



Facing the Unpleasant: Does Mindfulness decrease Anxiety by decreasing Avoidance?

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Abstract

Mindfulness can effectively reduce anxiety in clinical and nonclinical populations (Hofmann et al., 2010; Querstret et al., 2020). However, the underlying mechanisms are not sufficiently understood. Avoidance can influence anxiety levels (Eustis et al., 2020; Kashdan et al., 2014) and mindfulness might decrease avoidance by cultivating an open and accepting stance towards experience. Therefore, mindfulness might decrease anxiety by decreasing avoidance. The current study investigated if 1) mindfulness leads to significantly greater anxiety decrease than an audiobook control and if 2) mindfulness decreases anxiety by decreasing avoidance. Participants ($n = 69$) were assigned to a mindfulness or control condition. In the first lab session, participants listened to a meditation or audiobook, avoidance and anxiety levels were assessed. Participants then followed the meditation/audiobook daily for 12 days at home. Subsequently, participants returned to the lab where they listened to the mindfulness/audiobook again. Anxiety and avoidance levels were again assessed. Mediation analysis provided no support for an indirect effect of mindfulness on anxiety via avoidance. Hence, no evidence was found for avoidance as working mechanism of mindfulness. Current findings are restricted by limitations and should be interpreted with caution. Potential mechanisms of change and future directions are discussed.

Keywords: Mindfulness, mindfulness working mechanisms, anxiety, avoidance

Facing the Unpleasant: Does Mindfulness decrease Anxiety by decreasing Avoidance?

As a Neanderthal 100.000 years ago, thinking that one could encounter a saber-toothed tiger in the forest again while hunting dinner, one probably started worrying, felt tense and wanted to avoid that route. The former describes the experience of anxiety, which can be defined as natural reaction to perceived future threat that expresses itself in physiological, cognitive, and behavioral responses (Abramowitz & Blakey 2020). From a contemporary perspective fear is an emotional response to real imminent threat, whereas anxiety is characterized by the anticipation of future threats (American Psychiatric Association, 2013, p.189). Accordingly, anxiety has crucial adaptive value, as it encourages future planning (Barlow, 2000) which can be essential for survival (Abramowitz & Blakey 2020). The choice to avoid the dangerous route in the future could save the Neanderthal's life.

Fortunately, as homo sapiens of the 21st century, our way to the supermarket is seldomly thwarted by saber-toothed tigers or other threats to our livelihood; however, anxiety, specifically clinical anxiety, remains a common phenomenon affecting today's society. Clinical anxiety differs from developmentally normative anxiety in being excessive considering the real magnitude of threat and in being persistent beyond developmentally appropriate periods (Abramowitz & Blakey 2020; American Psychiatric Association, 2013, p. 189). It might be the general future-oriented problem-solving mindset nowadays that paves the way for clinical anxiety, regardless, clinical anxiety is highly predominant. In 2017 clinical anxiety formed the most prevalent mental health condition, affecting 284 million individuals worldwide (Dattani et al., 2021). Anxiety disorders further have severe negative impact on various life domains and health-related quality of life (Revicki et al., 2012). As a result, enormous healthcare costs are generated, which, however, can be reduced through optimized therapy (Konnopka et al., 2008). Mindfulness-based interventions (MBIs) have been credited anxiety attenuating effects (Hofmann et al., 2010). However, their effectiveness

in the treatment of anxiety could be improved by an increased understanding of underlying working mechanisms.

Mindfulness in the Treatment of Anxiety, Theory, Evidence and Working Mechanisms

Mindfulness originated from Buddhism and can be defined as nonelaborative, nonjudgmental, present centered awareness in which each thought, feeling or sensation that arises is acknowledged and accepted as it is (Bishop et al., 2004, p.232). From a contemporary Buddhist perspective, unpleasant experiences themselves are not a problem per se, but our relationship to them is what causes suffering (Teasdale & Chaskalson, 2011). This principle reflects mindfulness' core mechanism of change: Mindfulness changes our relationship to experience (Orzech et al., 2009).

Within the context of pathological anxiety, an individual's relation to personal adverse experiences often involves an "acting upon the negative affect, to prevent or solve it". However, related coping attempts such as avoidance are often ineffective as they are associated with heightened anxiety levels and favor their persistence (Panayiotou et al., 2014). Mindfulness on the other hand can change the relation to experience by offering an alternative response in simply "observing and accepting the negative affect, without the necessity to act upon it". Thus, by changing the relation to experiences rather than the content, mindfulness can replace ineffective coping strategies and alleviate anxiety symptomatology.

Different working mechanisms of mindfulness can contribute to reduced anxiety levels. Namely, a present moment focus (the ability to act with awareness in the present moment) (Medvedev et al., 2018), a nonjudgmental attitude (the ability to accept ongoing experiences as they are without judging) (Medvedev et al., 2018), or increases in dispositional/trait mindfulness (relatively stable predisposition to be mindful throughout the day) (Tomlinson et al., 2018). However, one working mechanism that might, in particular, change the relation to experience, thereby reducing anxiety is cognitive defusion/decentering.

Despite different terminology, decentering and cognitive defusion appear to be parallel constructs and reflect the same mental phenomenon (Bernstein et al., 2015; McCracken et al., 2014). Both describe the ability to step back and observe private events (such as thoughts and feelings) as temporary and subjective experiences in the mind, rather than true reflections of the self and the world (Fresco et al., 2007; Hayes et al., 2012, p.65). This allows anxious individuals to step out of ruminative cycles and disidentify from negative self-evaluations and judgment. For example, an anxious individual might experience negative self evaluative thoughts of being guilty. As this causes distress, the individual might try to suppress (avoid) these thoughts which causes even greater distress. With a more decentered perspective, the individual can observe the thoughts as transient phenomenon without the necessity to suppress them, which is likely to decrease anxiety and related distress. Research has shown that mindfulness training can cultivate a more decentered perspective within and beyond mindfulness practice (Shoham et al., 2017). A study by Hoge et al. (2015) investigated how decentering affects anxiety in the context of a Mindfulness Based Stress Reduction program (MBSR; Kabat-Zinn, J., 2011). Participants ($n = 38$) diagnosed with Generalized Anxiety Disorder (GAD; Rowa & Antony, 2008) were randomly assigned to an MBSR or active control condition comprising stress management education. The MBSR condition included in class and homework practice of breath awareness, body scans and hatha yoga over the course of 8 weeks. The stress management education group focused on education on diet, sleep, exercise, and resilience without addressing mindfulness practice. Anxiety was assessed with the Beck Anxiety Inventory (BAI; Beck et al., 1988) and Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) at baseline and after 8 weeks. Decentering was assessed with the decentering subscale of the Experience Questionnaire (Fresco et al., 2007). Multiple and simple mediation analyses were conducted. Results showed that participants in the MBSR condition demonstrated significant anxiety decreases after the program and that those were

fully mediated by increases in decentering (Hoge et al., 2015). Therefore, findings suggest that as an anxious individual, the extent to which one can relate to present experiences with a distant/"defused" awareness of its transience and subjectivity can influence the magnitude of experienced anxiety levels.

However, often anxious individuals are not able to relate to experience from a "defused" perspective, but rather from a "fused" one. In other words, the literal content of the mind (e.g., negative self evaluative thoughts) is interpreted as truth rather than as transient subjective experience (Cookson et al., 2019). In the context of anxiety, interpreting the mental content as literal truth can encourage avoidance (Bardeen & Fergus, 2016; Cookson et al., 2019).

Avoidance and Anxiety

Avoidance is a characteristic process of anxiety (McManus et al., 2010). By definition Experiential Avoidance (EA) describes an unwillingness to remain in contact with aversive private experiences and actions taken to alter their form, frequency, or context (Hayes et al., 1996). In other words, EA includes any action that is undertaken to escape, modify or control aversive experience. Different cognitive, emotional, and behavioral avoidance strategies exist, such as thought suppression and control, avoidance of affective responses, and escape of distressing situations (Chawla & Ostafin, 2007).

There are both adaptive and maladaptive forms of avoidance. One example of adaptive avoidance would be a student that suppresses thoughts and feelings of nervousness before an exam and engages in positive self talk. On the other hand, an example of maladaptive avoidance would be a person that doesn't want to leave the house as he is excessively scared of dogs and consequently experiences large impairments in his quality of life. Further, as the person due to the avoidance would not encounter any dogs, the maladaptive belief of "all dogs are a threat" could not be corrected. Hence, the correcting experience would be avoided, and

new adaptive learning (e.g., new belief of "most dogs are no threat") that could decrease anxiety prevented. The person would continue to experience high anxiety levels when encountering a dog. Therefore, when used intentionally in a flexible manner, avoidance can be an effective emotion regulation strategy; however, applied in rigid, habitual, inflexible attempts, avoidance tends to increase distress and impairs people's lives (Hayes-Skelton & Eustis, 2020, p.116).

Evidence shows that avoidance can predict increased anxiety. Two studies by Kashdan et al. (2014) investigated whether EA predicts and precedes social anxiety within social interactions. In the first study, an experience sampling method was used. The sample comprised individuals diagnosed with Social Anxiety Disorder (SAD; Ramsawh et al., 2010) ($n = 84$) and healthy controls ($n = 43$). Both groups received a mobile device with which they rated EA and social anxiety measures over the course of 14 days after each social interaction. Results suggested that individuals from the SAD condition experienced more EA than the control condition in social situations. Furthermore, greater use of EA predicted higher levels of social anxiety. In the second study, another experimental paradigm was used to allow more robust causal inferences (Kashdan et al., 2014). Undergraduates ($n = 106$) were randomly paired with opposite sex partners within the sample. The pairs were then randomly assigned to a closeness generating or small talk conversation condition. In the closeness generating condition, the pairs had to answer predetermined questions that required to disclose information about intimate topics. The small talk condition followed a similar structure, but the information required to disclose were more superficial. EA and social anxiety were assessed in the middle of the conversation and after the conversation. Results indicated that EA assessed in the middle of the conversation predicted social anxiety after the conversation. Thus, findings suggest a causal influence of EA on anxiety, as changes in EA temporally preceded changes in anxiety. More experimental studies should replicate this finding.

However, the evidence by Kashdan et al. (2014) demonstrated that changes in EA preceded and predicted changes in anxiety levels. Hence, it is reasonable to assume that EA can contribute to the onset and increase of anxiety levels.

On the other hand, evidence showed that decreases in avoidance can lead to decreased anxiety levels. A study by Eustis et al. (2020) examined if changes in EA temporally preceded and predicted changes in anxiety. Participants ($n = 179$) diagnosed with heterogenous anxiety disorders were randomly allocated to a waitlist or two active CBT conditions. One CBT condition followed a transdiagnostic treatment protocol for emotional disorders, the other condition followed a single disorder protocol. EA and anxiety were assessed at baseline, during and post treatment. After 12 sessions, anxiety levels decreased significantly in both CBT conditions. Results further indicated that changes in EA preceded and predicted subsequent changes in anxiety. Considering the assessment of temporal precedence, findings of Eustis et al. (2020) suggest a causal relation of EA and anxiety with decreases in EA leading to decreases in anxiety.

Altogether, evidence suggests that EA has the potential to increase (Kashdan et al., 2014) and decrease (Eustis et al., 2020) anxiety levels. Hence, EA seems to be a crucial mechanism of change in the treatment of anxiety (Eustis et al., 2020; Eustis et al., 2016). Through different working mechanisms, mindfulness might as well have the potential to decrease EA, thereby attenuating anxiety levels.

Mindfulness might decrease Avoidance by decreasing Anxiety

By definition, mindfulness appears to be the opposite of avoidance. For example, Bishop et al. (2004; p. 234) proposed mindfulness to be characterized by active attention regulation towards present moment experience, experiential openness, curiosity, and acceptance. This implies that unlike avoidance, characterized by an active engagement to

abandon a particular experience, mindfulness encourages taking an open and accepting stance towards all present experiences. Thus, mindfulness might decrease avoidance.

There is evidence supporting the idea that mindfulness could decrease avoidance. A randomized controlled trial by R othlin et al. (2020) investigated how mindfulness training affects psychological factors related to sports performance. Athletes ($n = 95$) were randomly assigned to three conditions, mindfulness training (MT), psychological skills training (PS) or a waitlist control (WC). MT aimed to teach the mindfulness skills of a present moment focus, defusion and acceptance (R othlin & Birrer, 2020) through theoretical education, exercises, homework, and question and answer sessions. The PS condition followed the same structure but taught mindfulness unrelated skills such as goal setting and positive self talk. Both interventions comprised four 90-minute sessions over the course of 4 weeks. Mindfulness and EA were assessed before and after the interventions. Results showed that compared to the PS and WC condition, the MT condition showed significant decreases in EA. Due to the RCT design, causal inferences might be drawn, suggesting that mindfulness training can decrease EA. In particular, mindfulness practice might decrease EA via the working mechanisms of a present moment focus, defusion and acceptance. However, this remains speculative and should be addressed in future research as R othlin et al. (2020) did not examine if the MTs effect on EA was mediated by mindfulness' working mechanisms. Other evidence further suggests that MBIs can lead to decreases in avoidance among students (Ye, 2017) and clinically anxious individuals (Goldin et al., 2016).

In sum, evidence suggests that mindfulness can decrease avoidance (e.g., R othlin et al., 2020). Furthermore, decreases in avoidance have been shown to decrease anxiety levels (Eustis et al., 2020). Therefore, mindfulness might decrease anxiety levels by decreasing avoidance levels.

Current study

The current research contributes to the existing literature concerning MBIs in the treatment of anxiety. It is to our knowledge the first that aims to bridge a knowledge gap by examining, by means of an experimental design, if mindfulness decreases anxiety indirectly by decreasing avoidance. Two hypotheses are investigated. First, it is hypothesized that mindfulness has an attenuating effect on anxiety levels. Secondly, it is hypothesized that mindfulness decreases anxiety levels by decreasing avoidance. Herewith, a new working mechanism through which mindfulness might attenuate anxiety levels is proposed. Altogether, we hope that our findings stimulate further research on mindfulness working mechanisms to optimize MBIs effectiveness for various conditions, but in particular anxiety.

Method

Participants

Before the study, participants with heightened anxiety were identified using the GAD-7 questionnaire (Williams, 2014). Only participants who had a total score of 9 or higher were selected for the current study as this cut off score indicates pathological anxiety (i.e., GAD; Plummer et al., 2016). The initial sample comprised 100 participants who were acquired in two recruitment periods. Between October 2019 and March 2020, 68 participants were recruited. The data collection was then halted due to the COVID-19 pandemic. Another 32 participants were recruited between October 2020 and June 2021. Due to incomplete responses, a total of 31 participants (20 control subjects, 11 mindfulness subjects) were removed from the initial sample. First, 28 participants were excluded due to completion of less than six homework practices. Further, three participants were excluded as their screen time indicated insufficient time to complete the homework practice appropriately. Hence, the final sample consisted of 69 participants (Mean age = 20.1 years, $SD = 2$) with 31 participants in the control condition and 38 participants in the mindfulness condition. Within the final sample 20.3 % ($n = 14$) of participants were female and 79.7 % male ($n = 55$). Nobody

identified as non-binary. All recruited participants were first year psychology students at the University of Groningen, recruited via a university related credit system (1st Year SONA Practicum Pool). For compensation after completion of the study, students were granted 5.5 SONA credits. The study was approved by the Psychology Department's Institutional Review Board.

Measures and Materials

Interventions

Mindfulness condition. In the Mindfulness condition, participants followed a 20-minute meditation audiotope in the first lab session. After the first lab session, participants followed a daily 10-minute meditation audiotope for 12 days consecutively. In the second lab session, participants again listened to the 10-minute mediation audiotope. The meditation audiotapes included roughly the same content. During meditation, participants were prompted to bring awareness first to their breath, then to their body and then to allow thoughts to come and go. Lastly, participants were guided to engage in an open awareness without a specific focus. The script of the daily mediation is attached in Appendix A. The mediation has been shown to significantly reduce anxiety levels in another study (Papenfuss, Lommen, Huisman, & Ostafin, manuscript in preparation).

Control condition. In the Control condition, participants followed a 20-minute audiotope in the first lab sessions. They then followed daily a 10-minute audiotope for 12 days consecutively between the lab sessions. In the second lab session, participants again listened to the 10-minute audiotope. The audiotapes contained voice recordings of consecutive sequences of a Harry Potter book. Participants were instructed to allow themselves to get absorbed into the story.

Measures

Anxiety. Anxiety was assessed in the first and second lab session with the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) (See Appendix B). The PSWQ consists of 16 items in form of statements that use a five-level response scale ranging from 0 (“Does not describe me”) to 5 (“Does describe me perfectly”). All items assess pathological worry typical for GAD (Fresco et al., 2003), e.g., “I’m always worrying about something”. Five items are reverse coded, e.g., “I don’t tend to worry about things”. The total sum score can range from 16 to 80 ($M = 48.8$, $SD = 13.8$) with higher scores indicating higher degrees of pathological worry (Meyer et al., 1990). A cut off score of 62 can optimally discriminate between healthy individuals and pathological anxiety among student samples (Behar et al., 2003). In the current study, the PSWQ approached acceptable internal consistency (Tavakol & Dennick, 2011) when administered before ($\alpha = .69$) and demonstrated high internal consistency when administered after the intervention ($\alpha = .93$).

Avoidance. EA was assessed in the first and second lab session with the Brief Experiential Avoidance Questionnaire (BEAQ; Gámez et al., 2014) (See Appendix C). The BEAQ consists of 15 items in the form of statements that use a six-level response scale ranging from 1 (“strongly disagree”) to 6 (“strongly agree”). The items address six different subdomains of EA, namely Behavioral Avoidance (e.g., “I am quick to leave any situation that makes me feel uneasy”), Distress Aversion (e.g., “The key to a good life is never feeling any pain”), Procrastination (e.g., “I won’t do something until I absolutely have to”), Distraction and Suppression (e.g., “When unpleasant memories come to me, I try to put them out of my mind”), Repression and Denial (e.g., “I feel disconnected from my emotions”) and Distress Endurance (e.g., “Fear or anxiety won’t stop me from doing something important”). Item 6, “Fear or anxiety won’t stop me from doing something important”, is reverse coded. The current study considered all subdomains to assess anxiety related avoidance. The total sum score can range from 15 to 90 with higher scores indicating higher degrees of avoidance.

To our knowledge there is no evidence suggesting a cut off score for the BEAQ to distinguish adaptive from pathological avoidance. In the current study, the BEAQ demonstrated good internal consistency (Tavakol & Dennick, 2011) when administered before ($\alpha = .85$) and after the intervention ($\alpha = .84$).

Procedure

Based on order of arrival, participants were alternately assigned to the Mindfulness or Control condition. Before the first lab session was initiated, participants were asked for informed consent, they then completed questionnaires at a computer. Questionnaires included the PSWQ and BEAQ that were part of a larger battery of questionnaires assessing other constructs (e.g., phobias, depression, meaning) irrelevant to this thesis project. Participants then listened to the condition specific 20-minute audiotape with headphones. Afterwards, participants were instructed to listen to the condition specific 10-minute audiotapes every day for 12 consecutive days. Every morning, participants received an email containing the daily audiotape. Then, 13 to 16 days after the first lab session, the second lab session was scheduled. In the second lab session, participants first listened to their condition specific audiotape, then completed the same questionnaires as they did during the first session, followed by a computerized task which is not relevant for the current research. After the second lab session, participation ended, and participants were debriefed.

Data Analyses

All statistical analyses were conducted with SPSS version 26 (IBM Corp., 2019). The first hypothesis stated that the mindfulness condition would show a significantly larger decrease in anxiety levels after the intervention than the control condition and was assessed with repeated measures ANOVA. Thereby, the independent variables were the between subjects (group) factor 'experimental condition' and the within subjects factor time. The dependent variable were the 'anxiety (PSWQ) scores'. A post hoc power analysis with G

Power version 3.1 (Faul et al., 2009) was conducted. The second hypothesis was assessed with a mediation analysis using the PROCESS macro version 4.0 (Hayes & Rockwood, 2017). In PROCESS, model four, 95% confidence intervals, and 5000 bootstrap samples were used. The independent variable was 'experimental condition'. The dependent variable was the change in anxiety (PSWQ) scores (i.e., differences score) from baseline to post intervention. The mediator variable was the change in avoidance (BEAQ) scores (i.e., differences score) from baseline to post intervention. A mediation was significant, if the confidence interval around the indirect effect based upon 5000 bootstrap samples would not include zero.

Results

Assumptions

Before conducting the analyses of the first hypothesis, the following assumptions were tested. For the conducted repeated measures ANOVA, a Levene's test of equality of variances for anxiety difference scores (PSWQ) indicated no violation of homogeneity ($F(1, 67) = .02, p = .89$). Box's test of equality of covariance matrices indicated that observed covariance matrices of the dependent variable are equal across groups ($F(3, 2054150.14) = 1.49, p = .216$). Shapiro-Wilk test indicated no violation of the normality assumption. Due to baseline mean anxiety differences between conditions, analysis of covariance was conducted. Accordingly, the following assumptions were tested. A visual inspection of Histograms (See Appendix D) and Normal QQ plots (See Appendix E) as well as Shapiro- Wilk tests for the control condition ($W(31) = .97, p = .508$ and mindfulness condition $W(38) = .97, p = .421$) suggested no violation of the normality assumption. Scatterplots indicated no violation of linearity (See Appendix F). No outliers were found via inspection of Boxplots (See Appendix G). Levene's test indicated no violation of homogeneity of variance $F(1, 67) = .02, p = .902$. A test of between subject effects suggested a violation of the homogeneity of regression slopes ($F(1) = 42.6, p < .001, \eta_p^2 = .56$). Owing to this violated assumption, results of the

ANCOVA were interpreted with caution and possible consequences emphasized in the discussion section.

Before conducting the analyses of the second hypothesis, the following assumptions were tested. For the conducted mediation analysis, visual inspection of a histogram and normal probability plot (See Appendix H) did not suggest a violation of normality. Further, visual inspection of a scatterplot did not suggest a violation of homoscedasticity (See Appendix I). Lastly, visual inspection of partial regression plots indicated no violation of the linearity assumption between difference scores in anxiety and the interaction effect of experimental condition and difference scores of anxiety (See Appendix J). The scatterplots for difference scores in avoidance and anxiety and for difference scores in anxiety and the experimental condition suggested that the linearity assumption might be violated (See Appendix K). This violation was likely due to the binary nature of the experimental condition variable and was considered in the interpretation of findings.

Hypothesis 1

The first hypothesis stated that after the intervention, the mindfulness condition will show a significantly larger decrease in anxiety levels than the control condition. Within the conducted repeated measures ANOVA, test of within subject contrasts indicated a significant main effect of time, anxiety levels decreased significantly from pre to post intervention in control and mindfulness condition $F(1) = 25.83, p < .001, \eta_p^2 = .278$ (Figure 1). Hereby, mean anxiety levels showed a marginally larger decrease in the mindfulness condition (Mean Difference = 6.6) compared to the control condition (Mean Difference = 4.1) from pre to post measurement (See Table 1). However, the anxiety reduction between conditions (i.e., time x group interaction) did not differ significantly ($F(1) = 1.42, p = .283, \eta_p^2 = .02$). A post hoc power analysis related to the interaction effect indicated power of .36 to detect a small effect size. Altogether, anxiety levels significantly decreased in both conditions from pre to post

intervention with no significant difference in anxiety reduction between conditions. Hence, no evidence was found for a significantly larger anxiety decreasing effect of the mindfulness intervention compared to the control intervention.

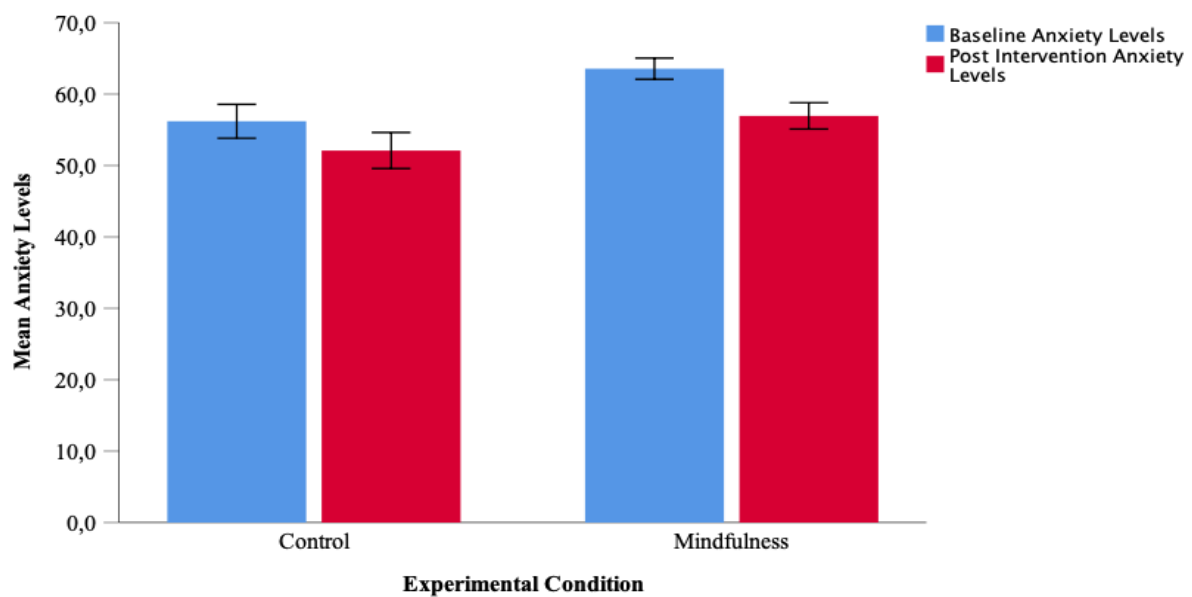
Despite random assignment to the conditions, there were significant baseline mean differences in anxiety levels between the control and mindfulness condition $F(1, 67) = 7.44, p = .008$. Given such condition, it is recommended to use analysis of covariance (ANCOVA) to correct for potential under or overestimation of the treatment effect (Overall & Doyle, 1994; Vickers & Altman, 2001). Thus, an ANCOVA was conducted with experimental condition as independent variable, baseline anxiety measures (PSWQ) as covariate and post intervention anxiety measures (PSWQ) as dependent variable. The ANCOVA showed that when controlling for baseline anxiety differences, experimental condition did not significantly account for variance in the post intervention anxiety scores ($F(1) = .36, p = .546, \eta_p^2 = .01$). A post hoc power analysis related to the ANCOVA indicated power of .54 to detect a small effect size. Hence, no evidence was found that the mindfulness condition led to a significantly larger anxiety decrease than the control condition after the intervention. This remained after controlling for initial mean anxiety differences between conditions at baseline. Thus, we found no support for the first hypothesis.

Table 1*Descriptive Statistics*

	Experimental Condition	Mean	Std. Deviation	N
Anxiety baseline measurement	Control	56.2	13.2	31
	Mindfulness	63.6	9.1	38
	Total	60.2	11.7	69
Anxiety post intervention	Control	52.1	14.1	31
	Mindfulness	56.9	11.4	38
	Total	54.7	12.8	69

Figure 1

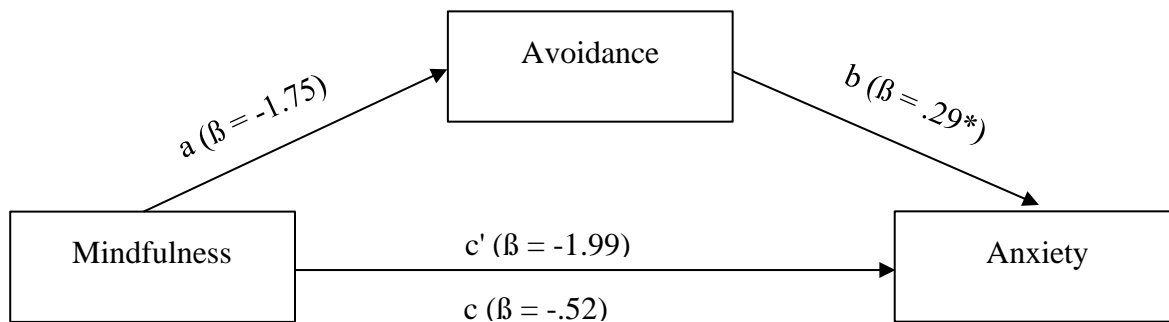
Mean anxiety levels for control and mindfulness condition at baseline and post intervention



Note. Bar graph with pre and post intervention mean anxiety levels for the control and mindfulness condition. The x-axis shows the experimental condition, the y-axis indicates mean anxiety levels. Error bars represent +/- 1 *SD*.

Hypothesis 2

The second hypothesis stated that the effect of mindfulness on anxiety is partially mediated by avoidance. Thus, it was hypothesized that mindfulness could have an indirect decreasing effect on anxiety levels through decreasing avoidance (See Figure 2). First, mediation analysis showed that the association of mindfulness and avoidance (path a) was not statistically significant ($\beta = -1.75$, $SE = 1.79$, $95\% CI = [-5.32, 1.81]$, $p = .330$). Thus, no evidence was found that mindfulness significantly predicted changes in avoidance from pre to post intervention. Secondly, mediation analysis showed that the association of avoidance and anxiety (path b) was statistically significant ($\beta = .30$, $SE = .14$, $95\% CI = [.02, .58]$, $p = .039$). Hence, changes in avoidance significantly predicted changes in anxiety scores from pre to post intervention with small effect size (Cohens $f^2 = .08$) (Cohen, 1988). The direct effect of mindfulness on anxiety when controlling for avoidance (path c') was not statistically significant ($\beta = -1.99$, $SE = 2.07$, $95\% CI = [-6.12, 2.14]$, $p = .340$). Thus, mindfulness did not significantly account for changes in anxiety from pre to post intervention when controlling for avoidance. Lastly, the indirect effect of mindfulness on anxiety through avoidance (path c) was not statistically significant as the confidence interval based on bootstrapping included zero ($\beta = -.52$, $BootSE = .72$, $BootCI = [-2.41, .46]$). Altogether, results of the mediation analysis did not support a mediation (See Figure 2). Hence, we found no support for the second hypothesis.

Figure 2*Mediation Model of Mindfulness, Avoidance and Anxiety*

Note. The mediation model illustrates how the effect of mindfulness (predictor) on anxiety (criterion) could be partially mediated by avoidance (mediator). Path a shows the association between mindfulness and avoidance; Path b shows the association between avoidance and anxiety; Path c shows the association between mindfulness and anxiety (total effect); Path c' shows the association between mindfulness and anxiety after controlling for avoidance (direct effect). Unstandardized coefficient Beta values are indicated and significant associations at $p < .05$ marked with *.

Discussion

The current study examined whether a mindfulness audiobook intervention leads to larger anxiety decreases than an audiobook control. Further, it was examined if avoidance mediates the effect of mindfulness on anxiety.

Hypothesis 1

It was first hypothesized that after the intervention, the mindfulness condition would show a significantly larger decrease in anxiety levels than the audiobook control condition. Current findings do not support the first hypothesis. In both conditions, anxiety levels decreased significantly from pre to post intervention. Anxiety decreases in the mindfulness condition were marginally larger compared to the control condition. However, the difference in anxiety decrease between conditions did not reach statistical significance. This

insignificance remained after controlling for initial baseline anxiety mean differences between conditions. Hence, current results do not show a significantly larger anxiety decreasing effect of the mindfulness intervention compared to the control audiobook intervention.

The fact that the mindfulness intervention and audiobook control show comparable effects on anxiety levels is not in line with previous research. A randomized controlled study by Strohmaier et al. (2021) examined the effects of two mindfulness interventions and one audiobook on anxiety. The sample included students and university staff ($n = 71$). Mindfulness interventions used a 20-minute and a 5-minute mediation recording of a qualified mindfulness teacher. Participants were instructed to return their awareness to the breath whenever becoming aware of mind wandering. The audiobook was an excerpt from a nonfictional book on the history of earth. Participants followed their meditation/audiobook in four sessions over two weeks. Results showed that both meditation interventions led to significant anxiety decreases whereas the audiobook control did not. Thus, differences in the characteristics of the audiobooks might have contributed to the different findings.

In contrast to the study by Strohmaier et al. (2021), audiobooks in the current study led to a significant anxiety decrease from pre to post intervention. Compared to the audiobook used by Strohmaier et al. (2021) the audiobook of the current study was fictional. Furthermore, participants were explicitly instructed to allow themselves to get absorbed into the story. It is not evident what instructions the participants received in the study of Strohmaier et al. (2021). Evidence shows that individuals who get more absorbed in an audiobook and show greater appreciation of its content demonstrate greater subsequent wellbeing and meaning in life (Poerio & Totterdell, 2020). Increases in well being and meaning in life have been shown to predict reduced anxiety (Fava et al., 2005; Korkmaz & Güloğlu, 2021). Thus, the audiobooks in the current study might have reduced anxiety through an increase in well being/meaning in life. It is also possible that the audiobooks led to

increased relaxation in the participants, which has been linked to anxiety decreases (Larson et al., 2010; Platania-Solazzo et al., 1992; Smith, 2008). Future research should further investigate how and via which mechanisms different types of audiobooks influence anxiety levels. Altogether current evidence suggests that different content and specific instructions might influence anxiety decreasing effects of audiobooks which might have caused the significant anxiety decrease in the audiobook condition of the current study. Nevertheless, the fact that the mindfulness intervention did not show a significantly larger effect size in decreasing anxiety than the audiobooks might have also been due to the mindfulness interventions methodology.

The Effect of Mindfulness Interventions on Anxiety

The current study used a meditation audiobook and participants in the mindfulness condition showed significant anxiety decreases after the intervention. Before applying the intervention, the mindfulness condition indicated mean anxiety scores above the cut off score 62 indicative for GAD (Behar et al., 2003). After the intervention, mean anxiety scores fell below the GAD cut off score (See Table 1). Thus, it is possible that the mindfulness intervention led to significant anxiety decreases in terms of GAD. This assumption would be in line with previous research which showed that a meditation audiotapes significantly reduced GAD levels in students (Haukaas et al., 2018). However, compared to the current study which used the PSWQ to assess anxiety, Haukaas et al. (2018) assessed anxiety with the GAD-7. Further, in the study by Haukaas et al. (2018) mean anxiety levels before the intervention were below the GAD cut off score. Though, despite different assessments of anxiety in both studies, it seems that meditation tapes can significantly lower anxiety (i.e., GAD) in student populations. However, the clinical utility indicated by findings of the current study should be interpreted with caution and verified by future research due to several aspects. First, the anxiety decreasing effect of the mindfulness intervention was not significantly larger

than the one of the audiobook control condition. Hence, it is also possible that no intervention exerted an anxiety decreasing effect but rather time was the anxiety decreasing factor. There is evidence that anxiety can, without intervention, decrease over time (Gullone et. al., 2001). Future research comparing mindfulness interventions and audiobooks should use manipulation checks to test if interventions affect trait mindfulness for mindfulness interventions and meaning in life/relaxation for audiobooks. Lastly, the clinical significance of the mindfulness intervention's anxiety decrease might have been due to the baseline anxiety mean differences between the two conditions. Whereas the mindfulness condition showed mean anxiety levels above the threshold for GAD before the intervention the audiobook condition showed mean anxiety levels below the threshold. Therefore, future research should test the effect of mindfulness interventions on anxiety (i.e., GAD) in a randomized sample without baseline mean anxiety differences.

Hypothesis 2

The second hypothesis stated that the effect of mindfulness on anxiety is partially mediated by avoidance. Our findings do not provide evidence for the second hypothesis. Within the proposed mediation model (See Figure 2) only avoidance significantly predicted anxiety with small effect size. This finding is in line with previous research in which avoidance predicted anxiety levels (Eustis et al., 2020; Kashdan et al., 2014). In the current study, changes in avoidance accounted for 7% of variance in anxiety scores from pre to post intervention. However, there was no indirect effect of mindfulness affecting anxiety levels via avoidance. Thus, we found no support for the idea that mindfulness decreases avoidance, thereby attenuating anxiety levels. Different factors might have accounted for mindfulness not affecting avoidance in the current study.

Mindfulness interventions and Avoidance

Other research in which MBIs significantly decreased avoidance (e.g., R othlin et al., 2020) used differently structured mindfulness interventions than the current study. In the study by R othlin et al. (2020), the mindfulness condition consisted of four 90-minute workshops (for a comprehensive overview see R othlin & Birrer, 2020) over the course of four weeks. All workshops were guided by a person experienced in applied sports psychology. The workshops were not purely mindfulness focused but further included aspects of Acceptance and Commitment Therapy (ACT; Hayes et al., 2012) with the aim to increase psychological flexibility. Psychological flexibility in the context of ACT constitutes the ability to act in line with personal values despite distressing thoughts, emotions, or sensations. In ACT psychological flexibility is, among others, encouraged via three working mechanisms namely a present moment focus, defusion and acceptance. Each of the first three workshops focused on stimulating one of these working mechanisms using theory and practice (R othlin et al., 2020). Every workshop ended with a meditation. The fourth workshop was used for repetition of everything previously learned. After the intervention, participants in the mindfulness condition showed significant reductions in avoidance as measured by the Acceptance and Action Questionnaire (AAQ; Bond et al., 2011).

Structural differences between the study by R othlin et al. (2020) and the current study are apparent. First, the mindfulness intervention by R othlin et al. (2020) combined theory, practice, and repetition. Hence, a multimodal approach might exert larger effects than solely practice (e.g., such as solely the meditation tape in the current study) in decreasing avoidance. Supporting evidence comes from another study in which a more complex mindfulness intervention led to larger increases in psychological flexibility than a more simplistic mindfulness intervention (Hindman et al., 2015).

Furthermore, the inclusion of ACT aspects in the mindfulness practice by R othlin et al. (2020) with the explicit focus to decrease avoidance by encouraging a present moment

focus, defusion, and acceptance might have also contributed to the significant avoidance decrease. However, in the study by Röthlin et al. (2020) the mediating role of these working mechanisms in the relation of mindfulness practice and avoidance levels was not assessed. Hence, to allow causal inference, future research should test within a mediational design if the working mechanism of present moment focus, defusion, and acceptance also mediate the relation of mindfulness practice and avoidance. Also, it remains to be investigated if a present moment focus, defusion, and acceptance are working mechanisms unique to mindfulness, ACT, or both. As the sample in the study by Röthlin et al. (2020) solely comprised athletes, findings should be replicated with a more heterogeneous sample to test if findings are generalizable to a broader population.

Altogether it seems that mindfulness interventions combining theory and practice focusing on ACT related working mechanisms of a present moment focus, defusion, and acceptance are more likely to affect and decrease avoidance. The fact that the mindfulness intervention used in the current study did comprise mindfulness practice without additional theory or an explicit focus on specific working mechanisms might explain why it did not significantly affect avoidance.

Strengths and Limitations

The current study is characterized by different strengths and limitations. First, the study design allowed to make causal inferences and thus, to investigate if effects of mindfulness on anxiety are mediated by avoidance. To our knowledge, it was the first study that investigated this relation within a mediational design. Moreover, it was to our knowledge the first study that proposed avoidance as working mechanism of mindfulness in the treatment of anxiety. Thus, findings are valuable as they can contribute to the optimization of MBIs in the treatment of anxiety.

The statistical analysis was compromised by several limitations. First, due to the COVID-19 pandemic recruitment of participants was hindered which resulted in a smaller sample size than intended. Consequently, statistical power throughout the analysis was rather low and the probability of Type I errors inflated. Therefore, implications that avoidance significantly affected anxiety within the proposed mediation model should be interpreted with caution. Ideally, this relation should be tested again with sufficient power.

Furthermore, in the ANCOVA run to test the first hypothesis, homogeneity of regression slopes was violated. If regression slopes are heterogeneous within ANCOVA, Type I error rates can exceed the prespecified level (Hollingsworth, 1980). However, the null hypothesis in the current study, namely, the mindfulness condition does not lead to significantly larger anxiety decreases compared to the audiobook, was not rejected. Hence, it appears that the violated assumption of homogeneity of regression slopes, did not bias the results.

Also, within the mediation analysis of the second hypothesis, scatterplots for difference scores in avoidance and anxiety and for difference scores in anxiety and the experimental condition suggested that the linearity assumption might be violated. Consequently, results of the mediation analysis might be biased and should therefore be interpreted with utmost caution.

Moreover, another limitation of the study was that before the intervention, mean anxiety levels significantly differed between both conditions. The small sample size and the nonrandom allocation to conditions might have accounted for that. Hence, this limitation might be avoided in future research using larger samples and appropriate randomization procedures.

Another limitation of the current research was that we did not establish a manipulation check to test if the mindfulness intervention significantly increased mindfulness.

Consequently, as anxiety levels after the intervention decreased significantly in both conditions, we can not exclude that this effect might have been due to a third variable. As previously discussed, time might have been such a factor that decreased anxiety. Furthermore, also the COVID-19 pandemic might have caused changes in anxiety levels. There is evidence that during the COVID-19 pandemic, anxiety levels fluctuate dynamically, depending on external circumstances and individual subjective well being (Wang et al., 2021). Hence, future research should establish manipulation checks to test if anxiety decreasing effects are due to the mindfulness intervention. Potential influence of the COVID-19 pandemic on anxiety levels should be considered.

Conclusion

To summarize, the present study investigated whether mindfulness decreases anxiety levels via decreasing avoidance. Results show that after the intervention, anxiety decreased significantly in the mindfulness and audiobook intervention with comparable effect size. Furthermore, the current study did not find evidence for the mediating role of avoidance in the relation of mindfulness and anxiety. Altogether, findings do not support the assumption that avoidance might be a working mechanism of mindfulness in the treatment of anxiety. However, considering limitations of the study, all findings should be interpreted with caution. Furthermore, future research with larger sample size and sufficient power should again investigate the mediating role of avoidance in the relation of mindfulness and anxiety. Temporal changes in working mechanisms such as a present moment focus, defusion, and acceptance should be assessed. Moreover, it should be further investigated which types of audiobooks significantly reduce anxiety levels considering clinical significance.

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Appendix A

Daily Mindfulness Intervention Audio Script

As best as you can, commit yourself to this practice audio following the instructions for the whole recording. This practice is helped if you can sit with an upright posture, with the head, neck, and back erect but not rigid, perhaps thinking of sitting with a sense of dignity. Once you have found an upright posture, take a moment to relax into it letting any tension leave from the shoulders, allowing your belly to soften, your face to relax. If you feel comfortable with it, allow your eyes to gently close. Otherwise allow your gaze to rest on a point somewhere in front of you. Just tune in to the feeling of your breath moving in and out of your body, focusing on the sensation of the breath when it passes the nostrils as it enters and leaves the body, whereas if the sensation of breathing is more vivid at the belly feel how the belly expands on each in-breath and relaxes gently with each out-breath.

Once you have found whether the sensations of breathing are stronger at the nostrils or the belly, bring your attention to feel each breath at that point. Noticing the sensations of breathing in, noticing the sensations of breathing out, letting our breath be natural, there is no need to try to control the breath, just allowing the breath to breath itself, just observing the breath as it naturally moves in and moves out. Of course, you will find that your mind will wander from time to time, often to thoughts, fantasies, anticipation of their future, worrying thoughts of the past, memories or whatever.

When you notice that your attention is no longer here, no longer on your breathing, without giving yourself a hard time just intentionally escort your attention back to your breath, fully conscious of the sensations of the in-breath and the out-breath moment to moment. Just give your full care and full attention to each in-breath and out-breath as they follow one to another in a never-ending cycle of inflow.

And as you are sitting here, allow your field of awareness to expand, bringing your attention to the sensations in your body, feeling the sensations of touch, of where your body makes contact with the chair and the floor including your buttock, your legs, and your feet. As you sit in a straight posture with your neck erect and your head balanced and dignified. And if you like expanding your awareness of your body as a whole noticing the experience of the physical sensations of the entire body. Allowing the experience of the body to be in the foreground with a sense of the breath in the background. Just feeling whatever is happening in the body, maybe you have a sense of tenseness in some parts of the body, or warmth or relaxation or tingling, sharp or dull sensations or perhaps a feeling of no sensations. Whatever it may be just noticing the body as you are experiencing it in this moment. Relaxing with whatever is happening right now allowing the sensations of your body to unfold and being with them. There are particularly intense sensations in the body. Bring your gentle and curious awareness to this experience, knowing what the sensation itself feels like, whether it is centered, whether it is spreading and where it spreads to, the quality of the sensations, whether its dull or sharp, warm, or cool, pleasant, or unpleasant or whatever. Just opening to and allowing these sensations to be whether they feel good or bad or somewhere in between, not having to do anything about them, accept to just observe them. Allowing your experience to unfold in each moment, creating space for all experience that occurs.

When you are ready let go of the awareness of the body so that we expand the awareness to include thinking, to include thoughts as they move through your mind. We focus our attention so that the objects of awareness are the thoughts that come and go in your mind. So, let your breathing and your body sensations be in the background. Allowing the thinking process itself to come to the central stage for the moment. Rather than following individual thoughts or getting involved in the content of thoughts or going from one thought to the next simply see each thought as it comes up in the mind as a thought, as an observable event. If it

is helpful, you can imagine your mind as a sky and thoughts as clouds that enter on the horizon, develop, and pass by, eventually fading out of awareness. Or perhaps imagining your mind as a river, and your thoughts floating in the river coming from upstream, observing them as they pass through your awareness and then pass by downstream.

Our thoughts of course can be about anything, the future, the past, our body, thoughts about thoughts, thoughts about feelings, food, sleep, thoughts about whether you like or don't like this practice, thoughts about time. Whatever they are just observing them as events in the field of your consciousness as they come into awareness, as they linger, and as they dissolve. Letting the thoughts just come and go as you sit and dwell in stillness, witnessing the thoughts, observing them. As best as you can noticing the thoughts that arise, develop, and pass away.

Now for the remaining time letting go of all objects of attention, your breathing, your body, your thoughts, and instead of focusing on anyone, allowing yourself to just sit here and be, fully aware in each moment and aware of whatever there is in this sphere of your being. If thoughts come observing thoughts, if sounds, observing sounds, if pain, observing pain and if it's the breath that is most predominant than being with your breathing from moment to moment. Just sitting in stillness looking for nothing and being sensitive and present with it all, just as it is, just as it unfolds. Just being aware of whatever it is that comes in your experience, noticing how it feels, just observing it and allowing it to pass.

Appendix B*Penn State Worry Questionnaire (PSWQ)*

Instruction: Please circle the answer that best describes the extent to which the statement is true for you.

		Does NOT describe me		Describes me PERFECTLY
1	If I don't have enough time to do everything, I don't worry about it	1	2 3 4	5
2	My worries overwhelm me.	1	2 3 4	5
3	I don't tend to worry about things.	1	2 3 4	5
4	Many situations make me worry.	1	2 3 4	5
5	I know I shouldn't worry about things, but I just can't help it.	1	2 3 4	5
6	When I'm under pressure, I worry a lot.	1	2 3 4	5
7	I'm always worrying about something.	1	2 3 4	5
8	I find it easy to dismiss worrying thoughts	1	2 3 4	5
9	As soon as I finish one task, I start to worry about everything else I have to do.	1	2 3 4	5
10	I never worry about anything.	1	2 3 4	5
11	When there is nothing more I can do about something, I don't worry about it anymore.	1	2 3 4	5
12	I've been a worrier all my life.	1	2 3 4	5
13	I notice that I've been worrying about things.	1	2 3 4	5
14	Once I start worrying I can't stop.	1	2 3 4	5
15	I worry all the time.	1	2 3 4	5
16	I worry about projects until they're finished.	1	2 3 4	5

Appendix C

Brief Experiential Avoidance Questionnaire

Please indicate the extent to which you agree or disagree with each of the following statements

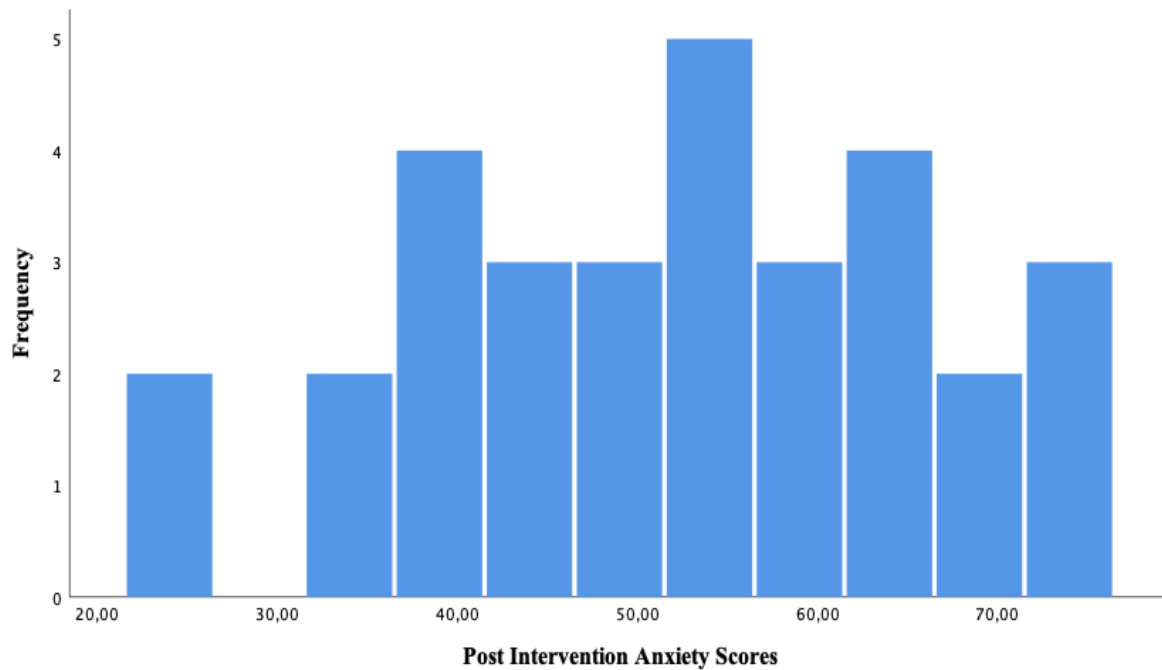
1-----2-----3-----4-----5-----6
 strongly moderately slightly slightly moderately strongly
 disagree disagree disagree agree agree agree

1	The key to a good life is never feeling any pain	1	2	3	4	5	6
2	I'm quick to leave any situation that makes me feel uneasy	1	2	3	4	5	6
3	When unpleasant memories come to me, I try to put them out of my mind	1	2	3	4	5	6
4	I feel disconnected from my emotions	1	2	3	4	5	6
5	I won't do something until I absolutely have to	1	2	3	4	5	6
6	Fear or anxiety won't stop me from doing something important	1	2	3	4	5	6
7	I would give up a lot not to feel bad	1	2	3	4	5	6
8	I rarely do something if there is a chance that it will upset me	1	2	3	4	5	6
9	It's hard for me to know what I'm feeling	1	2	3	4	5	6
10	I try to put off unpleasant tasks for as long as possible	1	2	3	4	5	6
11	I go out of my way to avoid uncomfortable situations	1	2	3	4	5	6
12	One of my big goals is to be free from painful emotions	1	2	3	4	5	6
13	I work hard to keep out upsetting feelings	1	2	3	4	5	6
14	If I have any doubts about doing something, I just won't do it	1	2	3	4	5	6
15	Pain always leads to suffering	1	2	3	4	5	6

Note. To score, first reverse key Item 6 (i.e., subtract the value from 7), then sum all items.

Appendix D**Figure 3**

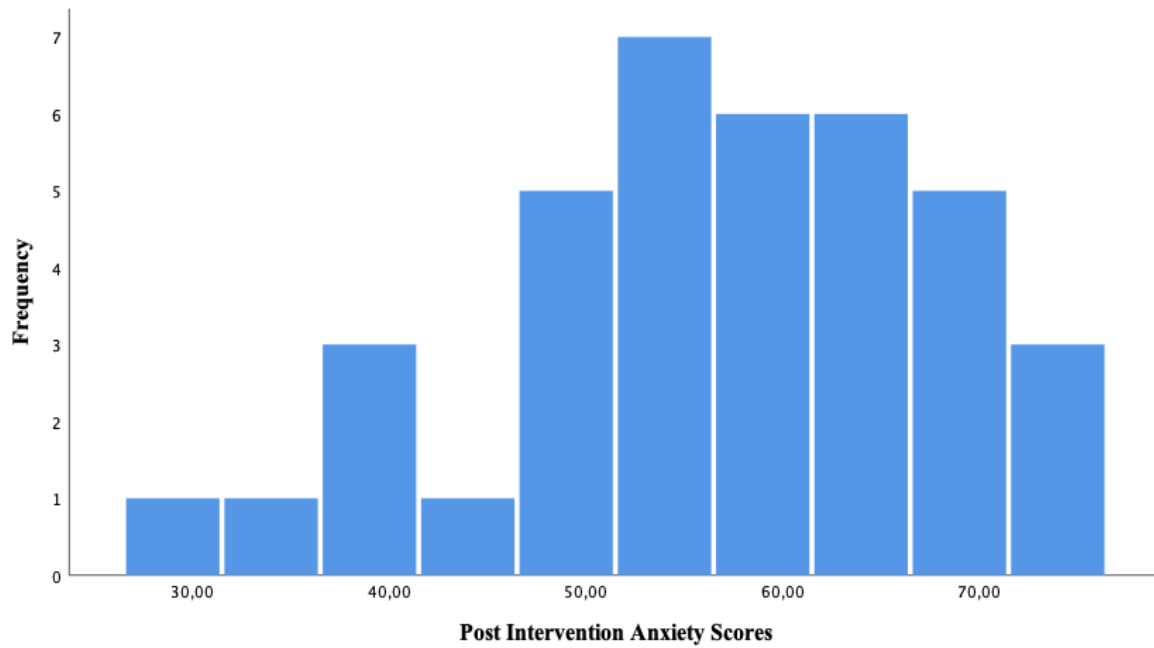
Normality assumption check: Histogram of control condition with frequency and post intervention anxiety scores



Note. Histogram with the frequency on the x-axis and the post intervention anxiety scores of the control condition on the y-axis.

Figure 4

Normality assumption check: Histogram of mindfulness condition with frequency and post intervention anxiety scores

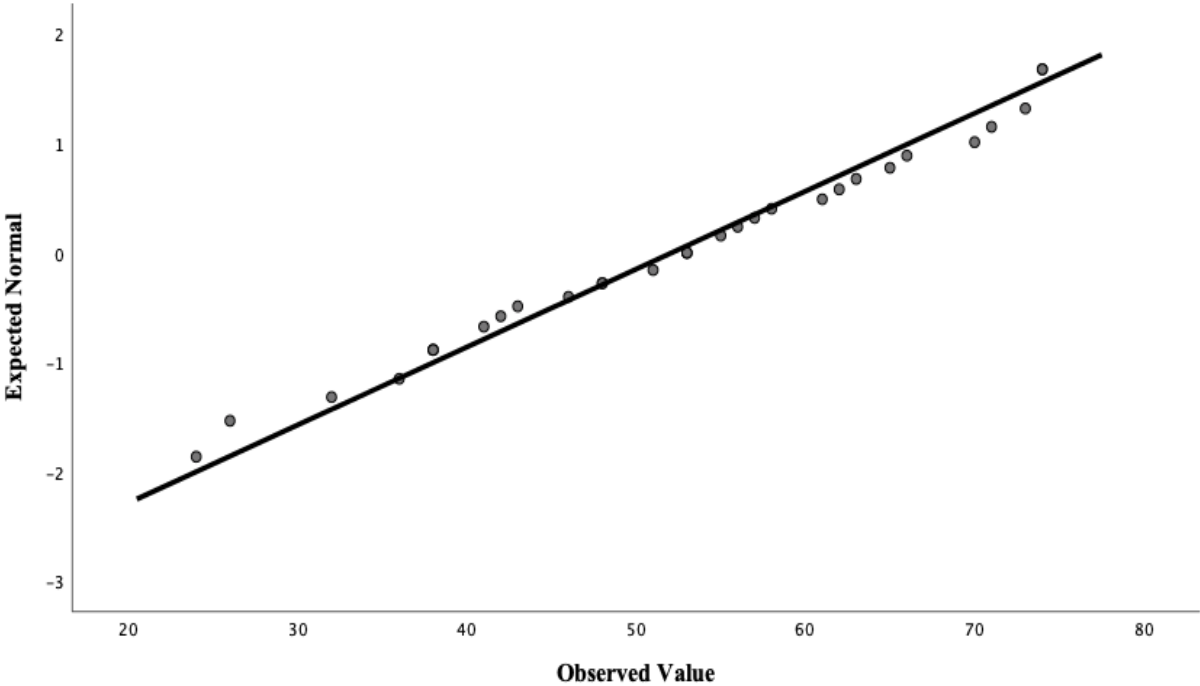


Note. Histogram with the frequency on the x-axis and the post intervention anxiety scores of the mindfulness condition on the y-axis.

Appendix E

Figure 5

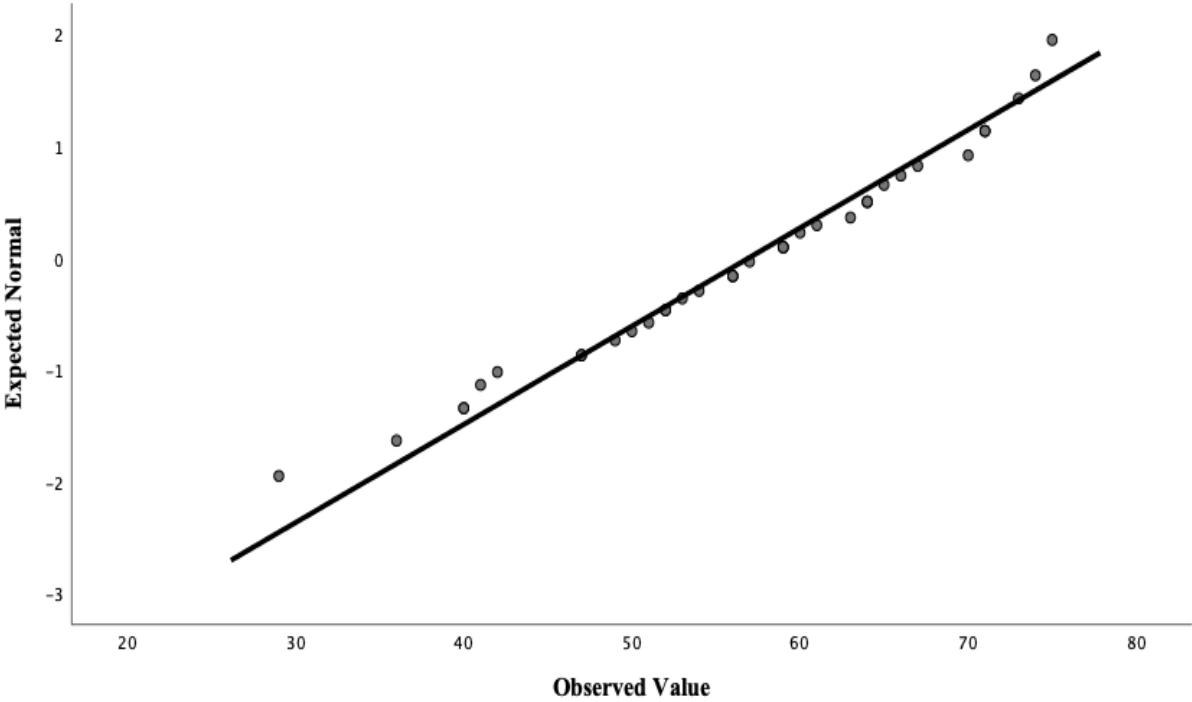
Normality assumption check: Normal QQ plot of control condition with expected normal and observed values of post intervention anxiety scores



Note. Normal QQ plot of the control condition with expected normal on the x-axis and observed values of post intervention anxiety scores on the y-axis.

Figure 6

Normality assumption check: Normal QQ plot of mindfulness condition with expected normal and observed values of post intervention anxiety scores

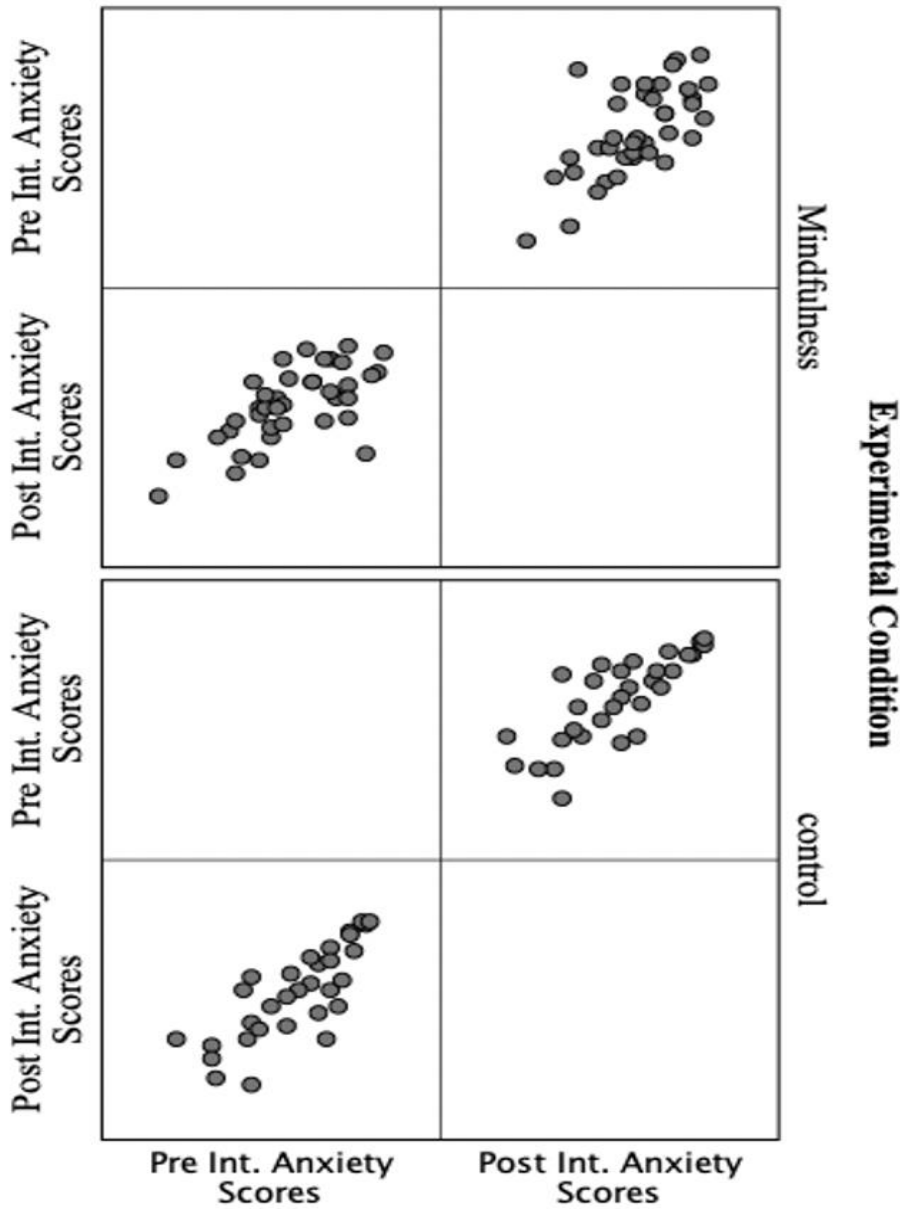


Note. Normal QQ plot of the mindfulness condition with expected normal on the x-axis and observed values of post intervention anxiety scores on the y-axis.

Appendix F

Figure 7

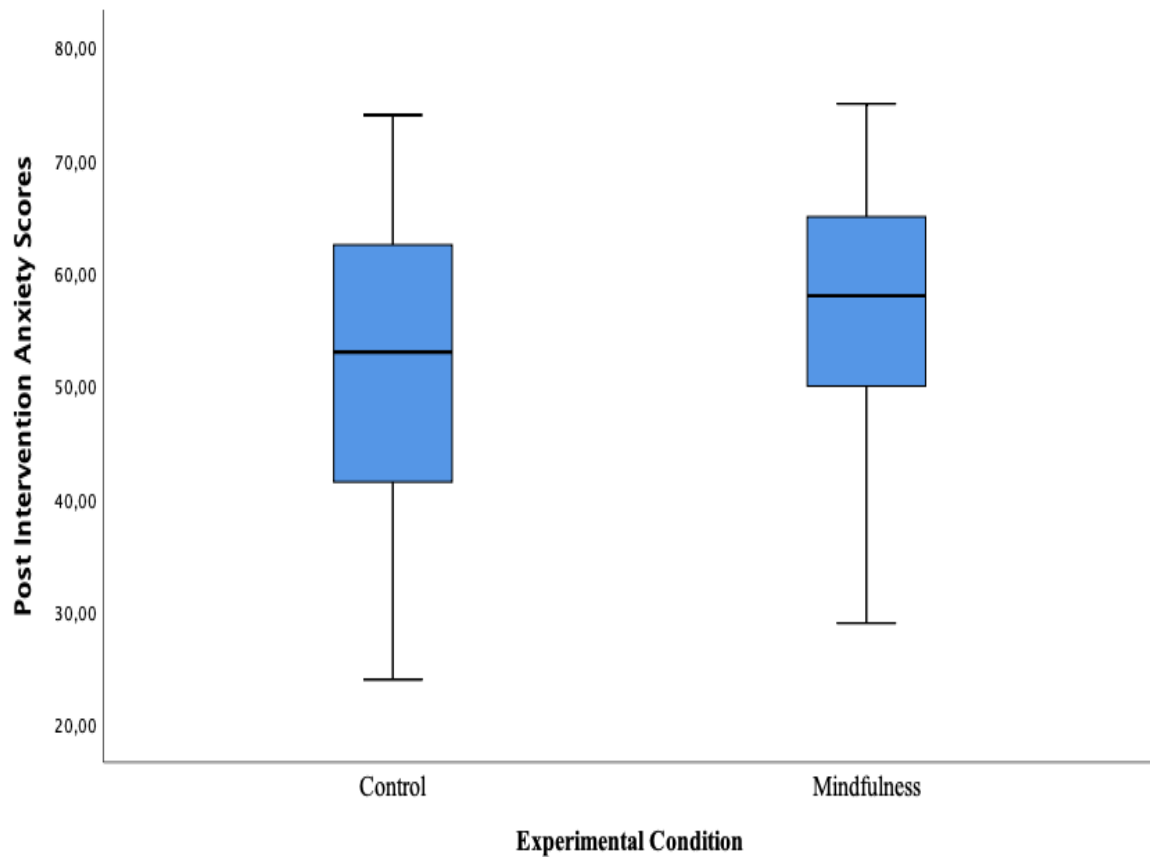
Linearity assumption check: Scatterplots of the control and mindfulness condition with pre and post intervention anxiety scores



Note. The left side of the scatterplot is interpreted with the mindfulness condition in the upper half and control condition in the lower half. On the x-axis pre intervention anxiety scores are indicated, on the y-axis post intervention anxiety scores.

Appendix G**Figure 8**

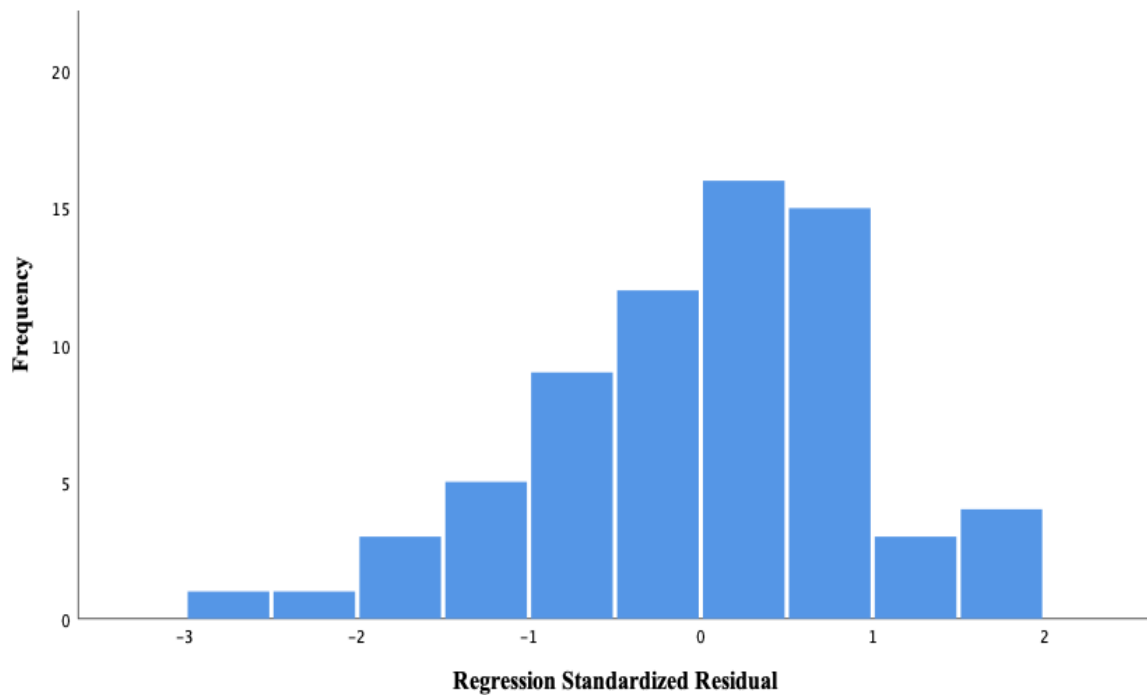
Check for outliers: Boxplots of the control and mindfulness condition considering post intervention anxiety scores



Note. Boxplots for the control and mindfulness condition with the experimental condition on the x-axis and post intervention anxiety scores on the y-axis. The boxplots indicate no outliers.

Appendix H**Figure 9**

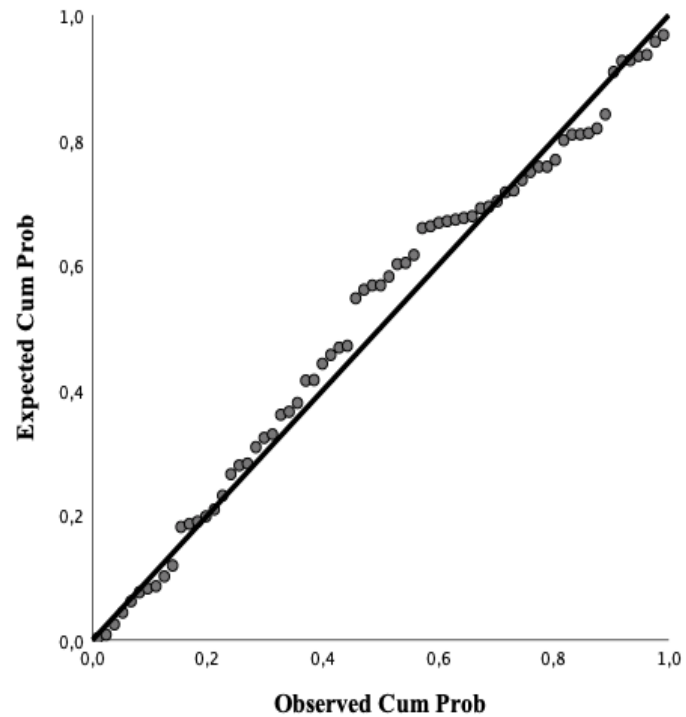
Normality assumption check: Histogram related to the mediation analysis of the frequency and standardized residuals



Note. Histogram related to the mediation analysis with frequencies displayed on the x-axis and standardized residuals on the y-axis.

Figure 10

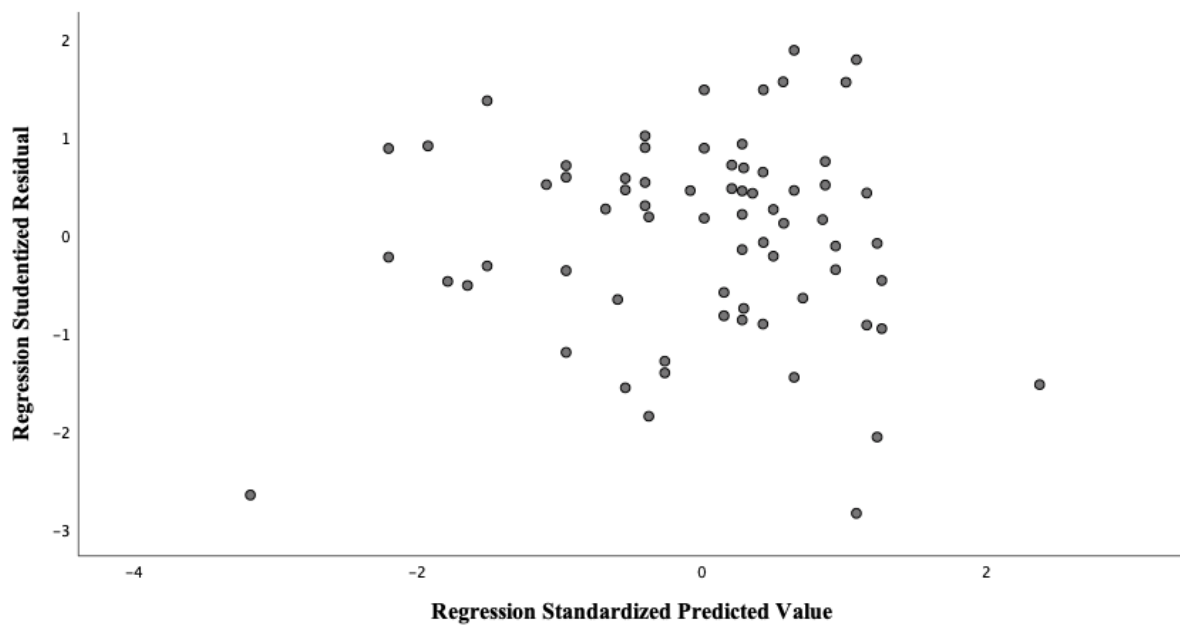
Normality assumption check: Normal probability plot with standardized residuals related to the mediation analysis considering expected cumulative probabilities and observed cumulative probabilities



Note. Normal probability plot with standardized residuals of the mediation analysis. Expected cumulative probabilities are displayed in the x-axis and observed cumulative probabilities are displayed on the y-axis.

Appendix I**Figure 11**

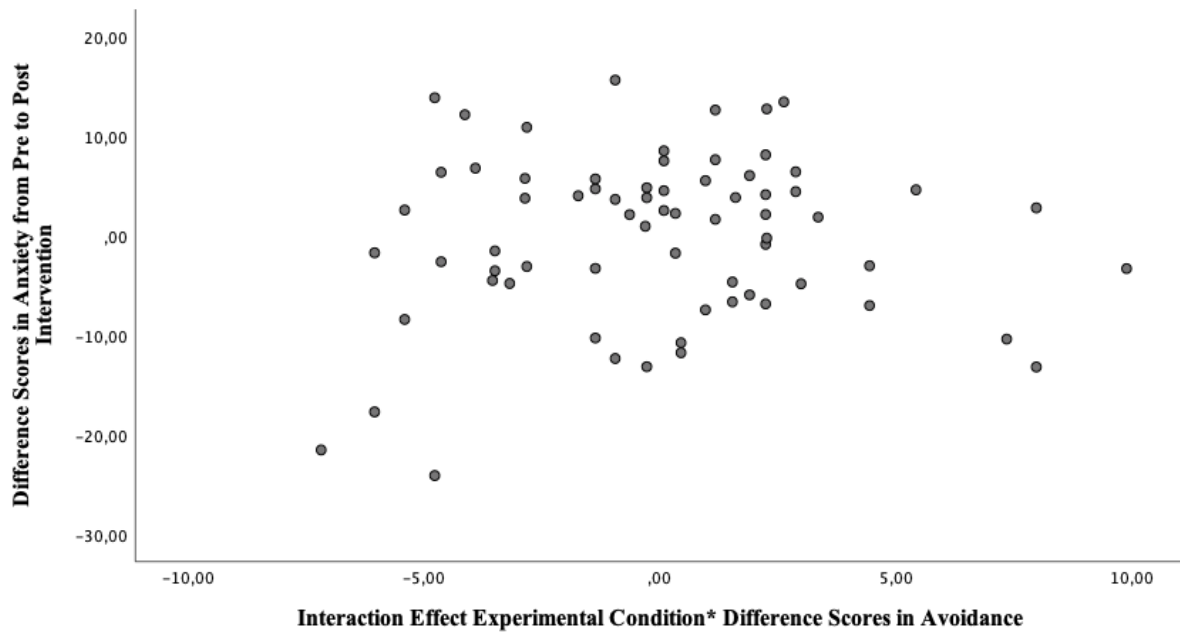
Homoscedasticity assumption check: Scatterplot related to the mediation considering standardized predicted values and studentized residuals



Note. Scatterplot related to the mediation analysis displaying studentized residuals on the x-axis and standardized predicted values on the y-axis.

Appendix J**Figure 12**

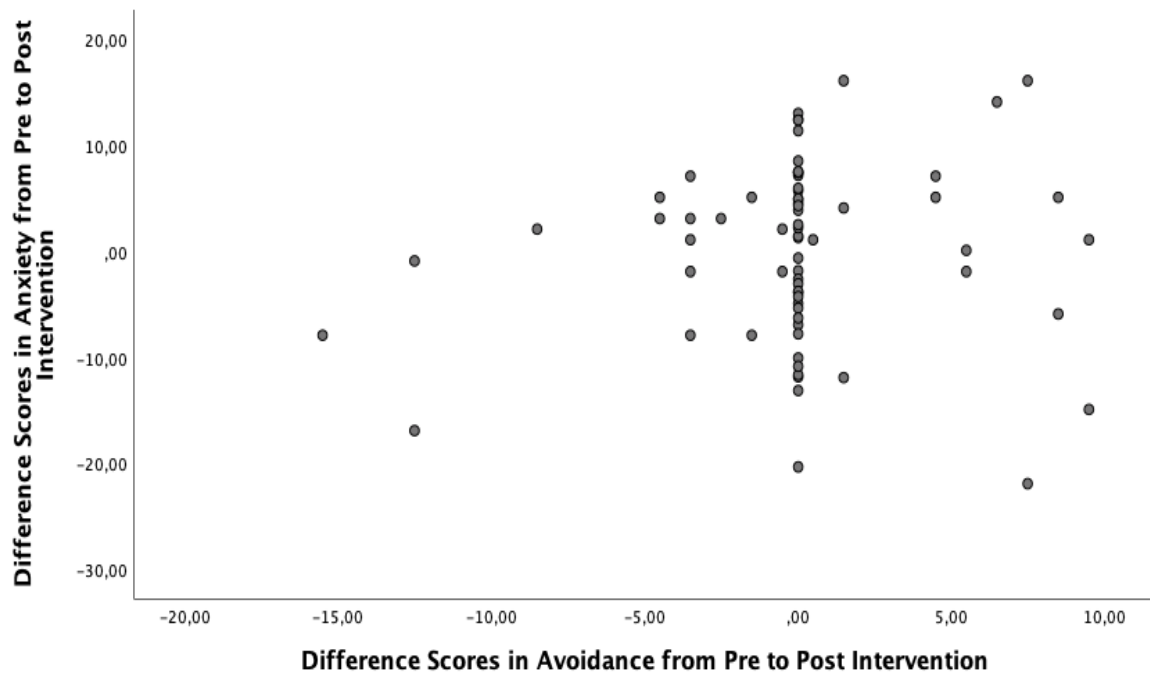
Linearity assumption check: Partial regression plot considering difference scores in anxiety and the interaction effect experimental condition x difference scores avoidance



Note. Scatterplot displaying the difference scores of anxiety from pre to post intervention on the x-axis and the interaction effect experimental condition x difference scores in avoidance on the y-axis.

Appendix K**Figure 13**

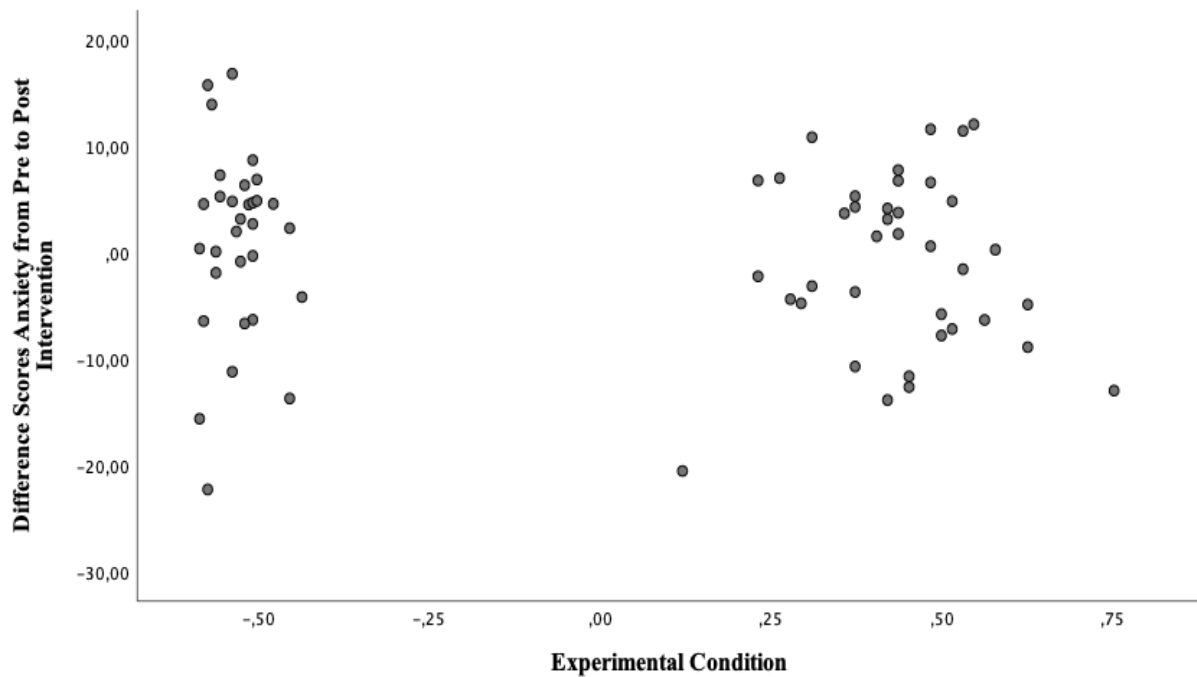
Linearity assumption check: Partial regression plot related to the mediation analysis considering difference scores in anxiety and difference scores in avoidance



Note. Partial regression plot displaying the difference scores in anxiety on the x-axis and difference scores of avoidance on the x-axis. The clustering at point 0 on the y-axis might suggest a violation of the linearity assumption.

Figure 14

Linearity assumption check: Partial regression plot related to the mediation analysis considering the difference scores in anxiety and experimental condition



Note. Partial regression plot displaying difference scores in anxiety on the x-axis and experimental condition on the y-axis. The clustering of data points in two groups might suggest a violation of linearity.