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Memory, mindfulness, and perfectionism: Is there a relationship between memory and perfectionism, and can mindfulness reduce false alarms?

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Is there a relationship between memory and perfectionism, and can mindfulness reduce false alarms?

by

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APPROVAL FOR SUCCESSFUL DEFENSE

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Introduction

Memory is a topic of interest that has been written about by ancient philosophers and is still of interest to current research scientists. An approach to studying memory in an experimental manner was developed in the late 1800s and the same process is used to this day. In most memory experiments participants study something, like words or pictures, in a controlled setting, and then their memory of the studied information is tested (Roediger et al., 2017). Memory experiments operate in three phases: encoding, storage, and retrieval. Encoding is the study phase where participants will be shown material that will be tested later. Storage is a phase which allows time to pass for retention of the information, and this phase may also include questionnaires or distractor tasks. Retrieval is the test phase, and this is where participants' responses will be measured for correct memory and memory errors. (Roediger et al., 2017)

There are many areas of interest within the topic of memory. Some areas of interest include memory across age, eyewitness memory, and understanding the functions of working memory and long-term memory (Wixted, 2017). Memory is not perfect, and this fact is supported by the interest in studying memory errors. Performance on memory tasks will depend on the material studied, the instructions, and the particulars of the memory test. There are a few ideas and theories about what may improve memory and reduce memory errors. Some studies have investigated processes that could reduce memory errors, such as repeating the material or using pictures or other association cues (Lloyd, 2007, Roediger et al., 2017). This type of research has increased the understanding of the conditions that cause memory errors.

In an experiment using a list of words as the stimuli the experimenter will measure response accuracy to *targets*, words that were studied in the encoding phase. Targets that were not correctly identified in the test phase are called *misses*, and *lure* words that were not studied

but identified as familiar words in the test phase are called *false alarms*. The results are a proportion of the responses called hit rates, miss rates, false alarm rates, and correct rejection rates. *Hit rates* are targets that are correctly identified as familiar or "old", and *miss rates* are targets that are incorrectly identified as unfamiliar or "new". *False alarm rates* are lures that were incorrectly identified as "old", and *correct rejection rates* are lures that were correctly identified as "new" (Rotello, 2017).

Mindfulness and Memory

Yoga is more than the common poses, called asanas, that come to mind in Westernized culture. Yoga is a word that describes the practice of meditation and mindfulness, as well as the physical movement through asanas. These terms, yoga, meditation, and mindfulness, are often thought of as separate, and this can be seen in media and scientific research. As explained in the Yoga Sutras of Patanjali, yoga is the stilling of the mind (Carrera, 2006, pp 9-22). In this definition, the word yoga comprises the physical aspect of yoga (asanas) and the mental aspects of mindfulness and meditation. However, in recent research that has been an abundance of definitions of mindfulness which creates ambiguity in interpreting empirical results (Van Dam et al., 2018). There has been a clear increase in research using the terms *mindfulness* or *meditation* in the keywords, title, or abstract (Van Dam et al., 2018). Van Dam et al. (2018) performed a scholarly search for media and research journals published between 1970 and 2015 and found that there was a significant spike around the year 2005. The review article by Van Dam and colleagues (2018) brings to light some concerns about the recent "hype" in research on mindfulness and meditation, such as the issue of defining mindfulness and meditation and this leading to multiple ways of operationalizing in experiments. Research using a meditation or mindfulness intervention has been seen in studies on memory as well as stress. Understanding

the use of mindfulness training and its effects on memory and stress is important for clinical use, as well as institutional use for creating mindfulness training programs intended to encourage the development of stress and coping skills. For the purposes of the current study, mindfulness will be associated with the definition above, as a stilling of the mind, and a mindfulness practice will focus on a body scan which will aim to help the participant focus their thoughts inward and ignore external environmental distractions.

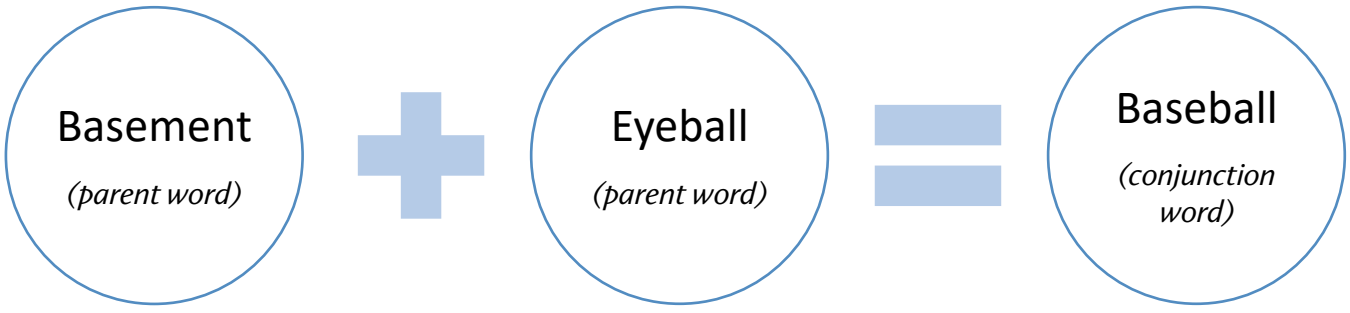
Research on mindfulness practice, meditation, and yoga has demonstrated improvements in working memory in populations of neurotypical participants (that is, patients without a diagnosis of a neuropsychological disorder). For example, mindfulness has been observed to increase performance on a working memory task in experiments using the n-back task, a working memory task in which one must recall a stimulus presented n repetitions prior (Zeidan et al. 2010; Wang et al., 2020). Immink (2016) performed a study evaluating the effect of meditation on memory consolidation using a motor memory key pressing task and found that the meditation condition group had shorter reaction times compared to the control group. Some common forms of mindfulness meditation include focused breathing, body scan, and mantra repetition. Focused breathing is a type of mindfulness exercise that asks participants to focus on their breathing and increase their awareness of the present moment (Eisenbeck et al., 2018). Eisenbeck et al (2018) found that compared to a control group, a focused breathing group was able to achieve higher recall scores on a story recall task, but were not able to find significant differences between the control and focused breathing groups on attention related tasks.

Memory has been shown to have a relationship with mindfulness practice, but the results are mixed and uncertain. Mindfulness practice has been examined in relation to memory and has been found to improve recall or recognition in some studies, and in other studies it has increased

false memory on recall or recognition tasks. Some researchers have found that mindfulness training led to an increase in false memory susceptibility (Rosenstreich, 2016; Wilson et al., 2015), but other research has replicated the Wilson et al. (2015) study and did not find the same results (Baranski & Was, 2017). These aforementioned studies used the DRM paradigm, a paradigm which creates a memory illusion by selecting words that are highly related to a target lure word that is not part of the to-be-studied word set, but when the testing phase includes the target lure participants often falsely recall it as part of the study phase. It is possible that a different method of studying memory could produce results that can be used to further understand the relationship between mindfulness and memory. Utilizing an alternative method would allow for further understanding of the relationship between memory and mindfulness from a fresh frame of reference. One possible concept that can be used as opposed to DRM is conjunction errors. Conjunction errors occur when two segments of a word like "basement" and "eyeball" are combined to form "baseball", as shown in Figure 1. In a study phase participants may study "basement" and "eyeball" and then be tested on the word "baseball" and falsely determine that it was a studied word. Lloyd (2013) was able to show that pictures associated with the words presented in the study phase were able to reduce the conjunction errors made in the test phase by decreasing the familiarity with the conjunction word. Further application of this

Figure 1

Example of the formation of a conjunction word from two parent words



finding could be extended to using a mindfulness practice and measuring conjunction errors during testing to see if the same familiarity effect is found. It is possible that a mindfulness condition can be used as an alternative approach to studying false memory improvement with a conjunction error task, similar to previous research by Wilson et al. (2015), Rosenstreich (2016), and Baranski and Was (2017) which was performed using the DRM paradigm. One way that participants can correctly dismiss a conjunction error is by a process called recall-to-reject (Gallo et al, 2006). Recall-to-reject is a type of disqualifying monitoring which occurs when a participant decides that a target has not been studied because they specifically remember a different target that conflicts with the presented one. In the previous example, if the participant is asked if "baseball" is a familiar word, they could decide that it is not because they specifically remember seeing one or both words "eyeball" and "basement". Recall-to-reject helps working memory processes this way, but it has also been shown that worry is a significant negative predictor of working memory performance (Crowe et al, 2007). Crowe et al. (2007) proposed that thought suppression may improve working memory performance because of the ability to ignore thoughts or concerns that were irrelevant to the task. A form of thought suppression is meditation and mindfulness. As discussed previously, mindfulness practice can help lessen the distraction from the external environment by focusing our thoughts positively inward.

In addition to work on the role of mindfulness in memory performance, other work has looked at broader effects on cognitive processing. Though much of the work is done in long-term, repeated sessions, there are some that have been successful in using short-term interventions. In one long-term intervention, Lemay et al., (2019) found significant decreases in reported stress and anxiety in college students who were given a once a week 60-minute yoga and mindfulness meditation practice in the 6 weeks leading up to finals. Prätzlich et al. (2016)

examined the use of expectation of mindfulness in their study which utilized a 20-minute mindfulness session for three consecutive days. Participants were told the mindfulness would have either a positive or negative outcome on performance and found that positive expectation led to improvement on Stroop and verbal fluency, while negative expectation had the opposite effect. Although 20-minutes is a relatively short time compared with the literature on long-term intervention experiments, the study used more than one session to implement the mindfulness practice. Lloyd et al. (2016) was able to show positive memory effects on an animacy word recognition task after a onetime mindfulness induction of 3-minutes. The finding by Lloyd et al. (2016) is important to the present study for its successful use of a one-time, short-term mindfulness practice. A similar approach will be used in the presented methods.

The current literature on mindfulness research suggests that there are some positive effects of a mindfulness practice on cognitive functioning. Yet, with replication issues, and inconsistent findings seen with the DRM paradigm (Wilson et al., 201; Rosenstreich, 2016; and Baranski and Was, 2017), as well as alternative methods such as the Stroop task (Prätzlich et al., 2016), animacy effect tasks (Lloyd et al., 2016), and in long-term treatments with goals to reduce stress and anxiety (Lemay et al., 2019), the extent to which mindfulness plays a role in memory performance and stress regulation is still unclear. There have been issues making inferences from the results of mindfulness research due to replication errors and the use multiple definitions of mindfulness (Van Dam et al., 2018). Definitions of mindfulness are varied in the literature, and each definition influences the use of mindfulness for that study. This causes an issue in being able to determine the reciprocity of one result in comparison to another. Van Dam et al. (2018) encourage the use of a systematic approach to studying mindfulness to create a cohesive understanding of methodology and interpretation and implication of the results found.

Perfectionism

Perfectionism is a personality trait defined by one's goals to be "flawless". People with perfectionistic traits will often set high standards for themselves and find themselves preoccupied with concern over performance (Stoeber & Otto, 2006). Early research focused on a one-dimensional view of perfectionism and was centered on negative characteristics and effects (Stoeber & Otto, 2006). Recent research uses a two-dimensional view of perfectionism, which was first suggested by Hamachek (1978) and has since been confirmed by continued research. The two dimensions can be concentrated to two main aspects of perfectionism, perfectionistic striving and perfectionistic concerns. Perfectionistic striving is associated with positive affect and outcomes, and perfectionistic concern is associated with negative affect and outcomes (Stoeber & Otto, 2006, Hill et al., 2010). Much of the recent research on perfectionism has focused on the differences between those with perfectionistic striving tendencies and those with perfectionistic concern tendencies. Research has shown that perfectionistic strivings is positive and adaptive and positively associated with psychological well-being, while perfectionistic concerns can be maladaptive and negatively associated with psychological well-being (Park & Jeong, 2015).

Stoeber, Chesterman, and Tarn (2010) found that participants who were high in perfectionistic striving were positively associated with higher task performance and time on a task. Their results indicate that people who rate high in perfectionistic striving take longer on a task due to their goal of achieving high performance. This finding leads to further inquiries regarding perfectionism and the relationship it has with cognition. For instance, what might happen if those who rate high in perfectionistic strivings were in a time restricted task? Would their performance on the tasks reflect the same results?

Another relationship worth investigating is that between memory and perfectionism. The research currently available on perfectionism is interested in the relationship between mood and well-being, and exam and scholastic success. Little research has explored the relationship that perfectionism has with memory. There has been one study by Besser et al. (2008) that investigated cognitive biases to mood and the relationship it has in memory for perfectionists. They found that when participants who had a higher level of perfectionistic thoughts, measured by the Perfectionism Cognitions Inventory, and placed into a negative mood induction condition, that they had higher recognition for negative words than participants placed in the neutral condition (Besser et al., 2008). Considering that perfectionism has been shown to have positive and adaptive effects on task performance for people who are categorized as a perfectionistic striving type (Stoeber et al., 2010), the relationship between memory and perfectionism has hardly been explored. Also, because the relationship between perfectionism and mood has been shown to be such that participants who rated high in perfectionistic strivings were more likely to report positive mood and affect, and participants who rated high in perfectionistic concerns were more likely to report negative mood and affect (Hill et al., 2010), it is worth investigating how a mindfulness induction may affect performance on a memory task.

The relationship between mindfulness and perfectionism has been explored in research, but not extensively. Beck et al. (2017) studied the effects of a 20-minute weekly mindfulness practice on measures of attention, perceived and biological stress, self-compassion, and perfectionism. Their findings showed that their mindfulness practice was able to decrease perceived and biological stress in addition to maladaptive perfectionism. Specifically, the researchers saw an increase in maladaptive perfectionism in the control group and a decrease in maladaptive perfectionism for the participants that engaged in the mindfulness condition. Argus

and Thompson (2008) conducted a study on social problem solving, perfectionism, and mindful awareness in a population of people diagnosed with clinical depression. The researchers used a mediation model analysis which described maladaptive perfectionism as being associated with a decrease in mindful awareness and that this relationship is associated with an increase in depressive symptoms. These results imply that those who rate high in maladaptive perfectionism, or perfectionistic concern, also have less mindful awareness. Due to the positive relationship between perfectionistic striving and task performance, it might be possible that a mindfulness practice could improve memory task performance for those who have high perfectionistic concerns.

In a conjunction error task, a recall-to-reject strategy can be used to decrease memory errors by aiding working memory in recalling targets that were truly seen. As shown in Crowe et al (2007), worry can be a negative predictor of working memory performance. The authors defined worry as including a component of preoccupation with performance and comparing performance to others. This overlaps with the defining characteristics of perfectionistic concerns. Perfectionistic concern is defined by concern over mistakes and a discrepancy between expectations for performance and actual performance (Stoeber and Otto, 2006). When doing a conjunction error task, performance needs to be the focus, and if a participant is worried about their performance rather than focusing on the task, then they may make more memory errors than someone who is not concerned with their performance and is instead focusing their attention on the task. However, if mindfulness can reduce how much concern is being experienced, then that should also reduce conjunction errors.

The dependent variables being examined in the present study are memory performance on a conjunction word task and perfectionism level for striving and concerns. The independent

variable in this study will be the random assignment to either the control group or the mindfulness practice condition. I hypothesize that a short-term mindfulness practice will decrease false alarms on a conjunction word task because of the use of a recall-to-reject strategy and more focused attention on the task rather than worry over performance. Also, I hypothesize that perfectionistic concerns will be positively associated with higher false alarm rates while perfectionistic striving will be associated with lower false alarm rates because of the associations with perfectionistic concerns being maladaptive and related to worry over performance. If mindfulness can lessen perfectionistic concerns, then it might be the case that people who rate themselves as being high in perfectionistic concerns will have decreased conjunction error rates.

Current Study

The goal of the study is to clarify the mixed results on the effect of mindfulness on memory, as well as to evaluate memory task performance in relation to perfectionism and determine if mindfulness will affect task performance for perfectionists. Participants will be tested on a conjunction word task similar to that of Lloyd (2007) and will be randomly assigned to either the mindfulness condition or the control group. The mindfulness condition will listen to a 4-minute body awareness meditation via the University of Vermont's Center for Health and Wellbeing guided meditation exercise. The mindfulness meditation will occur prior to retrieval as in the Lloyd et al. (2016) study due to their finding that in an experiment with a recognition task, mindfulness was able to reduce false memory for words when practiced prior to retrieval and rather than prior to encoding.

The participants will also be evaluated for perfectionism using the Frost Multidimensional Perfectionism Scale – Brief, or FMPS-Brief (Burgess et al, 2016). Their scores will be used to determine a correlation between perfectionism and memory on a conjunction

word task and to determine an effect of mindfulness on participants' level of perfectionistic striving and perfectionistic concerns.

Method

Participants

Participants were students currently taking Psychology courses at Seton Hall University and offered course credit or extra credit for participation. Students signed up for the study using SONA and participated in the study remotely. Based on a power analysis aiming for a medium effect size on conjunction errors, and to have sufficient amount of data for regression, the present study aimed for a sample size of 100 participants. Prior to the median split used to score perfectionism there were a total of 135 participants. The final sample used for analysis included 108 students, 82 female/1 non-binary/ 25 males, a majority of students were first-year (n = 30) or sophomore (n = 50), with 10 juniors and 4 seniors, and 14 did not respond to this question. Also, 93.5% of the participants fell between the ages of 18-20 (18 y/o n = 35, 19 y/o n = 51, 20 y/o n = 15), and 5 students fell between the ages of 21-29, and 2 students did not answer. Finally, 48% of the sample identified as White (n = 52), 20% identified as Asian, 17% as Hispanic, 5% as African-American, and 4% as Middle-Eastern.

Materials

A list of words that can produce a new word, the conjunction word, were used for the memory experiment. In a conjunction error task, a list of words called parent words are studied by the participant. In this experiment, participants studied a list of 60 parent words. In the test phase of a conjunction error task, the participants are shown a list of words which includes some of the parent words they had previously studied, conjunction words that are formed by combining stems from two parent words, and new words that share no stem with any of the

parent words. In this study, participants in the were tested on a list of 60 words which included 20 parent words, 20 conjunction words, and 20 new words. There were four counterbalanced test lists, and the experimental program (PsychoPy) randomly selected one list to test the participant on. The University of Vermont's Center for Health and Wellbeing 3-minute body awareness guided meditation exercise was used in the mindfulness practice condition. The "3 minute body awareness meditation" exercise can be found through soundcloud here Although the recording's title states it is 3-minutes long, the recording was 4-minutes total. For the control condition, participants listened to an audiobook for an equal length of time. The audiobook used in this study was *The Hobbit* by J. R. R. Tolkein. The audiobook contained the beginning of the first chapter, until the 4-minute mark was reached in the audio recording. The Frost Multidimensional Perfectionism Scale – Brief (Burgess et al, 2016), was used to measure perfectionistic striving and perfectionistic concern for each participant. This is a shortened format of the Frost Multidimensional Perfectionism Scale (Frost et al., 1990). The FMPS-Brief has been reviewed in research and shown to be as reliable as the original FMPS (Burgess et al, 2016; Simon, 2020; Woodfin et al., 2020). The Mindful Attention and Awareness Scale (MAAS) was used to measure the participant's experience with mindful awareness.

Design

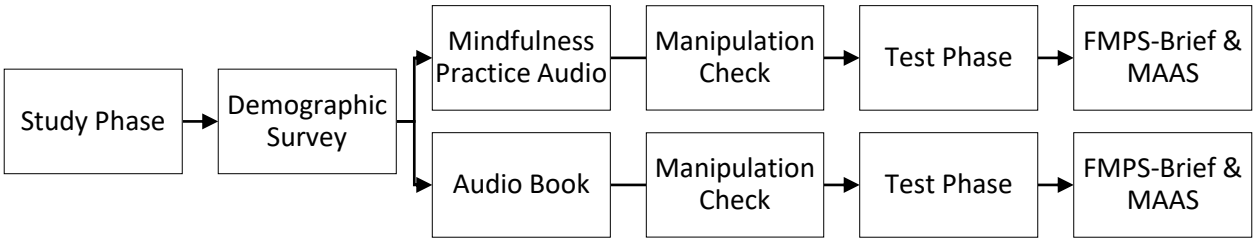
The experiment was programmed using PsychoPy and Pavlovia was used to host the experiment. Participants were randomly assigned to one of two conditions, mindfulness practice or control group. Participants first studied a list of words and were told that they will be tested on these words in a later part of the experiment. After the study phase participants completed a short demographic survey. Then, the participant either listened to a 4-minute guided mindfulness practice if assigned to the mindfulness condition, or an audio book of equal length if in the

control group. In the test phase participants were shown a list of words and asked to decide if the word was familiar as being seen in the study phase by using key presses to indicate yes or no responses. After the memory task was finished all participants completed the Frost Multidimensional Perfectionism Scale – Brief (Burgess et al, 2016) and the Mindful Attention Awareness Scale (MAAS). The independent variables of interest were condition (mindfulness practice or control group) and perfectionism scores, and the dependent variable of interest was memory errors.

Procedure

Figure 2

Flow chart of study design



The participants signed up via SONA systems and were provided with a link to the study and reviewed the informed consent form prior to beginning the experiment. PsychoPy randomly assigned participants to one of two study conditions, either the mindfulness practice group or the control group. All participants studied a list of 60 parent words in the study phase. Then the participants completed a short demographic questionnaire (see Appendix A). After, the participant listened to a 4-minute audio clip depending on their assigned condition, either a 4-minute body awareness guided meditation or 4-minute sample from an audio book. Upon

completion of the mindfulness or audio book the participants completed a brief manipulation check (see Appendix C) to test for an effect of the mindfulness exercise. In the test phase participants were presented with a list of 60 words which contained 20 parent words, 20 conjunction words, and 20 new words that shared no stem with the parent words from the studied list. The test lists were counterbalanced and randomly selected by PsychoPy for the test phase. Participants were instructed to use keypresses assigned to yes or no responses to indicate if the word on the screen was familiar to them as a word from the study phase. After the test phase the participants completed the Frost Multidimensional Perfectionism Scale – Brief (Burgess et al, 2016; see Appendix D), and the MAAS (see Appendix B). A debriefing screen was presented to the participant at the end of each session and course credit was granted in SONA.

Data Analysis

The scores on the FMPS-Brief were separated into high and low scores using a median split such that the median scores of 12 for perfectionistic concern and 9 for perfectionistic striving were not included in the final analysis. Any score above the median for concern or striving was labelled as “high” and any score below the median was labelled as “low”. The resulting 8 groups of participants is shown in Table 1.

Table 1

Participant grouping by condition and perfectionism scores after median split.

	Striving High		**Striving Low**	
Condition	Concern High	Concern Low	Concern High	Concern Low
Mindfulness	17	11	6	22
Audiobook (control)	16	14	7	15

A four-way repeated measures, 3x2x2x2 ANOVA was performed to evaluate the effects on word type (3 types: parent word, conjunction word, new word), by condition (2 conditions: mindfulness and audiobook), perfectionistic concerns (2 perfectionistic concerns levels: high and low) and perfectionistic strivings on word type (2 perfectionistic strivings levels: high and low). An alpha criterion of 0.05 was used to determine statistical significance. A second repeated measures ANOVA on MAAS score, 2 (condition: mindfulness and audiobook) X 2 (perfectionistic concerns: high and low) X 2 (perfectionistic strivings: high and low) was conducted to examine the scores on the MAAS and determine if there were any differences on for those in either condition or for perfectionistic concern or striving types. A t-test on manipulation check scores and a quasi-analysis on top and bottom quartile of manipulation check scores was performed to determine if there was an effect of condition. The software program Jamovi was used for primary analysis of ANOVAs, and R was used to create data visualizations.

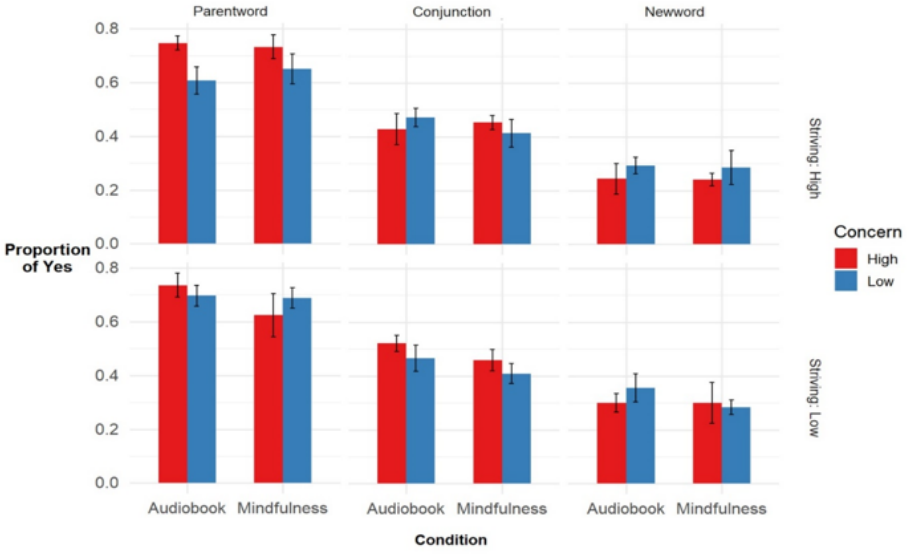
Results

In the four-way ANOVA looking at differences in word type, condition, concern and striving there was a main effect of word type ($F(2, 200) = 198.40$, $p < .001$, $\eta = .170$). Tukey's post-hoc analysis was run on word type revealing that there were significantly less conjunction error false alarms ($p < .001$) and new word false alarms ($p < .001$) than "yes" responses, or hit rates, to parent words. It also revealed that there were significantly less new word false alarms than conjunction error false alarms ($p < .001$). This result reveals a memory effect due to the conjunction error task. That is, there are more false alarm rates for conjunction words than there are for new words. This result is shown in the graph of Figure 3.

There were no significant main effects on task performance for levels of perfectionism; concern ($F(1, 100) = 0.279$, p =.60, $\eta = 0.0$), striving $F(1, 100) = 0.804$, p =.37, $\eta = 0.0$). The ANOVA found no significant differences of condition on task performance for those in the mindfulness or audiobook group ($F(1, 100) = 1.121$, $p = 0.292$). There were no significant interactions found for word type by condition ($F(2, 200) = .12$, p =.89, $\eta = 0.0$), word type by concern ($F(2, 200) = 2.27$, p = .11, $\eta = 0.0$), or word type by striving ($F(2, 200) = .54$, p =.58, $\eta = 0.0$), nor for condition by concern ($F(1, 100) = .00$, p =.98, $\eta = 0.0$), condition by striving ($F(1, 100) = .94$, p =.33, $\eta = 0.0$), and concern by striving ($F(1, 100) = .08$, p =.78, $\eta = 0.0$). There were no significant triple interactions for word type by condition by concern ($F(2, 200) = 1.46$, p = .24, $\eta = 0.0$), word type by condition by striving ($F(2, 200) = .14$, p =.87, $\eta = 0.0$), or condition by concern by striving ($F(1, 100) = .04$, p =.83, $\eta = 0.0$). However, we did observe a marginal interaction for word type by concern by striving ($F(2, 200) = 2.84$, p = .06, $\eta = 0.0$), showing that there may be a relationship between word type on the conjunction error memory task and perfectionism. Our study may not have had a sufficient sample size and

Figure 3

Graph of hit rates and false alarm rates



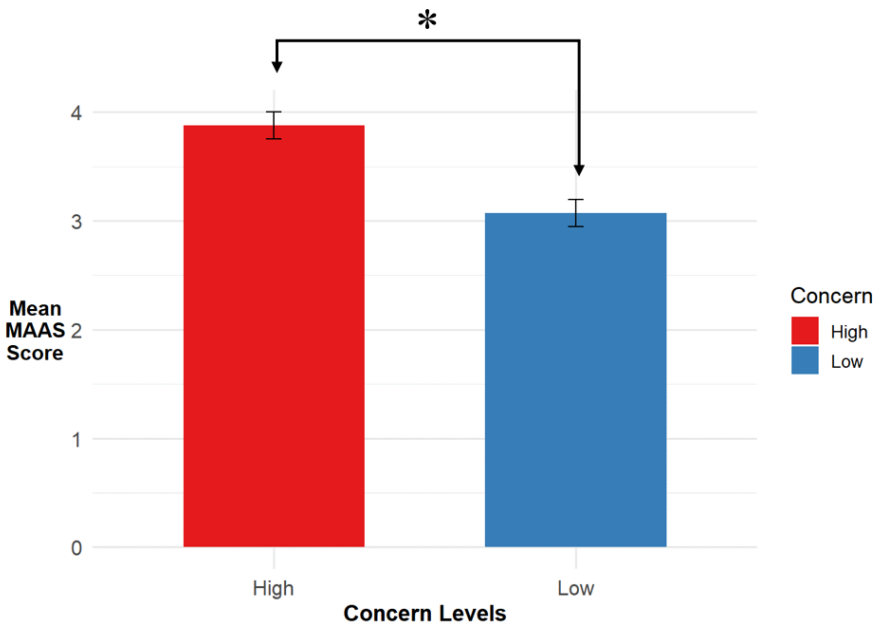
Note: This figure demonstrates the conjunction error effect by graphing hit rates (yes responses to parent words at test) and false alarm rates (yes to either new words or conjunction words at test) split by condition, perfectionistic concerns (high or low) and perfectionistic strivings (high or low). Error bars represent standard error.

power to see this interaction within our a priori alpha criterion. Lastly, there was not a four way interaction between word type by condition by concern by striving ($F(2, 200) = .51$, $p = .60$, $\eta = 0.0$).

The second ANOVA on MAAS scores, the measure that demonstrates the participant's mindful awareness, show that there was a significant main effect of perfectionistic concerns ($F(1, 108) = 16.738$, $p < 0.001$). Post hoc analyses were conducted using Tukey's post-hoc test and indicated that those who were high in perfectionistic concerns scored higher on the MAAS ($p < .001$), indicating higher mindful awareness than those who were low in concerns. This result is shown if Figure 4. There was a significant interaction between condition and perfectionistic strivings ($F(1, 108) = 7.452$, $p = 0.007$). Post hoc analysis on the condition and striving interaction indicated that individuals in the audiobook condition who were low in perfectionistic striving had higher MAAS scores than individuals in the mindfulness condition who were low in perfectionistic striving as well ($p = 0.04$). This result is shown in the graph in Figure 5.

Figure 4

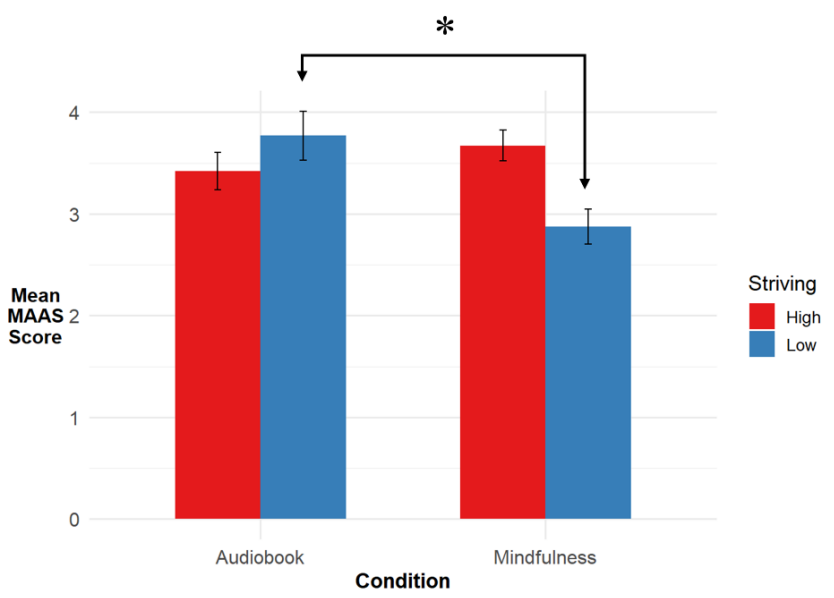
Graph of difference in MAAS scores for perfectionistic concerns



Note: This graph shows the main effect of perfectionistic concern found in the ANOVA on MAAS, condition, concern, and striving.
* represents p < .001

Figure 5

Graph of difference in MAAS scores for perfectionistic strivings by condition



Note: This graph shows the main effect of perfectionistic concern found in the ANOVA on MAAS, condition, concern, and striving.
* represents p < .001

A t-test was conducted on the manipulation check scores to determine if there was a difference in MAAS scores between those in the mindfulness (MAAS: M = 3.27, SD = 0.947, manipulation check: M = 11.8, SD = 3.67) and audiobook (MAAS: M = 3.57, SD = 1.07, manipulation check: M = 12.3, SD = 3.34) conditions. The t-test revealed no significant difference between the conditions and MAAS score, $t(106) = 0.775$, $p = 0.440$) or in the manipulation check scores $t(106) = 1.522$, $p = 0.131$).

A quasi-analysis was performed to determine if the manipulation check revealed any differences on the memory task performance for those in the mindfulness or control condition, as well as differences for perfectionistic concern or striving. The top and bottom quartile of manipulation check scores were further analyzed with a four-way repeated measure ANOVA, 3 (word type: parent word, conjunction, new word) x 2 (condition: mindfulness or audiobook control) x 2 (concern: high and low) x 2 (striving: high and low). There was a significant main effect of word type again because this part of the analysis was unchanged ($F(2, 142) = 451.79$, $p < .001$, $\eta = .843$). There was not a significant main effect of condition ($F(1, 71) = .54$, $p = .47$, $\eta = 0.0$), or concern ($F(1, 71) = .33$, $p = .57$, $\eta = 0.0$), or striving ($F(1, 71) = .24$, $p = .63$, $\eta = 0.0$).

The interactions of word type by condition ($F(2, 142) = .36$, $p = .70$, $\eta = 0.0$), word type by concern ($F(2, 142) = .40$, $p = .68$, $\eta = 0.0$), and word type by striving ($F(2, 142) = .23$, $p = .80$, $\eta = 0.0$) were not significant. The interactions of condition by concern ($F(1, 71) = .04$, $p = .84$, $\eta = 0.0$), condition by striving ($F(1, 71) = 1.85$, $p = .18$, $\eta = 0.0$), and concern by striving ($F(1, 71) = 1.15$, $p = .29$, $\eta = 0.0$), were not significant. The triple interactions were not significant; word type by condition by concern ($F(2, 142) = .05$, $p = .95$, $\eta = 0.0$), word type by condition by striving ($F(2, 142) = 1.80$, $p = .17$, $\eta = 0.0$), word type by concern by striving ($F(2, 142) = 1.03$, $p = .36$, $\eta = 0.0$), condition by concern by striving ($F(1, 71) = .04$, $p = .84$, $\eta = 0.0$). The four-way interaction between word type, condition, concern, and striving was not significant ($F(2, 142) = .05$, $p = .95$, $\eta = 0.0$).

Discussion

The current study was interested in the effects of a mindfulness practice on memory performance in a conjunction error task, while also investigating the role of perfectionism in memory performance. It was predicted that a mindfulness practice will decrease conjunction errors, or false alarms rates. It was also predicted that people who have the maladaptive, concerns type of perfectionism will have higher conjunction error rates, but that those in the mindfulness condition may be able to decrease these false alarms. These predictions were made based on findings from the limited research available on the relationships between memory and mindfulness, and memory and perfectionism, and perfectionism and mindfulness. Through statistical analyses and data visualizations it is noticed that the data trend in the direction of the hypothesis, however the results did not show a statistically significant relationship between condition and perfectionism type on conjunction error proportions. This may be due to a lack of

statistical power or because of noise due to conjunction errors not being changed by perfectionistic tendencies.

To the knowledge of the researcher, this is the first study to investigate the three variables together. Crowe et al., (2007) suggested that in response to their results, thought suppression may be a useful method for increasing memory performance on experimental tasks due to its ability to curb worrying and concerning thoughts, and assist the individual in focusing on the task at hand. Mindfulness was used in this study as a form of a thought suppressing method, as well as an aid for recall-to-reject techniques. This formed the hypothesis that those in the mindfulness condition who tend to be worried or concerned about their performance (a characteristic of perfectionistic concerns) will have less false alarm rates than those in the control condition. During the analyses this trend was observed, but it is marginal and was not statistically significant. Again, this trend is impossible to discern as noise or an underpowered interaction.

In Argus and Thompson (2008) the authors found the people who rated themselves as a concerns type of perfectionist had low levels of mindfulness, however the opposite was observed in the present study. Analysis revealed that those who were high in perfectionistic concerns also had significantly higher scores on the MAAS than others, indicating greater mindful awareness. It could be that individuals who are high in perfectionistic concerns have greater mindful awareness because they have sought out mindfulness or meditation practices in the past to cope with the worry and concerns they hold. Our manipulation check did not reveal any significant differences in MAAS or conjunction error task performance for those who were in the mindfulness condition compared to the control group.

The conjunction error paradigm was chosen in this study due to the use of the DRM paradigms in previous studies. The DRM paradigm is an illusion that can elicit false alarms, and

it was of interest to the current study to explore alternative methods of investigating the effects of mindfulness practices on memory performance in word related tasks. Much of the previous research using the DRM paradigm has led to mixed results, where some research supports mindfulness as a benefit to memory (Baranski & Was, 2017), while others find that it increases false alarms (Rosenstreich, 2016; Wilson et al., 2015). As the results of the current study show, the conjunction error paradigm can show consistent effects in the presence of a mindfulness practice. Therefore, this type of task could be an alternative task for studying the relationship between memory and mindfulness, rather than the DRM paradigm.

There are limitations of this study that must be considered. First, the participants performed the experiment unsupervised. Because of this there is no way of knowing if there were interruptions during the listening conditions. However, in a recent study it was shown that there was little or no differences in results of a supervised versus an unsupervised version of an experimental task (Lloyd et al, 2021). Second, a larger sample may help reveal the effects of mindfulness on memory for perfectionists because of the vast split created between those with high and low concerns and high and low strivings, and those within each condition. Future studies may choose to attempt a repeated exposure or an in-person guided mindfulness practice. Although Lloyd et al. (2016) showed that a short one-time mindfulness induction had positive effects on memory, perhaps a repeated, multiple session design may present interesting effects of mindfulness practice on memory for the different types of perfectionists. Further research may also consider investigating the effects of memory and perfectionism and memory and mindfulness separately. There is not much research present in the field on the relationship between memory, mindfulness, and perfectionism. Therefore, beginning with a simple design

may further the understanding of these relationships and allow for more complex study designs to follow.

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Appendix A

Mindfulness Attention Awareness Scale (MAAS)

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	**2**	**3**	**4**	**5**	**6**
Almost Always	Very Frequently	Somewhat Frequently	Somewhat infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1 2 3 4 5 6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1 2 3 4 5 6
I find it difficult to stay focused on what's happening in the present.	1 2 3 4 5 6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1 2 3 4 5 6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1 2 3 4 5 6
I forget a person's name almost as soon as I've been told it for the first time.	1 2 3 4 5 6
It seems I am "running on automatic," without much awareness of what I'm doing.	1 2 3 4 5 6
I rush through activities without being really attentive to them.	1 2 3 4 5 6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1 2 3 4 5 6
I do jobs or tasks automatically, without being aware of what I'm doing.	1 2 3 4 5 6
I find myself listening to someone with one ear, doing something else at the same time.	1 2 3 4 5 6
I drive places on 'automatic pilot' and then wonder why I went there.	1 2 3 4 5 6
I find myself preoccupied with the future or the past.	1 2 3 4 5 6
I find myself doing things without paying attention.	1 2 3 4 5 6
I snack without being aware that I'm eating.	1 2 3 4 5 6

To score the scale, simply compute a mean of the 15 items. Higher scores reflect higher levels of dispositional mindfulness.

Appendix B

Demographic Questions

1. What is your current age?
2. What is your gender identity?
3. What is your racial and ethnic identity?
4. What is your class standing? (Freshman, Sophomore, Junior, Senior)

Appendix C

Mindfulness and Audio Book Manipulation Check

1	**2**	**3**	**4**	**5**
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Mindfulness Practice	
I was easily distracted during the mindfulness practice.	1 2 3 4 5
I was focused on the mindfulness practice.	1 2 3 4 5
I felt judgmental over my performance during the mindfulness practice.	1 2 3 4 5
I felt relaxed during the mindfulness practice .	1 2 3 4 5
Audio Book	
I was easily distracted during the audio book listening.	1 2 3 4 5
I was focused on the audio book listening.	1 2 3 4 5
I felt judgmental over my performance during the audio book listening.	1 2 3 4 5
I felt relaxed during the audio book listening.	1 2 3 4 5

Appendix D

Frost Multidimensional Perfectionism Scale – Brief

1	**2**	**3**	**4**	**5**
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Evaluative Concerns	
If I fail at work/school, I am a failure as a person.	1 2 3 4 5
If someone does a task at work/school better than me, then I feel like I failed at the whole task.	1 2 3 4 5
If I do not do well all the time, people will not respect me.	1 2 3 4 5
The fewer mistake I make, the more people will like me.	1 2 3 4 5
Strivings	
I set higher goals for myself than most people.	1 2 3 4 5
I have extremely high goals.	1 2 3 4 5
Other people seem to accept lower standards from themselves than I do.	1 2 3 4 5
I expect higher performance in my daily tasks than most people.	1 2 3 4 5

SETON HALL UNIVERSITY
1 8 5 6

07/26/2021

Stefani Morgan
Seton Hall University

Re: 2021-233

Dear Stefani,

The Research Ethics Committee of the Seton Hall University Institutional Review Board reviewed and approved your research proposal entitled, "Memory, Mindfulness, and Perfectionism" as resubmitted. This memo serves as official notice of the aforementioned study's approval as exempt. If your study has a consent form or letter of solicitation, they are included in this mailing for your use.

The Institutional Review Board approval of your research is valid for a one-year period from the date of this letter. During this time, any changes to the research protocol, informed consent form or study team must be reviewed and approved by the IRB prior to their implementation.

You will receive a communication from the Institutional Review Board at least 1 month prior to your expiration date requesting that you submit an Annual Progress Report to keep the study active, or a Final Review of Human Subjects Research form to close the study. In all future correspondence with the Institutional Review Board, please reference the ID# listed above.

Sincerely,

Mara C. Podvey, PhD, OTR
Associate Professor
Co-Chair, Institutional Review Board

Phyllis Hansell, EdD, RN, DNAP, FAAN
Professor
Co-Chair, Institutional Review Board