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Does Mindful Meditation Enhance Eyewitness Memory and Prevent the Misinformation Effect?

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Abstract

Engaging in a brief mindful meditation task prior to witnessing an event may enhance event encoding and reduce susceptibility to post-event misinformation. Participants in this study completed either a 3-minute mindful meditation exercise or an unrelated filler task (Sudoku). Half of the participants in each group were first told their task was beneficial to memory, while the other half were told nothing. After completing the task, all participants viewed a video of a fictitious crime. After viewing the video, they listened to a narrative that introduced misleading information about the video. Finally, they took a memory test on the video. Despite data indicating that the mindful meditation task was effective, there was no difference between the two groups on memory performance. However, regardless of the task completed prior to the video, participants who were told they were doing something beneficial to memory reported fewer false memories. Finally, a correlation analysis found that for participants who engaged in the meditation task, greater states of mindfulness were associated with fewer reports of misinformation and a decrease in their ability to recollect discrepancies between the video and narrative. The same correlations were not significant in the control group. These findings have interesting implications for the relationship between mindfulness and memory. It appears that mindful meditation decreases a participant's ability to evaluate incoming information.

Keywords: Misinformation Effect, Mindful Meditation, Discrepancy Recollection Task

Introduction

Imagine being the only witness to a burglary, leaving you to be the one reliable eyewitness to testify in court. You must provide an infallible account of the events that transpired or else an innocent individual's freedom might be in jeopardy while the real felon escapes. However, before you can testify you meet with a police officer and give an official report of the incident. During this initial interview, he phrases questions in such a way that makes you question your original memory. At one point he states that "the man must have been awfully skinny in order to fit through that tiny space and steal those jewels, don't you think?" By saying this one comment, the police officer suggests the burglar was a lanky male. Even though you know the officer never saw the burglar, his statements implies that the burglar was a skinny man. The day of the trial, you confidently take the stand and identify the burglar. Eventually the case closes and the man on trial is convicted and sent to prison. Meanwhile, you go home thinking you relieved society of a criminal. Yet, what if you were wrong? What if the police officer's suggestions distorted your original memory while simultaneously making you feel more confident in your testimony?

Criminal cases often depend on the testimony of eyewitnesses. However, countless studies have found that the memories of eyewitnesses are actually quite pliable and easily distorted by leading questions or suggestions. A leading question is when an idea is suggested in the form of a question. For instance, the police officer in the previous example gave a leading question since his questioning encouraged the idea that the burglar was a skinny male. In the scenario described, by hearing the suggestion "skinny" and "man," your original memory may have been replaced or became less accessible due to the incorrect information. That is, the exposure to false information influenced your memory. Thus, even if you witnessed a burglar fitting a different description, you may erroneously recall a skinny man when later asked.

Suggested information can also be presented by other eyewitnesses or news reports. In either situation, exposure to inaccurate details about an event can interfere with an eyewitness's memory.

The scenario given here may seem farfetched, but unfortunately incorrect verdicts caused by faulty eyewitness memory are not rare. In fact, the Innocence Project, a group that utilizes DNA to exonerate innocent individuals from prison, found that out of the 200 individuals whose convictions were overturned due to new DNA evidence, 75% of them had been convicted due to faulty eyewitness testimony (Innocence Project, 2008). Yet, as illustrated in the previous burglary example, eyewitnesses are often unaware of their inaccurate memories, and instead are confident in their reports. This has led to an area of research on a phenomenon known as the *misinformation effect* (e. g., Pickerell, Bernstein, & Loftus, 2012). The concept of the misinformation effect is simple; an individual exposed to misinformation may incorporate that false information into their memory of a witnessed event. Therefore, in the example previously given, the witness's memory was susceptible to the misleading information suggested by the police officer.

Over the past several decades, researchers have formulated several theories to explain the misinformation effect. However, there is still no definitive answer, and new discoveries are still being made regarding the phenomenon. This continuous exploration is partly due to the devastating repercussions of the misinformation effect, as evidenced by the work done by the Innocence Project. Advancement in this field of study is necessary in order to ensure that no innocent person is wrongfully convicted due to faulty eyewitness memory.

In order to find techniques to prevent the misinformation effect and advance knowledge in this field, one must take a creative approach. For instance, this study investigates whether the

traditional Buddhist practice known as mindful meditation can prevent the misinformation effect. Although the practice has been around for centuries, recent empirical data on mindful meditation has sparked an interest in utilizing the practice for other purposes, such as enhanced cognitive ability. New technological advances have allowed scientists to see the connection between mindful meditation and the brain, thus linking meditation to alleviation of depression, anxiety, and ADHD (Chambers, Lo, & Allen, 2007; Holzel, Gard, Schuman-Olivier, Vago, & Ott,, 2016; Sauer-Zavala, Walsh, Eisenlohr-Moul, & Lykins, 2012). Other studies have found that mindfulness can help a person achieve lower blood pressure, stress reduction, increased alertness, and an improved working memory capacity (Grecucci, Pappaianni, Siugzdaite, Theuninck, & Job, 2015; Hawk, 2014, Lai, MacNeil, & Frewen, 2015). The present study was inspired after review of the many physical and mental health benefits associated with mindful meditation. Although a couple of previous studies analyzed the relationship between mindful meditation and false memory, few used a brief mindfulness task or looked specifically at the misinformation effect (see Rosenstreich, 2015; Wilson, Mickes, Stolarz-Fantino, Evrard, & Fantino, 2015). One study did use a brief mindfulness task, but the primary focus was on how animated versus unanimated words impacted the misinformation effect (Lloyd, Szani, Rubenstein, Colgary, & Pereira-Pasarin, 2016). Since there is limited research on the relationship between the misinformation effect and meditation, this study aims to answer whether mindful meditation can prevent the misinformation effect. It is proposed that mindful meditation may help people to focus on and better encode details from a witnessed event, and thus be less susceptible to misleading post-event information.

The Misinformation Effect

In order to fully understand the misinformation effect, it is vital to understand how memory functions. Memory storage is a process that is constantly changing. According to Diekelmann (2008), people's memories are not simply films one can play back. Memories are pliable and can be influenced by external forces, such as a leading question or by information that is already stored in the brain, such as thoughts and existing associations between concepts (Laney & Loftus, 2013). However, these faulty eyewitness's memories, caused by their pliable memory, become difficult to examine in the real world, especially since real world settings are not in a scientific, controlled environment. Therefore, scientists have tried to recreate false memories in the lab to further understand their origin and ways to avoid them. One common paradigm used to study false memories in a lab setting is the Deese-Roediger-McDermott (DRM) paradigm (Roediger & McDermott, 1995). The DRM is one of the oldest false memory paradigms that focuses on associative memory. In the DRM paradigm, participants study a list of closely related words (*e.g., bed, rest, nap, pillow*) and, after a duration of time, are tested on what words were on the list. Overwhelmingly, participants will report remembering a non-studied "lure" word, such as *sleep* (Eslick, Fazio & Marsh, 2011). Participants erroneously believe they actually saw this critical lure word because it was closely associated with other, similar words on the test and therefore seems familiar. In other words, false memories are internally generated via automatic associations individuals have between concepts.

More relevant to the present study are laboratory paradigms that directly impact memory for a witnessed event through suggestion. In one of the earliest studies on eyewitness memory errors, Loftus and Palmer (1974) had participants watch a video of an automobile collision. Following the video, participants were asked to estimate the speed of the vehicles. However, the wording of the question differed across subjects. Some participants were asked "how fast were

the cars going when they *bumped* into each other?", whereas other participants were asked, "how fast were the cars going when they *smashed* into each other?" The group that heard the word "smashed" reported higher speeds and also falsely reported remembering glass at the scene when in fact there was no glass present (Loftus & Palmer, 1974). This study demonstrated that people will create inaccurate representations of a memory, even with the most subtle suggestions. Ultimately, exposure to misinformation, via either external sources or faulty thought patterns, can lead people to succumb to false memories even if they directly experienced some event.

The misinformation paradigm stemmed from this early work by Loftus and Palmer (1974). Loftus, Miller, and Burns (1978) introduced the first study using this paradigm. Participants experience three typical stages in the misinformation paradigm: witnessing an event, receiving misinformation that directly contradicts details from the witnessed event, and then being tested for memory about the event. For example, in Loftus, Miller, and Burns (1978), participants were shown a slideshow of a car stopping at a sign. Then, the participants received inconsistent information about the slideshow in the format of a questionnaire. For example, they were asked "*how fast was the car driving when it stopped at a yield sign"*. This question suggests the false detail 'yield sign'. The researchers found that participants who were given misleading information erroneously reported seeing a yield sign on a later memory test (Loftus, Miller, & Burns, 1978).

Theories Explaining the Misinformation Effect

Several theories have been proposed to explain the misinformation effect. After observing participants report the misleading suggested yield sign and not the correct stop sign from the original slideshow, Loftus theorized that the misinformation effect had completely erased the original memory. This theory was labeled the destructive-updating hypothesis (Loftus,

Miller, & Burns, 1978). As stated, this study was an important first step in understanding the misinformation effect, but other researchers soon developed their opposing explanations.

In the 1980s, there was a shift in how people believed the misinformation effect was caused. McCloskey and Zaragoza (1985a) disagreed with Loftus's idea that the original memory was completely overwritten by post-event information. Instead, McCloskey and Zaragoza claimed that the original memory was not properly encoded to begin with and defined this theory as the strategic-effects account. According to this account, if the original event was never properly encoded, people would have difficulty retrieving information. Thus, McCloskey and Zaragoza suggested that participants encoded the event inadequately, causing them to either guess or accept the misleading information. After all, they had no reason to suspect that the post-event narrative would be deceptive (e. g., Zaragoza, Belli, & Payment, 2015). In order to demonstrate that the misinformation did not replace the original memory, Zaragoza and McCloskey (1985a) modified Loftus' original paradigm. Participants watched a slideshow, in which a handyman placed an item under a *hammer*, and the post-event narrative misinformed participants by stating the item was placed under a *wrench.* In the final recognition-based memory test, the researchers excluded the suggested misinformation (wrench) from being a choice. Additionally, they added a novel "foil" word (screwdriver) as one of the options to choose on the final memory test. Thus, participants could choose between the original item and a new foil item. The idea was that if memory is completely erased by post-event misinformation, as suggested by Loftus, then participants would be just as likely to choose the new item as the original item because they would have to resort to guessing. They found that participants who were misled with the suggested wrench performed no differently that a control group who was not misled. That is, both of these groups were equally likely to choose the correct original item

(hammer). Other studies have found similar results, thus confirming that one's memory for an original event is not indefinitely erased (Belli, Windschitl, McCarthy, & Winfrey, 1992; Ceci, Ross, & Toglia, 1987; Chandler, 1989).

The realization that the original memory was not completely overwritten sparked new interesting questions as researchers wondered what happened to the original memory. Thus, researchers suggested that both the true and false memory were coexisting in the brains memory storage (Belli et al., 1992, Ceci et al., 1987; Chandler, 1989, 1991; Gordon & Shapiro, 2012, Windschitl, 1996). However, some mechanism was making the memory of the original event less accessible and making the retrieval process more difficult (Chandler, 1991; Easkin, Schreiker, & Sergent-Marshall, 2003). Johnson, Hashtroudi, and Lindsay (1993) proposed that participants encode both the original memory and the post-event information, but have difficulty distinguishing between these sources of information on a later memory test. When an individual cannot correctly attribute a memory to a source, they are having difficulty with their ability to source monitor. This means that there is a failure in the process that connects memories to their origin. Source monitoring failure is a reasonable explanation for the misinformation effect because it is something experienced by many individuals, even outside of the laboratory. For instance, people fail to source monitor when they cannot remember if they told a funny story already to one of their friends. Perhaps, one might have source monitoring difficulties when believing a fact came from a professor, when instead it was heard on a television program (Johnson, Hashtroudi, Lindsay, 1993). Often source monitoring problems are relatively harmless, but in the context of eyewitness memory, the repercussions can be serious.

Encoding and the Misinformation Effect

Failure to encode, forgetting the witnessed event, or inability to source monitor are all possible explanations for why the misinformation effect occurs, and each of these may ultimately play a role. However, this study was designed to explore ways to potentially support adequate encoding of a witnessed event in order to enhance event memory, facilitate source monitoring, and reduce the misinformation effect.

Encoding is an instrumental component of memory. In order to better appreciate the importance of encoding, imagine the brain as a computer. Information is constantly being taken in, processed, and stored. If the computer cannot effectively place information onto the hard drive, it cannot be accessed later. Similarly, if our brain does not efficiently encode information, it is unable to be retrieved from memory when we later need it. When information is missing, it may be more easily 'filled in' with information provided by an external source, even if this information is inaccurate or misleading. On the other hand, when an event is properly encoded, there is a higher chance that the event details are stable in memory, and individuals may be less likely to rely upon details "filled in" by other sources when making a memory report.

Unfortunately, many factors can threaten one's ability to efficiently encode information such as poor attention (Lane, 2006), sleep deprivation (Frenda, Patihis, Loftus, Lewis, & Fenn, 2014), low working memory capacity (Jaschinski & Wentura, 2002), and negative emotions (Porter, McDougall, Bellhouse, ten Brinke, & Wilson, 2010). Studies have also reported that divided attention routinely led to fewer accurate reports, and increased participants' likelihood of relying on details that seemed familiar to the participant rather than relying upon true recollection of the witnessed event (Lane, 2006; Zaragoza & Lane, 1998). According to Lane (2006), simply having participants listen to music while encoding an event can significantly increase their susceptibility to the misinformation effect. Aside from having poorer event

memory, participants had difficulty monitoring the source of their memory compared to the full attention group. Another aspect known to impact encoding and attention capacity is sleep. Since a good night's sleep is related to these two concepts plus one's ability to learn, it is no surprise that participants who were sleep deprived before encoding a witnessed event reported high false details on a misinformation effect paradigm (Frenda et al., 2014).

Working memory capacity (WMC) is the brains ability to temporarily hold onto information as the brain processes it. For instance, the brain needs working memory capacity in order to do tasks such as reading. In order to comprehend a passage, the brain has to retain what was just read. Despite its finite capacity, working memory attempts to integrate information from a variety of sources, like a movie or post-event narrative. This enables a person to build a cohesive representation of an event (Jaschinski & Wentura, 2002). Individuals with lower working memory capacity have more difficulty doing multiple tasks at once which can make encoding complex event information more arduous. Comparatively, those with high levels of WMC have an easier and smoother time encoding information (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). One study explained that high levels of WMC may decrease suggestibility to the misinformation effect due to WMC's ability to make a constructive and detailed mental image of an event. By having a coherent image, the researchers theorized that participants could better source monitor between the original video they witnessed and the post-event narrative (Jaschinski & Wentura, 2002). Without WMC, a person would struggle to plan, focus on tasks, perform goals efficiently, and importantly, concentrate on and encode information (Leding, 2012). In support of the view that misinformation effects may stem from inadequate encoding of the original event, a number of studies have found that individuals with

greater WMC are less susceptible to the misinformation effect (Calvillo, 2014; Jaschinski & Wentura, 2002; Zhu et al., 2010).

As stated, negative emotions, such as stress, can influence one's encoding process. However, research in this area is split between stating stress can either increase or decrease susceptibility to misinformation (Porter, Bellhouse, McDougall & ten Brinke, & Wilson, 2010; Hoscheidt, LaBar, Ryan, Jacobs, & Nadel, 2014). One study found that false reports of misleading post-event information increased when participants ruminated over negative emotions (Porter et al., 2010). The researchers argue that this rumination decreased participants' ability to attend to the original information and thus build a strong memory representation. Thus, high levels of arousal caused by repetitive, negative thoughts leads to higher reports of misinformation (Porter et al., 2010). Alternatively, other researchers have proposed that stress can actually promote acute focus during encoding, which can promote resistance to post-event misinformation (Hoscheidt et al., 2013). While this proposal contradicts the idea that stress can negatively impact event memory, Porter and colleagues (Porter, Spencer, & Birt, 2003; Porter et al., 2010) have countered that while acute focus sounds beneficial, it can actually lead to an increase in false reports since acute focus excludes peripheral focus, and in many cases it is peripheral information that can be interfered with by misinformation. According to this view, there is a greater chance of accepting misinformation about peripheral details presented in the post-event narrative when under stress.

Expecting Benefits and its Effects on Memory

One fascinating concept that influenced the methodology of this study was how memory changes depending on one's expectations. For instance, in a study using the misinformation paradigm, participants who believed they would have good memory performance reported fewer

misleading details (Clifasefi, Garry, Harper, Sharman, & Sutherland, 2007). This study manipulated expectations of performance by dividing participants into two groups. Both groups were given an inactive drug. However, half of the participants were informed that it was an inactive drug that had no benefits, whereas the other half was told that the drug had cognitive benefits such as higher memory performance (Clifasefi, 2007). Afterwards, participants completed a typical three-stage misinformation experiment. The researchers discovered that the people in the inactive drug group who expected enhanced cognition reported fewer false memories compared to the other group that expected no benefit from the drug. According to the researchers, the inactive drug group's belief of their drug's cognitive benefits lead to their success; it gave them an empowering mindset. Just by expecting that the drug would improve memory, participants subconsciously paid more attention during a witnessed event and on the memory test (Clifasefi et al., 2007). Simply expecting that one will perform well on a cognitive task can reduce false memories (Clifasefi et al., 2007). It is important to extend this work on expectations and eyewitness memory. It is possible that because mindful meditation has been increasingly gaining attention as a beneficial mind exercise, individuals' memory may be affected simply due to these expectations. In the current study a control group was told specifically that their non-mindful control task was beneficial to cognition in order to tease part the impacts of mindful meditation exercises and expectations of performance on memory performance in the misinformation paradigm.

Basic Concept of MM

The idea of mindful meditation is rooted in three goals: be mindful, be in the present moment, and practice a nonjudgmental perspective (Grecucci et al., 2015; Holzel, Lazar, Gard, Olivier, Vago, & Ott, 2011). The first objective, being mindful, asks individuals to be aware of

their own internal thoughts and be conscious of the environment. For example, during a guided meditation, a person might be asked to acknowledge their thoughts as they come and go. In addition, they might be asked to be mindful of the temperature of the room or how their body feels while sitting in a chair (Chambers, Lo, & Allen, 2007). Individuals are also typically directed to be attentive to visual, auditory, olfactory, and tactile sensations that they experience. Thus, this mindfulness objective enables the person to become more connected to their inner self and their surroundings (Hawk, 2014).

The second objective is for people to be present in the moment. This objective complements the previous goal of being mindful. For example, if a person is mindful of the environment and hears a familiar song, the individual must stay in the present and not think of past instances when they heard that song (Sauer-Zavala et al., 2012). Being present means not contemplating on past memories or concerning oneself with the future. Therefore, being present allows the individual to take in their surroundings rather than be worried about pressing due dates, mistakes they may have made, or other issues that provoke stress (Grecucci et al., 2015).

Finally, the third objective of mindful meditation requests that the individual view all incoming information from a neutral perspective. This means when incoming thoughts come in, they are not evaluated or given any significance. For instance, if a person was meditating and the thought of pressing due dates appeared in their head, that person would recognize the thought and then let it go. By not giving the thought additional emphasis, it ensures that the person will not ruminate on that thought and therefore will not become stressed (Chambers, Lo, & Allen, 2007).

Techniques for MM

Although meditation generally follows the three principles previously described, meditation techniques vary. Some people advocate for simply focusing on one's own breathing, while others try to incorporate mindfulness into their daily lives by being mindful while listening to the radio or going for mindful walks in the park (Hawk, 2014; Sauer-Zavala et al., 2012). Other ways to be mindful in one's daily life include observing the taste of foods or noticing the sensations experienced throughout the work day (Grecucci et al., 2015)). Mindful meditation also can apply to sitting meditation, which is meditating while sitting upright, or while doing yoga, which incorporates the entire body (Sauer-Zavala et al., 2012). Sitting meditation is the more traditional approach to mindful meditation because it focuses on breathing, the sounds in the environment, bodily sensations, one's emotions, and thoughts (Sauer-Zavala et al., 2012). Because sitting while meditating is more convenient in a lab environment and it encourages many mindful meditation behaviors, it will be utilized in this study.

Mindful meditation is a practice that offers a sense of flexibility since the practice can be done anywhere at any time. However, another flexible feature of mindful meditation is its duration. One can obtain meditation's benefits by partaking in brief meditation, which could last anywhere from a couple of minutes to a week or practice over the course of several weeks (Bonamo, Legerski, & Thomas, 2014; Jha, Stanley, Wong, & Gelfand, 2010; Lloyd et al., 2016) According to one study, a brief three minute guided meditation can have positive effects on recognition memory performance (Lloyd et al., 2016) In addition, another study observed that encoding of Swahili-English pairs were better encoded after just a twenty minute meditation session (Bonamo, Legerski, & Thomas, 2014). Although studies have found benefits linked to brief meditation tasks, there are clear benefits to meditation tasks that go beyond one session. For

instance, Bonamo, Legerski, & Thomas (2014) found that the short session did not impact anxiety scores and did not enhance longer-term memory processing. Finding the optimal meditation session will require significant future research. In the present study, a brief three minute task was used since a brief task would more conveniently applicable for individuals who have busy lives.

General Benefits of MM

Mindful meditation has a number of benefits, including improvements to people's emotional, mental, and physical abilities. For example, Sauer-Zavala et al. (2012) found that sitting meditation and mindful yoga lead to an overall sense of well-being. This meant that people who participated in mindful meditation felt different aspects of their lives were positively impacted. Examples of these affected domains were cognitive abilities, emotional responses, and health. These positive benefits have also been consistent amongst several studies that observe mindful meditations influence on the body and mind (e. g., Bonamo, Legerski, & Thomas; Chambers et al., 2007; Grecucci et al., 2015; Jha et al., 2010; Mrazek et al., 2013).

Important to the present study, studies have found that practicing MM can enhance attention (Jha et al., 2010), working memory capacity (Mrazek et al., 2013), source monitoring ability (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010), and overall general memory (Chambers et al., 2007). According to Moss, Monti, and Newberg (2013), a mindful meditation task can benefit cognition even when a person is under stress. Mindfulness also enables individuals to regulate their emotions, which is one's ability to reduce stress and calm oneself (Sauer-Zavala et al, 2012). Participants in these studies above practiced mediation for as brief as three minutes and as long as eight weeks, thus providing additional evidence that mindful

meditation of various durations can consistently yield benefits (Jha et al., 2010; Mrazek et al., 2013; Rubenstein et al., 2016).

Some argue that mindful meditation is able to provide these benefits because it decreases brain activity responsible for mind wandering, controlling distracting emotions, or effectively training one to focus on the environment while concentrating on breathing (Jha et al., 2010; Zeidan et al., 2010; Mrazek et al., 2013). Although these are possible theories, scientists still are unsure what are the mechanisms behind these benefits and if there are more positive ways mindfulness can influence people's lives.

Exploring the possible benefits of MM on the Misinformation Effect

Since mindful meditation's benefits have only been researched in recent years, evidence on the relationship between meditation and false memory is scarce. However, research suggests that some of the known factors that contribute to false memories, such as the misinformation effect (e. g., factors like inattention during encoding or source monitoring difficulty) may be counteracted by mindful meditation, so the relationship is worth investigating. The studies that have been conducted looking at the impact of mindful meditation on false memories have been typically done using the DRM or a similar verbal learning paradigm, and have had mixed findings. Where some suggest that meditation increases the rate of false reports (Rosenstreich, 2016; Wilson, Mickes, Stolarz-Fantino, Evrard, and Fantino, 2015) others have found that mindfulness meditation reduces false reports (Lloyd et al., 2016).

The two studies that observed an *increase* in false memories after a meditation task claimed it was meditation's own non-judgmental and accepting attitude that yielded the results; participants appeared to be less likely to value incoming information, thus having a weaker representation of the correct memory on later memory tests (Lloyd et al.,2016; Rosenstreich,

2016; Wilson et al, 2015,). Lloyd et al. (2016) used non-DRM word lists as stimuli and examined participants' rates of false recognition of non-presented words after completing a brief mindfulness exercise. They found that mindful meditation *decreased* false memory using this methodology. Since research on the relationship between mindful meditation and false memory is limited to a couple of conflicting studies, it is important to try to extend this work to a new domain of false memory - the misinformation effect.

The Present Study

The primary goal of this study was to analyze the impact of a brief thee minute mindful meditation exercise on the misinformation effect. Specifically, I examined whether this brief meditation exercise could enhance encoding of an eyewitness event. Hopefully, if meditation can increase proper encoding, then misinformation effect will be reduced. For example, this paper has discussed how working memory capacity and the ability to correctly source monitor reduced the misinformation effect, whereas mindful meditation has also been known to increase these two cognitive abilities (Brotman 2008; Mrazek et al., 2013). However, that is not the only connections between what leads to the misinformation effect and mindful meditation. In fact, mindful meditation can counteract many factors linked to the misinformation effect, such as poor attention, stress, and inadequate sleep (Short, Kose, Mu, Borckardt, Newberg, George, & Kozel, 2010; Tang, Ma, Wang, Fan, Feng, Lu, Yu, Sui, Rothbart, Fan, & Ponser, 2007; Holzel et al., 2011). Therefore, based on this accumulation of research, it appears that meditation's benefits may ultimately reduce false memory in the misinformation effect paradigm. Thus the primary hypothesis is that participants who engage in a brief mindful meditation exercise prior to encoding an event will have better event memory, reduced susceptibility to misinformation, and better source monitoring than control participants who complete a non-mindful based task. A

second goal of this study was to look at how participants' perceptions of how mindfulness is beneficial to cognition impacted event memory and susceptibility to misinformation. As previously discussed, Clifasefi et al. (2007) found that believing a drug will increase cognitive abilities, even if said drug is inactive. Thus, by changing people's expectations about mindful meditation, I examined whether any effect of mindful meditation on memory in the misinformation paradigm was solely dependent on the belief that the task will enhance cognitive performance. To examine this, I included a manipulation in which participants who completed a non-mindful control task prior to event encoding were told that the task was beneficial to memory. Thus, the secondary hypothesis was that if mindfulness can enhance memory beyond what can be attributed to simply having knowledge of the benefits of mindfulness, then mindful meditation participants should have better memory performance compared to control participants whose expectations about the benefits of their task were manipulated.

Method

Participants

A total of 160 participants, 40 in each experimental group, were gathered from Assumption College's undergraduate population. Participants varied in age from 18-24 years. Of those who participated, 80% were female and 20% were male. Additionally, 81% of participants identified as white, 9% as black, 5% as Hispanic, 4% as Asian, and 1% as other. In order to encourage participation, students were given extra credit for their classes. Each participant received consent forms and a demographic survey.

Materials

Mindful Meditation Task. The mindful meditation exercise was a three minute audio recording called "Breathing Meditation," free for use from UCLA's Mindful Awareness Research Center website (found at http://www.uvm.edu/~CHWB/psych/audio/breathingspace.mp3). This session guided participants to focus on feeling "the sensations of breath," "the sensations of the body," and guided them to "gently redirect" attention to breathing. The audio emphasized maintaining a relaxed position and acknowledging the environment in a nonjudgmental manner.

Sudoku. Sudoku is a puzzle in which players insert the numbers one to six into a grid consisting of six squares with the goal of every number appearing once in each horizontal line, vertical line, and square. An easy version of this puzzle was used (see Appendix A).

Toronto Mindfulness Scale (TMS). This survey determined how frequently a participant engaged in a mindfulness state by categorizing responses into two mindfulness qualities: Decentering and Curiosity. Curiosity is one's ability to pay attention and be open to present sensations. For instance, participants were asked to rate how "curious" they were about each of the thoughts and feelings they were having during that moment (Lau, Bishop, Segal,

Buis, Anderson, Carlson, & Carmody, 2006). The survey defined participants who were curious as more attentive to their inner emotions. Decentering is a measure of the ability to experience these sensations "with some distance...rather than being carried away by one's thoughts and feelings" (Lau et al., 2006). For example, participants responded if they were more "open to experiences rather than trying to control or change experiences" (Lau et al., 2006). Altogether, the test was comprised of 13 mixed Decentering and Curiosity statements that asked participants to answer based upon how they felt in the moment (see Appendix B).

Witnessed Event. A 22 minute excerpt from the black and white silent film "Rififi" (Bezard, Berard, Cabaud, & Dassin, 1955) was used as the witnessed event. The clip portrayed a group of four men committing a burglary in the middle of the night.

Post-event Narrative. The audio narrative contained 24 critical sentences that introduced consistent, neutral, and misleading information about the video (8 details each), in addition to filler sentences that presented information that was not targeted on the final memory test. Consistent sentences contained details that were accurate regarding the witnessed event (e. g., *From a drawer that holds valuables, he removes a ring*.) Neutral sentences included details presented in the video, but not manipulated in the narrative (e.g., *From a drawer that holds valuables, he removes a piece of jewelry*.) Misleading sentences included details from the video that had been changed in the narrative (e. g., *From a drawer that holds valuables, he removes a necklace*.) Sentences serving as misleading, neutral and consistent were counterbalanced across participants. The critical detail (e.g., ring/jewelry/necklace) was always presented at the end of the sentence. A female voice read the narrative at a normal reading pace (Appendix C).

Demographic Survey. All participants received a demographic questionnaire that inquired about age, gender, race, and ethnicity (see Appendix D)

Memory Tests. Twenty four questions with specific details from the video were constructed as the memory test stimuli. Confidence ratings associated with responses were collected during each test, however were not central to any hypotheses and thus were not analyzed. Confidence ratings were made on a scale of zero (completely unconfident) to 100 (completely confident). A discrepancy recollection test followed the final post-narrative cued recall test. In this task participants were re-presented with each final test question and asked to respond "YES" if they remembered different details from the video and narrative in association with each question, and "NO" if they did not remember different details (see Appendix E). Discrepancy recollection served as a proxy for source monitoring.

Procedure

The experiment used a 2 (Mindfulness: Present, Not Present) x 2 (Benefit: Stated, Not Stated) x 3 (Item Type: Consistent, Neutral, Misleading) mixed design. Mindfulness and Benefit Statement served as between subject factors and Item Type served as a within subjects factor.

After informed consent, half of the participants completed the three minute mindful meditation exercise (MM group), and the other half completed Sudoku for an equivalent amount of time (Control group). The control group's Sudoku puzzle was collected after the three minutes. Before beginning the appropriate task, half of the participants in each of the MM and Control groups were given a statement that the task they were about to complete would be beneficial to their memory (see Appendix F). The other half did not receive such a statement. Next, all participants completed the TMS. After the TMS, all participants watched the 22 minute Rififi video. Following the video, all participants completed a filler task of simple math problems for five minutes before they listened to the audio post-event narrative describing the events from

the video. Afterwards, all participants completed a brief demographic questionnaire before they received the memory test.

Participants were allowed to withhold responses and stop the experiment at any time. Following the final test phase, participants were debriefed and thanked for their participation.

Results

Mindfulness Scores

It was important to first establish that the mindful meditation exercise was effective. Independent samples t-tests comparing the MM and Control groups were conducted on both Curiosity and Decentering Scores. The MM group (M = 15.7) reported higher Curiosity scores than the Control group (M = 11.3), t (158) = 5.655, $p < .001$, d = .90. Additionally, the MM group (M = 16.2*)* reported higher Decentering scores than the Control group *(*M = 12.8*), t* (158) = 4.98, $p < .001$, d = .81. Therefore, our mindfulness mediation manipulation was effective. Those who partook in the meditation task reported a higher state of mindfulness compared to the control group.

Memory Performance

When necessary, all pairwise comparisons utilized a Bonferroni correction. Memory performance was assessed in two ways. First, accurate recall of video details was assessed. Second, recall of suggested details from the narrative was assessed. These dependent variables are not fully complementary, as individuals could be wrong on the final test and report something other than suggested details, so both analyses are important to assessing the misinformation effect.

Accurate video recall on the final test. Table 1 displays the accurate recall probabilities on the final test. A 2 (Mindfulness: Present, Not Present) x 2 (Benefits: Stated, Not Stated) x 3 (Item Type: Consistent, Neutral, Misleading) mixed design analysis of variance (ANOVA) was conducted on mean final test accurate recall. A main effect of Item Type was significant, F (2, 312) = 149.00, $p < .001$, η_p^2 = .49. Participants were significantly more accurate on consistent

trials (*M* =.*77*) compared to neutral trials (*M* = .55), *t* (159) = 12.81, *p* <.01, *d* = 1.01. In addition, participants were the least accurate on misleading trails (*M* = .44), *t* (159) = 5.13, *p* < .01, *d* = .41. No other effects were significant, *ps* > .05.

Misinformation errors reported on the final test. Table 2 presents the misinformation errors reported on the final test. As can be seen, spontaneous reports of misleading narrative details on Neutral and Consistent trials were rare. This analysis was limited to Misleading trials, the only condition in which participants were exposed to misleading narrative information. A 2 (Mindfulness: Present, Not Present) x 2 (Benefit: Stated, Not Stated analysis of variance (ANOVA) was conducted on erroneous reports of misinformation. A main effect of Benefits was significant, *F* (1, 156) = 4.65, *p*< .05, η_p^2 = .03. Participants who received a statement of benefits *(M* = .34*)* were less likely to produce misinformation compared to participants who did not receive a statement *(M* = .40*).* No other significant effects were found, *ps* > .05.

Discrepancy Recollection. Mean discrepancy recollection is presented in Figure 1. A 2 (Mindfulness: Present, Not Present) x 2 (Benefits: Stated, Not Stated) ANOVA assessed participants' recollection of discrepancies between details shown in the video and presented in the post-event narrative on misleading trials. One subject was excluded from this analysis due to not complying with task instructions. A marginal main effect of mindfulness was found, *F* (1, 154*)* = 2.90, *p* = .09. The mindful meditation group accurately recollected discrepancies on 38% of trials, and those in the control group (Sudoku) recalled discrepancies on 45% of trials. No other effects were significant, *ps* > *.05.*

Correlations

The TMS scores indicated that the mindful meditation group achieved a higher state of mindfulness compared to the control group (see Figure 2). Therefore, we analyzed whether mindfulness scores within each of the groups were related to any of the memory measures. A series of bivariate correlations were conducted separately for the Control group and the MM group. To simplify these correlations, a composite Mindfulness score was created by averaging scores on the Decentering and Curiosity scales. The variables included in these analyses were: Overall Mindfulness, Accurate Video Recall on Consistent Trials, Accurate Video Recall on Neutral Trials, Accurate Video Recall on Misleading Trials, Inaccurate Reports of Misinformation on Misleading Trials, and Discrepancy Recollection, Accuracy. Interestingly, in the MM group, there was a significant negative correlation between overall mindfulness and erroneous reports of misinformation, r = -.231, N = 80, p = .039. Additionally, there was a negative correlation between Overall Mindfulness and accurate Discrepancy Recollection on Misleading Trials, r = -.277, N= 79, p = .013. Finally, there was a significant correlation with Overall Mindfulness and Accuracy on misleading trials, r=.236, N= 80, p = .035. See Table 3. In contrast, these same correlations were not significant in the Control group (see Table 4).

Discussion

The central objective of the present study was to investigate whether a brief mindful meditation exercise could assist with event memory and counteract the misinformation effect. Although there are several theories that explain the misinformation effect, the present study focused on the strategic effects account and source monitoring framework theory (Johnson, Hashtroudi, & Lindsay, 1993; McCloskey & Zaragoza, 1985a). Thus, this study observed whether mindful meditation could increase attention during encoding so suggested information would not fill in participants' memory. In addition, the study researched mindful meditations ability to increase source monitoring in the hopes this would also reduce the misinformation effect and augment to the studies that argue against the destructive-updating theory (Belli, Windschitl, McCarthy, & Winfrey, 1992; Ceci, Ross, & Toglia, 1987; Chandler, 1989).

Importantly, a standard misinformation effect was demonstrated in the data. That is, participants were less accurate on final test trials that had been targeted with misinformation compared to neutral or consistent trials. However, contrary to the original hypothesis, there was no significant difference in the ability to accurately recall original video details between the MM group and the Control group on any trial type. This finding suggests that the brief mindful meditation task used in this study did not enhance encoding of the witnessed event, as enhanced encoding would have led to better memory for those event details from the video. Moreover, there was no difference between the MM and Control groups on the number of misleading details reported on the final test. Finally, there was no difference between the MM and Control groups on the ability to accurately recollect that conflicting bits of information had been presented in the video and narrative on misleading trials. This suggests that in the present study, a brief mindful meditation exercise did not enhance differentiation between sources of

information, a process necessary for source monitoring. Taken together, the pattern of findings suggest that mindful meditation does not protect against the misinformation effect.

While mindful meditation did not appear to help memory, it is important to take note that the mindfulness task was effective as measured by the TMS. These scores demonstrated that the mindful meditation task was an effective manipulation since people in the MM group reported higher rates of Curiosity and Decentering. Interestingly, when specifically focusing on the MM group, two negative correlations were found between levels of mindfulness achieved and memory. Decentering was negatively correlated with misleading details and discrepancy detection. Thus, higher states of mindfulness were associated with fewer reports of misleading details. Further, higher states of mindfulness were associated with fewer recollections of discrepancies on misleading trials. Importantly, these correlations were not found in the control group. Considering both of these correlations were found in the MM group, it is possible that the nonjudgmental perspective, evoked by practicing mindful meditation, may have led participants to pay less attention to post-event misinformation. They may have not encoded the details, thus were less likely to report them on memory tests and be less likely to remember that contradictory details were present in the narrative. As previously touched upon, the nonjudgmental perspective that mindful meditation promotes made participants less likely to evaluate the difference between what information was consistent and misleading (Rosenstreich, 2016; Wilson et al., 2015).

This explanation may make sense in light of what is known about the effect of mindfulness on DRM false memories. Using a DRM paradigm, researchers (Rosenstreich, 2016; Wilson et al., 2015) have found that a nonjudgmental perspective did *not* prevent false memories

but increased them. So, how is the nonjudgmental perspective producing different results between previous studies (Rosenstreich, 2016; Wilson et al., 2015) and the present study?

The difference can be explained by each study's methodology since the DRM paradigm heavily relies on recognition memory, but the misinformation effect paradigm focuses on event memory. Subsequently, participants who partook in the DRM paradigm with a nonjudgmental perspective did not give emphasis to any word on the list due to their accepting mindset. These participants generalized the word list, rather than speculating what each word meant. Consequently, the inability to correctly evaluate the list made these participants more likely to report the lure word (Rosenstreich, 2016; Wilson et al., 2015). This makes the lure word easily blend in with the other, similar words on the list. In a misinformation effect paradigm, instead evaluating a word list, participants have to evaluate and judge the post-event narrative. However, like in the DRM paradigm, the nonjudgmental perspective enables participants in the misinformation effect paradigm to accept each sentence in the post-event narrative. As they accept each sentence, they place no emphasis on one sentence over the other. As a result, when these participants took the final memory test, they reported fewer misleading details because they evaluated less information compared to the control group. Therefore, past studies on the DRM reinforce the theory that a nonjudgmental perspective influenced the misinformation effect, even though the mindset manifested itself differently in the two paradigms.

One of the experimental manipulations in the present study did reduce the misinformation effect. Regardless of which pre-video task was completed, mindful meditation or Sudoku, participants who also received a statement of cognitive benefits prior to their task had fewer reports of misleading details on misleading trials. It is possible that the benefits group’s memory performance was better due to enhanced confidence. Those who believed their task had

cognitive benefits did better because they believed they were given an advantage. The statement of benefits promoted a sense of security and competence. These results are similar to the Clifasefi study (2007), which found that expecting that a drug will yield benefits, even when it is inactive, increase cognitive performance. Therefore, if a person believes their task will give them cognitive abilities, whether it is mindful meditation or Sudoku, then their mentality and confidence in the task will enable their expectations to come true. I originally predicted that if mindfulness can enhance memory beyond what can be attributed to simply having knowledge of the benefits of mindfulness, then mindful meditation participants would have better memory performance compared to control participants whose expectations about the benefits of their task were manipulated. This original hypothesis was not supported, but it is interesting that perceptions about task ability can change memory.

Although knowledge of the cognitive benefits of mindfulness specifically did not appear to impact memory, mindful meditation does have cognitive advantages as discussed previously. This could be another reason why the MM group did not have a reduced misinformation effect. For example, mindful meditation is noted for its ability to promote a sense of relaxation and stress reduction. However, according to a recent study that analyzed stress levels influence on the misinformation effect, the researchers observed that when participants were stressed they actually encoded an event more accurately and were less suggestible to the misinformation effect (Hoscheidt et al., 2014). Perhaps in the present study, a sense of relaxation disabled people from attending. If participants did not feel there was an urgent need to encode the incoming information, then they might not have focused intently on the video or the post-event narrative. However, this theory's influence on the present study can only be speculated since emotional variance was neither assessed nor manipulated. Further, a reduction in accurate video recall was

not observed in the MM group, so more research is needed to determined exactly how this brief mindfulness exercise may impaction attention and encoding to a witnessed event.

When considering the present study, it is important to keep in mind that participants completed only three minutes of guided mindful meditation. Perhaps in order to obtain mindful meditation's cognitive benefits, one must practice for longer durations. Many studies use longer mindfulness training programs. For example, Jha, Morrisson, Dainer-Dest, Parker, Rostrup, Stanley (2010) researched the effects mindful meditation had on a military cohort by instilling an eight-week meditation program. Another study looking at the positive impact meditation had on GRE scores the researchers had participants practicing meditation for a 2-week period (Mrazek et al., 2013). Even in Bonamo et al., (2014), encoding benefits were observed after participants either meditated for a brief 20 or 45 minute session. Collectively, these studies suggested that longer meditation intervals can more effectively improve emotional regulation and enhance longer-term memory processing compared to brief sessions (Bonamo et al., 2014; Jha et al., 2010; Mrazek et al., 2013). It may be that in order to receive encoding benefits and better memory performance, one must train the brain. This idea is reinforced in Lloyd et al (2016). They found that a brief three-minute meditation task, similar to the one used in the present study, had no impact on encoding of word lists and only a small benefit when the mindful meditation task was placed prior to retrieval on a later memory test.

The present study was limited in a few areas. First, it was limited by its lack of diversity. All participants were undergraduate students at Assumption College. Therefore, there was no significant variation in age. Additionally, it was difficult to control how participants responded to the meditation task. Since individuals were doing this experiment for extra credit, but were not being graded on performance, they may have had little motivation or incentive to take the

meditation task seriously. Finally, the present study was limited by time. Since the participants were students, they had other obligations such as class assignments, sport commitments, or other extracurricular activities. Therefore, the meditation task had to be brief and could not extend beyond one session for practical reasons.

Despite a few limitations, the present study yielded interesting results that have sparked further inquiry. For example, it would be interesting to see how mindfulness would impact memory if placed prior to retrieval, rather than before encoding, as in Lloyd's et al.'s (2016) study. While Lloyd et al. used a different false memory methodology, it would be important to see how the results would translate in the misinformation effect paradigm. Aside from placing the mindful meditation task prior to retrieval, it would also be interesting to expand the meditation task. Similar to Mrazek et al.'s (2013) study with mindful meditation and GRE scores, perhaps a one or two week meditation program could yield different results. For instance, participants may have an improved attention, WMC, reduced emotional variance, and other cognitive benefits after doing a longer training session. In conjunction with a longer meditation task, the experiment could directly assess the cognitive benefits known to reduce the misinformation effect *(*e.g., *attention, working memory capacity, emotional variance, sleep).* In such a study, it would be easier to pinpoint what cognitive benefit mindful meditation is influencing the most and how that correlates to the misinformation effect.

Even though the misinformation effect as been studied for over three decades, there is a deficit in understanding the relationship between the misinformation effect and mindful meditation. Although the mindful meditation group's performance did not support the original hypothesis, there are still many cognitive benefits to mindful meditation that have been confirmed by other studies (Chambers, Lo, & Allen, 2007, Chiesa, Calati, & Serretti,

2010;Mrazek et al., 2015; Zeidan et al., 2010;). Therefore, expanding knowledge on what triggers the misinformation effect, factors that reduce it, and mindful meditation's impact on the brain, can positively impact not only the criminal justice system, but other aspects of life. People are not just susceptible to the misinformation effect in an eyewitness situation. Rather, the inability to remember accurate details due to misleading information occurs on academic tests, during interpersonal relationships, and at one's place of employment. Thus, to protect innocent lives from incarceration and to improve the general population's cognitive abilities, researchers should aim to find a simple and easy tasks that can reduce the misinformation effect. Mindful meditation was one task that could easily be applied to people's lives, but there are possibly other meditation techniques that could be researched.

Table 1

Mean Proportion of Video Details Recalled Correctly on the Final Test in Experiment 1 as a Function of Item Type, Testing Group, and Benefits (standard error in parentheses).

	Consistent	Neutral	Misleading
Meditation/ No Benefits	.79 (.03)	.57 (.03)	.46 (.03)
Meditation/ Benefits	.74 (.03)	.51 (.03)	.45 (.03)
No Meditation/ No Benefits	.74 (.03)	.55 (.03)	.40 (.03)
No Meditation/ Benefits	.78 (.03)	.52 (.03)	.45 (.03)

Table 2

Mean Proportions of Misleading Reports on the Final Test as a Function of Item Type, Testing Group, and Benefits (Standard Error in Parentheses).

	Consistent	Neutral	Misleading
Meditation/ No Benefits	.04 (.01)	.07 (.01)	.37 (.03)
Meditation/ Benefits	.04 (.01)	.11 (.01)	.32 (.03)
No Meditation/ No Benefits	.06 (.01)	.11 (.01)	.42 (.03)
No Meditation/ Benefits	.04 (.01)	.09 (.01)	.35 (.03)

Table 3

Correlations Between Mindfulness and Memory on Misleading Trials in Mindfulness Group

Measure	1	2	3	4	5
1. Curiosity	--	.57**	-.20	-.07	-.05
2. Decentering		--	-.21	-.25*	.25*
3. Discrepancy Recollection			--	.01	.08
4. Inaccurate Recall of Misleading Detail				--	-.46**
5. Accurate Recall of Video Detail					--

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

Table 4

Correlations Between Mindfulness and Memory on Misleading Trials in Control Group

Measure	1	2	3	4	5
1. Curiosity	--	.59**	.02	-.11	.04
2. Decentering		--	.20	.06	-.09
3. Discrepancy Recollection			--	-.07	.15
4. Inaccurate Recall of Misleading Detail				--	-.55**
5. Accurate Recall of Video Detail					--

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

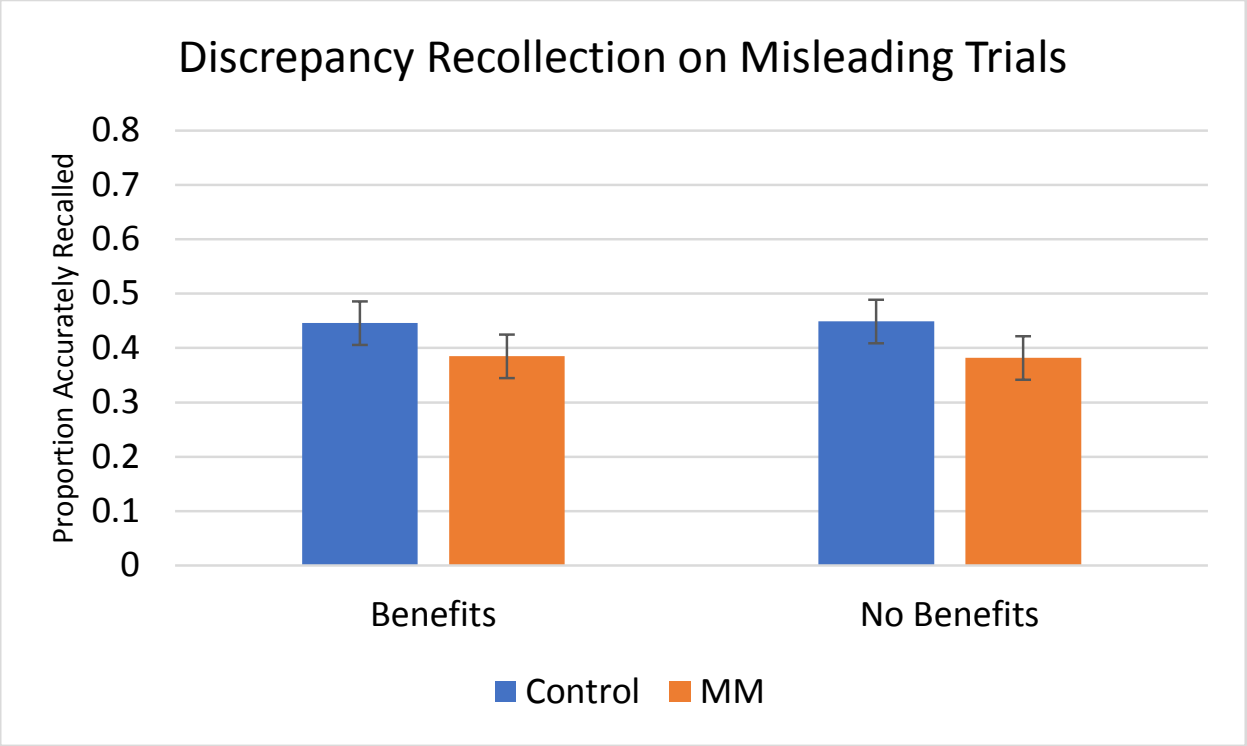


Figure 1. Mean proportion of recollected discrepancies between video and narrative reported as a function of item type, testing group, and benefits.

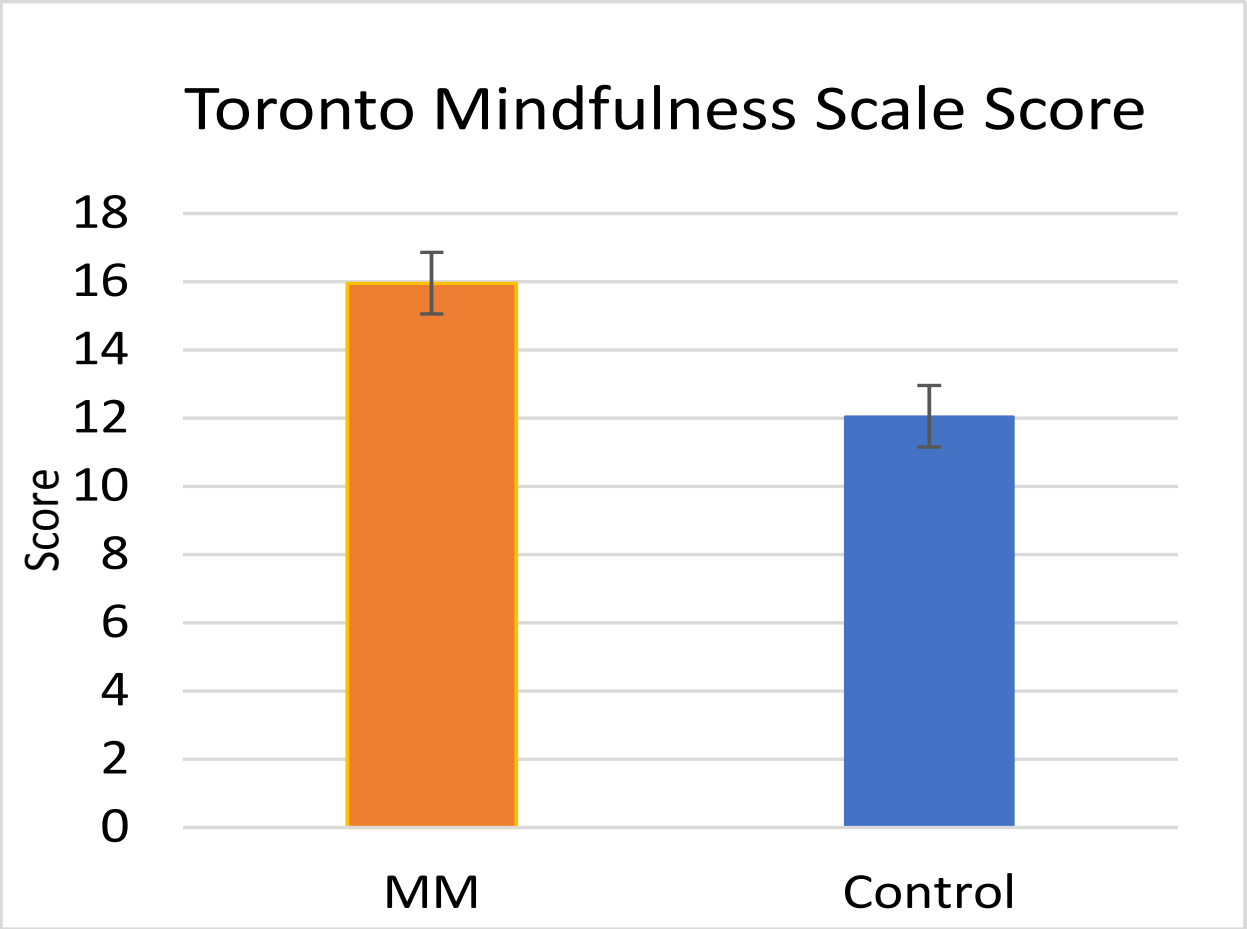


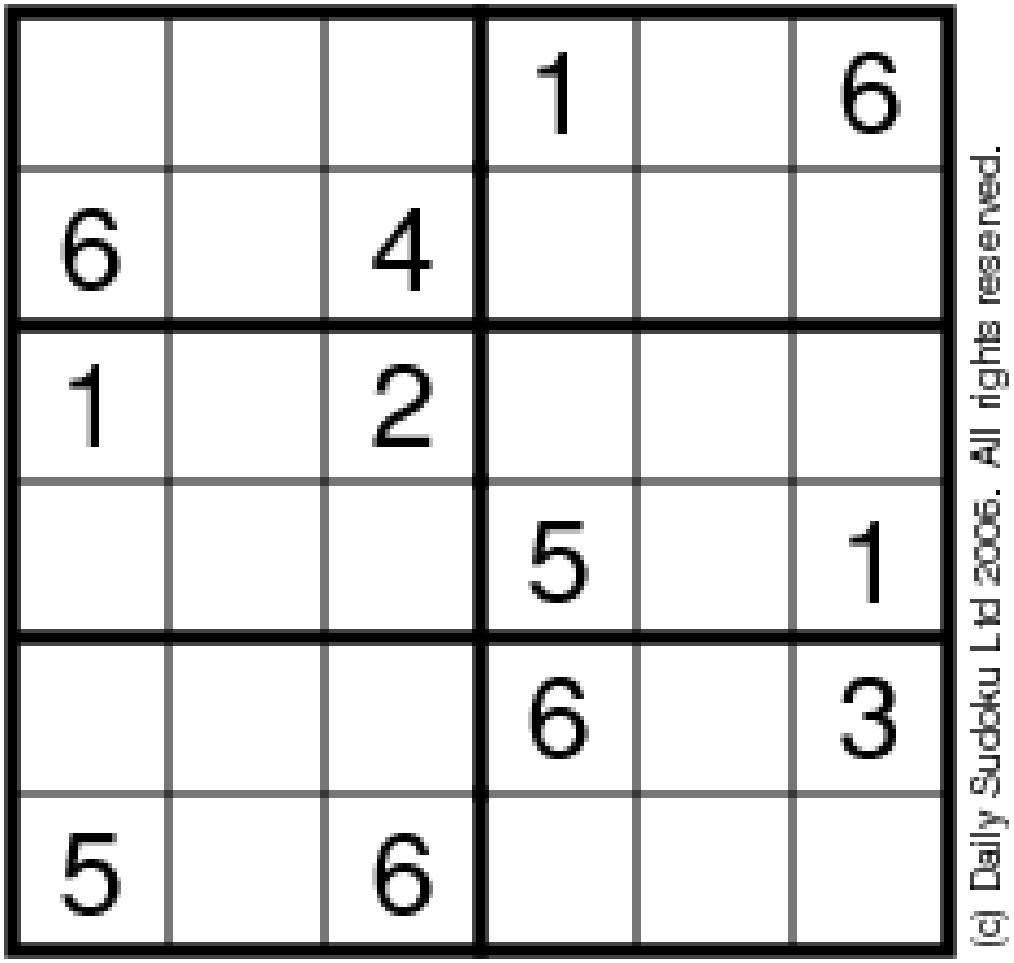
Figure 1. Mean Toronto Mindfulness Scale scores as a function of group.

Appendix A

Sudoku Rules:

Each puzzle consists of a 6x6 grid containing given clues in various places. The object is to fill all empty squares so that the numbers 1 to 6 (for 6x6 puzzles) appear exactly once in each row, column and box (Conceptis Puzzles, 2016).

Example of 6X6 Sudoku



Picture courteous of Google Images

Appendix B

Toronto Mindfulness Scale

Instructions: We are interested in what you just experienced. Below is a list of things that people sometimes experience. Please read each statement. Next to each statement are five choices: "not at all," "a little," "moderately," "quite a bit," and "very much." Please indicate the extent to which you agree with each statement. In other words, how well does the statement describe what you just experienced, just now?	Not at all	A little	Moderately	Quite a bit	Very much
1. I experienced myself as separate from my changing thoughts and feelings.	0	1	2	3	4
2. I was more concerned with being open to my experiences than controlling or changing them.	0	1	2	3	4
3. I was curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations.	0	1	2	3	4
4. I experienced my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are.	0	1	2	3	4
5. I was curious to see what my mind was up to from moment to moment.	0	1	2	3	4
6. I was curious about each of the thoughts and feelings that I was having.	0	1	2	3	4
7. I was receptive to observing unpleasant thoughts and feelings without interfering with them.	0	1	2	3	4
8. I was more invested in just watching my experiences as they arose, than in figuring out what they could mean.	0	1	2	3	4
9. I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant.	0	1	2	3	4
10. I remained curious about the nature of each experience as it arose.	0	1	2	3	4

11. I was aware of my thoughts and feelings without over-identifying with them.	0	1	2	3	4
12. I was curious about my reactions to things.	0	1	2	3	4
13. I was curious about what I might learn about myself by just taking notice of what my attention gets drawn to.	0	1	2	3	4

Scoring: Key: All items were written in the positively keyed direction, so no reverse scoring of items is required.

Curiosity score: The following items are summed: 3, 5, 6, 10, 12, 13
Decentering score: The following items are summed: 1, 2, 4, 7, 8, 9, 11

(Lau et al., 2006)

Appendix C

Post-event Narrative: Rififi Narrative Transcript

Misleading
Neutral
Consistent

A man opens the door to a hotel.
The sign next to the door reads concierge.
A gloved hand holds a rag over the man's face.
A woman follows downstairs, and a gloved hand reaches out for her.
The man and woman are blindfolded and gagged.
The couple is brought upstairs and ushered into a dark room.
Two assailants tie the couple to the chairs with neckties they found hanging in an armoire.
One of the assailants takes (a blanket, something, a curtain) to hang for privacy.
Another assailant finishes tying the woman's ankles to the chair.
As he is doing so, one of the assailants puts a pillow behind the woman's head.
He does not put one behind the man's head.
The assailants then change into different shoes.
Assailant D sits down and puts on a pair of (white, different, black) shoes.
Assailant A looks outside and sees a truck drive around the corner and continue up the street.
One man turns on the lights revealing four assailants, one is tall and blonde, one is balding, one has a moustache, and one has dark hair and is clean shaven.
They take off their coats and scarfs..
The men begin moving furniture.
One man moves (a vase, something, a bowl) off the piano.
Another assailant lines up the shoes they all changed out of
One of the men gestures over to the piano.
He needs assistance to complete a task.
To reveal the wooden floor beneath, (three, some, two) assailants roll a carpet back.
One of the men slides a case of tools over to the others.
Man D points to the ceiling and then taps the floors with this foot.
One assailant tightens the handle on a crowbar.
The others then take the rest of the tools out of the case.
Revealed at the bottom of the case is a (rope, item, towel).
One assailant rests a sledge hammer against the side of the case.
Another man lays a sock next to the sledge hammer.
Assailant B begins removing the wooden tiling with a crowbar.
Man A gets up to light a cigarette with (matches, something, a lighter).
After the wooden tiling has been completely removed from a section of the floor, Assailant B uses a mallet and chisel to break the concrete under the floor.
Assailant A checks his notebook, turns out the lights, and looks out the window.

He sees a police officer stick a note to a building across the street.
Once the officer passes, he motions for the lights to be turned back on and the men continue working on the floor.
To see if it will billow up, Man A places (a tissue, something, a paper) over the hole.
The men look at each other and smile.
This means they have broken through to the floor below them.
The men then work on widening the hole so they may descend through it.
They use a rope to secure a (umbrella, item, bucket) to catch falling debris.
The men pull out large pieces of fallen debris by hand.
This procedure takes quite some time.
Man A checks the time.
When the hole is large enough Assailant B collapses on a (chair, item, stool) clearly fatigued.
Man D begins gathering up the tools.
He starts to put them back into the tool case.
Assailant C comes over to assist the fatigued digger.
He offers Assailant B (a drink, something, a cigar).
Meanwhile, Man A prepares to descend to the level below.
He hangs a canister around his neck.
Man C turns on another light so everyone can see better.
Man A climbs down with a canister around his neck and lands safely (on the table, floor).
He takes a look around.
He then walks through the doorway to another room.
Once he is in the room he immediately approaches an alarm on the wall.
As he works on deactivating the alarm, he lights the space (with a flashlight, lamp).
The light source is placed on top of a filing cabinet drawer.
He moves another filing cabinet out of the way and places the nozzle of the canister in the alarm.
He sprays foam from the canister into the alarm, muffling it.
Immediately after spraying the substance, the assailant hits the side of the alarm with a (fist, something, hammer).
He opens the case to the alarm.
The alarm is ringing, but the sound is muffled by the phone.
Once the alarm is deactivated, Man A walks back over to the hole he climbed down and motions for the rest of the men to descend.
After the second man descends, an (suitcase, item, duffel bag) is lowered through the hole.
The final two assailants descend through the hole.
The men begin to assemble the tools.
They all walk over to a safe which is up against a wall.
From the wall above the safe, Man D removes a (picture frame, something, clock).
Before doing so he must clear some things off of the top of the safe.
They are books of some sort.
After the top of the safe is clear, Man B walks over to the safe.
Man B then climbs onto the safe (with assistance from the others, using a step ladder).

Another man hands him a crowbar and he begins to pry the safe from the wall.
When it is loose, he hops down from the safe.
The men then lower the safe.
To support the safe, they lower it onto a (wooden block, item, crate) that one man is holding.
Once the safe is lowered to the first level, the men are relieved.
One assailant climbs beneath the safe.
He uses his back as a support to hold the safe up.
The man beneath the safe is wearing a (Watch, something, a bracelet around his wrist.
The safe is finally lowered safely to an angle close to the ground.
Man D climbs over the safe to get a better angle.
He examines the back side of the safe.
Man D marks the spots that he will drill with a (white pencil, item, chalk).
He then uses the mallet and chisel to further mark the safe.
He places the drill into one of the indentations and begins.
To muffle the drill he ties a towel around the motor.
He begins drilling while Man C drips a liquid substance onto the drill bit.
The drill bit breaks, but it is quickly replaced with another.
Meanwhile outside, a delivery man drives up the street.
He man delivers flowers to a female shopkeeper.
He tips his hat to her as he returns to his vehicle.
As he returns to his vehicle, (a street washer, another vehicle, a mailman) drives around the corner.
The scene then flashes back to the crime scene.
The men are still attempting to penetrate the safe.
The clock reads that it is almost 6:00am.
Using additional tools, the assailants finally penetrate the safe.
Outside, two officers are walking their bicycles down the street.
After getting stuck in his bicycle, an officer tosses (a box, something, a newspaper) aside.
It lands on the sidewalk.
The officer turns to the other officer.
He takes out a notebook and checks it.
The officers' attention has been captured by a (car, something, man) in the alley.
The officers walk toward the alley to check things out.
Inside, the assailants have finished their heist and are climbing back up to the apartment above.
One of the assailants is half way up, when he decides to climb back down.
He walks back over to the area near the safe.
From a drawer that holds valuables, he removes a (ring, piece of jewelry, necklace).
He examines the piece carefully.
He tosses the piece into his jacket pocket.
He then pauses as if an idea has come to him suddenly.
Before exiting, he tosses (an envelope, an item, his gloves) into the safe.
The man then walks over to where they originally descended into the room.
He jumps onto the table.
He then grabs the rope and makes his escape.

Appendix D

Demographic Survey

1. Gender

__Female
__Male
__Transgender
__Prefer not to respond

2. Race/Ethnicity:
__African American/Black
__Asian/Pacific Islander
__Hispanic/Latino
__Multiracial
__Native American/American Indian
__White
__Not Listed (please specify)
__Prefer not to respond

3. Class status :
__Freshman
__Sophomore
__Junior
__Senior
__Graduate student

4. College Major:
__Social Sciences (Sociology/Criminology/Psychology/ect.)
__Human Services & Rehabilitation
__Life Sciences (Biology/Chemistry/ect.)
__Business & Marketing
__Accounting
__Education
__English
__Mathematics
__Philosophy/Religion
__Undecided
__Other

5. Age:

__ Under 18
__ 18-19
__ 20-21
__ 22-24
__ 25 and above

6. Are you considered an in-state or out-of-state student?
__ In-State
__ Out-of-state

7. Do you consider yourself to be a:

☐ International student

☐ NCAA athlete

☐ Commuter student

☐ Student with physical disability

8. Living arrangements:

__At home with parent/guardian
__On campus
__Other

9. Do you have plans for further education after graduation
__Yes
__No

10. How many hours of sleep do you usually have?

__ 0-4

__ 4-6

__ 6-7

__ 8-10

Appendix E

Memory Test

1. What do the assailants hang for privacy?
2. What color shoes does assailant D put on?
3. What item does an assailant move off of the piano?
4. How many assailants roll back the carpet once it is removed from underneath the piano?
5. What item is shown to be at the bottom of the tool case once the tools are removed?
6. What does assailant A use to light what he is smoking?
7. What do the assailants place over the hole when checking to see if they made it through to the other side?
8. The assailants secure what item in order for it to catch debris?
9. After finishing the hole, on what does the digger sit?
10. What does an assailant offer assailant B after he is done with the hole?
11. What do the assailants land on after descending into the hole?
12. What does assailant A use to light the space while deactivating the alarm?
13. After spraying the foam, what does assailant A hit the side of the alarm with?
14. What item is lowered into the hole after the second assailant descends?
15. What is removed from the wall above the safe?
16. How does assailant B get on top of the safe?
17. What object do the men lower the safe onto?
18. What is the man who gets underneath safe wearing around his wrist?
19. What does assailant D use to mark where he'll drill on the safe?
20. What kind of vehicle comes around the corner after the flower delivery?
21. What item gets stuck in the officer’s bicycle spokes?
22. What draws the officers’ attention to the alley?
23. What item does the last assailant take before leaving?
24. Before climbing up the rope, what does assailant D toss away?

Appendix F

Fictitious Statement of Benefits for Mindful Meditation

According to the New York Times, mindful meditation has been shown to drastically reduce levels of stress and blood pressure, while improving the individual's immune system, attention, and cognitive abilities (2015). Meditations ability to relax the mind and recognize bodily sensations allows the brain to encode memory more accurately (Bermerrel, 2016). Therefore, mindful mediation has been linked to higher scores on memory tests and lower false reports of misinformation. Even brief mindfulness sessions have significantly enhanced eyewitness memory and reduced the likelihood of incorrect information overwriting the original memory (Pickrell, Bernstein, & Loftus, 2014).

Fictitious Statement of Benefits for Sudoku

According to the New York Times, practicing simple math problems or participating in mind games like Sudoku has been shown to drastically reduce the risk of dementia and lower blood pressure, while improving the individual's analytical thinking, attention, and cognitive abilities (2015). The focus and critical thinking that is required to complete Sudoku allows the brain to encode memory more accurately (Bermerrel, 2016). Therefore, Sudoku has been linked to higher scores on memory tests and lower false reports of misinformation. Even a brief game of Sudoku can significantly enhance eyewitness memory and reduce the likelihood of incorrect information overwriting the original memory (Pickrell, Bernstein, & Loftus, 2014).

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