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**Mindfulness-based cognitive therapy for neuroticism (stress vulnerability):
A pilot randomized study**

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Abstract

Objective: Neuroticism, a characteristic associated with increased stress vulnerability and the tendency to experience distress, is strongly linked to risk of different forms of psychopathology. However there are few evidence-based interventions to target neuroticism. This pilot study investigated the efficacy and acceptability of mindfulness based cognitive therapy (MBCT) compared to an online self-help intervention for individuals with high levels of neuroticism. The MBCT was modified to address psychological processes that are characteristic of neuroticism.

Method: Participants with high levels of neuroticism were randomized to MBCT ($n = 17$) or an online self-help intervention ($n = 17$). Self-report questionnaires were administered pre-intervention and again at 4 weeks post-intervention.

Results: Intention to treat analyses found that MBCT participants had significantly lower levels of neuroticism post-intervention than the control group. Compared to the control group the MBCT group also experienced significant reductions in rumination and increases in self-compassion and decentering, of which the latter two were correlated with reductions in neuroticism within the MBCT group. Low drop-out rates, high levels of adherence to home practice and positive feedback from MBCT participants provide indications that this intervention may be an acceptable form of treatment for individuals who are vulnerable to becoming easily stressed.

Conclusions: MBCT specifically modified to target neuroticism-related processes is a promising intervention for reducing neuroticism. Results support evidence suggesting neuroticism is malleable and amenable to psychological intervention. MBCT for neuroticism warrants further investigation in a larger study.

Key words: Mindfulness based cognitive therapy, neuroticism, personality, stress vulnerability, treatment.

Introduction

Neuroticism is a personality factor that can be characterised by the tendency to experience negative affect (Costa & McCrae, 1987), as well as the propensity to arouse quickly and disproportionately to emotional stimuli, and for arousal to fall slowly (Eysenck & Eysenck, 1985). It is linked to increased stress vulnerability (Suls, 2001) and has been cited as one of the most important factors associated with psychopathology, including mood and anxiety disorders (Kotov, Gamez, Schmidt & Watson, 2010). Further, prospective evidence from a large twin study has also identified neuroticism as an independent predictor of major depression (Kendler et al., 2006).

Neuroticism may contribute to the onset of common mental disorders through altered cognitive processing of emotional material including negative biases in the interpretation of information (Matthews, 2004) and increased cognitive reactivity to negative stimuli (Barnhofer & Chittka, 2010), as well as through the development of detrimental coping strategies such as behavioural and experiential avoidance (Maack, Tull & Gratz, 2012). A related process that has been found to mediate the relationship between neuroticism and common mental disorders is rumination (Yoon, Maltby and Joorman, 2013); an emotion regulation strategy with significant relationships with depression and anxiety (Muris, Roelofs, Rassin, Franken & Mayer, 2005). Neurotic individuals also tend to report increased levels of worry, self-criticism and low self-esteem (Clara, Cox & Enns, 2003; de Bruin, Rassin & Murris, 2007; Schmitz, Kugler & Rollnik, 2003).

As well as being linked to maladaptive cognitive styles, neuroticism has also been shown to have a significant negative association with the construct of mindfulness, with evidence

suggesting that mindfulness is a moderator of the relationship between neuroticism and depressive symptoms (Barnhofer, Duggan and Griffith, 2011). Those high in neuroticism are overly sensitive and reactive to emotional stimuli, and employ maladaptive emotion regulation strategies. Mindfulness, on the other hand, is characterised by awareness and acceptance of ongoing emotional experience (Bishop et al., 2004) and thus may act as a protective factor against the negative processes associated with neuroticism. Neuroticism has also been shown to have a significant negative association with levels of self-compassion (Neff, Rude and Kirkpatrick, 2007), a construct with overlapping components with mindfulness (Feldman & Kuyken, 2011), and one which predicts increased psychological well-being over time (Gilbert & Proctor, 2006).

Given the prospective link between neuroticism and psychiatric difficulties, it has been argued there is a need for interventions that do not focus solely on outcomes related to neuroticism, but on neuroticism as an underlying cause of psychopathology itself (Cuijpers et al., 2010). However, despite these recommendations, there is a relative lack of interventions designed to target neuroticism.

Barlow, Sauer-Zavala, Carl, Bullis and Ellard (2014) have suggested in a comprehensive review that neuroticism may be more malleable than traditionally thought, and recent studies have provided preliminary evidence indicating that it may be possible to reduce neuroticism using existing interventions designed to address depression or anxiety. For example, an RCT for depression comparing patients taking SSRIs, placebo or undergoing cognitive therapy found that subjects taking SSRIs reported significantly greater personality change as assessed by the 60-item NEO-Five Factor Inventory (Costa & McCrae, 1985; Costa & McCrae, 1989), than placebo subjects, even when controlling for improvement in depression (Tang et al.,

2009). An uncontrolled exploratory trial of repetitive transcranial magnetic stimulation for depression found reductions in self-reported neuroticism scores on the Big Five Inventory (John, Donahue & Kentle, 1991), that were correlated with a decrease in depression (Berlim, McGirr, Beaulieu, Van den Eynde & Turecki, 2013). Carl, Gallagher, Sauer-Zavala, Bentley and Barlow (2014) compared the impact of a one-to-one cognitive-behavioural intervention (the unified protocol for transdiagnostic treatment of emotional disorders; UP; Barlow et al., 2011) with a waitlist control condition on levels of behavioural inhibition, assessed using the Behavioral Inhibition System / Behavioral Activation System scales (Carver & White, 1994). Behavioural inhibition, which is viewed as a motivational tendency in response to threat cues, is highly correlated with neuroticism. Their participants were recruited for having an anxiety disorder rather than high neuroticism or behavioural inhibition. They found greater decreases in behavioural inhibition following UP compared to waitlist, albeit with a small, non-significant effect size ($g = 0.33$). Further, decreases in behavioural inhibition were associated with decreases in depression and anxiety symptoms at post-treatment and six-month follow-up. However, although demonstrating promising changes, none of the above research utilised an intervention specifically designed to target neuroticism and the participants in these studies were recruited on the basis of the presence of psychological disorder rather than neuroticism.

Although not previously investigated for neuroticism, mindfulness-based interventions may provide an alternative therapy style to UP, in the form of group-based therapies, which may be preferable for some people and confer advantages such as being more cost-effective. Mindfulness-Based Cognitive Therapy (MBCT, Segal, Teasdale & Williams, 2002, 2013) is a group-based psychological therapy which combines elements of CBT with mindful practice designed to prevent depressive relapse. MBCT has been shown to be efficacious in

significantly reducing the risk of relapse in recovered, recurrently depressed participants (Ma & Teasdale, 2004; Teasdale et al., 2000), as well as for reducing anxiety symptoms in GAD (Evans et al., 2008). Indeed, evidence suggests that MBCT's treatment effects for recurrent depression are mediated by decreased levels of rumination (Aaldereen et al., 2012), and increased levels of mindfulness and self-compassion (Kuyken et al., 2010). MBCT has also been shown to be associated with reductions in unhelpful beliefs about emotions (e.g. Rimes and Wingrove, 2013).

Mindfulness-based interventions teach skills to help people notice thoughts, feelings and bodily sensations, whilst cultivating an accepting, curious and non-judgemental attitude (Hayes & Feldman, 2004). Mindfulness interventions may help people with high levels of neuroticism to notice the occurrence of potentially unhelpful processes, such as rumination, self-criticism, interpretation biases, avoidance and physical tension, and cultivate greater use of alternatives such as self-compassion and the allowing and acceptance of difficulties. .

Decentering, which has been posited to be a key mechanism of mindfulness interventions (Shapiro, Carlson, Astin & Freeman, 2006) is the ability to observe one's thoughts and feelings as passing mental events that are not necessarily true or a reflection of the self.

Practising a more detached perspective on thoughts and feelings may help to prevent negative thinking becoming perseverative and developing into a vicious cycle with low or anxious mood, hence resulting in decreased emotional sensitivity in highly neurotic individuals. A study by Oken, Miller, Goodrich and Wahbeh (2014) indicated that a one-to-one mindfulness intervention was associated with lower levels of neuroticism at post-treatment than a waiting list control condition in a 50-85 year old moderately stressed population, supporting the theoretical premise for addressing neuroticism with mindfulness-based methods. However, individuals were not selected on the basis of possessing high levels of neuroticism, and this

type of therapy warrants further investigation in a neurotic sample where the age range is not limited to older adults.

Current study and hypotheses

In summary, neuroticism is associated with elevated levels of cognitive processes such as rumination which are linked to common mental health problems and lower levels of protective attributes such as mindfulness and self-compassion. Despite this, no interventions that focus on reducing neuroticism have been investigated, either through a specifically targeted intervention or by recruiting participants on the basis of their level of neuroticism. However, targeting these processes with a novel MBCT intervention may help to reduce neuroticism. Therefore the current pilot randomized study aimed to investigate the acceptability of an adapted version of MBCT for individuals suffering with difficulties due to neuroticism compared to a self-help control condition, and the feasibility of this design for a larger-scale RCT. As such, as far as the authors are aware this was the first intervention of its kind. The control condition of an online self-help intervention was chosen as a minimal psychological intervention to control for the effects of receiving psychoeducation and advice about how to manage psychological problems, and for the ethical reason of providing assistance for distressed individuals.

It was hypothesised that:

- (1) MBCT participants would report significantly lower post-treatment levels of neuroticism (the primary outcome), anxiety, depression and functional impairment caused by stress vulnerability than participants in the control group.
- (2) MBCT participants would report significantly higher post-treatment levels of mindfulness, self-compassion and decentering, and lower levels of rumination and

unhelpful beliefs about emotions than participants in the control group.

- (3) The adapted MBCT intervention would be acceptable to participants and feasible to implement in this population.

Method

Design

A pilot randomized-controlled trial was conducted, with participants ($N = 34$) randomised to an 8-week MBCT course ($n = 17$), or to an online self-help course ($n = 17$). Acceptability of the interventions was assessed through engagement, drop-out and rated usefulness of the interventions. Outcome measures were assessed at baseline (T1) and 4 weeks (T2) following the end of the interventions using online questionnaires. As this was a pilot acceptability and feasibility study designed to inform future research hypotheses, a formal power calculation was not conducted.

Participants

Participants were undergraduate/postgraduate students and staff who responded to adverts and identified as having difficulties with coping with stress, at King's College London (KCL). Only one university was included, due to insufficient time available to secure ethical approval and undertake recruitment in a different organization.

Inclusion criteria were: (1) being 18 years old and above, (2) a score of 6 or above on the neuroticism subscale of the Revised Eysenck Personality Questionnaire, Short Form (EPQR-S; Eysenck, Eysenck & Barrett, 1985), based on previous studies that have used this cut-off to classify high levels of neuroticism (Liu et al., 2013; Zhang, Zhou, Wang, Zhao & Liu, 2013), (3) having access to a general practitioner, (4) if on anti-depressants, using stable

medication for period of at least three months, (5) available to attend at least seven of the mindfulness sessions, (6) having proficiency in written and spoken English sufficient for group participation and questionnaire completion (7) being a King's College London staff or student.

Exclusion criteria were: (1) currently experiencing, or within the last 3 months had experienced significant levels of suicidal ideation, (2) current psychological treatment (3) meeting DSM-IV diagnostic criteria for a psychotic disorder, substance dependence or an eating disorder with a body mass index currently below 17.5, (4) current significant life stress or on-going psychological issues that were judged by the assessor, through collaborative discussions with the participant, to be likely to adversely affect their ability to benefit from the intervention (e.g. recent bereavement), (5) having a disorder that is likely to impair capacity to give informed consent.

Materials

For each measure, a higher score indicates higher levels of the variable under investigation.

Clinical outcome measures

The primary clinical outcome measure was the *Neuroticism scale* of the *Revised Eysenck Personality Questionnaire- Short form* (EPQR-S; Eysenck et al., 1985), which is the brief version of the neuroticism scale of the well-known and validated Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975). The EPQR-S is a 12-item scale scored using a Yes-No dichotomy, and was used to measure neuroticism over the past two weeks. It is freely available and its brief length made it suitable as a convenient screening tool and outcome measure within a relatively large questionnaire set. A study of UK university

students reported mean EPQR-S neuroticism scale scores of 3.6 (SD 1.9) for males and 3.7 (SD 1.7) for females (Francis, Craig & Robbins, 2008). It has high internal consistency, with Cronbach's alpha coefficients of 0.84 and 0.80 for males and females respectively (Eysenck et al., 1985). The EPQR has been shown to significantly correlate with other well-validated neuroticism scales such as the NEO-PI-R ($r = 0.77$, $p < 0.001$; Aluja, Garcia & Garcia 2002) and the BFI ($r = 0.74$, $p < 0.01$; Vorkapić, 2012).

The *Work and Social Adjustment Scale* (WSAS; Marks, 1986; Mundt, Marks, Shear & Griest, 2002) was used to assess general impairment in functioning including difficulties in work and social activities. Wording was adapted to 'Please rate how much your tendency to get easily stressed impairs your ability to carry out the activity'. Responses range from 'not at all impaired' (0) to 'very severely impaired' (8). The scale is reliable and valid, with Cronbach's alpha coefficients ranging from 0.70 to 0.94 (Mundt et al., 2002). Scores above 10 indicate significant impairment associated with clinical symptomatology (Mundt et al., 2002).

The *Patient Health Questionnaire 9-item* (PHQ-9; Spitzer, Kroenke & Williams, 1999) was used to assess depressive symptomatology. The 9-item scale examines depressive symptoms experienced over the past two weeks with responses ranging from 0 (not at all) to 3 (nearly everyday). The scale has demonstrated high internal consistency and validity, with Cronbach's alpha coefficients ranging from 0.86 to 0.89 (Kroenke, Spitzer & Williams, 2001).

The *Generalized Anxiety Disorder 7-item* (GAD-7; Spitzer, Kroenke, Williams & Lowe, 2006) is a 7-item measure with good reliability and validity ($\alpha = 0.92$; Spitzer et al., 2006) and was used to assess symptoms of anxiety over the past two weeks, with responses scored on a 4-point scale from 0 (not at all) to 3 (nearly everyday).

Process measures

The *Five Facet Mindfulness Questionnaire* (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006) is a reliable and valid measure, and was used to measure trait mindfulness. The scale consists of 39 items and comprises five subscales (non-reactivity, observing, acting with awareness, describing and non-judging), with Cronbach's alpha ranging from 0.75 to 0.91 (Baer et al., 2006). Responses range from 'never or very rarely true' (1) to 'very often or always true' (5).

The *Self-Compassion Scale-Short form* (Raes, Pommier, Neff & van Gucht, 2011) is 12 item measure of self-compassion, with scores ranging from 1 (almost never) to 5 (almost always). Previous studies found that this scale has high overall internal consistency ($\alpha = 0.86$; Raes et al., 2011) and validity (Neff, 2003).

The *Beliefs about Emotions Scale* (Rimes & Chalder, 2010) is a 12-item scale that measures beliefs about the unacceptability of experiencing or expressing emotions. Participants indicated responses on a 7-point scale ranging from 0 (totally disagree) to 6 (totally agree). The scale is reliable ($\alpha = 0.91$) and valid, and has shown significant correlations with measures of anxiety and depression (Rimes & Chalder, 2010).

The *Rumination subscale* of the *Rumination Reflection Questionnaire* (Trapnell & Campbell, 1999) is a reliable and valid 12 item measure of rumination ($\alpha = 0.91$; Trapnell & Campbell, 1999). There are 5 response options ranging from 0 (strongly disagree) to 4 (strongly agree). The *Decentering scale* of the *Experiences Questionnaire* (Fresco et al., 2007) was used to measure the process of decentering. The 11-item subscale was scored using a 5-point scale

from 0 (never) to 4 (all the time) and has demonstrated high levels of internal consistency and validity ($\alpha = 0.83$; Fresco et al., 2007).

Treatment acceptability and engagement

The MBCT group were monitored for class attendance. At the beginning of each session they were asked about the amount of home practice between sessions (both frequency (number of days) and minutes), as well as the percentage of hand-outs they had read. The online control group were assessed for how much time they spent completing materials (both hours and weeks). Both groups were asked to rate the perceived usefulness of the intervention on a five point scale; 1 (no use), 2 (quite useful), 3 (useful), 4 (moderately useful), 5 (very useful).

Procedure

This study was approved by King's College London Research Ethics Committee (ref. PNM/13/14-31). Participants were recruited using email, online, and poster advertisements placed around the King's College London campuses. The adverts asked questions such as 'Do you get stressed a lot? Do you become stressed more easily than your peers?' The adverts stated that participants were being recruited for a study comparing two ways of helping people that experience difficulties due to these problems.

Information about the study was emailed to interested participants, who were then invited to complete the EPQR-S screening measure, and took part in a telephone assessment where Axis I diagnoses were assessed using the Mini-International Neuropsychiatric Interview 6.0 (MINI; Sheenan & Lecrubier, 2010), a short structured diagnostic interview. The MINI was used to check for exclusion criteria and to provide additional information about the characteristics of the sample. Eligible participants provided informed consent in writing to

take part in the study and completed all T1 questionnaires. Participants were subsequently randomly allocated to a treatment condition by an external researcher using a computer-generated randomization sequence. Blocks of two were used to ensure each intervention contained similar sized groups. At 4-weeks post-intervention participants were asked to complete T2 questionnaires, as well as a feedback questionnaire to further understand the acceptability and experiences of undergoing this mindfulness-based intervention. Results of this qualitative feedback will be reported separately. Control participants were asked to complete T2 questionnaires at the same length of time after starting the intervention, i.e. 12 weeks. See Figure 1 for the flow of participants through the study.

Treatment

Mindfulness-based cognitive therapy (MBCT) course

The MBCT course was an 8-week program, which was delivered in weekly two-hour sessions for the duration of the intervention. Sessions were conducted in a group format, and were delivered face-to-face by the second author, an experienced clinical psychologist and MBCT practitioner, who met the requirements of the Good Practice Guidelines for Teaching Mindfulness-based Courses (UK Network of Mindfulness-based Teacher Trainers, 2010).

The course was modeled on the protocol developed by Segal et al. (2002, 2013). It was adapted to address key characteristics of neuroticism, rather than being focused on depressive relapse. In conjunction with the standard MBCT session content, each session included a component and accompanying handout that addressed psychological processes previously identified in research as being important for neuroticism:

1: Stress reactivity. Session 1 included an introduction to the ‘fight or flight response’ and hypothalamic-pituitary-adrenal (HPA) axis, advantages and disadvantages of stress and a brief overview of two potentially unhelpful ways of responding to stress: avoidance and over-

thinking. Rumination about the past and worry about the future were contrasted to the present-moment focus of mindfulness practice. The ‘automatic pilot’ theme of session 1 was linked to the idea that we can develop habitual patterns stress reactions; mindfulness can help us to become more aware of these reactions so that we can learn new ways of responding.

2. *Interpretation biases*. In session 2, in addition to the usual ‘thoughts and feelings’ exercise in session 2 there was more detailed discussion about interpretations. This included components of interpretations influencing stress perceptions (perceived risk, consequences, internal coping ability and external coping resources), interpretation biases (e.g. catastrophizing, all-or-nothing thinking) and the impact of our interpretations on our emotions.

3. *Stress sensitivity*. The extra part of session 3 addressed reasons why some people are more sensitive to stress than others including genetic and environmental factors. There was also discussion about how mindfulness can help us to become aware of different aspects of our stress reactions including bodily reactions, thoughts and emotions. The usual Unpleasant Events Calendar which is set as homework after Session 3 was revised to include a column where they were invited to note down any interpretation biases.

4. *Avoidance and safety-seeking behaviours*. In session 4 there was discussion of the short-term and long-term consequences of different types of avoidance and safety behaviours. Methods for addressing avoidance behaviours were briefly outlined including creating a hierarchy for approach behaviours and testing out underlying beliefs. In the session there was also a discussion about the different aspects of stress reactions (including thoughts, bodily sensations, emotions and behaviours) that people had been noticing so far.

5. *Added suffering*. In session 5, in conjunction with the usual session theme, (*Allowing / Letting be*), there was also more specific focus on ways in which our interpretations, avoidance behaviours and attempts to avoid our sensations and emotions can add to our stress. Participants were invited to complete a home practice diary where they noted their direct sensations / emotions and “added suffering” in relation to situations during the week.

6. *Overthinking*. The usual content of session 6, (*Thoughts are not facts*) was expanded to include further discussion of forms of overthinking such as rumination and worry. Methods for increasing awareness of overthinking and ways of addressing it were covered.

7. *Self-criticism*. Session 7 included a discussion of self-acceptance, self-compassion and kindness. Participants were encouraged to undertake a Lovingkindness practice at home on alternate days during the week. The self-care plans in session 7 were modified for stress rather than depressive relapse.

8. *Stress vulnerability relapse prevention*. Session 8 focused on bringing together what they had learnt about stress management rather than depressive relapse.

Sessions included a mixture of guided meditation practice and group discussion, which centered on experiences and difficulties relating to both group and home practice.

Participants were provided with a USB stick containing mindfulness meditation tracks and were invited to complete homework each week, which involved listening to the tracks and completing exercises that built on the material covered in each session. The handouts for each session included a modified version of the handouts from Segal, Williams and Teasdale (2013) as well as additional psycho-education about the above-listed processes.

Online self-help course; Get Self Help

The free and open access online self-help course, which can be accessed at www.getselfhelp.co.uk contains self-help resources that may be beneficial for common mental health problems. The website was developed by a certified CBT practitioner, who is accredited by the British Association of Behavioural and Cognitive Psychotherapies. The website contains psychoeducation about many different problems and modules which provide guidance about how to develop skills that are taught in evidence-based psychological therapies, including understanding and changing unhelpful thoughts.

Participants were given guidance on how to access the information on the website, and were asked to use the website in their own time using a personal computer. Participants were encouraged to complete the seven-step CBT self-help course provided by the website, and to contact the researchers with any questions.

Data preparation and statistical analysis

Data were checked for normality of variance, which met the required assumptions. Preliminary chi-square analyses were undertaken to investigate between-group similarities for categorical demographic variables, and independent samples t-tests were used to compare baseline continuous outcome measures for the two groups. Ethnicity categories were combined into white versus non-white to allow statistical analysis. Univariate ANCOVA's were utilised to compare the effects of MBCT versus self-help for each outcome measure, where the independent variable was treatment group, the dependent variable was T2 scores on each outcome measure, and the covariate was T1 scores on each respective outcome measure. The primary treatment outcome was neuroticism at T2, and partial eta-squared (η^2) was calculated as a measure of effect size, where effect sizes above 0.26 can be considered

large; between 0.13 and 0.26, medium; and between 0.02 and 0.13, small (Cohen, 1988).

Exploratory analyses of treatment mechanisms were conducted, where two-tailed Pearson's correlation coefficients were used to measure the degree of relationship between changes in the process measures and changes in the primary treatment outcome (neuroticism).

As this was a pilot investigation, aiming to detect possible effects that could be investigated in future larger trials, corrections were not made for multiple comparisons. Primary analyses were conducted using intention to treat (ITT) methods. This conservative procedure includes outcome data for all participants regardless of whether they completed treatment, where the last observations are carried forward in the case of missing data.

Results

Internal consistency of all measures

The majority of measures displayed good internal consistency at Time 1; WSA, $\alpha = 0.70$, PHQ-9, $\alpha = 0.854$, GAD-7, $\alpha = 0.86$, FFMQ, $\alpha = 0.68$, SCS, $\alpha = 0.70$, BAES, $\alpha = 0.88$, RRQ, $\alpha = 0.82$, EQ, $\alpha = 0.63$. Cronbach's alpha for the EPQR-S at Time 1 was 0.61, which may be explained by the fact participants were selected based on high scores on this measure. Time 2 data indicates $\alpha = 0.86$. Test-retest reliability analysis demonstrates a high correlation between the EPQR-S administered at screening and at Time 1 two weeks later, $r(32) = .86, p < .001$.

Participant characteristics

The sample ($N = 34$) consisted of 20 members of KCL staff, 14 students and five who were both. Demographic characteristics of the sample are summarised in Table 1. There were no

significant differences between the MBCT and control groups in any demographic variable (all χ^2 , $p > .05$).

Psychological characteristics of the sample are summarized in Table 2. Independent t-tests showed there were no significant pre-treatment differences on measures of functional impairment caused by stress vulnerability, mindfulness, unhelpful beliefs about emotions, rumination or decentering (all t values, $p > .05$). However the control group had higher levels of neuroticism, $t(32) = -2.71$, $p = .011$, anxiety, $t(32) = -2.56$, $p = .015$ and depression, $t(32) = -2.51$, $p = .017$ and lower levels of self-compassion, $t(32) = 2.26$, $p = .031$. Baseline levels of all measures were entered as covariates in the main analyses.

Eight (47.1%) MBCT participants and nine (52.9%) control participants screened positive for at least one DSM-IV psychiatric disorder. There were no significant differences between the MBCT group and the control group in regards to the presence of a psychiatric diagnosis, $\chi^2 = 0.12$, $p > .05$. Eight MBCT participants had one diagnosis, with major depression the most common disorder ($n = 6$) followed by generalised anxiety disorder ($n = 2$). Six control participants had two diagnoses, and three had only one diagnosis. Major depression was the most common disorder in control participants ($n = 6$) followed by generalised anxiety disorder ($n = 5$), panic disorder ($n = 2$) and obsessive-compulsive disorder ($n = 1$). Three participants in each condition were on anti-depressant medication, the dose of which had been stable for at least three months.

Acceptability: Treatment engagement and drop-out

Of 17 participants starting MBCT, 15 completed the course. Of these, five participants attended 100% of sessions, with the others attending 87.5% ($n = 7$), 75% ($n = 1$) and 62.5%

($n = 2$). In those not completing the course, one attended 50% of sessions, and one attended 25% of sessions. The participant who attended 50% of sessions completed the assessments at T2. Of the 15 participants completing the MBCT course, the mean number of sessions attended was 7 ($SD = 1$).

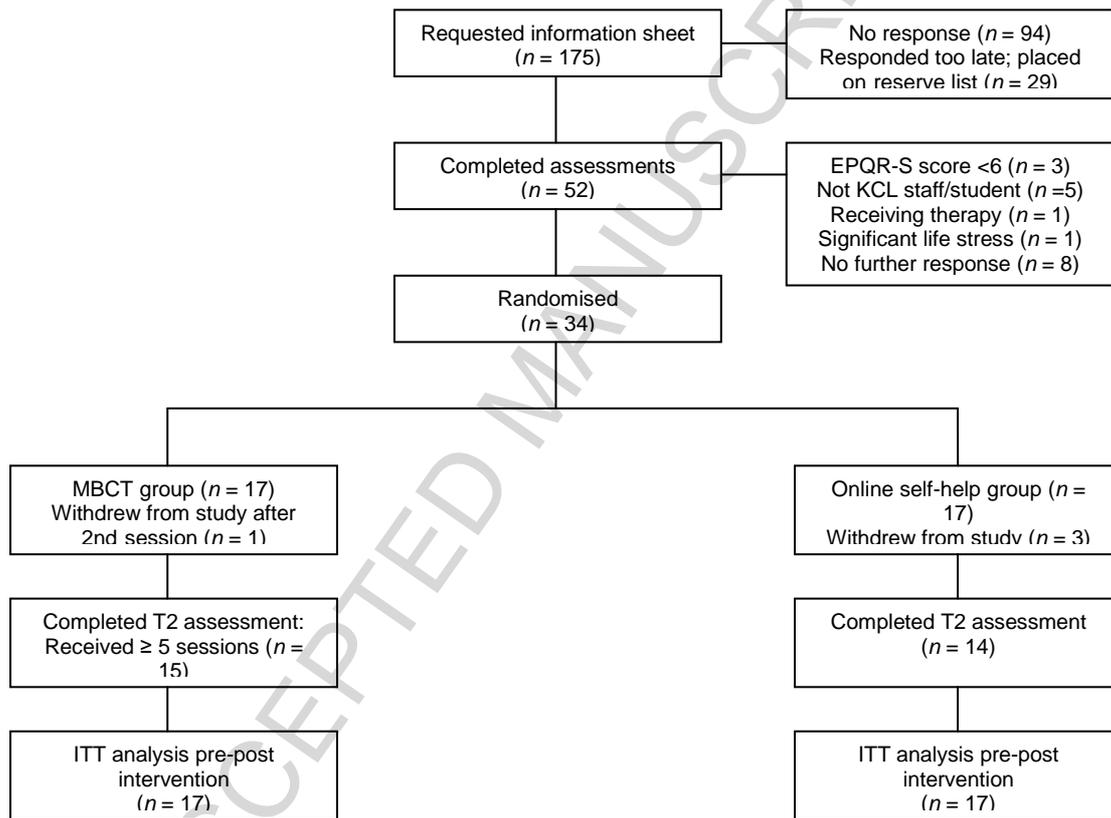


Figure 1. CONSORT Flowchart of recruitment and participants throughout the study.

MBCT, Mindfulness-based cognitive therapy; ITT, intention to treat.

In the control group, 13 completed feedback at T2. Self-reported total use of the online course ranged from 1 week to 4 weeks ($M = 2$, $SD = 0.91$). In summary, participants reported using the course over 1 week ($n = 4$), 2 weeks ($n = 6$), 3 weeks ($n = 2$) or 4 weeks ($n = 1$). Eight participants (61.5%) reported spending 1 hour to 5 hours completing course material. Of these eight, one completed 5 hours, with others completing 4 hours ($n = 1$), 3 hours ($n =$

2), 2 hours ($n = 1$) and 1 hour ($n = 3$). Five participants (38.5%) completed less than one hour's worth of exercises. One participant completed post-intervention questionnaires but did not provide feedback about the online course.

Table 1

Demographic characteristics of the sample

Characteristic	MBCT group		Control group	
	$(n = 17)$		$(n = 17)$	
	<u>$N(\%)/M(SD)$</u>		<u>$N(\%)/M(SD)$</u>	
<i>Age, years</i>	29.4	(8.7)	29.7	(8.4)
<i>Gender</i>				
Female	16	(94.15)	15	(88.2%)
<i>Employment status</i>				
Staff	10	(58.8%)	10	(58.8%)
Student	10	(58.8%)	10	(58.8%)
Both	4	(23.5%)	2	(11.8%)
<i>Ethnicity</i>				
White British	7	(41.2%)	9	(52.9%)
White Irish	1	(5.9%)	0	(0%)
Other White background	6	(35.3%)	7	(41.2%)
Bangladeshi	1	(5.9%)	0	(0%)
Pakistani	0	(0%)	1	(5.9%)
Indian	1	(5.9%)	0	(0%)
Other Asian background	1	(5.9%)	0	(0%)
<i>Relationship status</i>				
Single	10	(58.8%)	10	(58.8%)

Married/living together	2	(11.8%)	2	(11.8%)
Living apart from partner	5	(29.4%)	5	(29.4%)

MBCT home practice and exercises

The mean duration of weekly formal home practice between MBCT sessions, reported at post-treatment, was 89.2 minutes ($SD = 64.8$). The mean number of days of formal home practice per week between MBCT sessions was 3.1 ($SD = 1.6$). For the 16 MBCT participants who completed post-intervention assessment, 10 reported reading 80% ($n = 4$), 90% ($n = 4$) or 100% ($n = 2$) of the session handouts. Others reported reading 70% ($n = 2$), 60% ($n = 2$), 50% ($n = 1$) or 30% ($n = 1$).

Perceived usefulness of the interventions

62.5% ($n = 10$) of participants completing MBCT rated the course as very useful, with the remaining 37.5% of participants rating it as useful ($n = 3$) or quite useful ($n = 3$). In the control group 21.4% rated it as moderately useful ($n = 3$), 7.1% as useful ($n = 1$), 28.6% as quite useful ($n = 4$) and 35.7% ($n = 5$) as no use at all. Chi-square analysis comparing those who rated the interventions as ‘no use at all’ or ‘quite useful’ with those who rated the interventions as ‘useful’, ‘moderately useful’ or ‘very useful’, found there were significant between-group differences with the greater usefulness reported in the MBCT group ($\chi^2 = 7.24, p = .006$).

Group differences at post-treatment

Clinical outcome measures

ANCOVAs showed that when co-varying for baseline levels, the MBCT group had significantly lower levels of neuroticism at post-treatment than the control group. There were

no significant differences between the groups in anxiety or depression post-treatment. There were non-significant trends for group differences in functional impairment caused by stress vulnerability. See Table 2 for means, standard deviations and results of all ANCOVAs.

Process measures

ANCOVAs (see Table 2) showed that when co-varying for baseline levels, the MBCT group had significantly lower levels of rumination, and significantly higher levels of self-compassion and decentering at post-treatment than the control group. There were non-significant trends for group differences in unhelpful beliefs about emotions and mindfulness.

Exploratory processes of change analysis

Pearson's correlation coefficients were calculated between change in the primary outcome measure (EPQR-S) and change in all process measures, to provide preliminary evidence regarding mechanisms of change; see Table 3.

Correlations between MBCT home practice and changes in all variables

Pearson's correlations showed that a greater total number of days practiced over the whole course was significantly correlated with greater changes in rumination, $r(15) = .58, p = .015$.

Frequency of total home practice (both days and minutes) was not significantly correlated with changes in any other clinical or process measure (all $p > .05$). Average amount of weekly home practice (both days and minutes) was not significantly correlated with changes in any clinical or process measure either (all $p > .05$).

Table 2

Means and standard deviations of all clinical and process measures, and results of all ANCOVAs

Analysis/Measure	MBCT <i>M</i> (<i>SD</i>) (<i>n</i> = 17)		Self-help <i>M</i> (<i>SD</i>) (<i>n</i> = 17)		Group Difference at post-treatment, covarying for baseline scores		
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	<i>F</i>	<i>p</i>	<i>Partial</i> η^2
<i>Clinical Outcomes</i>							
Neuroticism	8.5 (1.8)	4.5 (3.1)	10.2 (2.0)	9.2 (2.9)	10.25	0.003	0.248
Functional impairment	18.2 (7.6)	11.4 (10.4)	20.9 (7.8)	18.2 (8.8)	3.16	0.085	0.093
Anxiety	7.3 (4.5)	4.1 (4.4)	11.1 (4.1)	8.1 (4.9)	0.97	0.332	0.030
Depression	6.6 (5.6)	6.1 (5.6)	11.1 (4.9)	8.8 (4.28)	0.04	0.840	0.001
<i>Process Measures</i>							
Mindfulness	107.8 (13.4)	132.8 (25.0)	102.2 (17.1)	116.0 (20.5)	3.27	0.080	0.095
Rumination	40.3 (7.0)	28.2 (11.9)	39.9 (4.2)	35.5 (7.3)	6.50	0.016	0.173
Beliefs about emotions	44.4 (12.6)	29.8 (18.2)	48.8 (13.0)	41.3 (11.9)	4.06	0.053	0.116
Self-compassion	27.2 (7.0)	40.7 (9.1)	23.1 (2.8)	27.9 (6.3)	14.83	0.001	0.324
Decentering	28.4 (4.6)	39.2 (10.2)	25.9 (2.5)	29.7 (5.2)	8.58	0.006	0.217

Table 3

Correlations for change in the EPQR-S and change in all outcome measures in both conditions

		WAS	PHQ-9	GAD-7	FFMQ	RRQ	BES	SCS-SF	EQ
MBCT (<i>N</i> = 17)	EPQR-S	.56*	-.24	.06	-.53*	.41	.59*	-.62*	-.52*
Control (<i>N</i> = 17)	EPQR-S	.68*	.13	.48	-.75*	.57*	.02	-.78**	-.78**

Note. EPQR-S = Eysenck Personality Questionnaire Revised- Short form; WAS = Work and Social Adjustment scale; PHQ-9 = Patient Health Questionnaire 9-item; GAD-7 = General Anxiety Disorder 7-item; FFMQ = Five Facet Mindfulness Questionnaire; RRQ = Rumination Reflection Questionnaire; BES = Beliefs About Emotions Scale; SCS-SF = Self Compassion Scale- Short Form; EQ = Experiences Questionnaire.

* $p < .05$. ** $p < .01$.

Discussion

The MBCT group had lower levels of neuroticism than the control participants at four weeks post-treatment, after adjusting for baseline levels. This is consistent with previous research that has demonstrated decreases in neuroticism in depressed participants receiving SSRI treatment (Tang et al., 2009) or repetitive transcranial magnetic stimulation (Berlim, McGirr, Bealieu, Van den Eynde & Turecki, 2013), and non-significant reductions in behavioural inhibition after psychological treatment in people with anxiety disorders (Carl et al., 2014). However, as far as the authors are aware, this is the first pilot randomized study to test a psychological intervention specifically aimed at reducing neuroticism. Mindfulness based interventions have the advantage of being popular and non-stigmatising, without the potential side-effects associated with SSRIs.

Together these results suggest that neuroticism may be amenable to change through different forms of intervention, including psychological therapy. The current findings contest suggestions by some authors (e.g. Eaton, Krueger & Oltmans, 2011) that neuroticism is stable and inflexible in nature and are more consistent with evidence that suggests flexibility in the

construct of neuroticism (Carl et al., 2014; Oken et al., 2014). The form of the EQPR-S used in the present study showed high test-retest reliability between screening and pre-treatment, indicating that the significantly lower scores after the interventions is unlikely to be due to measurement error of the instrument. Obviously the long-term impact of all of these interventions requires investigation.

There were no significant group differences in post-treatment functional impairment caused by stress vulnerability, however results did approach significance, indicating that a significant effect may be found in future RCTs with larger sample sizes. No significant differences between groups in measures of anxiety or depression were found, and correlations between change in neuroticism and these measures were not significant either. The lack of between-group differences in anxiety and depression in the current study could be due to the fact that the MBCT group were not in a clinically significant range at baseline assessment for these constructs.

Treatment participation, completion and perceived usefulness were higher in the MBCT than the self-help group, supporting the acceptability of this new intervention. This occurred despite the necessity to travel to the group and to attend at a set time each week, compared to the ease of access and timing flexibility for the online intervention. This pilot study also provides positive evidence regarding the feasibility of recruiting to a larger RCT as it was easy to recruit suitable participants by advertising for people who get more easily stressed than other people. Of the 54 participants who were assessed, only three were excluded for having neuroticism scores below cut-off.

In terms of processes of change, at post-treatment the MBCT group had significantly lower levels of rumination, and higher levels of self-compassion and decentering post-treatment

compared to the control group. However, when correlations between reductions in neuroticism and changes in the other variables were examined within each group separately, the pattern of significant correlations was broadly similar. Reductions in neuroticism were associated with improvements in self-compassion, mindfulness and decentering in both groups, so there is no indication that MBCT has unique capacity to address these factors. In contrast, only in the MBCT group was reduction in neuroticism associated with improvements in beliefs about the acceptability of experiencing or expressing negative emotions. This is consistent with previous research which has found MBCT is associated with reductions in such beliefs (Rimes & Wingrove, 2013). In MBCT, suffering is explicitly viewed as a normal part of everyday life and participants are encouraged to practice staying with difficult feelings rather than suppressing or avoiding them. The group enquiry process may also facilitate a more accepting attitude towards difficult emotions.

Limitations

Limitations of the current study should be considered; as a pilot study, the small sample size limits the generalizability of the findings and statistical power. Most of the participants were women, White and either working or studying at a university, and as such represent a highly selective sample; it cannot be assumed that these results would generalize to other populations. Further, participants were staff and students at the same institution as the researchers. This might have resulted in greater interest in the study than might have otherwise been the case, so recruitment feasibility could have been overestimated. Furthermore, although no participants had direct working relationships with the researchers, it could also be argued that there may be social desirability effects with participants tending to want to please researchers from the same organization. Future research should be conducted with participants from different organizations from which the researchers are

based. Due to the lack of long-term follow-up assessments, it is unknown whether the benefits seen in the current study are maintained in the longer-term. Therefore it cannot be concluded that the intervention has resulted in lasting personality change. Additionally, although participants were screened for stability of anti-depressant medication and the three participants on medication in each group had agreed not to change their medication during the course of the study, this was not checked at Time 2. Further, despite the random allocation there were differences in-group characteristics at baseline, with the control group displaying more severe impairments in some psychological measures. Although co-variance analyses were used which controlled for baseline levels of each variable, the results should be interpreted with caution. Future research should use larger sample sizes and could stratify by pre-treatment neuroticism scores to ensure closer matching of participants on baseline psychological characteristics. Physiological measures of stress reactivity could also be included. Another limitation was the reliance on self-reported use of the website in the control group. This could be improved by utilizing additional source of information such as log-in counts and time spent on exercises. Finally, because the online self-help control group had much lower attendance than the MBCT group, treatment dose might explain the group difference observed. Future studies of MBCT for neuroticism should compare it to alternative interventions and active control conditions such as a group psychoeducation intervention that controls for non-specific factors such as therapist facilitation and group support but without the mindfulness or cognitive components.

Conclusion

In conclusion, MBCT is a promising and acceptable intervention for individuals with high levels of neuroticism. Heeding calls to target the underlying cause of common mental disorders rather than just the associated symptomatology, the current study suggests that this

type of intervention may be feasible and efficacious. Although the current study investigated MBCT as an intervention for reducing neuroticism, the findings also offer implications for the prevention of future clinical symptomatology. A larger RCT with longer-term follow-up is now needed.

Conflict of interest

The authors declare that there is no conflict of interest.

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Highlights for “A pilot randomised-controlled study of mindfulness-based cognitive therapy versus online self-help for neuroticism (stress vulnerability)”

- We examine a new MBCT intervention for neuroticism versus online general self-help
- Compared to self-help, MBCT results in significantly lower levels of neuroticism
- Rumination and self-compassion also improved more in the MBCT group
- MBCT is an acceptable and feasible intervention for neuroticism
- Neuroticism may be amenable to change through psychological intervention

ACCEPTED MANUSCRIPT