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THE MINDFULNESS QUESTION: NO EVIDENCE OF INCREASED FALSE MEMORY IN SHORT-TERM INTERVENTIONS RATHER INCREASES IN ACCURACY

By

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Abstract

The Mindfulness Question: No Evidence for Increased False Memory in Short-term Interventions rather Increases in Accuracy

Larry D. Fort

Mindfulness is defined as the process of attending to one's awareness in the present moment (Creswell, 2016). Recently, research has been growing on the effects of mindfulness on false memory, often yielding nebulous results (Brainerd & Reyna, 1998; Wilson, Mickes, Stolarz-Fantino, Evrard, & Fantino, 2015). Furthermore, research has shown that trait mind-wandering and cognitive error proneness are related to absorption in altered states, leaving them factors of interest that will be correlated with memory outcomes in the current research (Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013; Cheyne, Carriere, & Smilek, 2006). Participants were randomly assigned to either an experimental (breathing-based mindfulness) or a control group (mind-wandering mindfulness),receiving six word lists taken from the Deese-Roediger-McDermott paradigm before and after their condition (Roediger, Watson, McDermott, &Gallo, 2001). Both mindfulness conditions involve written recall on word lists presented before and after the audio intervention. After completing recall, both conditions proceed to a five minute filler maze task, and finally the completion of a recognition task. The breathing-based groups received a l5-minute breathing-based mindfulness audio intervention, whereas the control received a 15-minute mind-wandering mindfulness audio intervention. Data do not support the notion of short-term mindfulness interventions having a measurable effect on false or correct memory on either recall or recognition, yet shows increased *d'* accuracy from pretest to posttest conditions. Future studies should seek to enhance the intensity of the mindfulness intervention, perhaps through multi-modal sensory control or longer-term mindfulness interventions.

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Chapter 1:

Introduction

The current research examined the effect of consciousness manipulation, i.e. mindfulness on false memory. The goal of this research is to ascertain the effect of two distinct mindfulness types, breathing-based and mind-wandering, on false memory in the context of short-term interventions (i.e. 15 minutes). Furthermore, the research aims to address whether there are potential negative effects in manipulating one's state of consciousness in the form of increased false memory creation.

The current paper provides an overview of the systems-based approach to consciousness, a theory stating that a discrete state of altered consciousness (d-ASC) is a result of disruption and patterning forces to the baseline state of consciousness (b-SoC), by examining its modern biological support and application (Dietrich, 2010). After, research regarding mindfulness is discussed including its rise in psychological science, methodological issues including lack of operational definitions and flawed psychometric procedures regarding mindfulness measurement is addressed. Finally, mindfulness and false memory research primarily through a fuzzy-trace framework (FTT) relative to other false memory theories are reviewed (Brainerd & Reyna, 1998, 2005). Furthermore, this theory generally uses a well-established technique to collect and analyze data in the Deese-Roediger-McDermott (DRM) paradigm. The paper ends reviewing method and analysis used while offering insights on the findings.

The Systems Based Approach to Consciousness

Charles Tart provided a theoretical map of consciousness systems and how they are altered and disrupted in the form of states (Tart, 1983). This multilevel theory of consciousness involves the destabilization of the baseline state of consciousness (b-SoC) to restructure into a

discrete altered state of consciousness (d-ASC). To support this systems conceptualization, Weil (1997) proposed that altered states flow from the baseline state, supporting Tart's theory on the disruption of the b-SoC to create a d-ASC. However, to reach this d-ASC the b-SoC would have to destabilize due to the advent of both patterning and disruptive forces. Patterning forces can be thought of as laying the groundwork for a d-ASC. For example, guided breathing meditation instructs the participant to act in certain ways to alter their consciousness, paving the way for a discrete state.

Disruptive forces on the other hand, work to disable the b-SoC so that such restructuring can occur. An example of this can be found in stimulus restriction, where controlling for a sensory modality, such as hearing, can disrupt the b-SoC. After disruptive forces cause the b-SoC to crumble into near freefall, it progresses through what is known as a transitional state of consciousness where the patterning forces then construct the d-ASC. While these are poorly researched, and generally thought of as a step to the d-ASC, it is important to note that a d-ASC is not always achieved. It is possible for a transitional state to restructure back into a b-SoC if patterning and disruptive forces are not strong enough. While Tart's systems approach to consciousness may seem outdated, research has found psychobiological support for his mapping of the consciousness operation giving structural meaning to the shapes in his various figures wherein states are comprised of a pattern of neurobiological functioning via different structures and brain wave production.

Alterations in human consciousness ultimately involve two components: attention and control (Dietrich, 2010). Lack of attentional control can lead to mind-wandering, daydreaming, or even intense fantasy, whereas having attention focused is central to a mindful state in breathing-based mindfulness interventions as they pattern the structure of the d-ASC (i.e.

mindful state; Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013). Because of this, it becomes paramount to understand what exactly is being manipulated in terms of consciousness and how it is affecting the cognitive system. Tart's theory can explain why sensory deprivation, or the lack of intensity in a stimulus, can lead to a greater patterning of altered states such as in a dimly lit lamp.

In 2010, Dietrich solidified his theory of transient hypofrontality, which offered novel biological insights into altered states of consciousness. Other theories generally proposed that activity in the brain always meant more effort, yet Dietrich posits that destabilization of a b-SoC to a d-ASC, or even transitional state, are the function of prefrontal cortical deregulation displaying that more activity does not always equal change. This prefrontal deregulation is defined as any circuital disruption to the prefrontal system, including dorsolateral and ventromedial areas. Since the prefrontal cortex has largely been considered an area for attentional control, it plays a crucial role in altered states of consciousness. The construct of prefrontal cortex deregulation and its genesis out of Charles Tart's theoretical work, allows us a framework through which to understand mindfulness and its effect on the bio-cognitive system (Tart, 1983).

In conclusion, states of consciousness involve various systems and subsystems that can either maintain a b-SoC or break off into a transitional state or d-ASC given proper disrupting and patterning forces. This same system is built from a biological and hierarchical order that augments based on deregulation to various areas of the brain, but mainly the prefrontal cortex in terms of phenomenological variation. These deregulated areas are then classified under a psychobiological approach to consciousness that constructs them as biologically validated altered states, or transitional states like drowsiness. Because aspects of altered consciousness such as

mind-wandering, and cognitive error proneness display a lack of attentional control (Mrazek, et al., 2013; 2013; Cheyne, Carriere, & Smilek, 2006), it is feasible that trait cognitive error and mind-wandering proclivity, defined as one's stable tendency towards task unrelated thoughts, could inform us about absorption (i.e., a disposition in which one becomes absorbed in his or her mental state. Absorption and its comorbid factors such as cognitive error proneness and mind-wandering proclivity, become of interest to false information as it is endemic to altered states and their effect on memory.

Mindfulness

Mindfulness, attending to one's awareness in the present moment, has faced several difficulties in its research application from lack of an operational definition to psychometric failings of its measurement (Creswell, 2016; Van Dam et al, 2017). First, the issue of mindfulness' definition relies in the fact that its variation and application is context dependent, meaning that based on how it is being used, or the lens through which it is viewed, the definition changes. This is supported by a lack of cohesion and replicability in the results of mindfulness research.

Van Dam et al. (2017) offer a novel way to explore and explain mindfulness in an attempt to remedy the issues a lack of operational definition has had on the study of mindfulness by focusing on certain features. In their feature-based approach to capturing the complexity of mindfulness, primary and secondary features are ascertained. Features of mindfulness range from arousal (alertness/awakeness), orientation (where attention is directed), and objects of attention as primary; supplemented with posture, motivation, and affective valence (emotional tone of the practice) as secondary features are ascertained. From these, one can examine mindfulness interventions, each one affecting these primary and secondary features.

Creswell (2016) identified two key types of mindfulness interventions: the mindfulness-based stress reduction (MBSR) and mindfulness retreats/brief interventions. Mindfulness-based stress reduction approaches were first developed by Kabat-Zinn, implementing an eight week long training program including group-based weekly sessions lasting around two hours with a trainer, guided audio home sessions lasting around 45 minutes, and a day long retreat that occurred near the end of the eight weeks. The program itself focuses on attending to bodily functions, stretching, yoga, and stress management.

Mindfulness retreats and brief interventions, as explained by Creswell (2016), are a non-exclusive way for those outside of MBSR to deliver mindfulness interventions. The retreats can range from several days to several months with the brief interventions lasting anywhere from three weeks to three days for laboratory research. The question here regards the length of the interventions on how it effects the outcome. As Creswell posits, laboratory results with short interventions tend to have weak effects .

Mindfulness interventions implement either long-term exposure or short-time exposure, both appearing to influence the cognitive outcome of mindfulness research. Most research on mindfulness examines long-term exposure in the form of interventions wherein participants check in weekly through a longitudinal research design, such as MBSR (Chiesa, Calati, & Serretti, 2011). While this is beneficial in studying long-term effects that can hopefully be generalized to an applied setting, it does not address the short-term effects mindfulness interventions can have. Second, an issue regarding mindfulness returns to the lack of consensus on a concrete definition. As previously mentioned, there are both long-term and short-term exposures of mindfulness. Each chosen approach may change our conceptualization of mindfulness while examining it in a laboratory setting (Van Dam et al., 2017).

Research has shown that engagement with mindfulness (i.e. absorption) experience is highly influenced by trait attentional variables. Given established psychometric relationships between variables like trait mind-wandering, mindfulness awareness, cognitive error proneness exists in regard to sustained attention, these variables would inevitable arise as areas of interest in the mindfulness experience (Mrazek, et al., 2013; Cheyne, et al., 2006). However, the empirical study of mindfulness and its effects on memory and cognition remain nebulous. This is no more evident than in the nebulous findings of various studies.

False Memories and Mindfulness

Historically, the Deese-Roediger-McDermott (DRM) paradigm emerged to study false memory phenomena via a list learning paradigm which evokes high levels of false recall and recognition (Roediger & McDermott, 1995). The DRM paradigm is a list learning paradigm that uses lists of words that are semantically related. Critical items are words that are not presented with the list, but are items with the highest semantic relation to the list items. (Stadler, Roediger, & McDermott, 1999). For example, the list SLEEP, sleep being the critical item, is comprised of semantically similar words such as BED and REST. In free recall testing, a participant is asked to remember as many words as they can from list items after it is given. In recognition testing, the participant is asked to identify a series of targets. If a participant identifies a critical item as present, for example SLEEP, it is evident that they created a false memory. This false memory creation within the list learning paradigm is known as the DRM effect.

Brainerd and Reyna (1998) used fuzzy-trace theory to explain the DRM effect that integrates meaning, and memory. According to (FTT), memory is comprised of two memory traces working in tandem: verbatim and gist traces. In the DRM list learning paradigm, both verbatim and gist traces are formed during the learning of list items; however, it is upon recall

and recognition that the traces are activated, either one or both. Both traces being formed upon learning occurs in parallel, an essential feature to the dual-process aspect of FTT (Brainerd & Reyna, 1998). Research has shown that items that were presented serve as better cues for the verbatim traces, whereas items that were not presented yet retained a semantic similarity to items that were presented appeared as better cues for gist traces (Reyna & Kiernan, 1994). Since list items activate both verbatim and gist traces, it is the activation of the non-presented critical item that alerts researchers to the creation of a false memory. Verbatim traces are associated with item-specific processing and are utilized in correct recall and recognition. In contrast, gist traces are associated with relational processing that encodes similarities (i.e. false recall and recognition). It is important to note, however, that correct recall and recognition can arise from the usage of the verbatim or gist trace (or both simultaneously), but only false recall and recognition can occur from the gist trace. This is a potential weakness of FTT, in that the use of verbatim traces must be inferred from the absence of gist use upon retrieval.

As mentioned, verbatim traces preserve a target's item-specific information, whereas gist traces deal with relational properties. In DRM, verbatim traces are evident when correct rejections and correct recognitions are made during the recognition task. For example, if a list had the critical item SLEEP and participants confirmed that SLEEP was not presented, researchers could then assume that the correct rejection was the result of no gist trace being formed. This assumption is supported by the notion of dissociated retrieval as discussed earlier where these findings are displaying a distinct verbatim pathway. If a participant identified an item that was on the list as actually existing on the list, it would be considered a correction recognition (Roediger & McDermott, 1995). False recognitions and false recall are just the opposite, and often highlight errors in gist traces (Brainerd & Reyna, 1998). A miss would be a

participant claiming that a word on the list was not actually there; a false recognition would involve the participant falling for the critical lure by claiming a word was on the list that was not actually presented. Verbatim traces are activated upon retrieval in correct rejections and correct recognitions due to the absence of gist traces, though they can also occur in gist. Gist traces can be associated with errors in the DRM paradigm, such as false recognitions and false recall, due to their reliance on semantic and relational properties. Recent research has used this paradigm as a method to investigate false memories and mindfulness with FTT as a lens through which to view its effects on memory.

Research on the effect of mindfulness manipulations on false memories is fairly limited in scope. For example, Wilson, Mickes, Stolarz-Fantino, Evrard, and Fantino (2015) conducted a series of experiments using a short-term mindfulness induction. In the first study, Wilson et al. assigned participants to either a mind-wandering or mindfulness induction through 15-minute audio exposure. Participants sat in individual rooms listening to either breathing-based mindfulness audio or mind-wandering mindfulness audio. Participants received one DRM list after their respective interventions and viewed words appearing on the computer screen at 1.5 second intervals. Wilson et al. instructed participants to type their free recall responses. Here, participants in the breathing-based mindfulness group falsely recalled more information than the mind-wandering group.

The second study maintained a similar design but used a total of 12 DRM lists (Wilson et al., 2015). Before induction, participants learned and recalled six lists. When their randomly assigned condition (breathing-based versus mind-wandering) finished, participants learned and recalled six different lists. Again, researchers found that participants in the breathing-based mindfulness condition falsely recalled more than the mind-wandering group with a moderate

effect (d = 50), though they did not implement a recognition task to supplement the recall data, which would allow for an assessment of relational processing in regard to mindfulness interventions. However, Wilson et al. remedied this by using a recognition task in a third experiment where participants would rate a presented item as old or new on a 4-point scale. In the third experiment, under the same conditions, participants learned paired words via a database rather than the DRM lists where they again found more false memory in the breathing-based mindfulness group. Wilson et al. explained that increased false memory by the inability to distinguish memory traces brought on by the inherent non-judgement focus of breathing-based mindfulness.

According to Wilson et al . (2015) participants were unable to detect the source of information, thus making them unable to discriminate externally generated from internally generated information, increasing their false memories. When viewed through FTT, one could interpret this as a lack of detecting information as leading to an overreliance on the gist trace, thus increasing gist errors (i.e. false memories). Furthermore, it becomes harder to establish relational traces, leading to more potential false memories. Findings displaying that short-term mindfulness inventions lead to an increase in false memory are also evident in the work of Rosenstreich (2016).

Eyal Rosenstreich (2016) ran two experiments testing the effect of mindfulness interventions on the DRM paradigm. In the first experiment, the researcher utilized volunteers to participate in a mindfulness workshop who needed to commit to attending all sessions and to practice at home. The workshop included five 30 minute sessions with a practiced instructor and an audio file to follow at home. The first session utilized breathing-based mindfulness, while the rest utilized the mind-wandering variant. Participants were split into a training group and a

waiting list group. Participants were measured by utilizing a sheet which contained ten DRM lists, ultimately leading to 100 words being studied. They were then instructed to study the words for a later memory task. After, filler tasks in the form of questionnaires unrelated to DRM were presented to interrupt working memory rehearsal, and after, participants proceeded to the recognition task. At the conclusion of the fifth session, the same procedure was used: participants learned their 100 words, proceeded to a filler task, and then completed the recognition task. The first experiment demonstrated that while the waiting list group did not display any differences in false memories, the training group had more false memories after the meditation practice. Additionally, the training group had more correct memories and were less biased in responding to unstudied words.

Rosenstreich's (2016) study ran a second experiment which ensured that each group had consistent mindfulness practice while attempting to replicate the results of the first experiment. This time the control group underwent a mind-wandering condition where the experimental group underwent a breathing-based mindfulness. Data support that true memories and false memories increased in breathing-based mindfulness, but not the mind-wandering condition. He explains these findings in two ways: first, mindfulness may not increase memory performance but rather response bias where a more liberal response strategy is adopted; second, mindfulness may increase the efficacy of semantic activation (i.e. relational processing). While this study addressed relational processing, it did not attempt to address retrieval through free recall, and though it replicated Wilson et al.'s (2015) results, it remains contested by several studies suggesting the effect does not exist.

Baranski and Was (2017) aimed to replicate and extend the findings of the Wilson et al. (2015) by utilizing the same design on participants with the same mindfulness interventions of

15 minutes that focused on non-judgmental observations, hypothesizing that control of attention would stop participants from experiencing supposed increased false memories. In the first experiment, researchers assigned participants to four groups: mindfulness with DRM warning, mindfulness without DRM warning, mind-wandering with DRM warning, and mind-wandering without DRM warning. Participants were presented with DRM word lists in front of a computer screen, typing in as many as they could remember. After this pretest, participants received either a 15 minute mindfulness or mind-wandering induction depending on their condition, all viewing a flickering candle on the screen during the experiment. Prior to the posttest measure of recall, participants in the warning groups were informed that the lists were designed to induce false memories.

After the recall procedure, participants completed a recognition task utilizing lists presented before and after the intervention (Baranski & Was, 2017). This experiment revealed there were no significant effects to replicate Rosenstreich's (2016) and Wilson et al's (2015) results that mindfulness interventions increase false memories and true memories. However, the first experiment did reveal a significant effect of the warning such that mind-wandering and breathing-based groups had less false memories, more true memories, and less intrusions because of its inclusion. The second experiment attempted to replicate that fewer false memories occurred in mindfulness conditions with the addition of a control group that worked on puzzles for 15 minutes instead of listening to mindfulness audio. Data supported the notion that false memories decreased after the induction, regardless of the type. Exploratory analyses suggest that the breathing-based mindfulness group was significantly less likely to falsely recall than the mind-wandering group.

In terms of correct recall, data suggest correct recall improved after in both groups as well (Baranski & Was, 2017). These studies also revealed that correct recalls increased from pretest to posttest, suggesting that the interventions improved the ability to identify items. These findings are in contrast to both Wilson et al. (2015) and Rosenstreich (2016) results of increased false memory susceptibility, going as far to even suggest that mindfulness reduces these rates of false information. Researchers explain the differences potentially in terms of different word lists, as they used Roediger and McDermott's 1995 lists where Wilson et al. (2015) used Stadler et al.'s (2001) list. Another explanation is a critique on Wilson et al.'s effect sizes, where in Baranski and Was proclaim those effects were not "robust," leading to "variable" results. They also criticize Wilson et al.'s explanation about non-judgment leading to the inability to distinguishing external and internal information, as it would mean that trained practitioners exhibit higher rates of false memories. Lastly, they consider that a 15 minute intervention may not be enough to yield a proper relationship between mindfulness and meditation if one exists. Yet, research by Lloyd, Szani, Rubenstein, Colgary, and Pereira-Pasarin (2016) challenges the idea that the intervention was not long enough to yield a true relationship.

Lloyd et al. (2016) ran four experiments to test the effect of brief mindfulness interventions on memory. In the first experiment, participants engaged in a study phase where they were presented with 100 words on a computer screen for 1 second intervals. Then, they were assigned to three groups: the first group involved a 3 minute mindfulness exercise that was told the intervention reduced stress, the second that the intervention improved memory, and the third which was a 3 minute neutral program on the history of radio. After the condition, participants proceeded to a recognition task. Data support that the type of intervention had an effect on non-living (e.g. "runs on batteries"), as opposed to living items (e.g. "has a four

chambered heart") items such that those in mindfulness group falsely recalled less than the control group (Lloyd et al., 2016).

The second experiment now utilized properties presented to participants in the study phase designating words as living or non-living. Again, participants in the mindfulness had fewer false memories than the control group. The third experiment was designed to test if the intervention before encoding would still have the same effect. Participants this time engaged with their condition before the study phase. Data did not support that having the intervention before encoding reduced false memories, given this effect a potential important temporal quality (Lloyd, et al., 2016). The fourth experiment replicated the first experiment identically save for the intervention being presented before encoding. Data support the notion of this temporal effect as having importance, showing reduced false memory rates across conditions for non-living items when the intervention is placed before encoding.

Lloyd et al. (2016) explain this finding by supposing that lures become less familiar before retrieval because one can avoid irrelevant information on deciding if a word was present or not, yet if presented before encoding this does not seem to happen. Although researchers did not use DRM lists, the findings are similar to Baranski and Was (2017) suggesting that short-term interventions improve correct recall and recognition. This increase in correct recall and recognition rates is further supported by a recent study done by Calvillo, Flores, and Gonzalez (2018).

Calvillo et al. (2018) ran a study utilizing three groups of participants: brief mindfulness induction before encoding, induction following encoding, and the third group was a control that never received an induction. The control condition solved math problems for 3 minutes before moving to encoding a total of 120 DRM words, then to 3 minutes of math problems before doing

the recognition task and completing a manipulation check. The before encoding mindfulness group began with the 3 minute mindfulness induction before moving to encoding, then to 3 minute math problems and ending with a recognition task and a manipulation check. The after encoding procedure was the same except they began with 3 minutes of solving math problems and moved to the encoding, then receiving the 3 minute induction before completing a recognition task and manipulation check. Data support the notion that the 3 minute mindfulness intervention after encoding had reduced false memories in recognition data. Yet, mindfulness interventions before encoding did not differ significantly from the control in the recognition data. These findings are explained by the reduction in liberal response biases after the induction.

Future research should be aware of the temporal quality of intervention placement as discovered by Lloyd et al. (2016) and Calvillo et al. (2018). Furthermore, future research should utilize a comprehensive research procedure that includes measures of both retrieval and relational processing through recall and recognition respectively. And finally, it should investigate the main claim of Wilson et al. (2015) and Rosenstreich (2016) that breathing-based mindfulness increases false memory susceptibility against the findings of Baranski and Was (2017), Lloyd et al (2016), and Calvillo et al. (2018) that short-term mindfulness reduces false memories.

The Current Study

The current study borrows from the DRM paradigm by utilizing recall and recognition tasks. As to the placement of the mindfulness induction introduced by Calvillo et al. (2018) and Lloyd et al. (2016), current research uses a pre-test/post-test design that will measure memory outcomes before and after the mindfulness intervention. In contrast to Wilson et al.'s (2015) and Rosenstreich's (2016) research, the proposed research will use both recall and recognition data to

examine false memories using the DRM paradigm. In contrast to Baranski and Was (2017) who utilized a similar approach, this study will test for recognition (i.e. relational processing) before and after the intervention. Additionally, this study uses a filler task to prevent working memory rehearsal between measurements similar to Rosenstreich (2016).

It is predicted that, like Wilson et al. (2015) and Rosenstreich (2016), increased false recall and recognition will be seen in the breathing-based mindfulness group compared to the mind-wandering group with the pretest-posttest design allowing for an intervention before and after encoding/retrieval. Given that a FTT view of Wilson et al.'s explanation of a less detectable information source leading to increased false memoires is explained by an increase in gist trace reliance, the researcher hypothesizes that the breathing-based group will lead to more increased gist errors because of the inability to detect source information. Additionally, the MWQ and ARCES will be used to assess attentional errors, seeing if they correlate with recognition and recall scores. As such, researchers expect both scales to yield a strong, positive relationship given their attentional factors and relationship within previous literature.

Chapter 2:

Method

Participants & Design

The research utilizes a 2 (Condition: breathing v. mind-wandering) x 2 (Time: pre v. post) factorial design with 60 participants for 80% statistical power calculated from GPower. Participants were recruited from Towson University's Psychology Research Pool of students over the age of 18 who speak English as their native language and who have not been in a similar study. Furthermore, participants will complete the MWQ and ARCES scales prior to participation as part of a prescreen measure within the online research pool system. Once in the lab, participants were given an informed consent and asked if they have any questions regarding the study (see Appendix A). After, participants received a short demographic survey (see Appendix I). Participants received course credit for their participation. The sample consisted of men (21.7%), women (76.7%), and gender non-binary (1.7%) of varying ethnicities: White/Caucasian (43.3%), African American (35.0%), Asian Pacific Islander (11.7%), Hispanic/Latino (1.7%), and Other/Multiracial (8.3%). Ages ranged from 18 to 58, (M = 19.61, SD = 1.87).

Materials

Researchers utilized one small room containing two chairs, a computer with headphones, and a halogen lamp. The lamp was dimmed on a slider, marked by a piece of tape so that lighting was consistent throughout the trials. Twelve word lists of 15 items each were derived from Stadler et al., (1999) for their high likelihood in evoking false recall and are as follows: SMELL, DOCTOR, SWEET, NEEDLE, SMOKE, ROUGH, SLEEP, TRASH, CHAIR, ANGER, SOFT, WINDOW (see Appendix B). The presentation of word lists was randomized via a Latin square method which derived twelve sequences that were distributed evenly across pre and post

conditions, meaning six lists were given to the pre-condition and six lists given to the post-condition.

Mind-wandering Questionnaire (MWQ). The Mind-wandering Questionnaire (see Appendix E), or MWQ, is a trait mind-wandering scale consisting of five items on a 6-point scale where participants rated how often certain experiences happened to them ranging from 1 (*almost never*) to 6 (*almost always*; Mrazek et al., 2013). The MWQ has shown high internal consistency (α= .850), and convergent validity with related scales such as the Mindful Attention Awareness Scale (i.e., MAAS; r = -0.578, p < .001; Mrazek et al., 2013). Furthermore, the MWQ was found to correlate with task unrelated thoughts (TUTs; r = 0.233, p < .01). One of the items reads as follows: "I have difficulty maintaining focus on simple or repetitive work."

Attention-Related Cognitive Errors Scale (ARCES). The ARCES (see Appendix F) is a trait cognitive measure scale consisting of 12 items measured on a 5-point Likert scale where participants rate how often an experience has happened to them ranging from 1 (*never*) to 5 (*very often*). The ARCES displayed high internal consistency (α= .88), and correlates with the MAAS (r = -.071, p < .001, and Sustained Attention to Response Task Error (r = .032, p < .001; Cheyne, et al., 2006). Sample items include: "I have gone to the fridge to get one thing (e.g., milk) and taken something else (e.g., juice); "I go into a room to do one thing (e.g., brush my teeth) and end up doing something else" (e.g., brush my hair); and "I have lost track of a conversation because I zoned out when someone else was talking."

Audio. Participants received one of two 15-minute audio clips based on their randomly assigned condition: Breathing-based Mindfulness Training V.2.1 by Dr. Kevin Chen (experimental; https://www.youtube.com/watch?v=7crY8cfOmSU), or Guided Meditation for Deep Relaxation by Michael Sealey, which is a mind-wandering intervention (control;

https://www.youtube.com/watch?v=td6BhfC7Xwk). The breathing-based mindfulness audio instructs participants to close their eyes and focus on the pace of their breathing, teaching them how to utilize deeper and fuller breaths. The Sealey audio instructs participants to close their eyes and let their mind drift, asking them to focus on nothing in particular.

Filler Task. Filler tasks were four page packets each containing a maze taken from Google images (see Appendix D). Participants were assigned two packets, one for the pre-test procedure and one for the post-test. During the pre-test procedure participants were instructed to proceed through the packet linearly, front to back. During the post-test procedure, participants were instructed to proceed through the packet in reverse order, starting with the back maze. This was done to attempt to negate practice effects long enough to consume five minutes of time to act as a proper filler.

Recognition Test. Recognition tasks are constructed of 36 items measured on a 4-point scale on how novel the presented word was including 1 (*certainly new*), 2 (*somewhat new*), 3 (*somewhat old*), and 4 (*certainly old*) adopted from Roediger and McDermott's 1995 research. For scoring purposes, 4 and 3 were taken as 'yes' responses and 2 and 1 were taken as 'no' responses. Each of the 12 lists are represented by 36 items on the recognition task. The first item representing a list will be the critical lure. The following three words were items that were presented in serial position one, eight, and ten from their respective lists of 15 items. The last two items on the recognition task were unrelated items taken from the Stadler et al (1999). Items on the posttest recognition task were reverse ordered to prevent participants from learning a pattern of item presentation (see Appendix C).

Manipulation Check. The manipulation check (see Appendix E) consists of five items measured on a 5-point scale adapted from the 5D-ASC (i.e., the Five-Dimensional Altered States

of Consciousness rating scale) where participants rate how like their experience the manipulation was ranging from 1 (*not at all like my experience*) to 5 (*very much like my experience*; Dietrich, Lamparter, & Maurer, 2010). This manipulation check will contain the following items: “I feel calm;” “I feel focused on the present;” “I feel free of judgment;” “I feel as if I am witnessing my own experience;” “I feel more in touch with myself.” Given Creswell’s (2016) explanation of mindfulness, these items appear to be the best at capturing its core component, that is, feeling calm and focused, among others.

Procedure

All aspects of the procedure, save for the addition of the recognition tasks, are similar to the work of Wilson (2015). Participants will complete the MWQ and ARCES as part of a prescreen procedure which ensures that a participant will not be able to participate in the study unless the measures are completed. The prescreen procedure involves participants signing up for a study online through a database that has them enter demographic information as well as any other information a researcher may request. From there, they volunteered for a timeslot and were given course credit for showing up to the study. After the prescreen, participants were randomly assigned to a breathing-based condition or a mind-wandering condition.

Participants were tested individually in a small room, dimly lit by a lamp. Participants sat in front of a computer screen with a pair of headphones. Then, participants listened to six assigned counterbalanced orders of word lists of 15 items each before their respective condition with 2.5 seconds between each stated word. Then, participants were given two minutes to write down as many words as they could remember in any order after the presentation of each list. The recall tests consisted of six lists of words for pre and post conditions in stapled packets. After, they completed a filler task consisting of four varied mazes lasting five minutes (see Appendix

K). When the filler task is complete, participants completed a 36-item recognition task. Then, all participants were instructed to relax and close their eyes, listening to the 15 minute audio of their respective condition while the researcher left the room. After the researcher returned, participants received the manipulation check adapted from the 5D-ASC. Upon completion, participants listened to six new word lists, again assigned to counterbalanced orders, and after each list they were again given two minutes to write down as many words as they could remember in any order. After recall, participants proceeded to the mazes and another 36-item recognition task corresponding to the new word lists.

Chapter 3:

Results

Recall

Means, standard deviations and 95% confidence intervals for correct and false recall in breathing-based and mind-wandering mindfulness conditions are included in Table 1. Two separate 2 (Condition: breathing v. mind-wandering) x 2 (Time: pre v. post) mixed factorial ANOVAs for correct and false recall. For correct recall, there was not a main effect of Time $F < 1$, no main effect of Condition $F < 1$, and no significant interaction between Time and Condition $F < 1$ (see Figure 1). For false recall scores, there was not a main effect of Time $F < 1$, no main effect of Condition, and no significant interaction between Time and Condition $F < 1$. These data are interpreted to mean that testing before or after the intervention had no effect on retrieval and neither did intervention type.

Recognition

Means, standard deviations and 95% confidence intervals for correct and false recognitions in breathing-based and mind-wandering mindfulness conditions are included in Table 1. A 2 (Condition: breathing v. mind-wandering) x 2 (Time: pre v. post) mixed factorial ANOVA was used to assess the effect of Condition and Time on correct and false recognitions. For correct recognitions there was not a main effect of Time $F < 1$, no main effect of Condition $F < 1$, and no significant interaction between Time and Condition $F < 1$ (see Figure 4). For false recognitions, there was not a main effect of Time $F\text{Time}(1, 58) = 1.353$, $p = .250$, $\eta p2 = .023$, no main effect of Condition $F < 1$, and no significant interaction between Time and Condition $F < 1$ (see Figure 3). These are interpreted to mean that there were no significant effects on relational processing as a result of testing before or after the intervention or as a result of intervention type.

Means, standard deviations and 95% confidence intervals for *d'* and C values in breathing-based and mind-wandering mindfulness conditions are included in Table 1. A 2 (Condition: breathing v. mind-wandering) x 2 (Time: pre v. post) mixed factorial ANOVA was used to assess the effect of Condition and Time on accuracy and bias scores in the form of *d'* and C for recognition scores. The *d'* score and C criterion were calculated in a manner consistent with Snodgrass and Corwin (1988).

On *d'* values, there was a main effect of Time $F(1, 58) = 23.15$, $p < .001$, $\eta p2 = .285$ such that participants in the posttest ($M = .30$, $SD = .11$) scored higher in accuracy than in the pretest ($M = .43$, $SD = .20$) across conditions, meaning that participants had fewer false recalls and recognitions after their respective mindfulness condition. There was not a main effect of Condition $F < 1$, and there was no significant Time and Condition interaction $F < 1$ (see Figure 5). In terms of C criterion values, there was no main effect of Time $F < 1$, no main effect of Condition $F < 1$, and no significant Time and Condition interaction $F < 1$ (see Figure 6). These values suggest that response bias did not change as a result of testing before or after the intervention, or as a result of intervention type; however, the positive C value demonstrates a tendency for participants to respond to unstudied words (Rosenstreich, 2016).

Scale Measures

Means, standard deviations and 95% confidence intervals for ARCES, MWQ, and Manipulation Check in breathing-based and mind-wandering mindfulness conditions are included in Table 2. Independent *t*-tests did not reveal significant differences in scale measures by Condition. On the ARCES, participants in the breathing-based group did not score significantly different than the mindfulness group, $t(58) = 1.15$, $p = .618$, $d = .30$ [95% CI: -0.21, 0.80]. On the MWQ, participants in the breathing-based group did not score significantly different than the mindfulness group $t(58) = 1.83$, $p = .072$, $d = .46$ [95% CI: -0.05, 0.98]. On the

manipulation check, participants in the breathing-based group did not score significant different than the mindfulness group $t(58) = .344$, $p = .470$, $d = .09$ [95% CI: -0.42, 0.60].

A moderate positive correlation was found between the ARCES and MWQ, $r(60) = .592$, $p < .001$ (see Figure 7). This replicates a common psychometric finding wherein both the ARCES and MWQ have moderate positive correlations with similar scales, such as the Mindful Attention Awareness Scale (MAAS; Mrazek et al., 2013). This correlation supports the notion that cognitive error proneness is associated with mind-wandering proneness where the more likely you are to mind wander, the more likely you are to commit cognitive errors of attention. In spite of this correlation, these trait attentional errors did not correlate with recall, recognition, *d'*, or C scores (see Table 3).

Chapter 4:

Discussion

The Mindfulness Question

The researcher hypothesized that in accordance with Wilson and colleagues' (2015) research there would be an increase in false memories (i.e. false recognitions/false recall) in the breathing-based mindfulness group as compared to the mind-wandering mindfulness group. Given that there was no main effect of condition in false recall or recognition data, that hypothesis cannot be supported. However, the finding is consistent with the work of Baranski and Was (2017) who found that there were no effects of condition in the same 15 minute meditation groups in regard to false memories. The current research offers further evidence to support the notion that increased false memories in short-term mindfulness may just be a chance finding. Creswell (2016) and Van Dam et al. (2017) mention that mindfulness studies in laboratories often yield small and transient effects on memory outcomes.

In terms of correct recall and recognition, this research did not find a main effect of time in contrast to Baranski and Was (2017) who claimed although the short-term interventions did not increase false memories, they increased correct recall. Yet, the current research partially supports this hypothesis through the *d'* measure, which can be viewed as a more accurate transformation of correct hit and recognition data in terms of signal detection theory. Here, *d'* indicates discrimination accuracy, that is an increase in *d'* displays that participants were able to perform the task better (i.e. more accurately) with less false recall and recognition. While there was no effect of time in raw hit and correct recognition data, there was a main effect of time in the *d'* scores showing that accuracy increases in the recognition data from pretest to posttest. There are two reasons why this could be the case. First, there was not a control group, one

without any mindfulness intervention, therefore it is plausible that the increase in *d'* was a result of practice effects from being exposed to the DRM paradigm in the pretest. The second explanation assumes that a control group would yield no difference in *d'* scores, yet that the breathing-based and mind-wandering mindfulness do not differ enough such that short-term exposure to either type of mindfulness would increase accuracy. This explanation is supported by the fact there was not a time and condition interaction, and further, that the breathing-based group and the mind-wandering group did not differ significantly on the manipulation check.

This is similar to the findings of Experiment 1 in Baranski and Was' (2017) research where something is affecting both conditions equally to the extent that it is improving accuracy from pretest to posttest measurements. Given that the current study utilized dim lighting during the measurement procedure in the form of a halogen lamp, and that Baranski and Was utilized an on-screen flickering candle, sensory deprivation during the measurements could explain the increase in accuracy. The lack of incoming stimuli could possibly allow for the use of both verbatim and gist traces upon activation, and not simply an overreliance on the gist trace. One could also suppose that Lloyd et al.'s explanation applies here such that sensory deprivation brings in less irrelevant information making the critical lures less familiar (Lloyd et al., 2016)

Next, Calvillo et al. (2018) and Lloyd et al. (2016) highlighted the importance of intervention placement in terms of false memory, for which this study controlled for by having comprehensive recall and recognition tasks before and after the mindfulness exercise (Calvillo, et al., 2018). Even with these factors controlled, it was still not possible to replicate the findings of Wilson and colleagues (2015), again supporting evidence from Baranski and Was (2017). While there may be no evidence to support increased false memories in these specific, short-

term, altered state inductions, it does not necessarily mean it is endemic to all non-pharmacological modes of altering one's consciousness.

Wilson et al. (2015) explained their increased false memory findings as the byproduct of mindfulness' inherent non-judgement. This can be explained within the framework of fuzzy trace theory (FTT) where the non-judgmental feature produced an inability to detect the source of information, leading to an increase in gist trace reliance, and therefore, more gist errors. The researchers claimed that observing with non-judgement is crucial to breathing-based mindfulness, yet perhaps it is the self-monitoring combined with the non-judgement that caused their findings, as non-judgement is essential to all forms of mindfulness according to Creswell (Creswell, 2016). This echoes criticism levied by Van Dam et al. (2017) regarding mindfulness' operationalization problem where replication becomes near impossible when the definitions are not agreed upon between researchers. Interestingly in terms of FTT, the current research comes to almost opposite conclusions. Since there was no effect of time in false recognition and recall but an effect of time in *d'* scores, one could make the case that short-term mindfulness interventions reduce gist trace reliance, instead strengthening the activation of verbatim traces or verbatim and gist traces upon activation, supporting the results of Baranski & Was (2017), Calvillo et al (2018), and Lloyd et al (2016).

It is important to note that in his review of mindfulness interventions and research, Creswell (2016) does not categorize breathing-based as a type of mindfulness juxtaposed to mind-wandering. Rather, his review focuses more on the lengthier Kabat-Zinn MBSR and NMSR, both of which differ more so in their length and intensity than of the instruction (Creswell, 2016). Since the divide between breathing-based and mind-wandering mindfulness seemed largely imposed on this area of research by Wilson and colleagues' study, it allows one

to wonder if the right type of question was being asked in the first place. Perhaps the divide is not between breathing-based and mind-wandering "types' of mindfulness after all.

The researcher hypothesized that trait mind-wandering and trait cognitive error proneness would yield a strong, positive correlation, and that this relationship would positively correlate with false memory outcomes and negatively correlate with correct memory outcomes. This is due to the fact that both trait mind wandering and trait cognitive error proneness are errors of attention, and given that previous work has found the manipulation of attention at the focus of the DRM effect in mindfulness, it would make sense of these variable to correlate in this way (Wilson et al., 2015 & Lloyd et al, 2016). However, the current work only yielded a moderate, positive correlation between the MWQ and ARCES, which have reported similar correlation coefficients to other scales like the MAAS (Mrazek, et al., 2013). The correlation coefficients did not reveal the MWQ or ARCES to be related to recall or recognition scores.

The Future of Consciousness Manipulations

Charles Tart maintained two key features in the establishment of an altered state of consciousness, namely patterning and disruptive forces (Tart, 1983). Often, if these forces were not intense or long enough, they would not cause an altered state to form, rather it would allow for a transitional state to linger before collapsing back to a baseline state. Much may be the case in the situation of the short-term mindfulness induction where it is lacking both in length and intensity. One way the current study lacks in intensity is the limit of its sensory control. Because Lloyd et al (2016) and Calvillo et al (2018) found effects within 3 minute interventions, length of the intervention alone is not responsible for the effect as Baranski and Was (2017) posit. While there was a clear effect of intervention placement in Lloyd et al's and Calvillo et al's studies, there remains a question of intensity: would multi-modal iterations of short-term mindfulness

(i.e. blindfold and audio) yield more support for Wilson et al.'s (2015) findings of increased false memory, strengthen the current findings along with Baranski and Was (2017) that there is an increase in correct recall and/or accuracy, or have no effect? Given the increase of accuracy across conditions in the current work and the work Baranski and Was, sensory deprivation may prove an interesting avenue down which to further pursue these measurements. A blindfold in a multi-modal setup would act as a strong destabilizing force.

In terms of FTT, it is important to note the effect consciousness manipulation has on verbatim and gist traces. If it is true that short-term interventions decrease gist reliance, one could expect a multi-modal iteration of short-term mindfulness to further strengthen the singular activation of the verbatim trace or the dual activation of verbatim and gist traces. This could reveal an interesting interplay between Tart's destabilizing/patterning forces and Brainerd and Reyna's (1998) verbatim/gist traces where a potential increase in b-SoC destabilization and increase in d-ASC patterning could result in the strengthening of certain traces at the weakening of another. Given Dietrich's (2010) theory of hypofrontality, this could be the result of the b-SoC destabilization and d-ASC patterning leading to prefrontal deregulation which then affects verbatim and gist traces.

Limitations & Future Directions

As mentioned, a major limitation to the study was the length and intensity of the intervention. It is likely given emerging research in the field of altered consciousness induction methods that a stronger independent variable could have created a measurable effect on false memory or have strengthened current findings. This would make research utilizing a mulit-modal short-term mindfulness intervention of great interest where participants wear a blindfold while also listening to the audio. Work from John C. Lily supports the strength of sensory deprivation in consciousness manipulations (see the Deep Self, 1976), such that Tart's theories

later built on them and incorporated sensory deprivation as a disruptive force in state based consciousness change leaving the implementation of such experimental tools as essential in the question of short-term mindfulness effects. Perhaps it is not just the length of the intervention, but the intensity.

Another limitation appears in the lack of real time attention monitoring. Without measuring task unrelated thoughts (TUTs) during the experiment (see Kane et al, 2007), it was difficult to decipher if the participants engaged with the procedure with attentional effort. This measure should be included along with a control group that does not engage in any intervention to test exactly why accuracy seems to be increasing from pretest to posttest. Sample size could also be an issue, while 60 participants was sufficient to reach Cohen's conventions of 80% statistical power, the time constraints of thesis work made it near impossible to stretch data collection any further. There is also the inherent bias of using a college sample, leaving most participants to be white females between the ages of 18 and 21. This suggests that at face value, this sample is not representative of the population.

In summation, future research should prepare for longer data collection while incorporating more sensory controls into the intervention to increase its intensity (i.e. using a blindfold to control for vision) on DRM dependent variables such as false recognition. A control group will be necessary to test the decrease in gist reliance that seems to be hinted at through the current study and correct recall data from several studies should the finding replicate (Baranski & Was, 2017; Calvillo et al., 2018; Lloyd et al, 2016). Additionally, monitoring TUTs during the procedure will be interesting to measure the attentional effort of participants in real time. Ideally, the study will be able to extend beyond a very homogenized college populace and perhaps glean data from a more diverse group in terms of gender, age, and race.

References

Baranski, M. & Was, C., A. (2017). Mindfulness may not increase false-memory and may instead protect against false-memory susceptibility. *Mindfulness, 8,* 1569-1579. doi: 10.1007/s12671-017-0729-7

Brainerd, C., J, & Reyna, V., F. (1998). Fuzzy-trace theory and children's false memories. *Journal of Experimental Child Psychology, 71,* 81-159. doi: 0022-0965/98.

Calvillo, D., P., Flores, A., N., & Gonzalez, L., C. (2018). A brief mindfulness induction after encoding decreases false recognition in the Deese-Roediger-McDermott paradigm. *Psychology of Consciousness: Theory Research and Practice, 5.* 131-139. doi:10.1037/cns0000145

Cheyne, J., A., Carriere, J., S., A., & Smilek, D. (2006). Absent-mindedness: lapses of conscious awareness and everyday cognitive failures. *Consciousness and Cognition, 15,* 578-592. https://doi.org/10.1016/j.concog.2005.11.009

Chiesa, A., Calati, R., Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review, 31,* 449-464. doi: 10.1016/j.cpr.2010.11.003

Creswell, J, D. (2016). Mindfulness interventions. *Annual Review of Psychology*. doi: 10.1146/annurev-psych-042716-051139

Dietrich, A., & Stoll, O. (2010). Effortless attention, hypofrontality, and perfectionism. In B. Bruya (Ed.), *Effortless attention* (pp. 159–178). Cambridge: MIT Press.

Dietrich, A., Lamparter, & Maurer. (2010). 5D-ASC: Questionnaire for the assessment of altered states of consciousness. A short introduction. Zurich, Switzerland: PSIN PLUS.

Kane, M., Brown, L., McVay, J., Silvia, P., Myin-Germeys, I., & Kwapil, T.(2007) For whom the mind wanders, and when. Psychological Science, 18. 614-621. http://dx.doi.org.proxy-tu.researchport.umd.edu/10.1111/j.1467-9280.2007.01948.x

Lloyd, M., Szani, A., Rubenstein, K., Colgary, C., & Pererira-Pasarin, L. (2016). A brief mindfulness exercise before retrieval reduces recognition memory false alarms. *Mindfulness, 7*. 606-613. doi: 10.1007/s12671-016-0495-y

Mrazek, M. D., Phillips, D. T., Franklin, M. S., Broadway, J. M., and Schooler, J. W. (2013). Young & restless: validation of the mind-wandering questionnaire (MWQ) reveals disruptive impact of mind-wandering for youth. *Frontiers of Psychology, 4*. doi: 10.3389/fpsyg.2013.00560

Reyna, V. & Kiernan, B. (1994). Development of gist versus verbatim memory in sentence recognition: Effects of lexical familiarity, semantic content, encoding instructions, and retention retrieval. *Development Psychology, 30*, 178-191.

Roediger, H. L., III, Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis. *Psychonomic Bulletin & Review, 8,* 385–405. doi: 10.3758/BF03196177

Roediger, H. L., III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented on lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 803–814. doi: 10.1037/0278-7393.21.4.803

Rosenstreich, E. (2016). Mindfulness and false-memories: The impact of mindfulness practice on the DRM paradigm. *The Journal of Psychology: Interdisciplinary and Applied, 150*, 58-71. doi: 10.1080/00223980.2015.1004298

Snodgrass, J., G., & Corwin, J. (1988) Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology*. *117*. 34-50. doi: 0096-3445/88/S00.75

Stadler, M. A., Roediger, H. L., III, & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition, 27*, 494-500. https://doi.org/10.3758/BF03211543

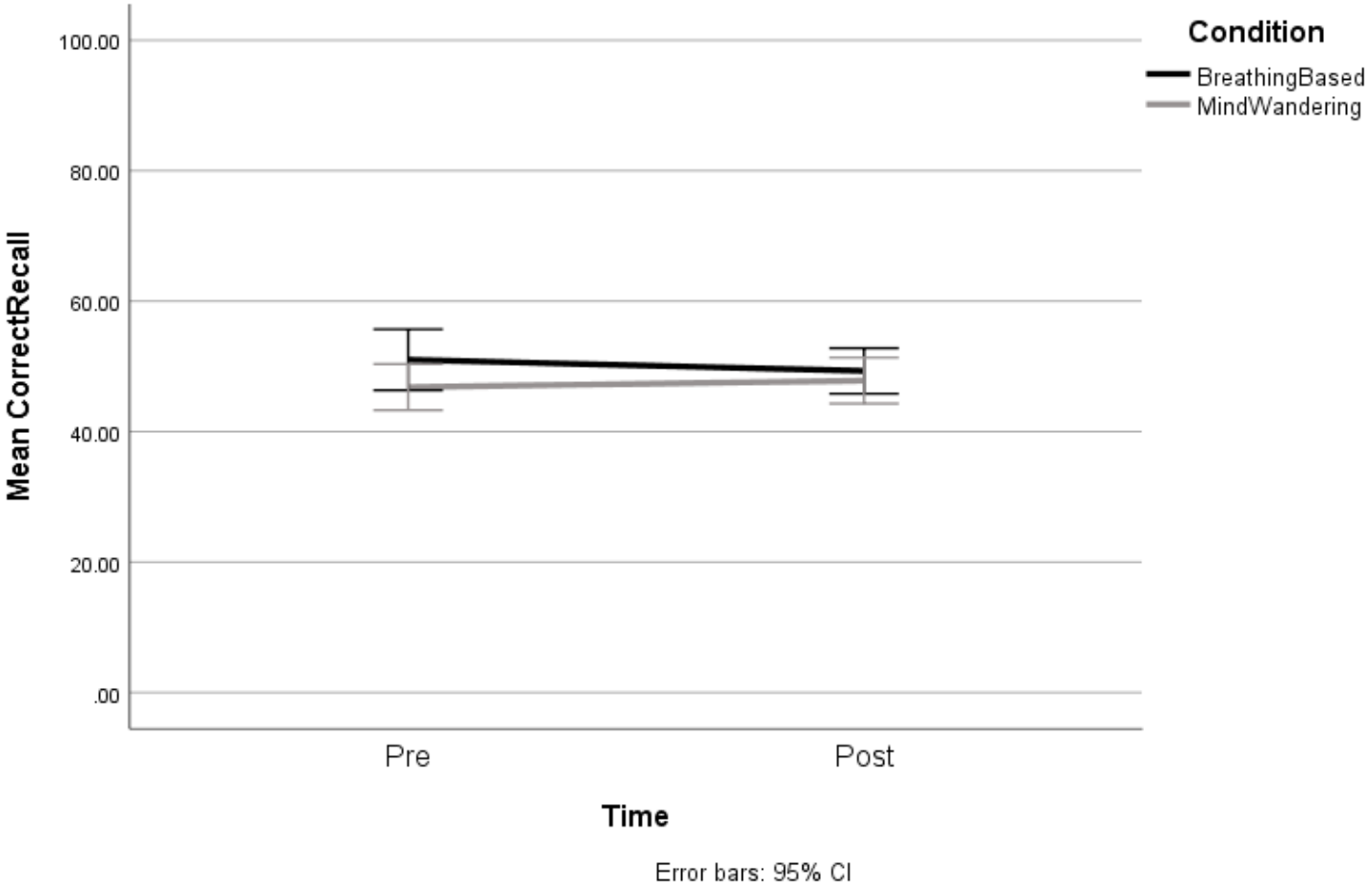
Tart, C. (1983). *States of Consciousness*. iUniverse.com, Inc. Lincoln, NE.

Van Dam, N., T., van Vugt, M., Vago, D., R., Schmalz, L., Saron, C., D., Olendzki, A., Meissner, T., Lazar, S., W., Kerr, C., E., Gorchov, J., Fox, K., C., R., Field, B., A., Britton, W., B., Brefczynski-Lewis, J., A., Meyer, D., E. (2017). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science*. doi: 10.1177/1745691617709589

Weil, A., R. (1996). Pharmacology of consciousness: A narrative of subjective experience. In S.R. Hameroff, A. W. Kaszniak, & A. C. Scott (Eds.), *Toward a science of consciousness* (pp. 677-689). Cambridge, MA: MIT Press.

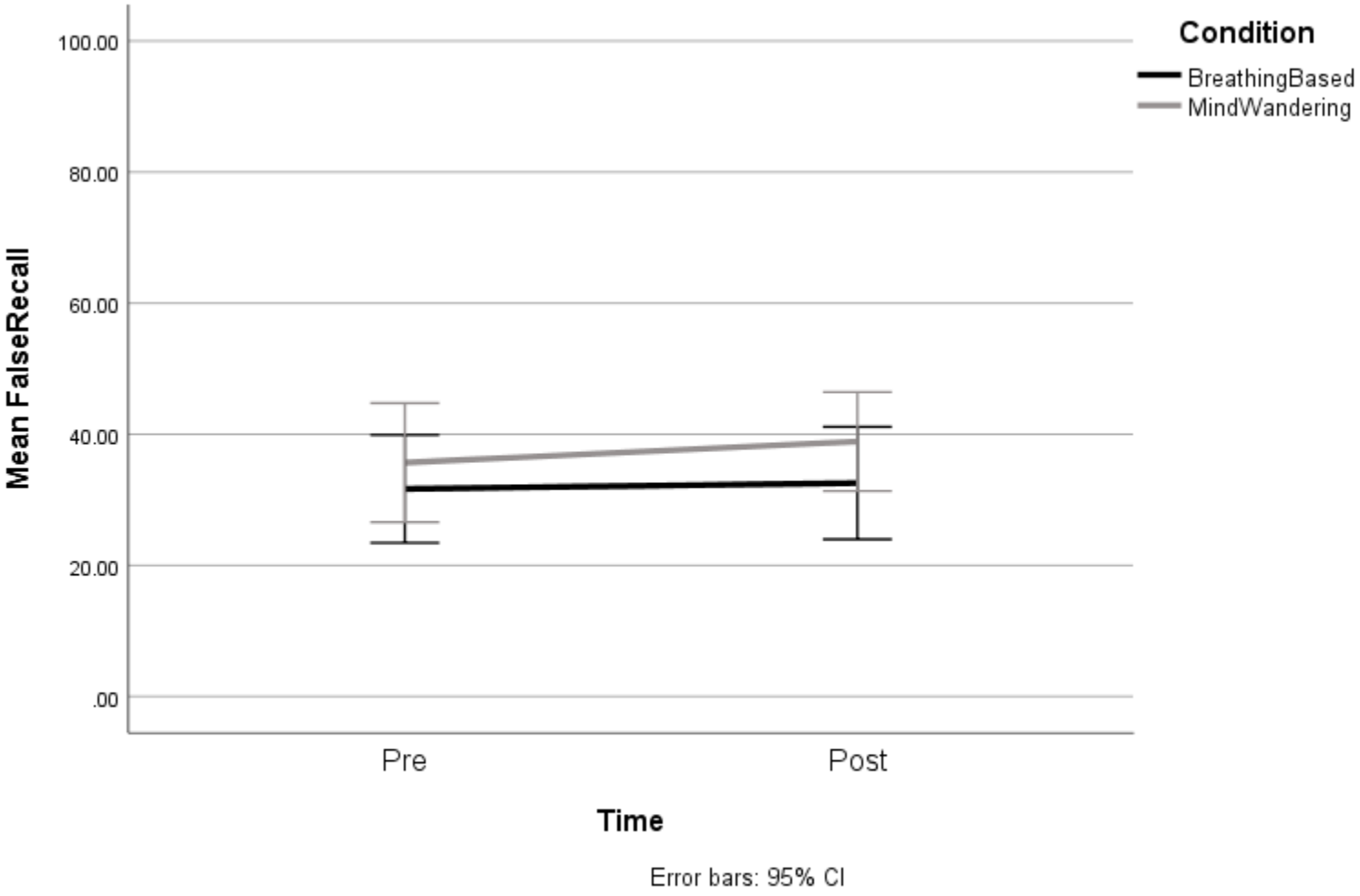
Wilson, B., M., Mickes, L., Stolarz-Fantino, S., Evrard, M, Fantino, E. (2015). Increased false-memory susceptibility after mindfulness meditation. *Psychological Science*. *26*, 1567-1573. doi: 10.1177/0956797615593705

Figure 1. Percentage of Correct Recall during Free Recall Before and After Interventions



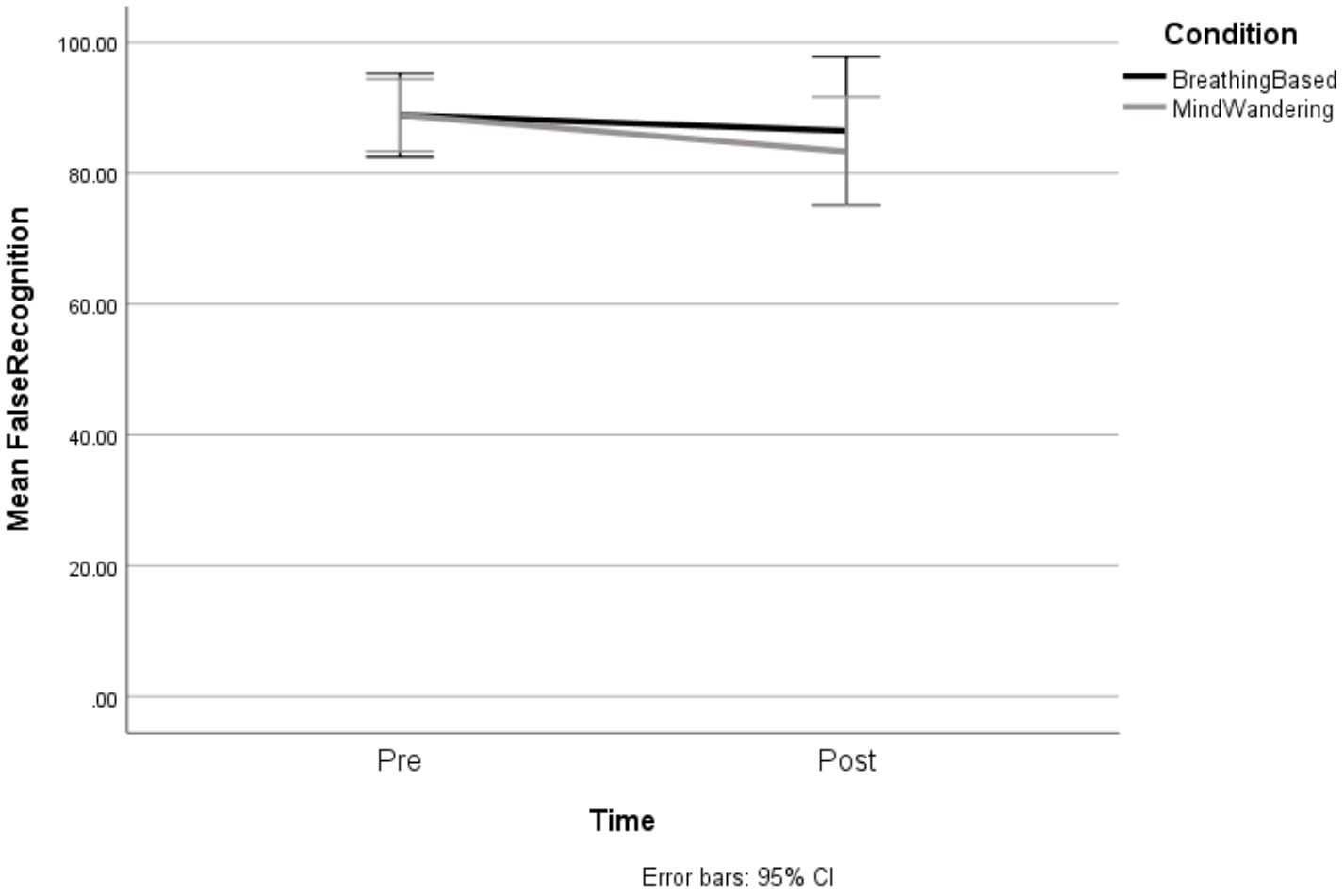
*F*Time < 1;
*F*Condition < 1;
*F*Interaction < 1

Figure 2. Percentage of False Recall during Free Recall Before and After Interventions



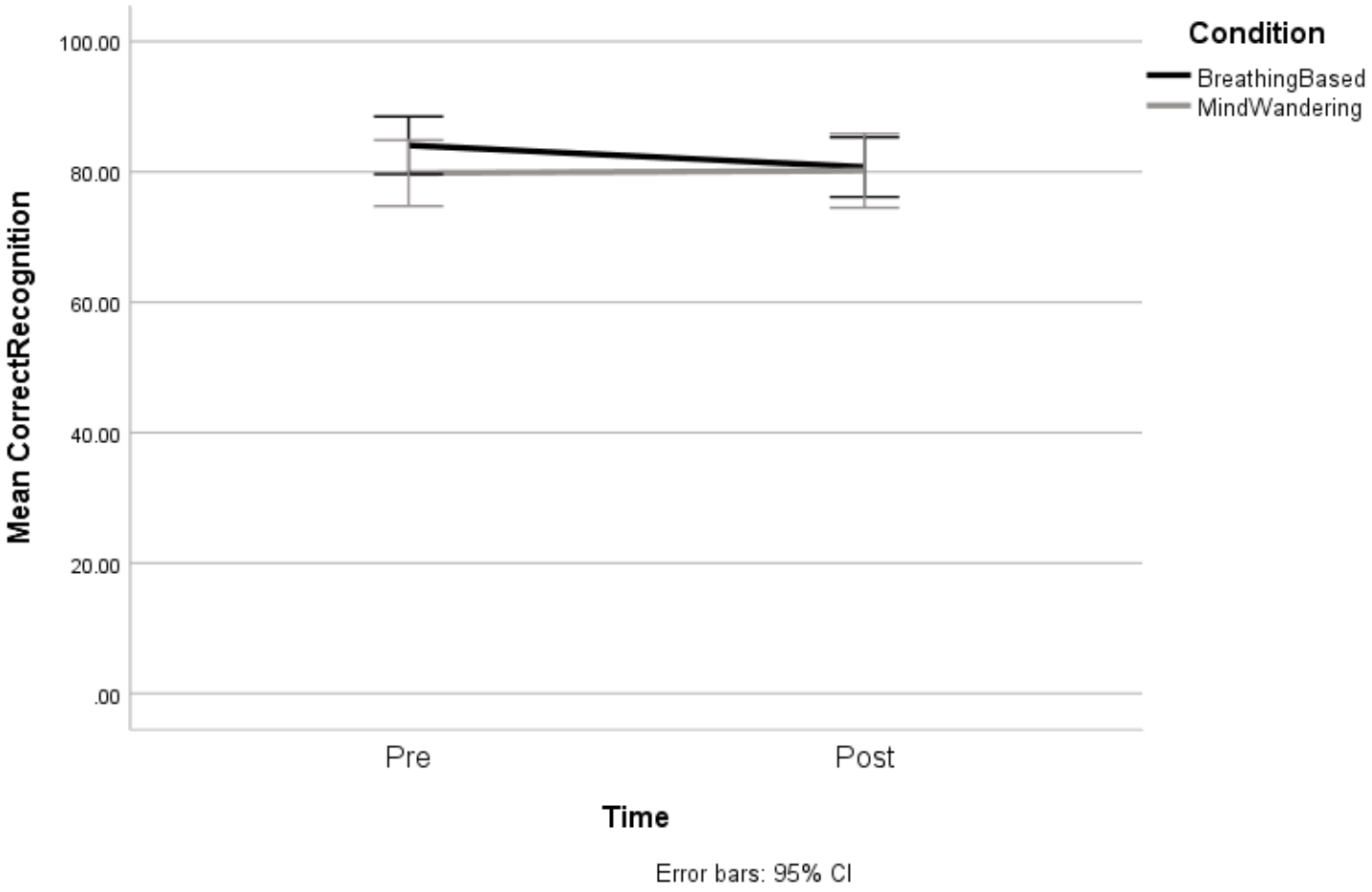
*F*Time < 1;
*F*Condition < 1;
*F*Interaction < 1

Figure 3. Percentage of False Recognition Before and After Interventions



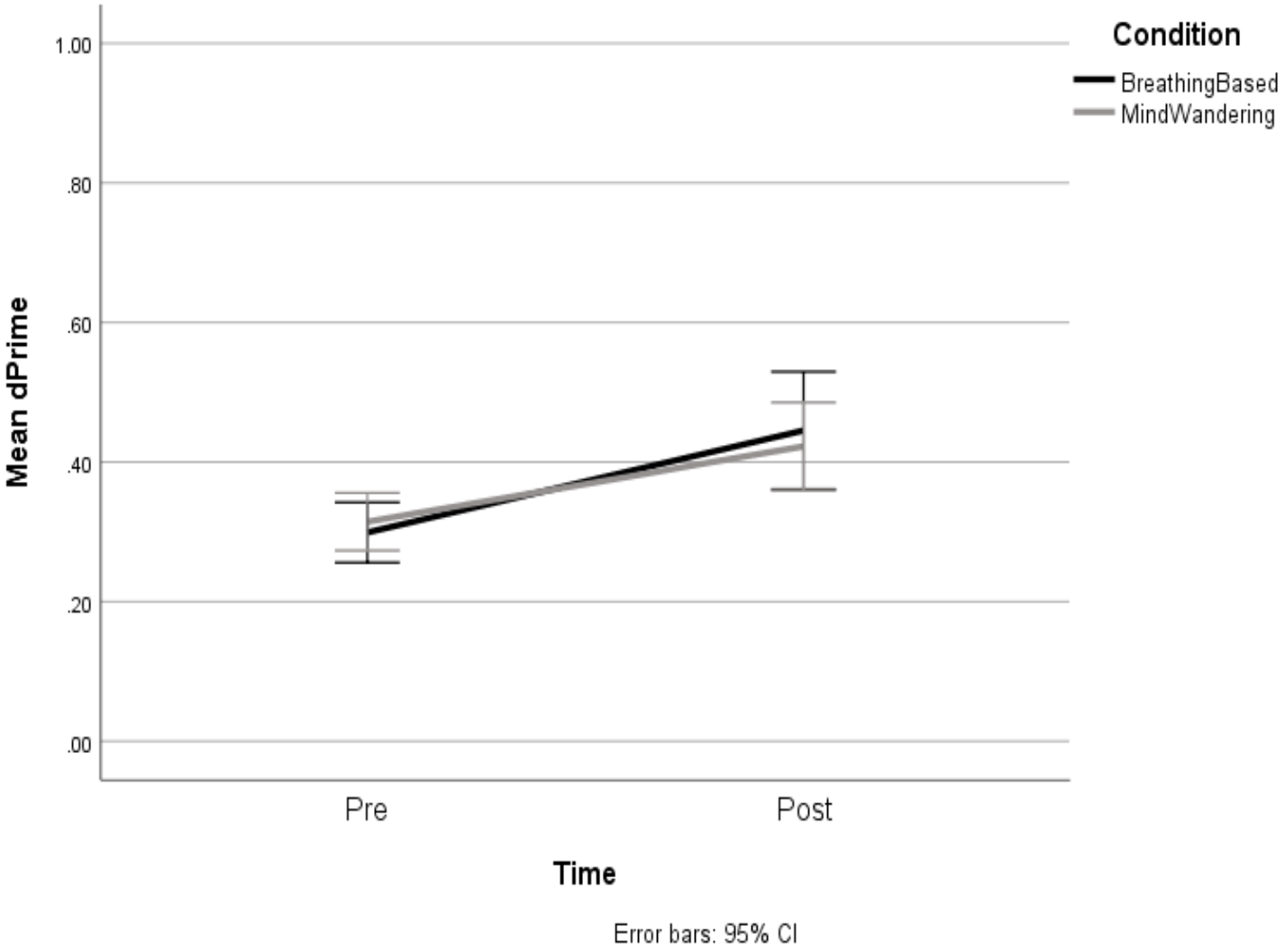
*F*Time(1, 58) = 1.353, *p* = .250, ηp2 = .023;
*F*Condition < 1;
*F*Interaction < 1;

Figure 4. Percentage of Correct Recognition Before and After Interventions.



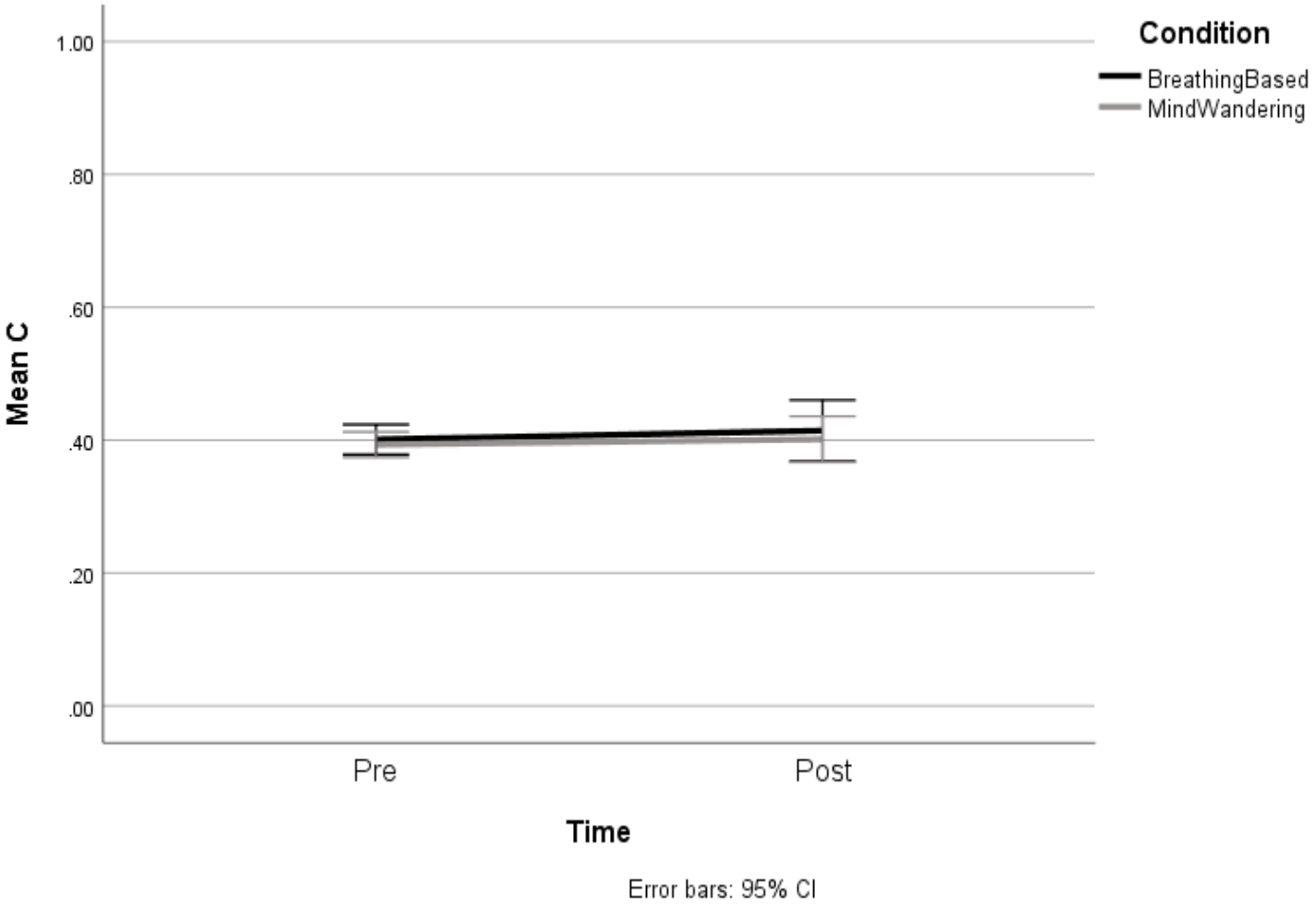
*F*Time < 1;
*F*Condition < 1;
*F*Interaction < 1

Figure 5. *d'* Measure of Accuracy Before and After Interventions



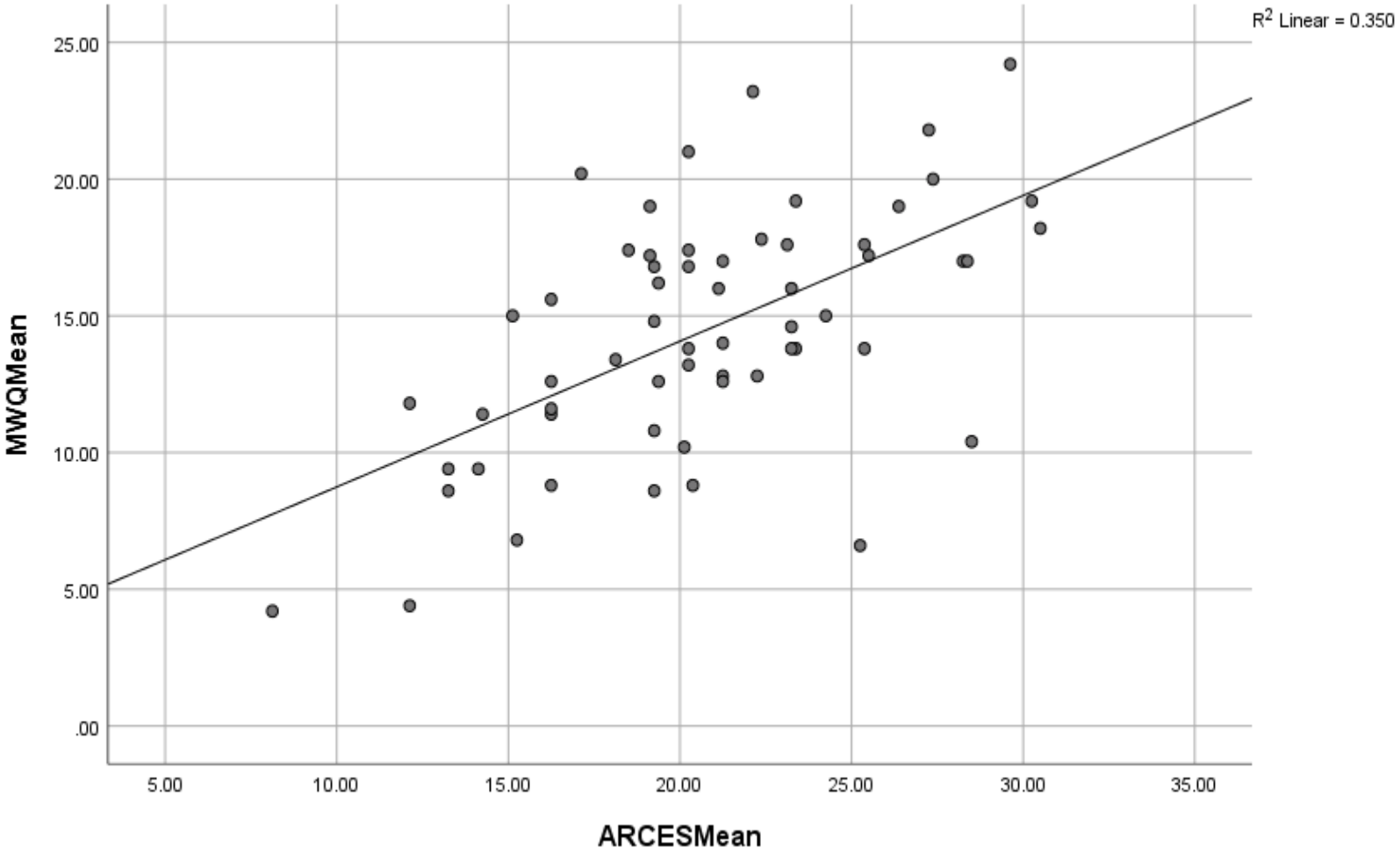
*F*Time(1, 58) = 23.15, $p < .001$, ηp2 = .285;
*F*Condition < 1;
*F*Interaction < 1

Figure 6. C Measure of Bias Before and After Interventions



*F*Time < 1;
*F*Condition < 1;
*F*Interaction < 1

Figure 7. Moderate positive correlation of ARCES and MWQ scale means



$r(60) = .592$, $p < .001$.

Table 1. Mindfulness Intervention Percentage Means, *SD*s, and 95% CI on Dependent Measures

	Breathing-Based		Mind-Wandering	
	Prescore *M*(*SD*) 95% CI	Postscore *M*(*SD*) 95% CI	Prescore *M*(*SD*) 95% CI	Postscore *M*(*SD*) 95% CI
Correct Recognition	84.07 (11.83) [79.8, 88.3]	80.74 (12.27) [76.4, 85.1]	79.81 (13.57) [75, 84.7]	80.18 (15.21) [74.7, 85.6]
False Recognition	88.88 (17.14) [82.8, 95]	86.48 (30.38) [75.6, 97.4]	88.89 (14.74) [83.6, 94.2]	83.33 (22.32) [75.3, 91.3]
Correct Recall	51.02 (12.51) [46.5, 55.5]	49.20 (9.34) [45.9, 52.5]	46.82 (9.46) [43.4, 50.2]	47.81 (9.44) [44.4, 51.2]
False Recall	31.67 (22.04) [23.8, 39.6]	32.56 (22.97) [24.3, 40.8]	35.67 (24.34) [27, 44.4]	38.89 (20.22) [31.7, 46.1]
d’	.30 (.12) [0.257, 0.343]	.45 (.23) [0.368, 0.532]	.31 (.11) [0.271, 0.349]	.42 (.17) [0.359, 0.481]
C	.40 (.06) [0.379, 0.422]	.41 (.12) [0.367, 0.453]	.40 (.06) [0.379, 0.422]	.40 (.09) [0.368, 0.432]

Table 2. Scale Means, *SD*s, and 95% CI by Mindfulness Intervention

	Breathing-based *M*(*SD*) 95% CI	Mind-wandering *M*(*SD*) 95% CI
Manipulation Check (MC)	6.66 (1.15)	6.77 (1.33)
	[6.25, 7.07]	[6.29, 7.25]
Attentional Related Cognitive Error Scale (ARCES)	2.50 (.60)	2.68 (.62)
	[2.29, 2.72]	[2.46, 2.9]
Mind-wandering Questionnaire (MWQ)	2.69 (.80)	3.09 (.92)
	[2.4, 2.98]	[2.76, 3.42]

Table 3. Correlation Matrix of Dependent Measures

Measure	1	2	3	4	5	6	7	8	9	10
1. ARCES	-	.592**	-.171	-.051	-.008	.008	.037	-.095	.229	-.002
2. MWQ		-	-.136	.080	.082	.003	.142	-.072	.168	.080
3. PrCorRecog			-	.308*	-.008	.186	.270*	.362**	-.019	.026
4. PoCorRecog				-	.017	.242	.453**	.573**	.253	.149
5. PrFalRecog					-	.308*	.007	-.036	-.003	-.058
6. PoFalRecog						-	-.005	.256*	.152	.021
7. PrCorRecall							-	.424**	.218	.278*
8. PoCorRecall								-	.187	.178
9. PrFalRecall									-	.233
10. PoFalRecall										-

Note. This table displays the Attentional-Related Cognitive Error Scale (ARCES) and the Mind-wandering Questionnaire (MWQ) along with dependent measures of recall and recognition represented by pretest (pr) and posttest (po) respectively.* indicates a significance of $p < .005$ and ** indicates a significance of $p < .001$.

Appendix A

Informed Consent

PRINCIPAL INVESTIGATOR: Larry Fort EMAIL: lfort1@students.towson.edu

Purpose of the study:

The purpose of the current study is to help us understand the relationship between mindfulness exposure and verbatim/gist memory traces. Furthermore, this research is completed as part of the principal investigator's Master's thesis under the supervision of Dr. Kerri Goodwin in the Department of Psychology at Towson University.

Inclusion/Exclusion:

To be eligible to participate in the study, students should be at least 18 years of age and have English as their native language without having participated in a similar study. Furthermore, participants should have completed the prescreen procedure on research pool. This procedure involves prospective participants completing measures of several studies to allow them eligibility to participate. Data from the prescreen measures will be used for research purposes.

Procedures:

This study will take place in one day during one session. You will be asked to listen to six word lists at 1.5 second intervals. After each list presentation, you will be given two minutes to freely recall any you remember by writing your responses in the provided packet. You will then have five minutes to complete a maze packet. After, you will complete a recognition task where you will identify items that may or may not have been on the lists. Then you will listen to 15 minutes of audio and complete a mindfulness scale. Finally, you will be asked to do the same tasks as before the intervention with new words. Your participation should be approximately one hour. You will receive 4 research credits for your participation.

Risks/Discomfort:

There are no known risks for participating in our study. Any discomfort that you experience during our study will be no different from that experienced in everyday life activities.

Benefits:

You will learn about verbatim/gist memory traces and mindfulness. Furthermore, you will learn how laboratory research in psychology is conducted. The results are beneficial in that they may

help us gleam the effect of altering human consciousness (mindfulness exposure) on cognitive operations such as verbatim and gist memory traces.

Alternatives to Participation:

Participation in this study is voluntary. You are free to withdraw or discontinue participation at any time. Withdrawal of participation at any time will not result in penalty or loss of benefits entitled to you, this includes withdrawing in the middle of the study. Non-participation will not impact your class standing. There are no circumstances under which the researcher will terminate one's participation.

Confidentiality:

Your privacy will be protected as you will not be identified by name as a participant in this project.

All records from this study will be kept confidential. Your responses will be kept private and we will not include any information that will make it possible to identify you in any report we might publish. Research records will be stored securely in a locked cabinet and on password protected computers.

If you understand everything in this document, and agree to participate in this study, please INITIAL the statements and sign your name below.

_____ I am at least 18 years of age.

_____ I have read the information on this form and I understand it.

_____ All questions I have been answered to my satisfaction and understanding.

OVER □

_____ _____

Participant's Signature Date

_____ _____

Participant's Printed Name Email Address

_____ _____

Witness to Consent Procedures Date

If you have any questions regarding this study please contact Dr. Kerri Goodwin at (410) 704-3202 or kgoodwin@towson.edu, or the Institutional Review Board Chairperson, Dr. Elizabeth Katz, Office of University Research Services, 8000 York Road, Towson University, Towson, Maryland 21252; phone (410) 704-2236.

THIS PROJECT HAS BEEN REVIEWED BY THE INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN PARTICIPANTS AT TOWSON UNIVERSITY.

**If investigator is not the person who will witness participant's signature, then the person administering the informed consent should write his/her name and title on the "witness" line.

Appendix B

Word Lists

SMELL	DOCTOR	WINDOW
nose	nurse	door
breathe	sick	glass
sniff	lawyer	pane
aroma	medicine	shade
hear	health	ledge
see	hospital	sill
nostril	dentist	house
whiff	physician	open
scent	ill	curtain
reek	patient	frame
stench	office	view
fragrance	stethoscope	breeze
perfume	surgeon	sash
salts	clinic	screen
rose	cure	shutter

CHAIR	ANGER	SOFT
table	mad	hard
sit	fear	light
legs	hate	pillow
seat	rage	plush
couch	temper	cloud
desk	fury	cotton
recliner	ire	fur
sofa	wrath	touch
wood	happy	fluffy
cushion	fight	feather
swivel	hatred	furry
stool	mean	downy
sitting	calm	kitten
rocking	emotion	skin
bench	enrage	tender

SWEET	NEEDLE	SMOKE
sour	Thread	cigarette

candy
sugar
bitter
good
taste
tooth
nice
honey
soda
chocolate
heart
cake
tart
pie

pin
eye
sewing
sharp
point
prick
thimble
haystack
thorn
hurt
injection
syringe
cloth
knitting

puff
blaze
billows
pollution
ashes
cigar
chimney
fire
tobacco
stink
pipe
lungs
flames
stain

TRASH
garbage
waste
can
refuse
sewage
bag
junk
rubbish
sweep
scraps
pile
dump
landfill
debris
litter

ROUGH
smooth
bumpy
road
tough
sandpaper
jagged
ready
coarse
uneven
riders
rugged
sand
boards
ground
gravel

SLEEP
bed
rest
awake
tired
dream
wake
snooze
blanket
doze
slumber
snore
nap
peace
yawn
drowsy

Appendix C

Recognition Task Example

PRE

Rate the following on your confidence that the word was presented (old).
(4 = certainly old, 3 = probably old, 2 =probably new, 1 = certainly new).

ROUGH	4 3 2 1
SMOOTH	4 3 2 1
COARSE	4 3 2 1
RIDERS	4 3 2 1
MOUSE	4 3 2 1
BOMB	4 3 2 1
CHAIR	4 3 2 1
SOFA	4 3 2 1
CUSHION	4 3 2 1
TABLE	4 3 2 1
HARP	4 3 2 1
DOG	4 3 2 1
DOCTOR	4 3 2 1
NURSE	4 3 2 1
PHYSICIAN	4 3 2 1
PATIENT	4 3 2 1
CAR	4 3 2 1
CAT	4 3 2 1
SMELL	4 3 2 1
NOSE	4 3 2 1

WHIFF	4 3 2 1
REEK	4 3 2 1
LACE	4 3 2 1
FINGER	4 3 2 1
ANGER	4 3 2 1
MAD	4 3 2 1
WRATH	4 3 2 1
FIGHT	4 3 2 1
RAINBOW	4 3 2 1
DANCE	4 3 2 1
SOFT	4 3 2 1
HARD	4 3 2 1
TOUCH	4 3 2 1
FEATHER	4 3 2 1
GIRAFFE	4 3 2 1
TACO	4 3 2 1

POST

Rate the following on your confidence that the word was presented (old).
(4 = certainly old, 3 = probably old, 2 =probably new, 1 = certainly new).

SWEET 4 3 2 1

SOUR 4 3 2 1

NICE 4 3 2 1

SODA 4 3 2 1

HORSE 4 3 2 1

TOOTHBRUSH 4 3 2 1

WINDOW 4 3 2 1

DOOR 4 3 2 1

OPEN 4 3 2 1

FRAME 4 3 2 1

ROSE 4 3 2 1

RAIN 4 3 2 1

SLEEP 4 3 2 1

BED 4 3 2 1

BLANKET 4 3 2 1

SLUMBER 4 3 2 1

CARROT 4 3 2 1

ACE 4 3 2 1

TRASH 4 3 2 1

GARBAGE 4 3 2 1

RUBBISH 4 3 2 1

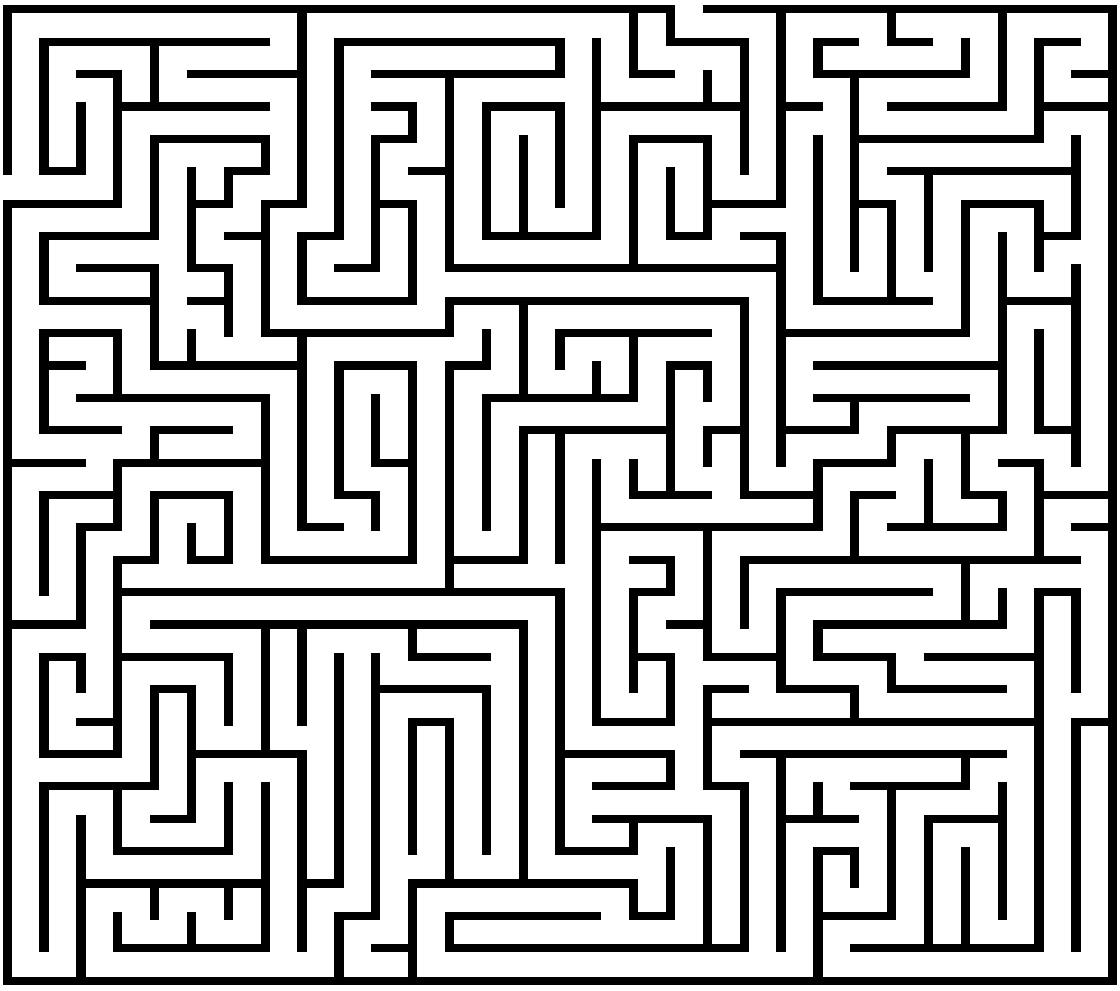
SCRAPS 4 3 2 1

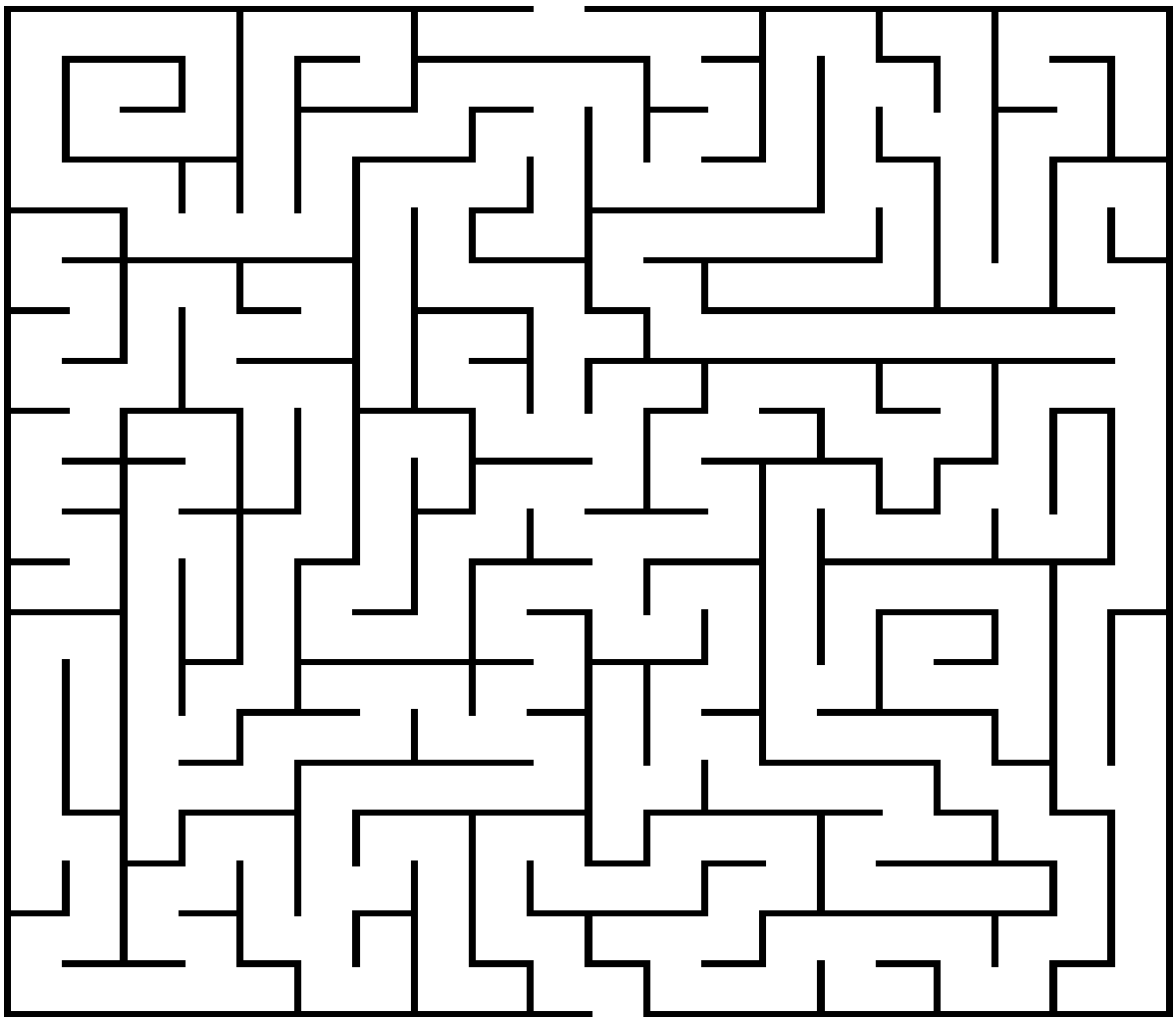
CLOCK 4 3 2 1

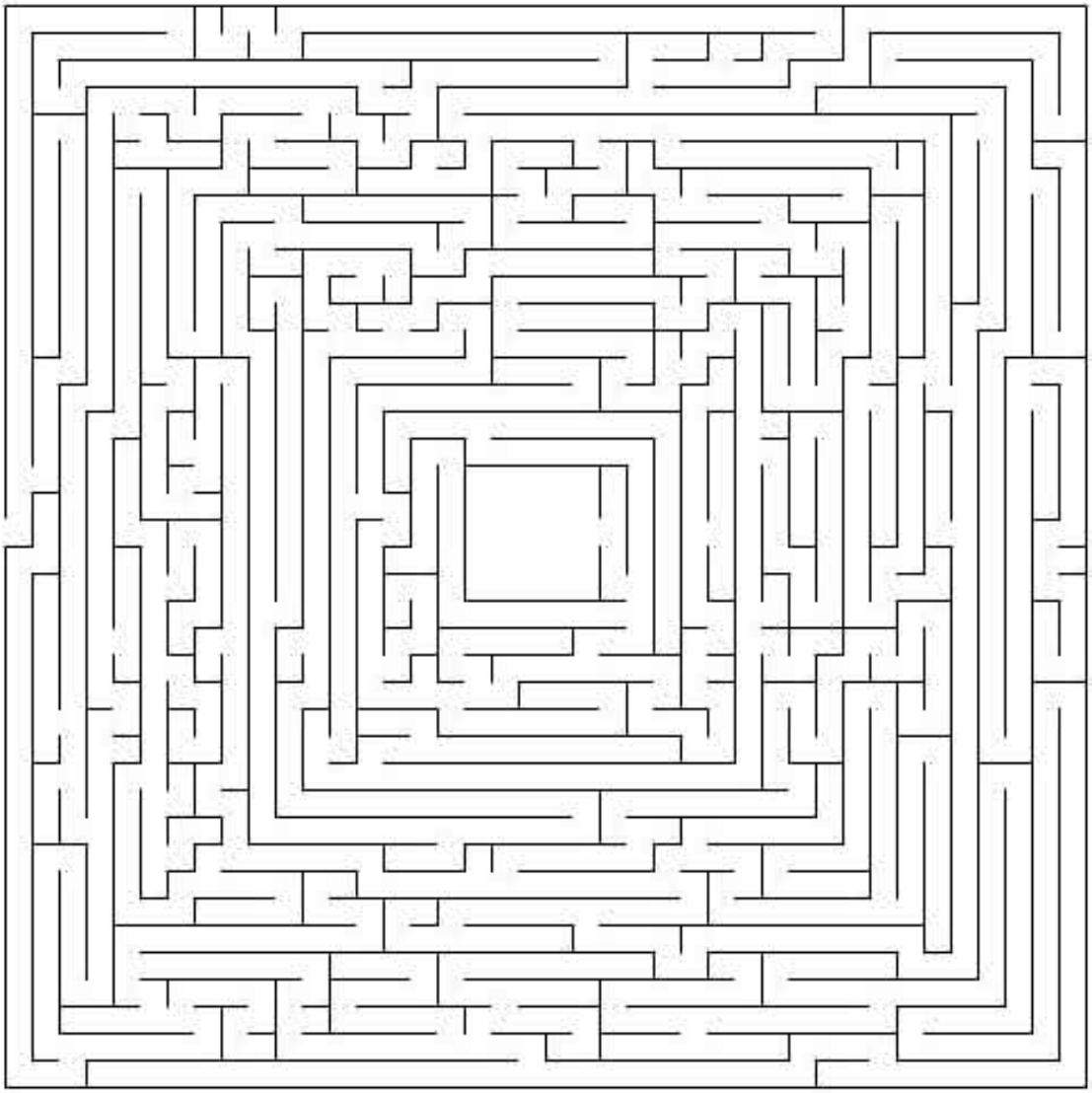
SPONGE	4 3 2 1
NEEDLE	4 3 2 1
THREAD	4 3 2 1
THIMBLE	4 3 2 1
THORN	4 3 2 1
DUCK	4 3 2 1
RABBIT	4 3 2 1
SMOKE	4 3 2 1
CIGARETTE	4 3 2 1
ISLAND	4 3 2 1
THIN	4 3 2 1
CHIMNEY	4 3 2 1
TOBACCO	4 3 2 1

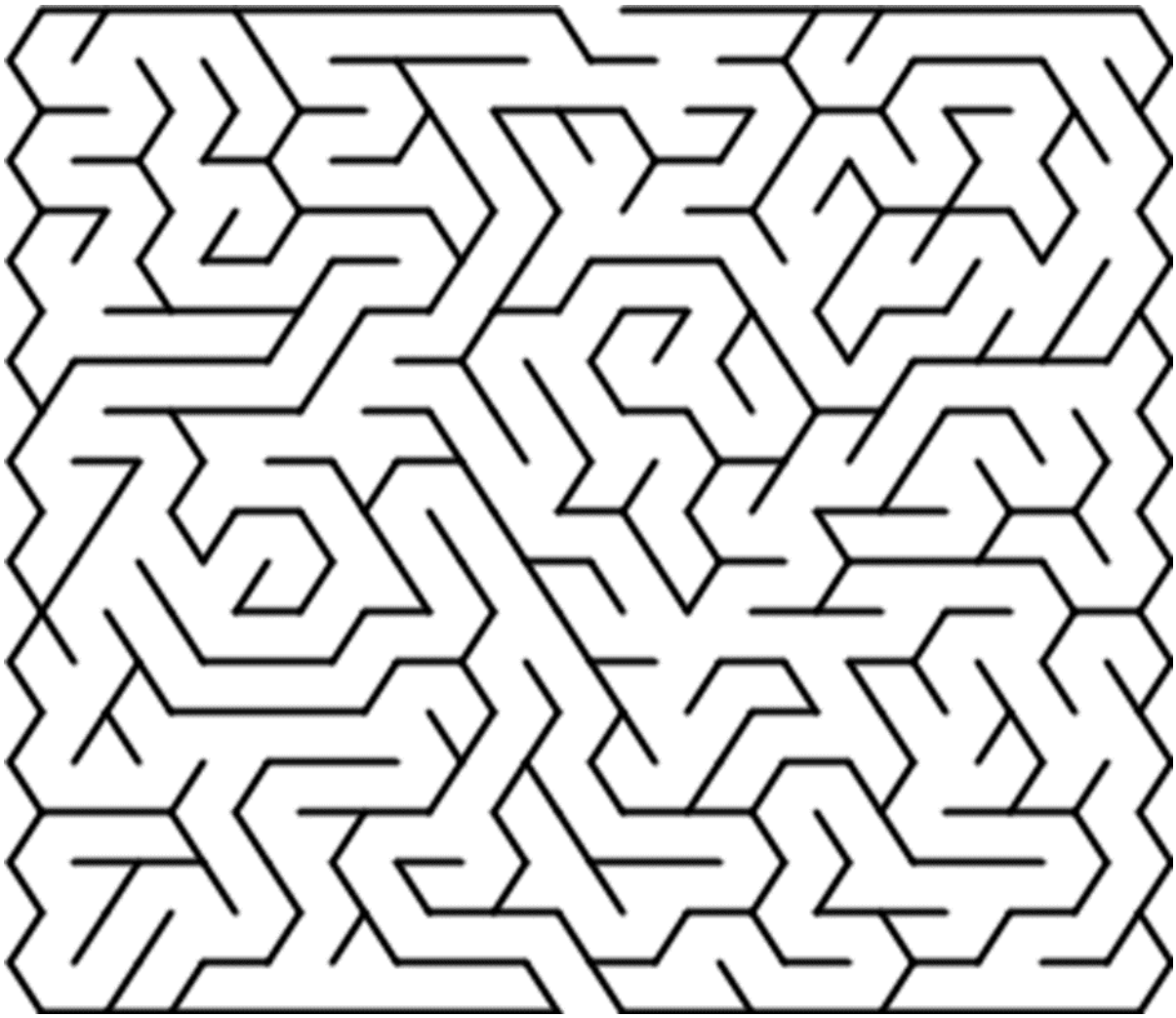
Appendix D

Maze Filler Task









Appendix E

Mind-wandering Questionnaire

Please circle the items as they apply to you: (1- almost never, 2- very infrequently, 3 – somewhat infrequently, 4 – somewhat frequently, 5 – very frequently, 6 – almost always)

1. I have difficulty maintaining focus on simple or repetitive work.

1 2 3 4 5 6

2. While reading, I find I haven't been thinking about the text and therefore must read it again.

1 2 3 4 5 6

3. I do things without paying full attention.

1 2 3 4 5 6

4. I find myself listening with one ear, thinking about something else at the same time.

1 2 3 4 5 6

5. I mind-wander during lectures of presentations.

1 2 3 4 5 6

Appendix F

Attention-Related Cognitive Error Scale

Please circle the items as they apply to you: (1- never, 2- almost never, 3 – sometimes, 4 – often, 5 – very often)

1. I have absent-mindedly placed things in unintended locations (e.g., putting milk in the pantry or sugar in the fridge).
1 2 3 4 5

2. When reading I find that I have read several paragraphs without able to recall what I read.
1 2 3 4 5

3. I have misplaced frequently used objects, such as keys, pens, glasses, etc.
1 2 3 4 5

4. I have found myself wearing mismatched socks or other apparel.
1 2 3 4 5

5. I have gone into a room to get something, got distracted, and left without what I went there for.
1 2 3 4 5

6. I fail to see what I am looking for even though I am looking right at it.
1 2 3 4 5

7. I begin one task and get distracted into doing something else.
1 2 3 4 5

8. I absent-mindedly mixed up targets of my action (e.g., pouring or putting something into the wrong container).
1 2 3 4 5

Appendix G

Manipulation Check

Please circle the number on how much it relates to your experience (1 = most unlike my experience; 10 = most like my experience).

1) I feel calm

1 2 3 4 5 6 7 8 9 10

2) I feel focused on the present

1 2 3 4 5 6 7 8 9 10

3) I feel free of judgment

1 2 3 4 5 6 7 8 9 10

4) I feel as if I am witnessing my own experience

1 2 3 4 5 6 7 8 9 10

5) I feel more in touch with myself

1 2 3 4 5 6 7 8 9 10

Appendix H

IRB Approval

IRB Approval 1903048600 Inbox ×

IRB <irb@towson.edu> Tue, Apr 30, 11:21 AM

to me, IRB, Kerri

The IRB has approved your protocol "Manipulating Consciousness: False Memory Susceptibility in Mindfulness Exposure," **effective 4/30/2019 and expiring 4/29/2020.**

Your IRB protocol can now be viewed in MyOSPR. **Student investigators - protocols can be viewed by your faculty advisor.** For more information, please visit the MyOSPR Desktop Grant Software webpage.

Since your application has been approved via standard review, your protocol requires annual continuing review and renewal. Please submit a completed copy of the form prior to your expiration date. If you complete your research prior to the renewal date, please return a completed copy of the IRB Protocol Closure Form to the IRB so your protocol may be officially closed out.

Please Note: *Formal approval letters are provided upon request. If you would like to have one drafted, please notify the IRB staff.*

If you should encounter any new risks, reactions, or injuries to subjects while conducting your research, or require changes to your current protocol, please notify IRB@towson.edu. Should there be substantive changes in your research protocol, you will need to submit another application.

We wish you much success in your research endeavors.

Sincerely,

Towson IRB

Appendix I

Demographic Sheet

Age: _____

Gender:

a. Male
b. Female
c. Other

Race:

a. African American/Black
b. Asian/Pacific Islander
c. Caucasian/White
d. Hispanic/Latino/Latina
e. Native American
f. Middle Eastern
g. Other, Biracial, Multiracial

Is English your first language?

a. Yes
b. No

CURRICULUM VITAE

Name: Larry Douglas Fort

Contact Information: [redacted]

Education:

M.A. (anticipated)	2019	Experimental Psychology Towson University, Towson, Maryland
B.S.	2017	Psychology (Minor in English) Stevenson University, Stevenson, Maryland
Diploma	2013	Urbana High School, Frederick, Maryland

Research Interests:

-Altered States of Consciousness
-Neurocomputational and Neuroimaging Approaches to Consciousness

Research Experience:

Research Intern, **Freie Universität**, Berlin, Germany, July 2019-September 2019. Responsible for learning and utilizing MatLab as well as fMRI scanning protocols and data analytics. Additionally, learning to operate TMS and EEG equipment for data collection. *Supervisor: Timo Schmidt, several hours a week*.

Graduate Research Assistant, **Towson University**, Towson, Maryland, August 2017-Current. Responsible for developing hypotheses and methods relating to cognitive psychology. Additionally, responsible for assisting the lab in running research protocols ranging from questionnaires to O-SPAN/R-SPAN tasks for eventual presentation and/or publication. *Supervisor: Kerri Goodwin, several hours a week.*

Research Assistant, **Stevenson University**, Stevenson, Maryland, May 2016-May 2017. Responsible for developing hypotheses and methods, promoting cohesion within the laboratory environment, knowing basic biological research techniques,

animal husbandry, data management, and conducting ethical animal behavioral observations. *Supervisor: Ingrid Tulloch, 8 hours a week.*

Research Publications:

Fort, L., D., & Tulloch, I. (2016). Behaviors of a captive coenobita clypeatus in the presence of varying light stimuli. *Modern Psychological Studies*. *21(2).* 23-32.

Research Presentations:

Fort, L., D. (2019). Manipulating consciousness: False memory in mindfulness exposure. The Science of Consciousness Conference. Interlaken, Switzerland.

Fort, L., D. & Ford, S. (2018). Altering consciousness: Acute mindfulness exposure decreases verbatim trace reliance. Psychonomic Society. New Orleans, LA.

Fort, L., D. (2018). The Quantum Mind: Consciousness and 'Spooky' Cognition. Psychological Graduate Student Conference. Towson University, Towson, MD.

Fort, L., D., Berger, K., & Heeke, M. (2018). Should I Stay or Should I Go: Personality Traits and Physiological Responses in Decision Making. Psychological Graduate Student Conference. Towson University, Towson, MD.

Clein, R., S., **Fort, L., D.**, Ewart, L., & Leonard, A. (2017). Assessment of behavioral, neurochemical, and cellular effects of light manipulation in coenobita clypeatus. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L., D. (2017). To read or not to read: the effect of positive reinforcement on reading behavior. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Ewart, L., Shah, S., & **Fort, L., D.** (2017). Habituation and sensitization in coenobita clypeatus. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Clein, R., **Fort, L., D.**, Hastings, S., Shah, S., & Tulloch, I. (2016). Varying wavelengths of light alters serotonin positive cells and associated behaviors in coenobita clypeatus. Annual Biomedical Research Conference for Minority Students. Tampa, FL.

Fort, L., D., & Hastings, S. (2016). Behaviors of coenobita clypeatus in the presence of varying light stimuli. Experiential Learning Expo, Stevenson University, Stevenson, MD.

Fort, L. D., & Metzger, R. (2016). Escape from reality: daydreaming and dissociation. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L., D., & Hastings, S. (2016). Behaviors of coenobita clypeatus in the presence of varying light stimuli. Eastern Psychological Association National Conference. Marriott Hotel, New York City, NY.

Fort, L., D., & Hastings, S. (2016). Behaviors of coenobita clypeatus in the presence of varying light stimuli. Paul D. Lack Scholar's Showcase. Stevenson University, Stevenson, MD.

Fort, L., D, Taverna, S., Guzman, E., & Self, B. (2015). Service learning at Asylee Women's Enterprise. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L., D., Kaur, K., Schlinder, C., & Rampath, A. (2015). The relationship between race, memory of a crime, and crime policy preference. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L., D., & Hastings, S. (2015). Behaviors of coenobita clypeatus in the presence of varying light stimuli. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L. D., & Metzger, R. (2015). Maladaptive daydreaming prediction scale (MDPS): a study of reliability. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Fort, L. D., (2015). Light discrimination in coenobita clypeatus. Psychology Student Showcase. Stevenson University, Stevenson, MD.

Teaching Experience:

Graduate Teaching Assistant, **Towson University**, Towson, Maryland, August 2017-August 2018. Responsible for assisting professors in guiding class discussions, giving lectures, grading, and providing out of class study sessions for assigned undergraduate classes including Behavioral Statistics, Human Development and Introduction to Psychology. Additionally, responsible for grading papers and examinations. *Supervisor: Geoff Munro, 10 hours a week.*

Teaching Assistant, **Stevenson University**, Stevenson, Maryland, August 2016-May 2017. Responsible for assisting professors in guiding class discussions, giving lectures, and providing out of class study sessions for both biopsychology and research methods II. Furthermore, extensive review of student papers for content, mechanics, grammar, and APA style. *Supervisor: Ingrid Tulloch, 8 hours a week.*

Supplemental Instructor (SI), **Stevenson University**, Stevenson, Maryland, February 2014-2015. Responsible for reviewing written works by students for grammar, organization, and content. Additionally, instructing briefly on the mechanics of grammar and style. *Supervisor: Christine Flax, 6 hours a week.*

Literary Publications:

Fort, L., D., (2019). **Eigenlicht**. In R. Butts & A. Uzzell (Eds.) *Tales of the Siblings-Not-So-Grim*. Laflin, PA: Hollow Hills Publishing.

Fort, L., D., (2018). **We Called It Azimov**. In R. Butts & A. Uzzell (Eds.) *Still Standing*. Laflin, PA: Hollow Hills Publishing.

Training and Certifications:

Research Proposal Writing Workshops**, Berlin School of Mind and Brain**, Summer 2019

Social and Behavioral Responsible Conduct of Research Training, **Collaborative Institutional Training Initiative (CITI)**, Fall 2017

Responsible Conduct of Research Training, **Collaborative Institutional Training Initiative (CITI)**, Fall 2014

Students Conducting Course-based Research Training, **Collaborative Institutional Training Initiative (CITI),** Fall 2014

QPR Gatekeeper Training for Suicide Prevention, Fall 2013

Honors and Awards:

Einstein-Berlin Mind & Brain Travel Award, 2019
Who's Who Among Students in American Colleges & Universities, 2016
Alpha Chi Honor Society Membership, 2015
PsiChi Membership, 2015
Delta Epsilon Iota Honor Society Membership, 2014
Dean's List, Stevenson University, 2013-2017