The Creative Mind:

The Effects of Mindfulness Meditation on Divergent Thinking and the Interplay of Mood and Neuroticism

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Abstract

Research shows that mindfulness meditation intervention can improve divergent thinking. Additionally, it seems that mood and neuroticism influence the effect of mindfulness meditation on divergent thinking. Generally, evidence shows that mindfulness meditation improves positive mood and that positive mood improves divergent thinking. However, what role neuroticism plays in this regard remains unclear. This study examines how a seven-day mindfulness meditation intervention affects divergent thinking, whether mood acts as a mediator between mindfulness meditation and divergent thinking and whether neuroticism moderates the effect of mindfulness meditation on mood. The participants (n = 63) were randomly assigned to one of two groups: the mindfulness meditation group or the control group. The mindfulness meditation group was instructed to daily practice 10 minutes of mindfulness meditation for seven consecutive days using the Waking Up meditation app. The control group had to listen to a 10-minute podcast segment every day for seven days. The levels of mood and divergent thinking were measured at both pretest and posttest, whereas neuroticism was measured only at pretest. The results show a significant effect of neuroticism on mood, indicating that higher levels of neuroticism lead to higher levels of negative mood. The results revealed no significant effect of mindfulness meditation on divergent thinking. Additionally, the results found that mood did not mediate the effect of mindfulness meditation on divergent thinking and found that neuroticism did not moderate the effect of mindfulness meditation on mood. Further research is required to get a deeper understanding of the influencing roles of neuroticism and mood with regard to the relationship between mindfulness meditation and divergent thinking.

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The Creative Mind: The Effects of Mindfulness Meditation on Divergent Thinking and the Interplay of Mood and Neuroticism

Creativity could be described as the generation of ideas that are both useful and original (Abraham, 2018) and is an important facilitator of societal progress (Moran, 2010). Creativity fuels innovation and produces new goods, services, and scientific findings (Cropley, 2006). It is the psychological mechanism that allows humans to solve problems at both the individual and societal levels and keeps society moving forward by producing economic growth and facilitating social development (Cropley, 2006; Moran, 2010). Creativity is therefore a valuable resource for organizations. It is the key to innovation in all organizational sectors ranging from business to government to nonprofit organizations (Mumford et al., 2012). From an organizational perspective, creativity and innovation have become a competitive advantage because new ideas, when implemented successfully, help organizations move forward (Anderson et al., 2014). Thus, creativity is essential for the growth and success of organizations (Mumford et al., 2012). Therefore, creative individuals are considered a valuable human resource in organizations (Lee et al., 2010). Accordingly, this means that from the individual's perspective, organizational value and, therefore, career opportunities improve with more individual creativity (Agars et al., 2012; Florida, 2004; Lee et al., 2010). Overall, creativity is an important facilitator of a society's development (Cropley, 2006). Creative people facilitate new products, economic growth, and societal development, and it is therefore necessary to study how creativity can be enhanced. Considering the importance of creativity on both individual and societal levels, there is a good incentive to find means to facilitate or improve creativity.

However, creativity is a broad term. When one aims to improve creativity, one must first investigate its underlying features. Accordingly, this study mainly focuses on divergent thinking,

which is commonly considered a component of creative thinking (Runco & Acar, 2012) and refers to the ability to generate various ideas from one single idea or concept (Kaufman et al., 2016). Divergent thinking is regularly contrasted with convergent thinking and refers to the ability to generate a single useful idea by combining multiple ideas (Abraham, 2018; Guildford, 1967; Kaufman et al., 2016). Therefore, divergent thinking leads to multiple ideas and particularly facilitates the originality of ideas instead of their actual usefulness (Runco & Acar, 2012). Meanwhile, convergent thinking facilitates the usefulness of the produced idea because it is an appropriate fit within the given context (Abraham, 2018). Research has shown that divergent thinking is an appropriate indicator of creative potential and achievement (Kim, 2008; McCrae, 1987; Silvia et al., 2008). For example, Kim's (2008) meta-analysis concerning the association of creative achievement with divergent thinking and IQ shows that divergent thinking is positively associated with creative achievement with a correlation coefficient of .216. Furthermore, Kim (2008) highlights that prior research has indicated that IQ is also a strong predictor of creative achievement but suggests that divergent thinking is an even better predictor of creative achievement than IQ is. Therefore, Kim (2008) concludes that divergent thinking is one of the best indicators for creative achievement. Divergent thinking facilitates creative outputs by means of three distinct features of divergent thinking: fluency, flexibility, and originality. Fluency refers to the total number of generated ideas. Flexibility refers to the switching between different conceptual categories and reflects how easily someone can switch between categories. Originality is the frequency of the given idea relative to others' responses, reflecting the ability to come up with novel ideas (Guilford, 1967).

A potential means to enhance or facilitate divergent thinking is mindfulness meditation (Colzato et al., 2012; Lebuda, 2016; Zabelina et al., 2011). Mindfulness is an introspective

method that comes from the old Buddhist contemplative traditions (Shapiro et al., 2006). Put briefly, mindfulness is a mental state of open attention to the fleeting contents of consciousness without judgment (Ghetin, 2011; Shapiro et al., 2006). A substantial amount of scientific literature highlights the many psychological benefits of the method of mindfulness, such as improving mood, improving working memory, and reducing anxiety (Zeidan et al., 2010). In addition, research has also demonstrated that various mindfulness meditation techniques can have a positive effect on many aspects of creative performance, including divergent thinking (Colzato et al., 2012; Lebuda et al., 2016; Zabelina et al., 2011). This particular effect that is mindfulness meditation on divergent thinking, is part of the focus of this study.

Previous research suggests that the personality trait neuroticism influences the extent to which meditation training affects divergent thinking abilities (Ding et al., 2015; Zabelina et al., 2011). Neuroticism shows an individual's proclivity toward depression, anxiety, worry, negative feelings, and self-criticism (McCrae & Costa, 1999; Crescenti & Capurso, 2015). Neuroticism can be described as one's tendency toward negative emotion and emotional instability (Ormel et al., 2004). Mindfulness meditation could aid in combating these negative moods and emotions to which individuals high in neuroticism are more prone. Several studies have demonstrated that mindfulness meditation can lower negative and increase positive emotions (Chang et al., 2004; Grossman et al., 2004; Zeidan et al., 2011). This aligns with studies showing a strong negative correlation between mindfulness as a general state of mind and neuroticism (Giluk, 2009). In turn, some studies have suggested that mindfulness meditation can lower tendencies toward neuroticism through observing and accepting negative thoughts and feelings (e.g., van den Hurk et al., 2011).

Furthermore, prior studies concerning mood's effect on creativity indicate that positive mood states could improve individuals' divergent thinking (Baas et al., 2008; Davis, 2009; To et al., 2012). Individuals with more positive emotions are more likely to be creative and score higher on divergent thinking abilities (Baas et al., 2008; Davis, 2009). Additionally, according to Baas et al. (2008), negative mood seems to have a negative effect on divergent thinking. However, the positive effect of positive mood on divergent thinking and the negative effect of negative mood on divergent thinking seem to be especially prevalent for certain types of emotions associated with the mood state. These types of emotions are further discussed in the theoretical framework.

In sum, mindfulness meditation has been shown to facilitate and enhance divergent thinking. Furthermore, it has been shown that positive moods and emotions positively contribute to divergent thinking abilities. However, individuals high in neuroticism have a proclivity toward negative moods and emotions, which negatively affect divergent thinking. Since mindfulness meditation can lower negative and increase positive emotions, which could cause an increase in divergent thinking, it is plausible that divergent thinking can be improved to a greater extent for individuals high in neuroticism than individuals low in neuroticism by means of mindfulness meditation. However, it seems that this proposition has not yet been studied. Hence, this study asks the following research question:

To what extent does mindfulness meditation enhance divergent thinking, and in what way is this relationship affected by individual differences in the personality trait neuroticism and mood?

Finally, the following underlines the relevance of this study. The positive effect of meditation on divergent thinking is supported by a large body of literature (Lebuda et al., 2016).

However, most studies have been done on long-term meditation. Studies have also examined the effects of short-term meditation (e.g., Ding et al., 2014; Ren et al., 2011). However, its scope remains limited. Moreover, personality occupies an important role in the relationship between meditative practices and creative processes such as divergent thinking (Ding et al., 2015; Zabelina et al., 2011). Nonetheless, very little research has been done on the extent to which personality traits such as neuroticism influence this relationship. In addition, most research has focused on the association between trait mindfulness and neuroticism. However, only a small amount of studies have examined the relationship between mindfulness as a practice and neuroticism (van den Hurk et al., 2011). Finally, it seems that the variable of mood serving as a mediator in the association between mindfulness meditation and divergent thinking with neuroticism moderating the relationship of mindfulness meditation on mood has not yet been studied. The objective of this thesis is to further examine the effect individual personality differences of trait neuroticism have on the relationship between meditative practices and divergent thinking and, in doing so, extrapolate on existing research. More precisely, the main goal of this thesis is to examine how and to what extent the personality trait neuroticism influences the relationship between short-term mindfulness meditation practice, mood, and divergent thinking.

Theoretical Framework

The Relationship Between Mindfulness Meditation and Divergent Thinking

Research shows that various meditation techniques can have a positive effect on many aspects of creative performance (Ding et al., 2014; Zabelina et al., 2011; Ren et al., 2011). Moreover, it seems that meditation techniques that are part of mindfulness meditation are able to enhance divergent thinking abilities. According to Colzato et al. (2012), the meditation technique

open-monitoring has a positive effect on divergent thinking. Colzato et al. (2012) examined the open-monitoring and focused-attention techniques, which are commonly used within mindfulness meditation. Open-monitoring entails a state of open attention to whatever arises in one's consciousness. The observer notices whatever might appear without any judgment and does not fixate their attention on whatever appears. In contrast, focused-attention requires the meditator to attentively focus on a single object within their field of consciousness, such as the breath (Colzato et al., 2012). The researchers expected to find that open-monitoring improves divergent thinking and that focused-attention improves convergent thinking. The Alternative Uses Test (AUT) was used to assess divergent thinking. All subjects were given a commonly used item and instructed to generate as many possible use cases as they could think of. Additionally, convergent thinking was measured by using the Remote Associates Task. This test asks participants to give the common link among three concepts with which they have been presented. The results showed that open-monitoring has a positive effect on divergent thinking since fluency, flexibility, and originality were improved. However, the results showed that focused-attention has no significant effect on convergent thinking. Furthermore, other studies that made no distinction between open-monitoring and focused-attention techniques but referred to mindfulness meditation, which typically includes a mixture of the two techniques, also showed that divergent thinking abilities improve after mindfulness meditation practices (Lebuda, 2016; Zabelina et al., 2011). Considering the above literature, the expectation is that mindfulness meditation has a positive effect on divergent thinking. Hence, the following hypothesis is proposed:

H1: Mindfulness meditation has a positive effect on divergent thinking.

The Relationship Between Neuroticism and Mood

As previously discussed in the introduction, neuroticism is a personality trait that indicates a person's predisposition toward unpleasant feelings and negative emotions such as sadness, anxiety and worry (McCrae & Costa, 1999; Crescenti & Capurso, 2015). Neuroticism is part of the five-factor model commonly referred to as the big 5 and is used to assess individual differences in personality (Costa & McCrae, 1992). The big 5 are the personality traits agreeableness, extraversion, openness, conscientiousness, and neuroticism (Costa & McCrae, 1992). The existing literature on personality differences seems to strongly indicate that individuals who score higher on the trait neuroticism are more susceptible to negative mood states than individuals who score lower on the trait neuroticism (Costa & McCrae, 1992; DeYoung et al., 2007; Larsen & Ketelaar, 1989). This means that individuals with higher levels of neuroticism are more sensitive to situations that provoke negative affect, such as stressful events, which will cause them to be in a negative mood more easily than those who score low on the trait neuroticism (Larsen & Ketelaar, 1989). Therefore, the following is hypothesized:

H2: People scoring high on the trait neuroticism will have a more negative mood than people scoring low on the trait neuroticism.

The Relationship Between Mood and Divergent Thinking

Mood states could have an effect on creative performance (Baas et al., 2008; Davis, 2009; De Dreu et al., 2008). A meta-analysis by Baas et al. (2008) on the relationship of mood states on creativity showed that positive mood states seem to benefit creativity by enhancing divergent thinking abilities and creative insight. Particularly promotion-focused states, which imply a motivation to achieve a positive outcome. Additionally, positive mood states that are activating (e.g. joy) instead of deactivating (e.g. relaxed) seem to be enhancing divergent thinking abilities

(Baas et al., 2008; De Dreu et al., 2008). Certain negative mood states, on the other hand, can inhibit creativity. States such as anxiety or fear entail a motivation to prevent a negative outcome and have been found to decrease divergent thinking (Baas et al., 2008). Moreover, research by Baas et al. (2008) suggests that these specific types of negative mood states decrease flexibility in particular. In addition to these insights, another meta-analysis by Davis (2009) showed results compatible with Baas et al.'s (2008) claims and suggested that, in most situations, positive mood benefits divergent thinking. Davis (2009) argues that positive moods benefit divergent thinking abilities because individuals have a wider spectrum of information at their disposal. As a result, individuals can create more connections between concepts and are able to better identify distinctions between concepts or items. Nonetheless, some findings seem to indicate that certain negative mood states are able to benefit divergent thinking abilities as well. So do De Dreu et al. (2008) suggest that negative mood states are still able to benefit originality and fluency as long as they entail activating emotions. However, their results indicate that activating mood states, in general, enhance components of divergent thinking. Thus, De Dreu et al. (2008) suggest that both activating positive moods and negative moods are better facilitators for divergent thinking than deactivating positive and negative mood states. Therefore, De Dreu et al. (2008) do not make an assumption about whether negative moods or positive moods are more beneficial for divergent thinking but rather suggest that activating moods seem to be more beneficial for divergent thinking than deactivating moods.

Hence, the existing literature on the relationship between divergent thinking has shown different directional effects of negative moods on divergent thinking (Baas et al., 2008; Davis; 2009, De Dreu et al., 2008). Some findings have shown that certain negative mood states could have a positive effect on divergent thinking (De Dreu et al., 2008), whereas other findings

indicated that negative mood does not benefit divergent thinking (Davis, 2009) and sometimes even impedes divergent thinking (Baas et al., 2008). However, previous research has generally found support for the assertion that positive moods enhance divergent thinking abilities (Baas et al., 2008; George & Zhou, 2007), especially when compared to a state of neutral mood (Davis, 2009).

Taken together, research on the relationship between mood and divergent thinking indicates that positive mood facilitates divergent thinking. Therefore, it is hypothesized that:

H3: People with a more positive mood score higher on divergent thinking tasks as compared to people with a less positive mood.

The Relationship Among Mindfulness Meditation, Mood, Neuroticism, and Divergent Thinking

Both personality and mental state have roles to play in the differences between individuals' creative performance (Kaufman, 2015; Barron & Harrington, 1981). Ding et al. (2015) researched the interplay of these factors by examining how differences in personality and mood influence the extent to which short-term meditation increases creative performance. Their results showed that individual differences can affect the extent to which meditation training affects creative performance. Ding et al. (2015) showed that people with high emotional stability, meaning those who score low on the trait neuroticism, respond better to meditation training and that they could increase their creative performance by improving divergent skills to a greater extent compared to people who score high on the trait neuroticism. Thus, this study demonstrates that people who are less prone to negative emotions are able to increase their divergent thinking more because they benefit more from meditation. Furthermore, other research has shown that people high in neuroticism find it more difficult to benefit from meditative practices (Norris et

al., 2018) and experience greater barriers, which makes it more difficult for them to continue practicing meditation (Whitford & Warren, 2019).

In contrast with these findings, other research indicates that mindfulness meditation can reduce neuroticism by decreasing negative thoughts and feelings (Van den Hurk et al., 2011). Van den Hurk et al. (2011) suggest that mindfulness meditation could actually affect personality traits, which is contrary to research suggesting that personality is unmalleable (Heatherton & Weinberger, 1994). Furthermore, various studies have demonstrated a strong inverse relationship between mindfulness and neuroticism (Baer et al., 2004, 2006; Brown et al., 2007; Giluk et al., 2009). However, important to note is that these studies measured mindfulness as a general trait and not the practice of mindfulness meditation.

Taken together, these results seem to conflict with one another. It also appears that individuals high in neuroticism can see a larger improvement in terms of negative feelings and mood but find it more difficult to practice and actually benefit from meditation. Nonetheless, Ding et al.'s (2015) results suggest that people high in neuroticism find it more difficult to improve their divergent thinking by means of meditation practice. However, another study by Zabelina et al. (2011) suggests otherwise. Their study examined the effect of mindfulness meditation on creative performance and the influence of neuroticism on this effect. Creative performance was measured by means of a shortened version of the Torrance Test of Creative Thinking (TTCT; Goff & Torrance, 2002; Torrance, 1972). Important to mention is that the TTCT measures creative performance, which includes divergent thinking abilities (Kim, 2008). Zabelina et al.'s (2011) results showed that neuroticism and creative performance are negatively related. Zabelina et al. (2011) argue that this is due to the proclivity toward self-criticism and self-consciousness in individuals high in neuroticism, which has been found to particularly

inhibit creative elaboration. Moreover, Zabelina et al. (2011) argue that mindfulness reduces this proclivity toward self-criticism and self-consciousness, which in turn leads to better creative performance. Subsequently, Zabelina et al. (2011) concluded that mindfulness meditation had a greater effect on creative performance for individuals who scored high on neuroticism than for individuals who scored low on neuroticism.

A notable difference between these two studies is that Ding et al. (2015) did not use mindfulness meditation as an intervention but instead used Integrative Body-Mind Training (IBMT). IBMT integrates elements of mindfulness, but it consists of a combination of various other meditation techniques and is therefore not the same as mindfulness meditation (Ding et al., 2014). Since mindfulness has a clear negative relationship with neuroticism, it is likely that mindfulness meditation is more beneficial in this regard compared to IBMT. Therefore, considering the discussed literature, the final hypothesis, divided into three sub hypotheses, is as follows:

H4a: Mindfulness meditation has a positive effect on mood and is moderated by neuroticism by strengthening the positive effect of mindfulness meditation on mood.

H4b: Mindfulness meditation has a positive effect on divergent thinking and is mediated, in part, by mood.

H4c: Neuroticism serves as a moderator between mindfulness meditation and mood and, in turn, people who score high on neuroticism will improve their mood to a greater extent than people who score low on neuroticism and will therefore experience a greater improvement in divergent thinking.

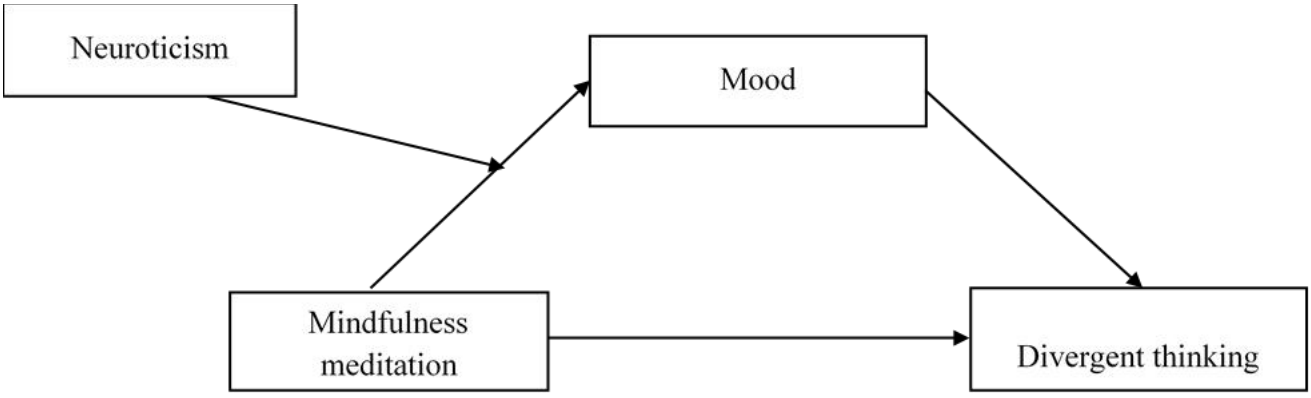
Methods

Design

This study was conducted using a two-group pretest-posttest experimental research design (Treadwell, 2017). Using block randomization (Kim & Shin, 2014), participants were assigned to one of the two groups, namely one control group and one intervention group. Block randomization was conducted using Sealed Envelope Ltd.'s (2021) randomization tool. Random assignment was used to decrease the probability of preexisting differences between the two groups and to prevent spuriousness, improving internal validity (Treadwell, 2017). The experimental variable used to manipulate the intervention group was the independent variable *mindfulness meditation.* The variables to be measured were *divergent thinking, mood,* and *neuroticism.* In this regard, *divergent thinking* is the dependent variable, *mood* is a mediator, and *neuroticism* is a moderator of the relationship between *mindfulness meditation* and *mood*. Figure 1 shows a visual representation of these relationships.

Figure 1

Visualization of the conceptual model



Participants

In total, 63 participants started the study, seven of whom did not complete the entirety thereof. The participants who completed the study (*n = 56*) consisted of 21 men and 35 women aged 19 to 30 (*M* = 23.21; *SD* = 2.98). Nonprobability sampling methods (Treadwell, 2017) were used to obtain the sample. The participants were recruited through volunteer sampling via the undergraduate participant pool of Tilburg University and through snowball sampling via requests on the platforms LinkedIn, Instagram and WhatsApp. The participants were deemed eligible if they were not regular practitioners of mindfulness meditation. Here, being a regular practitioner means that a person practices mindfulness meditation once per week or more (Pepping et al., 2014). This criterion was included to ensure that all participants were beginners in order to prevent any discrepancy between their meditation levels, thereby increasing the internal validity (Treadwell, 2017). To incentivize participation and the completion of the study, the participants recruited through the undergraduate participant pool received 1.5 SONA credits as a reward for completing the study. In addition, every participant received a free month of the Waking Up app as an extra incentive to participate. This was done to minimize attrition due to dropouts (Treadwell, 2017).

Materials and Measurements

Divergent Thinking

The AUT was used to measure divergent thinking. The AUT is a component of the widely used TTCT, which is a valid and reliable measurement for divergent thinking (Silvia et al., 2008; Torrance, 1972). This method requires the respondents to suggest as many alternative use cases as possible for a common item, such as a newspaper or paperclip, within a short timeframe (Gilhooly et al., 2007; Guildford, 1967). The two objects the participants had to suggest

alternative use cases for were a brick and a paperclip. For both tests, participants had 3 minutes to list as many alternative use cases as possible. The three components of divergent thinking, fluency, flexibility and originality, were measured to operationalize divergent thinking. The total number of responses was calculated to assess fluency by adding up each participant's number of responses. Flexibility was measured by counting the total number of times the participants switched between semantic categories (Ding et al., 2015; Guilford, 1967; Kaufman et al., 2016). Finally, the originality score was measured using the SemDis tool, which calculates the semantic distance between the object and the given response. The SemDis tool does not measure originality directly, but it is highly correlated with other measurement techniques of originality, such as assigning uniqueness scores to each response (Silvia et al., 2008) and is shown to be a valid instrument for operationalizing originality (Beaty & Johnson, 2020). The participants' responses were entered into the SemDis tool, which generated semantic distance scores for each response. The SemDis tool uses five different models to calculate semantic distance scores. Three models use a neural network structure akin to word2vec technology and focus on the similarity of the words' contexts to calculate semantic distance (Beaty & Johnson, 2020). The other two models focus on counting the frequency of the selected words appearing in a large body of literature. One model uses latent semantic analysis (LSA) and the other global vectors (Beaty & Johnson, 2020). The mean of these five computed scores was taken and used as the participant's originality score.

Mood

The variable mood was measured using the Profile of Mood States (POMS) questionnaire originally designed by McNair et al. (1971). The scale measures negative and positive mood states (Spinella, 2007). It has been used for this purpose by several foregoing studies using

meditation as an intervention (e.g., Ding et al., 2015). The POMS consists of a 40-item scale entailing questions about the person's current mood state (Grove & Prapavessis, 1992). The questionnaire makes use of a 5-point Likert scale with 1 (not at all) at the low end and 5 (extremely) at the high end. A high total score indicates a negative mood. Hence, for someone to be in a positive mood state, they would have to get a low total score. Furthermore, the POMS has good internal reliability and construct validity (Grove & Prapavessis, 1992; McNair et al., 1971; Spinella, 2007). Moreover, to test the internal consistency between the items within both the pretest and posttest measurements, Cronbach's alpha reliability test of internal consistency was conducted. The POMS at both the pretest and posttest proved good internal consistency with a Cronbach's α of .850 for the POMS at pretest and .876 at posttest.

Neuroticism

The personality trait neuroticism was measured using Sato's (2015) EPQ-BV 12-item scale. This scale is derived from the widely used Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1992) and is commonly used to capture the individual's level of neuroticism and extraversion and made into a shortened version consisting of 12 items. Furthermore, the 12 items only measure neuroticism, not extraversion. The questionnaire makes use of a 5-point Likert scale with 1 (not at all) at the low end and 5 (extremely) at the high end. A high score indicates high levels of neuroticism. Moreover, Sato (2015) found that the EPQ-BV has a good test-retest reliability and internal consistency. Furthermore, the EPQ-BV is highly correlated (.88) with the EPI scale and therefore has good concurrent validity (Sato, 2015). Finally, to test the internal consistency between the items of the EPQ-BV scale, Cronbach's alpha reliability test of internal consistency was conducted. The scale proved good internal consistency with a Cronbach's α of .913.

Procedure

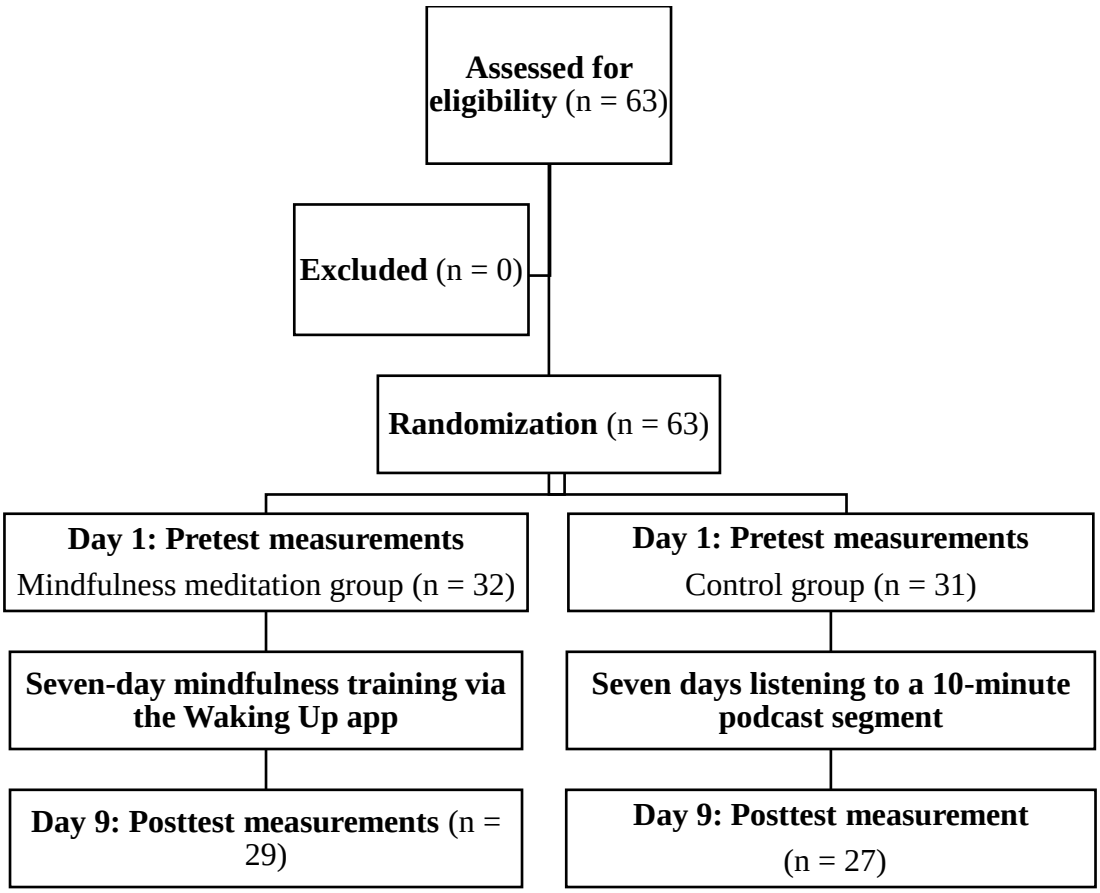
The experiment entailed a preintervention divergent thinking test, a preintervention measurement of mood state and neuroticism, a mindfulness intervention, a postintervention divergent thinking test, and a postintervention measurement for mood state. Individuals who wanted to participate in the study were first randomly placed in one of two conditions: the mindfulness meditation condition or the control condition. Subsequently, the participants were sent an email containing detailed information about the study in accordance with their assigned conditions. The next day, participants were sent a link to the first questionnaire, which included the informed consent, demographic questions, and all pretest measurements. Subsequently, the seven-day intervention started. The mindfulness meditation group was instructed to perform 10 minutes of mindfulness meditation for seven consecutive days. The meditation sessions were guided using the Waking Up meditation app. Within the Waking Up app, participants had to complete seven days of the introductory course. No additional instructions were given for the setting apart from sitting in a comfortable posture on a chair or cushion. During these seven days, the control group was instructed to listen to an informative podcast segment of the Waking Up app for 10 minutes every day. The podcast's topic is the differences between the right and left sides of the brain, and it was selected because it does not contain any content related to mindfulness meditation. Moreover, all participants received daily reminders via email to practice mindfulness meditation or listen to the podcast segment. The day after the seven-day intervention, every participant was requested to complete the second questionnaire containing the posttest measurements.

Furthermore, the preintervention and postintervention measurements were conducted using Qualtrics software (Qualtrics, Provo, UT). At pretest, both the control group and

intervention group were asked to fill in the EPQ-BV to measure neuroticism. Additionally, both groups had to complete the two AUTs to measure their divergent thinking skills and the POMS to measure their current mood state. At posttest, the divergent thinking skills and mood state of both groups were measured again with the AUT and POMS. To increase reliability (Treadwell, 2017), the two measurements were done one day after the end of the seven-day mindfulness intervention to avoid the results being influenced by any short-term effects of mindfulness meditation. Finally, to provide further insight into the participant flow during the procedure, Figure 2 shows the participant flowchart.

Figure 2

Participant Flowchart



Intervention

The intervention was completed within seven days by both the intervention group and the control group. During these seven days, the intervention group was instructed to practise mindfulness meditation by means of the Waking Up app. Each meditation session took approximately 10 minutes. During these 10 minutes, the participants were instructed by a guide to perform both open-monitoring and focused-attention techniques. These techniques entail introspective practices such as closely observing one's breathing, noticing thoughts arise and flee without judgment, or focusing on a single object. In addition, the control group was instructed to listen to a 10-minute podcast segment about the difference between the left and right sides of the brain for the same seven consecutive days. This 10-minute clip was also taken from the Waking Up app and narrated by the same voice as the meditation guide. Furthermore, there was no exact time of the day specified to perform the meditation with the goal of allowing the participants some flexibility and thereby minimizing the dropout rate.

Data Analysis

The collected data were imported into SPSS version 27 for analysis. As part of the initial preliminary data analysis (Roni & Djajadikerta, 2021), before each analysis was conducted, the relevant assumption checks and the normality test for each analysis were completed. An overall data cleaning process for all the variables was performed, and an analysis of standardized residuals was conducted to find any outliers in the data and identified three legitimate outliers. Case no. 22 for the variable originality (at pretest) was replaced with the nearest highest value (Duan, 1998) to improve the normality. The other two outliers were not removed or replaced since it did not negatively affect the normality and thus was of no concern.

Four independent samples t-tests were performed to check if there were significant differences between the mindfulness meditation group and the control group at pretest. Furthermore, all the relevant assumptions were met with the exception of the normality assumption of the fluency variable since the Shapiro-Wilk test was found to be significant at p = .002. A moderated mediation model (Hayes, 2017) was used to test all proposed hypotheses and was carried out with PROCESS v3.5 (Hayes, 2017). To run the analysis, process model 7 was selected because it measures a moderated mediation, with *neuroticism* (W) only moderating the relationship between *mindfulness meditation* (X) and *mood* (M). Since the independent samples t-test revealed that there were no significant differences between groups, the posttest scores were used (Field, 2018).

Divergent thinking (dependent variable) was assigned to the Y variable, *mindfulness meditation* (independent variable) was assigned to the X variable, *mood* was assigned as mediator (M), and *neuroticism* was assigned as moderator (W). Since the dependent variable consists of the subfactors fluency, flexibility, and originality, the analysis was run three times for each subfactor. Prior to conducting a moderated mediation analysis, the relevant assumptions for mediation and moderation analyses were carried out through regression, and the moderated mediation model was replicated. The analysis revealed that the assumption of linearity was found to be violated for the first analysis (Hair et al., 1998; Pallant, 2020). A standard procedure to detect outliers was performed within the regression analysis, and the result showed one outlier in the model, which was no threat to the overall analysis. Moreover, the assumption tests for the second analysis showed that the linearity assumption was violated. Furthermore, the Kolmogorov-Smirnov test was found to be significant at p = .035 for violating the normality assumption. Finally, the assumption of linearity was found to be violated for the third analysis.

The remaining relevant assumptions for all three analyses have been met. According to Hair et al. (2018), the minimum sample size for simple regression must be at least 50 samples, and a sample of 100 is required for most research since the sample for the current study was n = 56, for a complex moderated mediation analysis the sample was found to be very small.

Finally, four mixed-design ANOVA analyses were carried out to determine if the mindfulness meditation group improved their mood and divergent thinking. This was done to provide more insight into the data since the sample size was found to be small for a complex, moderated mediation analysis (Hair et al., 2018). Prior to proceeding with the mixed-design ANOVA, the initial step was to analyze the data to meet all the assumptions to further continue with the analysis and interpretation. The dependent variable must be an interval or ratio scale (e.g., a continuous variable), and both the within and between subjects must have at least two levels of measurements and must be categorical. All the aforementioned assumptions were met to proceed with the analysis and further check the assumptions. To check the assumption that no group either between-subject or within-subject should have any outliers, each group was analyzed, and the result of the analysis showed that 11 outliers were found in some of the pretest and posttest groups. To further continue and meet the assumption, the data was cleaned, and the outliers were excluded from the data. Further analysis was conducted on a sample of n = 45. Furthermore, the analysis showed that the dependent variable was normally distributed for each combination of groups, and the value of the Shapiro-Wilk test for all the variables was found to be nonsignificant at alpha > .05. The test for homogeneity of variance was also found to be nonsignificant at alpha >.05. Finally, the assumption of sphericity was not considered because it only applies to the model, including within-subject variable to have three or more levels (Murrar & Brauer, 2018).

Results

Descriptive Statistics

A total of 63 participants started the study and were randomly assigned to the mindfulness meditation condition (n = 32) or the control condition (n = 31). Of the 63 participants, five dropped out during the seven-day intervention, and two failed to complete the final survey on day 9. Hence, this left 56 data points ready for analysis, of which 29 data points belonged to the mindfulness meditation condition and 27 to the control condition. To provide a clear overview of the data that was used for analyses, the descriptive statistics were calculated and are shown in Table 1. In addition, to provide further insight into the data, the correlations of the continuous variables were calculated. These are presented in Tables 2 and 3.

Table 1

Descriptive Statistics

		Pretest				Posttest			
	Variables	Mean	SD	Min	Max	Mean	SD	Min	Max
MMC	Neuroticism	30.34	10.61	14	52	-	-	-	-
	Mood	84.62	18.39	46	128	77.07	17.14	45	123
	Fluency	6.60	3.15	2	14	8.74	4.71	2.5	21.5
	Flexibility	4.19	2.58	0	10.5	6.52	3.82	.5	15
	Originality	.943	.049	.840	1.090	.955	.036	.872	1.01
CC	Neuroticism	28.04	9.81	14	55	-	-	-	-
	Mood	80.48	18.46	47	55	77.07	23.61	44	148
	Fluency	6.69	3.49	2	14	7.82	4.08	3	16.5
	Flexibility	4.30	2.34	1	10	5.26	2.81	1.5	12
	Originality	.963	.038	.9	1.02	.963	.038	.9	1.02

Note: MMC = mindfulness meditation condition, CC = control condition

Table 2

Correlation Matrix Continuous Variables at Pretest

Variable	1.	2.	3.	4.	5.
1. Mood	1				
2. Neuroticism	.622**	1			
3. Fluency	.234	.214	1		
4. Flexibility	.230	.194	.918**	1	
5. Originality	-.017	-.095	-.084	-.065	1

Note: *p < .05, **p < .01, ***p < .001

Table 3

Correlation Matrix Continuous Variables at Posttest

Variable	1.	2.	3.	4.	5.
1. Mood	1				
2. Neuroticism	.594**	1			
3. Fluency	.046	.357**	1		
4. Flexibility	.009	.317*	.965**	1	
5. Originality	-.003	-.149	-.086	-.096	1

Note: *p < .05, **p < .01, ***p < .001

Hypothesis Testing

Four independent samples t-tests were performed to check whether there were significant differences between the mindfulness meditation group and the control group in terms of the scores of the pretests. No significant differences between groups were found for the pretest scores of mood ($t(54) = .84$, $p = .405$). For the variable fluency, an independent samples t-test using 2,000 bootstrap samples was performed since the normality assumption was violated (95% CI = -1,784; 1,609). No significant differences between groups were found for the pretest scores of fluency ($t(54) = -.092$, $p = .927$). However, the violation of the normality assumption lowered the p value's reliability. No significant differences between groups were found for the pretest

scores of flexibility ($t(54) = -.1,62$, $p = .872$). Additionally, no significant differences between groups were found for the pretest scores of originality ($t(54) = -.1,714$, $p = .092$). Conclusively, no differences between the conditions were found ($p > .05$) in the pretest scores of mood, fluency, flexibility, and originality. Consequently, this shows the similarity of the two conditions at pretest, which, in turn, increases the internal validity of the study since it decreases the possibility that the results were influenced by differences between the two conditions (Treadwell, 2017).

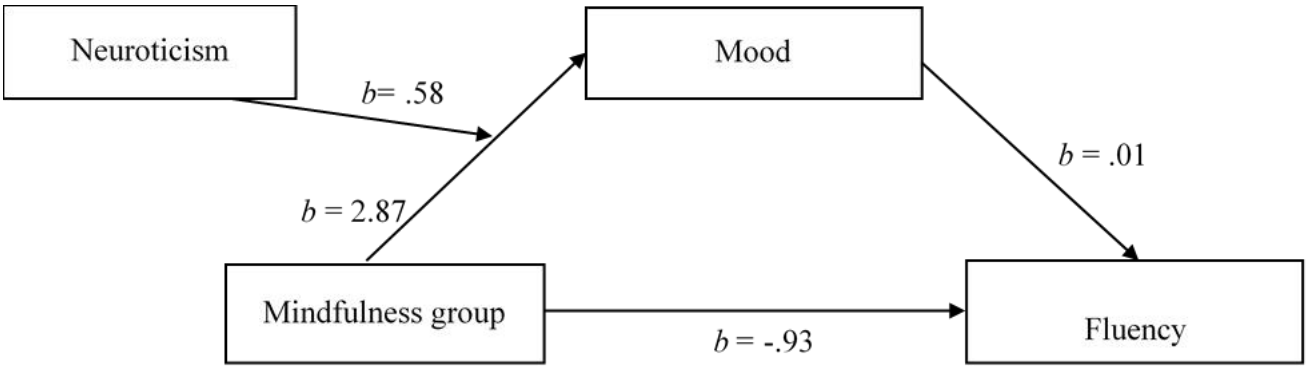
To test all the proposed hypotheses, three moderated mediation analyses were performed to find the mediating effect of mood on the relationship between mindfulness meditation and divergent thinking on the different levels of the moderating variable neuroticism. The moderated mediation analyses were performed using the SPSS statistical package PROCESS v3.5 (model 7) using 5,000 bootstrap samples for bias correction and to establish 95% confidence intervals (Hayes, 2013). The first analysis included fluency scores as the dependent variable. The second analysis included flexibility scores as the dependent variable. The third and final analysis included originality scores, as measured by the SemDis tool, as the dependent variable.

The result of the first analysis showed that the mindfulness meditation group was found to be a nonsignificant predictor of mood ($b = 2.87$, $t = .64$, $p = .520$), whereas neuroticism was found to be a significant predictor of mood ($b = 1.22$, $t = 5.55$, $p < .001$), which supports hypothesis 2. Furthermore, the interaction between neuroticism and the mindfulness meditation group was also found to be a nonsignificant predictor of mood ($b = .58$, $t = 1.31$, $p = .197$). Moreover, in both the mindfulness meditation and control groups, the independent categorical variable was found to be a nonsignificant predictor of fluency in the presence of the mediating variable mood ($b = -.93$, $t = -.78$, $p = .440$). Finally, the mediating variable mood was found to be

a nonsignificant predictor of fluency (b = .01, t = .34, p =.737). Conclusively, no significant mediation or moderation was found; therefore, the moderated mediation model was found to be nonsignificant with the moderation index = .006, *SE*= .03 (95% CI = -.032; .067). The regression table can be found in Appendix A. Thus, the results partly reject hypothesis 1, hypothesis 3, hypothesis 4b, and hypothesis 4c and fully reject hypothesis 4. Furthermore, the results confirm hypothesis 2.

Figure 3

Moderated Mediation Model of Mindfulness Group and Fluency Through Mood on the Levels of Neuroticism as Moderator



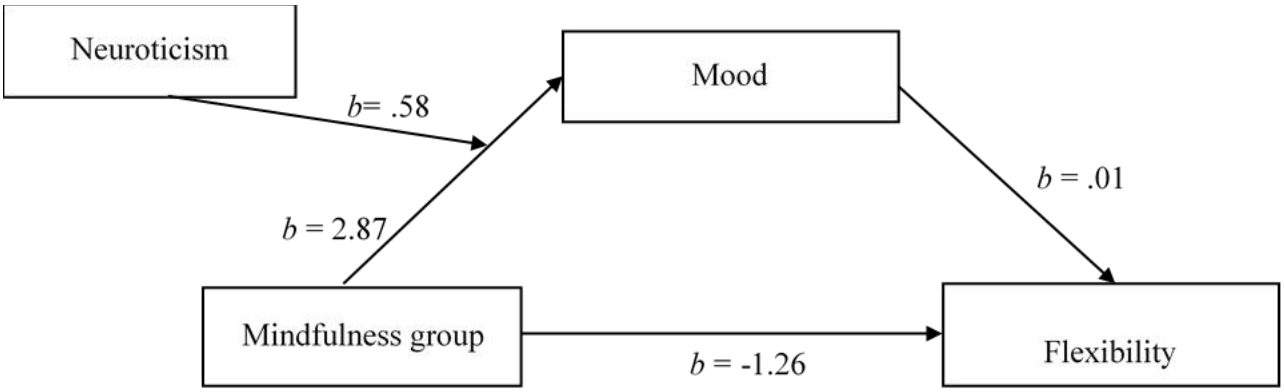
Note: *p < .05, **p < .01, ***p < .001

The second analysis' results showed that the mindfulness meditation and control groups—the independent categorical variables—were found to be nonsignificant predictors of flexibility in the presence of the mediating variable mood (b = -1.26, t = -1.38, p = .173). Finally, the mediating variable mood revealed to be a nonsignificant predictor of flexibility (b = .01, t = .06, p = .949). Conclusively, the result of the analysis showed that there was no significant mediation and moderation found; therefore, the moderated mediation model was found to be nonsignificant with the moderation index = .001, *SE* = .015 (95% CI = -.029; .035). The

regression table can be found in Appendix B. Therefore, the results partly reject hypothesis 1, hypothesis 3, hypothesis 4b, and hypothesis 4c.

Figure 4

Moderated Mediation Model of Mindfulness Group and Flexibility Through Mood on the Levels of Neuroticism as Moderator

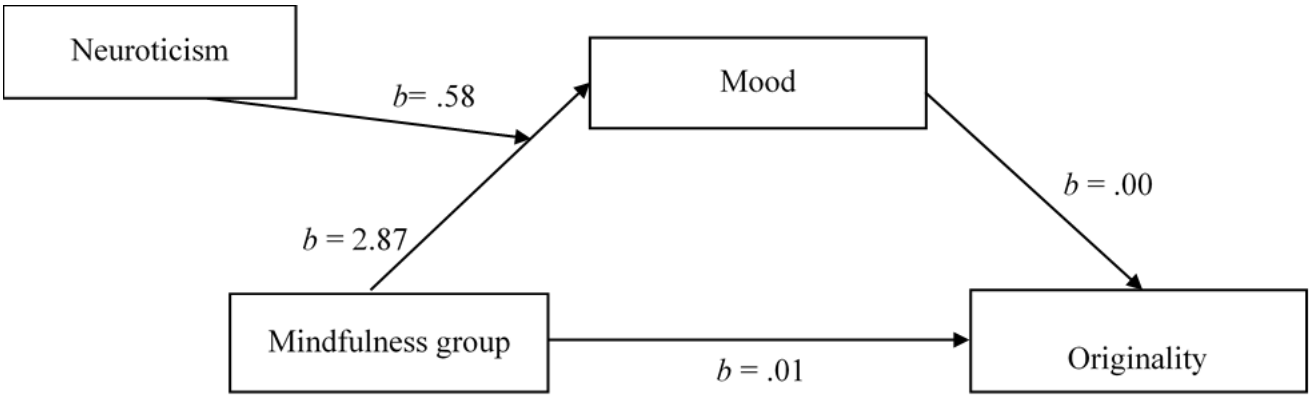


Note: *$p < .05$, **$p < .01$, ***$p < .001$.

The result of the third analysis shows that in both the mindfulness meditation and control groups, the independent categorical variable was found to be a nonsignificant predictor of originality in the presence of the mediating variable mood ($b = .01$, $t = .77$, $p = .446$). Finally, the mediating variable mood was found to be a nonsignificant predictor of originality ($b = .00$, $t = -.022$, $p = .983$). Conclusively, the analysis' results indicated no significant mediation and moderation; therefore, the moderated mediation model was found to be nonsignificant with the moderation index = .000, *SE*= .000 (95% CI = .000; .000). The regression table can be found in Appendix C. Therefore, the results partly reject hypothesis 1, hypothesis 3, hypothesis 4b, and hypothesis 4c.

Figure 5

Moderated Mediation Model of Mindfulness Group and Originality Through Mood on the Levels of Neuroticism as Moderator



Note: *$p < .05$, **$p < .01$, ***$p < .001$

Finally, the above three analyses' results show that all of the proposed hypotheses, apart from hypothesis 2, were rejected.

Further Exploration of the Data

In addition to the moderated mediation analyses, four mixed-design ANOVAs were performed to further examine the effect of mindfulness meditation on the variables mood, fluency, flexibility, and originality. The interaction effect of mindfulness meditation relative to the control condition on mood proved nonsignificant ($F(1, 43) = .383$, $p = .539$, $\eta^2_p = .009$). The findings suggest that the effect of mindfulness meditation failed to produce any significant differences in mood score from pretest to posttest. The interaction plot for group condition and time is displayed in Appendix D, Figure D1. Furthermore, the interaction effect of mindfulness meditation relative to the control condition on fluency revealed to be nonsignificant ($F(1, 43) = 1.825$, $p = .184$, $\eta^2_p = .041$), suggesting that the effect of mindfulness meditation failed to

produce any significant differences in fluency from pretest to posttest. The interaction plot for group condition and time is shown in Appendix D, Figure D2.

Additionally, the interaction effect of mindfulness meditation relative to the control condition on flexibility proved nonsignificant ($F(1, 43) = 2.360$, $p = .132$, $\eta^2_p = .052$), suggesting that the effect of mindfulness meditation failed to produce any significant differences in flexibility from pretest to posttest. The interaction plot for group condition and time is shown in Appendix D, Figure D3. Finally, the interaction effect of mindfulness meditation relative to the control condition on originality proved nonsignificant ($F(1, 43) = .993$, $p = .324$, $\eta^2_p = .023$), suggesting that the effect of mindfulness meditation failed to produce any significant differences in originality from pretest to posttest. The interaction plot for group condition and time is shown in Appendix D, Figure D4.

Discussion

The goal of the current study was to examine the relationship between mindfulness meditation and divergent thinking, the mediating role of mood, and the moderation effect of neuroticism on the association between mindfulness meditation and mood. These relationships were investigated using a pretest-posttest experimental research design, examining the effects of a seven-day mindfulness meditation training through 10-minute guided meditation sessions using the Waking Up meditation app.

Summary and Interpretation

The moderated mediation analyses that were conducted revealed no significant results for the effect of mindfulness meditation on divergent thinking. This was true for the three moderated mediation models that each included one of the variables fluency, flexibility, and originality as its

dependent variable, each of which is one of three components of divergent thinking. Since all three models failed to produce significant results, the first hypothesis was rejected. These results are contrary to prior research that suggest that mindfulness meditation positively affects divergent thinking (Colzato et al., 2012; Ren et al., 2011; Lebuda et al., 2016; Zabelina et al., 2011). Moreover, neuroticism has a significant positive relationship with mood. Since a higher mood score on the POMS indicates a more negative mood, the results show support for the hypothesis that people scoring high on the trait neuroticism will have a more negative mood than people scoring low on the trait neuroticism. This finding is commensurate with previous research on neuroticism and mood that suggest that individuals high in the trait neuroticism have a stronger proclivity toward negative mood states (Costa & McCrae, 1992; DeYoung et al., 2007; Larsen & Ketelaar, 1989). Furthermore, the results show no evidence of a positive association of positive mood on divergent thinking abilities. Therefore, the results fail to support the general findings of prior research, which has indicated a positive association between positive mood and divergent thinking (Davis 2009; Baas et al., 2008). Moreover, since no significant relationship was found between mindfulness meditation and mood, the expectation that mood serves as a mediator between mindfulness meditation and divergent thinking with neuroticism moderating this relationship is not met. Consequently, hypothesis 4a, stating that mindfulness meditation has a positive effect on mood and is moderated by neuroticism by strengthening the positive effect of mindfulness meditation on mood, was rejected. Additionally, this showed that hypothesis 4b, that mindfulness meditation has a positive effect on divergent thinking and is in part mediated by mood, was not confirmed. Finally, the results made it necessary to reject hypothesis 4c that neuroticism serves as a moderator between mindfulness meditation and mood and, in turn, people who score high on neuroticism will improve their mood to a greater extent than people

who score low on neuroticism and will therefore experience a greater improvement in divergent thinking. Even though all hypotheses, with the exception of the second hypothesis, were rejected, the additional analyses that were conducted to further explore the data revealed a nonsignificant trend in the expected direction. The trend indicates that after the seven-day mindfulness meditation intervention, the mean for negative mood seems to have decreased to a greater extent for the mindfulness meditation condition than for the control condition. Furthermore, the trend also shows that the means for flexibility and originality have increased more for the mindfulness conditions than for the control conditions, whereas the mean of fluency appears to have increased to a similar extent for both conditions. However, since these results proved nonsignificant, no conclusions can be drawn from this. Finally, a noteworthy observation is the correlations among fluency, flexibility, and originality. The data shows fluency and flexibility to have a significant strong positive association, which is commensurate with prior research (Hebert et al., 2002; Reiter-Palmon et al., 2019). Originality, however, had no significant relationship with either fluency or flexibility. This observation is contrary to the literature that suggests that originality is positively associated with fluency (Forthmann et al., 2020; Hocevar, 1979; Silvia, 2008).

A possible explanation for the results to show no effect of mindfulness meditation on divergent thinking concerns the use of the AUT. The participants performed the AUT on day one and day 9. It is possible that the participants in both groups thought about other alternative use cases after the first test on day one. In turn, when they made the second AUT on day 9, they could have had access to more ideas if they were able to quickly remember them, which would have influenced their fluency results. This might explain why both groups increased in mean for

the variable fluency and, because of its significant high correlation with fluency, an increase in mean of flexibility.

Furthermore, the results found no moderation effect of neuroticism on the relationship of mindfulness meditation on mood since the moderated mediation analysis shows that mindfulness meditation has no significant relationship with mood. Therefore, it would not have been possible for neuroticism to moderate this nonsignificant relationship. In other words, because the results found no support for the expectation that mood serves as a mediator between mindfulness meditation and divergent thinking, no support could have been found for the moderating role of neuroticism.

The results of the current study are compatible with findings of prior research on the relationship between mood and the personality trait neuroticism. A substantial body of literature indicates that individuals high in neuroticism have a stronger predisposition for negative mood and emotion than individuals low in neuroticism (Costa & McCrae, 1992; Crescenti & Capurso, 2015; McCrae & Costa, 1999). In line with the literature, current study results revealed that higher levels of neuroticism strongly associate with higher levels of negative mood. Hence, it could be concluded that neuroticism negatively affects an individual's mood. Nonetheless, the majority of the results of this study failed to find support for the aforementioned preliminary studies' findings. Prior studies have shown that mindfulness meditation positively affects all three divergent thinking abilities (Colzato et al., 2012; Zabelina et al., 2011; Lebuda et al., 2016). A notable study to contrast the current study's result with is the study by Colzato et al. (2012). In opposition to the current research, Colzato et al.'s (2012) findings indicate that the mindfulness technique open-monitoring improves fluency, flexibility and originality. Similar to the current study, Colzato et al. (2012) assessed fluency, flexibility, and originality through the AUT. In

addition, the study by Colzato et al. (2012) also made use of a short-term mindfulness meditation practice. Their intervention consisted of three 45-minute sessions spread out over ten days. However, Colzato et al. (2012) only used experienced meditators. Additionally, the first mindfulness meditation session was guided by a professional mindfulness meditation coach. Meanwhile, the current study only used beginning practitioners and guided the meditators with the use of a meditation app. It could be possible that seven ten-minute guided sessions using an app are not enough for beginning practitioners to properly learn the mindfulness meditation techniques. However, other studies, such as Ding et al. (2014) and Ding et al. (2015), used only beginning practitioners and a short-term meditation intervention of seven days. Subsequently, despite only involving beginning practitioners and a short-term intervention, the meditative practices still improved divergent thinking (Ding et al., 2014, 2015). Therefore, it could be of interest for future researchers to explore whether the length of the mindfulness meditation intervention would have an effect on the current results.

Finally, this study's results are incompatible with both Zabelina et al. (2011) and Ding et al. (2015). Both studies found that mood and neuroticism influence the relationship between mindfulness meditation and divergent thinking. However, their two studies reached different conclusions about how mood and neuroticism influence the effectiveness of meditation interventions. Ding et al. (2015) suggest that people high in neuroticism will see a smaller increase in divergent thinking than people low in neuroticism, whereas Zabelina (2011) suggests the opposite. Since Ding et al. (2015) used IBMT as an intervention and Zabelina et al. (2011) used mindfulness meditation, the expectations of the current study were commensurate with the findings of Zabelina et al. (2011). However, the present study's results found no support for the claims made by Zabelina et al. (2011) since the present study failed to find a significant

relationship between mindfulness meditation and mood and therefore found no significant result regarding the moderating effect of neuroticism in this relationship. Thus, more research will be needed to further investigate how mood and neuroticism influence the relationship between mindfulness meditation and divergent thinking.

Limitations and Future Research

The current study entails several limitations. One limitation concerns the study's sample size. Considering the study's length and the efforts that were required from the participants to finish the study, it proved difficult to obtain an appropriate sample size for conducting analyses on a moderated mediation model. The current sample size (n = 56) could have been a limiting factor (Hair et al., 2018) and is a possible reason for the majority of the results being nonsignificant. The mindfulness meditation training could have had an effect but was not found due to the small sample size, which would imply a type II error. Therefore, A larger sample size might have produced more significant results than the current sample size. Hence, future studies are recommended to obtain a bigger sample size, appropriate for a moderated mediation, and replicate this study.

A second limitation pertains to the measurement technique used for flexibility. To obtain a flexibility score for every participant, the total number of times the participant switched between categories was counted and added up to generate a single score. This approach is a commonly used technique to determine flexibility scores (e.g. Ding et al., 2015; Kaufman et al., 2016), but this technique remains to involve a subjective component since the scorer needs to decide whether the given response falls into a different semantic category than the previous one (Reiter-Palmon et al., 2019). Studies typically use more than one scorer to count the participants' number of categorical switches and assess the inter-scorer reliability to increase the reliability of

the measurement technique (Reiter-Palmon et al., 2019). Since this study has only made use of one scorer, the measurement is less objective than it would have been if a second scorer had been included. By including a second scorer, the inter-scorer reliability could have been assessed and benefitted the measurement's reliability.

Moreover, another limiting factor concerns the use of the SemDis tool (Beaty & Johnson, 2020). As previously mentioned, the SemDis tool is not a direct measure of originality but rather measures the semantic distance of the responses to the presented objects, which in this case were a brick and paperclip. Consequently, responses that are very semantically distant produce a high originality score but do not take into account whether the response entails features such as wit or cleverness (Beaty & Johnson, 2020; Reiter-Palmon et al., 2019). Therefore, the SemDis tool is only sensitive to the remoteness of concepts, whereas manual scoring would have taken the cleverness of the response into account by judging whether the use case also entailed actual usefulness (Beaty & Johnson, 2020; Silvia et al., 2008).

Furthermore, the total sample included more women (n = 35) than men (n = 21), which made for a sampling bias in terms of gender. Consequently, the external validity is threatened since this lowered the generalizability to both genders. Additionally, the results' internal validity is threatened due to selection bias because of an uneven distribution of gender within the control group. The mindfulness meditation group included n = 13 men and n = 16 women, whereas the control group included n = 8 men and n = 19 women. The literature on personality trait differences suggests that, on average, women score higher on the trait neuroticism than men do (Costa et al., 2001; Lynn & Martin, 1997) and are therefore more susceptible to negative mood states (Larsen & Ketelaar, 1989). This might have impacted the results by influencing the

neuroticism and mood scores. It is suggested that future researchers include an equal number of men and women and, subsequently, evenly distribute them across groups.

In terms of future research, it would be useful to take the above limitations into account when further examining the effects of mindfulness meditation on mood, divergent thinking, and neuroticism. Moreover, future studies could expand on the current research by taking into account the variable of gender and examine whether the results would differ between men and women since, on average, women score, on average, higher on the trait neuroticism (Costa et al., 2001; Lynn & Martin, 1997). Furthermore, as briefly mentioned earlier in the discussion section, future studies could replicate this study and expand the length of the intervention by increasing the number of instructed mindfulness practices on the Waking Up app.

Lastly, previously discussed literature suggests that an increase in positive mood will lead to increased divergent thinking abilities (Baas et al., 2008; Davis, 2009). Baas et al. (2008) argue that particularly activating and promotion-focused moods enhance divergent thinking. Therefore, Baas et al. (2008) make a distinction in different types of positive mood, which this study did not do. Future studies could elaborate on the present study by investigating the moderated mediation model this study has examined but should differentiate between certain types of positive mood. For example, future researchers could examine whether a possible mediating effect of mood on the relationship between mindfulness meditation and divergent thinking would differ for activating or deactivating positive moods.

Contribution

The study's results contribute to the current body of research on mindfulness meditation, creativity, mood, and personality. More specifically, this study has extrapolated on the findings of research on the association between meditation and divergent thinking and the influencing

roles of mood state and personality trait neuroticism. The current study has investigated the mediating relationship of mood between mindfulness meditation and divergent thinking and examined whether neuroticism moderates the relationship between mindfulness meditation and mood. The examined body of literature seemed to indicate that this exact model had not yet been investigated. Consequently, this study would be the first to have investigated whether neuroticism moderates the relationship of mindfulness meditation on mood. Therefore, the study contributes by giving further insight into the role the personality trait neuroticism plays within the effect of mindfulness meditation on divergent thinking, mediated by mood. Moreover, it appears that not many studies have explored the effects of short-term mindfulness meditation training on divergent thinking. This study made use of a seven-day mindfulness meditation intervention and thus contributes to the limiting scope of studies that have studied short-term mindfulness meditation.

Conclusion

In sum, this study examined the effect of mindfulness meditation on divergent thinking and the interplay of mood as a mediating variable and neuroticism as a moderating variable. The results indicate no effect of the seven-day mindfulness intervention on the divergent thinking abilities fluency, flexibility, and originality. Furthermore, the results show that neuroticism and mood do not influence the relationship of mindfulness meditation on divergent thinking. Accordingly, mood does not mediate a possible effect of mindfulness meditation on divergent thinking, and neuroticism does not moderate the relationship between mindfulness meditation and mood. Besides, one significant effect was found and shows that individuals high in neuroticism have a more negative mood state than individuals low in neuroticism. However, the current results must be interpreted carefully since the study entails a number of limitations.

Nonetheless, despite these limitations, the present study contributes to the line of research concerning the relationships among mindfulness meditation, divergent thinking, mood, and neuroticism. Preliminary research shows ambiguous findings about the effect of neuroticism on the relationships among mindfulness meditation, mood, and divergent thinking. This study addresses this literature gap by investigating the role of neuroticism as a moderator on the relationship between mindfulness meditation and mood. Furthermore, this study contributes to the small scope of research on short-term mindfulness meditation.

Conclusively, this study provides deeper insights into the associations among mindfulness meditation, mood, neuroticism and divergent thinking by addressing the following research question: 'To what extent does mindfulness meditation enhance divergent thinking and in what way is this relationship affected by individual differences in the personality trait neuroticism and mood?' The findings suggest that mindfulness meditation does not enhance divergent thinking. Furthermore, the findings indicate that mood and neuroticism do not influence the aforementioned relationship.

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Appendix A

Table A1

Moderated mediation analysis 1

Antecedent	Consequent			
	Mood		Fluency	
	Coeff. (SE)	*95% CI*	*Coeff. (SE)*	*95% CI*
Constant	77.40(2.72) ***	72.96, 81.85	7.52(2.36) **	2.80, 12.25
Group condition	2.87(4.437)	-6.03, 11.76	-.93(1.19)	-3.32, 1.46
Neuroticism	1.22(.22) ***	.78, 1.66	-	-
Group condition _x_ Neuroticism	.58(.44)	-.30, 4.46	-	-
Mood	-	-	.01(.03)	-.05, .07
	R^2 = .378		R^2 = .013	
	$F(3,52) = 10.540$, $p < .001$		$F(2, 53) = .359$, $p = .700$	

Note. Regression coefficients are unstandardized; bootstrap sample size = 5,000. CI = confidence interval. *p < .05; **p < .01; ***p < .001

Appendix B

Table B1

Moderated mediation analysis 2

Antecedent	Consequent			
	Mood		Flexibility	
	Coeff. (SE)	*95% CI*	*Coeff. (SE)*	*95% CI*
Constant	77.40(2.72) ***	72.96, 81.85	5.80(1.80) **	2.18, 9.41
Group condition	2.87(4.437)	-6.03, 11.76	-1.26(.91)	-3.08, .57
Neuroticism	1.22(.22) ***	.78, 1.66	-	-
Group condition _x_ Neuroticism	.58(.44)	-.30, 4.46	-	-
Mood	-	-	.01(.03)	-.04, .05
	R^2 = .378		R^2 = .035	
	$F(3,52) = 10.540$, $p < .001$		$F(2, 53) = .956$, $p = .391$	

Note. Regression coefficients are unstandardized; bootstrap sample size = 5,000. CI =, confidence interval. *p < .05; **p < .01; ***p < .001.

Appendix C

Table C1

Moderated mediation analysis 3

Antecedent	Consequent			
	Mood		Originality	
	Coeff. (SE)	*95% CI*	*Coeff. (SE)*	*95% CI*
Constant	77.40(2.72) ***	72.96, 81.85	.96(.02) ***	.92, .99
Group condition	2.87(4.437)	-6.03, 11.76	.01(.01)	-.01, .02
Neuroticism	1.22(.22) ***	.78, 1.66	-	-
Group condition _x_ Neuroticism	.58(.44)	-.30, 4.46	-	-
Mood	-	-	.00(.00)	-.01, .00
	R^2 = .378		R^2 = .011	
	$F(3,52) = 10.540$, $p < .001$		$F(2, 53) = .295$, $p = .746$	

Note. Regression coefficients are unstandardized; bootstrap sample size = 5,000. CI = confidence interval. *p < .05; **p < .01; ***p < .001

Appendix D

Figure D1

Interaction between group condition and time for mood score

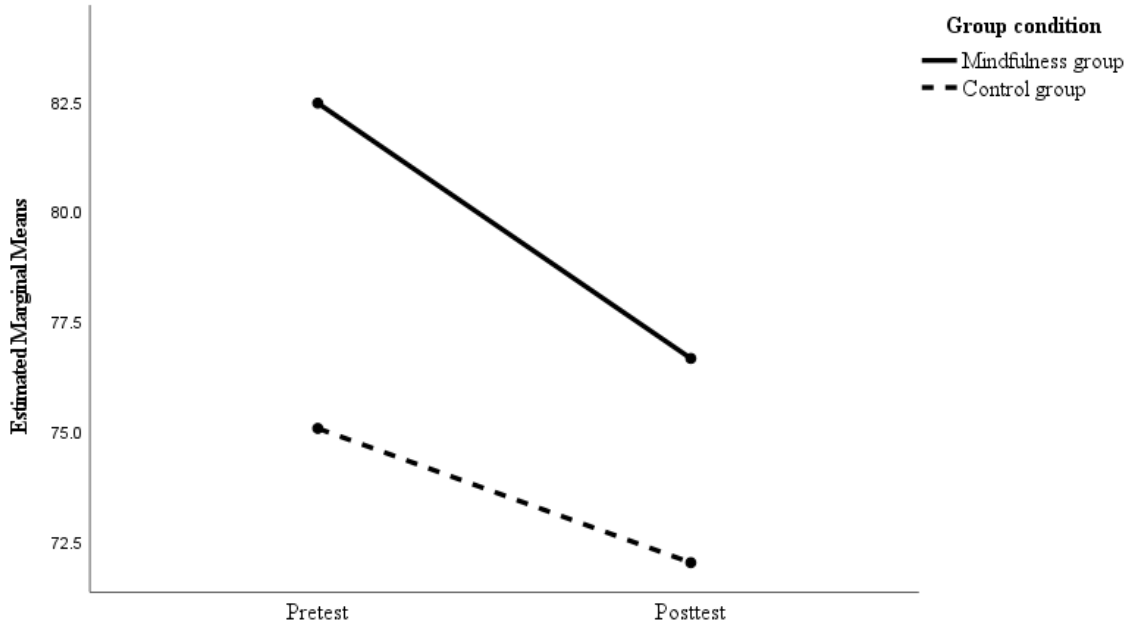

Figure D2

Interaction between group condition and time for fluency score

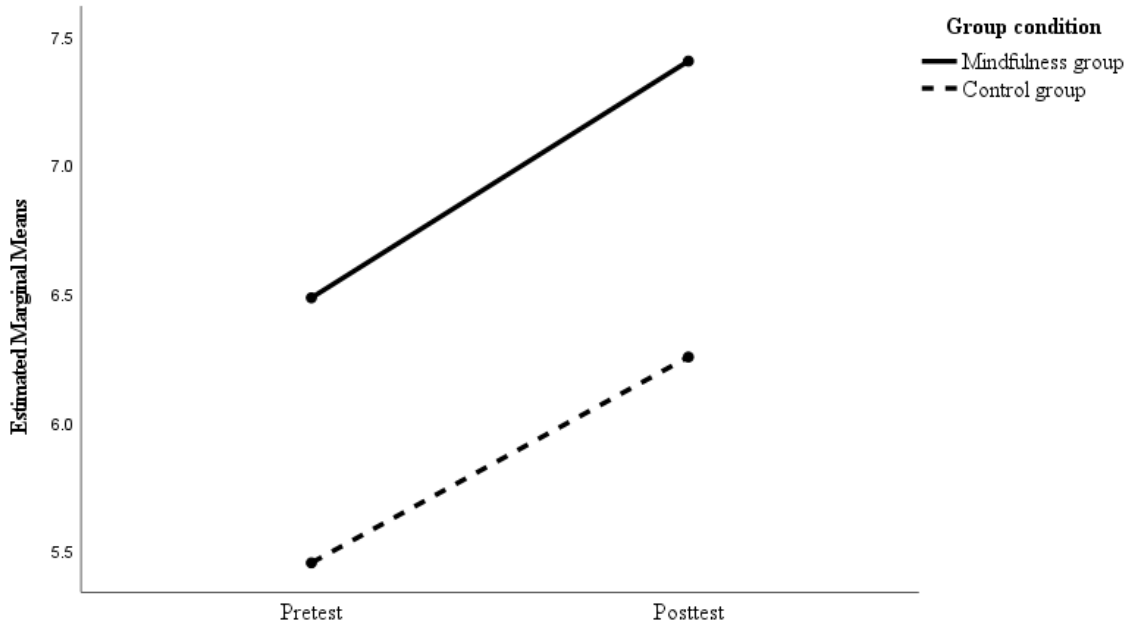

Figure D3

Interaction between group condition and time for flexibility score

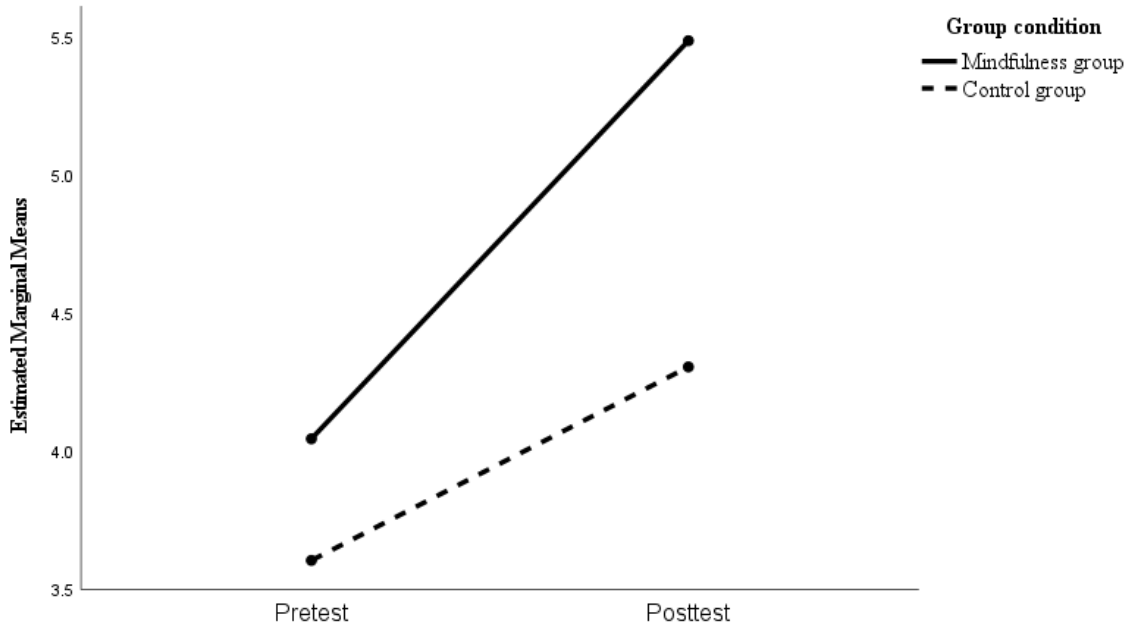

Figure D4

Interaction between group condition and time for originality score