that only the mindfulness condition experienced a significant increase in mindfulness from week 1 to week 4.

**Hypothesis Two**

To determine whether difficulties in emotion regulation significantly decreased from week 1 to week 4, DERS scores were measured from pre-post intervention in both conditions. Table 3 provides the means and standard deviations for the DERS at weeks 1 and 4.

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\(^5\) Mauchly’s test was not significant so sphericity was assumed.

\(^6\) To control for two pairwise comparisons the Bonferroni correction provided a new significance value of .025.

\(^7\) Effect sizes were calculated using an online effect size calculator (Effect Size Link, 2011) and interpreted according to guidelines (Cohen, 1988) where a small effect size = .25, medium = .50 and large = .80.
A 2 X 2 mixed factorial ANOVA was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects-independent variable was the condition (mindfulness or control) and the dependent variable was the DERS score. Significant main effects were not found for assessment time, $F(1, 32) = 2.12, p = .155$ or condition, $F(1, 32) = .13, p = .719$. However a significant interaction effect was observed, $F(1, 32) = 6.91, p = .013$. Figure 2 illustrates this interaction.

Table 3
Descriptive statistics for the DERS at week 1 and week 4

<table>
<thead>
<tr>
<th>Participant group</th>
<th>Mindfulness $(n = 18)$</th>
<th>Control $(n = 16)$</th>
<th>Total Sample $(N = 34)$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment time</strong></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>DERS week 1</td>
<td>86.22</td>
<td>25.24</td>
<td>78.69</td>
</tr>
<tr>
<td>DERS week 4</td>
<td>78.39</td>
<td>23.52</td>
<td>80.94</td>
</tr>
<tr>
<td>Overall</td>
<td>82.31</td>
<td>--</td>
<td>79.81</td>
</tr>
</tbody>
</table>

Figure 2: A plot to illustrate the interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the DERS

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8 Mauchly’s test was not significant so sphericity was assumed.
Post-hoc tests

To determine the source of significance within the ANOVA paired sample t-tests were conducted separately for each condition where the independent variable was assessment time (week 1 and week 4) and the dependent variable was the DERS score. A significant decrease from week 1 ($M = 86.22$) to week 4 ($M = 78.39$) was found for the mindfulness condition, with a medium effect size, $t(17) = 2.88, p = .010$, $d = .69$, but not for the control group from week 1 ($M = 78.69$) to week 4 ($M = 80.94$), $t(15) = .84, p = .415$. This indicates that only the mindfulness condition experienced significant decreases in ER from week 1 to week 4.

Hypothesis Three

To determine whether stress levels significantly decreased from week 1 to week 4, DASS scores were measured from pre-post intervention in both conditions. Table 4 provides the means and standard deviations for the DASS for both mindfulness and control conditions at weeks 1 and 4.

Table 4
Descriptive statistics for the DASS and week 1 and week 4

<table>
<thead>
<tr>
<th>Participant group</th>
<th>Mindfulness ($n = 18$)</th>
<th>Control ($n = 16$)</th>
<th>Total Sample ($N = 34$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment time</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>DASS week 1</td>
<td>15.44</td>
<td>8.60</td>
<td>10.13</td>
</tr>
<tr>
<td>DASS week 4</td>
<td>12.89</td>
<td>7.24</td>
<td>13.44</td>
</tr>
<tr>
<td>Overall</td>
<td>14.17</td>
<td>--</td>
<td>11.78</td>
</tr>
</tbody>
</table>

A 2 X 2 mixed factorial ANOVA was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects independent variable was condition (mindfulness or control) and the dependent variable was the DASS score. Significant main effects were not found for assessment time, $F(1, 32) = .11, p = .741^{10}$ or condition, $F(1, 32) = .78, p = .383$. However a significant interaction effect was observed, $F(1, 32) = 6.67, p = .015$. Figure 3 illustrates this interaction.

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9 To control for two pairwise comparisons the Bonferroni correction provided a new significance value of .025.

10 Mauchly’s test was not significant so sphericity was assumed.
Figure 3: A plot to illustrate the interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the DASS

Post-hoc tests

To determine the source of significance within the ANOVA two paired-sample t-tests were conducted\(^{11}\) separately for each condition where the independent variable was assessment time (week 1 and week 4) and the dependent variable was DASS score. No significant decrease was found for the mindfulness condition from week 1 (\(M = 15.44\)) to week 4 (\(M = 12.89\)), \(t(17) = 1.59, p = .131\) or for the control group from week 1 (\(M = 10.13\)) to week 4 (\(M = 13.44\)), \(t(15) = 2.09, p = .055\). Therefore no significant changes in stress were found from week 1 to week 4 in either condition.

Hypothesis Four

Regression analyses were carried out within the mindfulness condition to determine if at week 4 ER was a mediator between mindfulness and stress. Baron & Kenney (1986) identify four steps to determine mediation. Firstly the initial predictor variable (mindfulness) must be shown to affect the criterion variable (stress) in a regression analysis. Secondly, the mediator (ER) must be affected by the predictor in a further regression analysis. Thirdly, in a regression analysis involving both the mediator and the predictor, the mediator must be shown to affect the criterion variable. Fourthly, in this same regression analysis the effect of the initial predictor variable on the criterion variable must be less in this stage than it was in the first. Perfect mediation is said to have occurred if this value becomes non-significant when controlling for the mediator. Preacher & Hayes (2004) identified a fifth step to test whether the mediation, or indirect effect, is significant using a Sobel test.

\(^{11}\) To control for two pairwise comparisons the Bonferroni correction provided a new significance value of .025.
To clarify, the initial predictor variable was week 4 scores of the FFMQ, the mediator variable was week 4 scores of the DERS and the criterion variable was week 4 scores of the DASS for the mindfulness condition. Separate coefficients for each equation were estimated, and according to the instructions of Baron & Kenney (1986) hierarchical or stepwise regression were not necessary. A correlation matrix was generated to determine whether there was a relationship that could be mediated, which is demonstrated in Table 5. Scatter plots can be found in Appendix Q.

Table 5
Pearson correlation matrix between the FFMQ, DERS and DASS scores at week 4 ($N = 18$)

<table>
<thead>
<tr>
<th></th>
<th>FFMQ</th>
<th>DERS</th>
<th>DASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFMQ</td>
<td>-.841**</td>
<td>-.623*</td>
<td></td>
</tr>
<tr>
<td>DERS</td>
<td></td>
<td>.827**</td>
<td></td>
</tr>
<tr>
<td>DASS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .01$. **$p < .001$, one-tailed.

In regards to multicollinearity, Langdridge & Hagger-Johnson (2009) suggest that correlation values of above .70 should be investigated further. A common rule of thumb is that tolerance values of less than .20 or VIF values of more than 10 indicate harmful collinearity (O'Brien, 2007). In the present study tolerance was .29 and VIF was 3.29 with regards to the correlation between the FFMQ and DERS, indicating no cause for concern.

Tables 6, 7 and 8 display the three separate regression analyses needed to determine mediation between mindfulness and stress, via ER for the mindfulness condition.\(^{12}\)

Table 6
Summary of regression analysis for predicting week 4 DASS scores from week 4 FFMQ scores ($N = 18$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>Sig.(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (intercept)</td>
<td>43.37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFMQ</td>
<td>.39</td>
<td>-.62</td>
<td>-3.18</td>
<td>.006</td>
</tr>
</tbody>
</table>

Note: $R^2 = .39$ (.35).

In this first analysis the FFMQ was shown to be a significant predictor of the DASS ($t = -3.18$, $p < .006$), thus as mindfulness increases, stress is shown to decrease. This regression model explains that 39% of the variance in stress is predictable from mindfulness which is statistically significant, $F(1, 16) = 10.14$, $p = .006$ and meets the first stage for mediation.

\(^{12}\) Adjusted $R^2$ values are included in parentheses.
In this second analysis the FFMQ was shown to be a significant predictor of the DERS ($t = -.62, p < .001$), thus as mindfulness increases difficulties in ER decrease. This regression model explains that 71% of the variance in difficulties in ER is predictable from mindfulness which is statistically significant, $F(1, 16) = 38.68, p < .001$ and meets the second stage for mediation.

In this final analysis the DERS was shown to be a significant predictor of the DASS ($t = 3.97, p = .001$), thus as difficulties in ER decrease so do levels of stress, meeting the third stage for mediation. This regression model explains that 70% of the variance in stress is predictable from difficulties in ER and mindfulness which is statistically significant, $F(2, 15) = 17.60, p < .001$. In this analysis the FFMQ was not shown to be a significant predictor of the DASS ($t = .95, p = .357$), thus when controlling for difficulties in ER an increase in mindfulness does not result in a decrease in stress.

This meets the final stage for mediation, with this model demonstrating perfect mediation between mindfulness and stress via ER. The Sobel test demonstrated that this indirect effect was significant ($z = 4.29, p < .001$). Figure 4 demonstrates this mediation.

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13 The Sobel test was calculated using an online Sobel test calculator (Sobel Test Link, 2010).
Discussion

Hypothesis One: Mindfulness

As predicted, it was found that trait mindfulness as measured by the FFMQ significantly increased from week 1 to week 4 in the mindfulness condition but not in the control condition. This supports the findings of Carmody & Baer (2008) who also found that mindfulness training leads to increases in self-reported mindfulness. However, this study utilised mindfulness homework, which has found to be an effective adjunct to intervention (Vettese et al., 2009). Similarly, Weinstein et al. (2009) measured mindfulness three times a day over the course of an intervention to determine whether participants were in a mindful state on a day to day basis.

The current study provided no way of measuring if participants were practicing mindfulness away from the intervention, and thus whether this was a factor contributing to their increased mindfulness. However, the current finding that increases in trait mindfulness did not lead to increases in state mindfulness as measured by the TMS supports research by Thompson & Waltz (2007) and suggests that trait and state mindfulness are indeed two independent constructs.

Hypothesis Two: Emotion Regulation

As hypothesised it was found that difficulties in ER as measured by the DERS significantly reduced from week 1 to week 4 for the mindfulness condition, but not for the control condition. As with Erisman & Roemer (2010) a medium-sized effect for reduction in difficulties in ER was found, offering preliminary support for the role of mindfulness in regulating ER. These results support theorising that the increased awareness that is brought about as a result of mindfulness training leads to a greater clarity of emotional experience (Chambers et al., 2009). This clarity of emotions
leads to a greater acceptance of thoughts and feelings, which in turn promotes adaptive ER strategies (Kohls et al., 2009).

Hypothesis Three: Stress

Significant changes in stress levels were not found in either condition from week 1 to week 4, offering no support for the hypothesis that the mindfulness intervention would decrease stress. This contradicts research conducted by Kang et al. (2009) who found that a mindfulness intervention significantly decreased stress, whilst a control group actually became more stressed over the same period of time. A likely explanation is that the present study was underpowered, and the short term duration of the study was not lengthy enough to demonstrate significant changes in this variable.

Myint et al. (2011) found that a short-term mindfulness intervention was only effective in reducing stress for students without exam pressure, which may also explain the results of the current study, as the intervention took place over a period when students were facing a large amount of academic pressure. To make sure students receive the full benefit of mindfulness in future interventions, this should be taken into account and extra sessions included to compensate for the stress that imposing deadlines and exams can create (Walsh et al., 2010).

Hypothesis Four: Mediation

Supporting the final hypothesis, it was found that ER significantly mediated the relationship between mindfulness and stress at week 4. This supports Coffey & Hartman (2008) who discovered that self-reported ER mediated the relationship between mindfulness and psychological distress in a student population.

These results are also in line with the transactional theory of stress (Lazarus & Folkman, 1984) where mindfulness affects an individual’s cognitive appraisals, leading to more adaptive coping styles in response to stress (Weinstein et al., 2009). Therefore, the improved emotional responding to potential stressors and negative events that is found with increased mindfulness (Eifert & Heffner, 2003), including an overall reduced reactivity to threatening stimuli (Campbell-Sills et al., 2006) appears to be one mechanism by which mindfulness is able to reduce stress.

Due to the lack of research investigating the specific mechanisms of action of mindfulness (Hölzel et al., 2011), the current study therefore offers important theoretical implications. The findings support existing literature regarding the relationship between mindfulness and ER (Chambers et al., 2009), but also offer insight into exactly how mindfulness is able to exert its positive effects, thus allowing more direct and effective research to be carried out.

Limitations and Implications

In addition to the suggestions already posed, there are a number of issues that need to be addressed before conducting future short-term intervention studies.

The current study did employ an active control condition, however future research should follow Jain et al. (2007) by comparing mindfulness to interventions that are also designed to improve well-being. By comparing mindfulness to similar techniques, for example focused-attention meditation (Raffone et al., 2010), unique
outcomes would be able to be identified, serving to clarify the nature of mindfulness even further, as there are still contentions as to exactly how it differs from other constructs, and therefore how it should be operationalized (Brown & Ryan, 2003; Chambers et al., 2009). To determine whether a mindfulness intervention is significantly more effective than a specified control intervention, participants could also be matched for each outcome variable pre-intervention, allowing for a more direct comparison between groups in the final week (Delgado et al., 2010).

Secondly, although the current study did not find any significant changes in stress, the relationship between mindfulness and stress has been widely demonstrated (Keng et al., 2011), and in parallel with Lynch et al. (2011), correlation analysis supports the expectation that there is a negative correlation between mindfulness and stress. Taking this into consideration, the current findings should be considered an underestimate of the potential effect of longer duration practice, but also suggests that the minimum number of sessions needed to significantly reduce stress still needs to be determined.

The format of the interventions could have also been altered to maximise the positive impact of mindfulness training. In traditional MBSR interventions a group facilitator has been used to conduct the sessions (Carmody & Baer, 2008), who will often have many years of experience (Grossman et al., 2007). This may be a much more effective way of evoking mindfulness and therefore the associated benefits within the participants. However, podcast recordings are a very accessible way for students to engage with mindfulness, and offer a simple, low-cost way for individuals to practice mindfulness in their own time.

Further, the present study does indicate that a short-term study is effective in eliciting a significant increase in trait mindfulness, which is concurrent with research by Zeidan et al. (2010). Given that students are particularly vulnerable to mental health difficulties (Kessler et al., 2005), the finding that a short-term mindfulness intervention significantly improved ER, a construct that has been linked to psychopathology (Hayes, 2003), is also promising. Therefore the current study offers a rationale for employing short-term, mindfulness-based interventions aimed at reducing difficulties in ER in undergraduate students.

Conclusion

The current study demonstrated that a short-term mindfulness intervention was successful in increasing mindfulness and decreasing difficulties in ER, which may be of use to an emotionally vulnerable student population. Conversely, the intervention was not successful at significantly reducing stress levels, which suggests that further research needs to focus on the longer term efficacy of short-term interventions. However, an investigation into the mediating effect of ER between mindfulness and stress suggests that a slightly longer intervention would have further improved ER, leading to larger declines in stress. The findings from the mediation analysis also offer suggestions for explaining how mindfulness exerts the positive effects that are consistently demonstrated across the literature (Keng et al., 2011).
References


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