2022

The Relationship Between Trait Mindfulness and Memory Performance

Kyra Belden

THE RELATIONSHIP BETWEEN TRAIT MINDFULNESS AND MEMORY PERFORMANCE

Kyra Belden

Faculty Supervisor: Leamarie Gordon, Ph.D.

Department of Psychology

A Thesis Submitted to Fulfill the Requirements of the Honors Program at Assumption University

Spring 2022

Abstract

Previous research has found a link between trait mindfulness and various aspects of well-being and cognition. Further, research on state mindfulness has found it to relate to performance on a memory task designed to examine eyewitness susceptibility. In the present study, I sought to expand on these findings by examining whether levels of trait mindfulness would also predict how susceptible individuals' memories are to external suggestion. Seventy-three participants studied six common household scenes, and then rated the pleasantness of items they were told were recalled by another participant. These items included six suggested items not present in the scenes. After completing a two-part memory task including a free recall test and a source recognition test, participants completed a mindfulness questionnaire to measure levels of trait mindfulness. Results showed that participants demonstrated false memory for the suggested items on the recall test, but not the recognition test. Further, I found a positive correlation between mindfulness levels and accurate recognition. These results suggest that people who are higher in mindfulness may show better source monitoring abilities, but their susceptibility to misleading information from a social source may not be related.

A long-standing Buddhist practice, mindfulness has worked its way into North American culture for a myriad of purposes. The practice has been shown through peer-reviewed research to benefit many human experiences, such as attention (Ford et al., 2020), memory (Yeh & Lu, 2017), well-being (Yu & Clark, 2015), and general mental health (Segal et al., 2018), among others. In recent work, Gordon and Price (2023) found that participants who reported higher levels of state mindfulness following a mindfulness induction task tended to have better memory on a task designed to examine eyewitness memory errors. Gordon and Price concluded that using brief exercises to induce states of mindfulness could be a useful manipulation in some contexts. However, since the experience can vary across people, that individual difference in mindfulness was important to study in relation to memory. The present study examines how differences in self-report measures of trait (or dispositional) mindfulness between individuals – as opposed to state levels of mindfulness – relate to memory performance in the social contagion paradigm, a different memory paradigm than the one used by Gordon and Price.

Mindfulness

Mindfulness as a concept comes from the Buddhist religion. The traditional language of Buddhism, Pali, uses the term *sati* to refer to mindfulness, which means "to recall" and "to bear in mind" (Yeh & Lu, 2017). It has been used by Buddhists to cultivate a path to a cessation of mental suffering. In Buddhism, mental suffering is characterized by a general feeling of "unsatisfactoriness" – that is, the general feeling that no matter where one is at in life, they are never fully satisfied (Botha, 2022). The general goal of the religion is to understand this suffering and where it comes from, and then to find a path to end it, which often entails the practice of mindfulness. Such practices typically induce a state of mindfulness, but some individuals might have a natural tendency to be mindful – this is referred to as trait mindfulness.

Due to its success in the Buddhist tradition, mindfulness practices have been used in medical settings for therapeutic purposes, such as to treat depression, sleep disorders, anxiety, and other mental illnesses (Segal et al., 2018). Similarly, forty-two breast and prostate cancer patients showed enhanced quality of life and decreased stress symptoms following an 8-week mindfulness-based stress reduction program (Carlson et al., 2003). A more recent study found higher levels of dispositional mindfulness to correlate with less eating disorder symptoms in individuals diagnosed with anorexia nervosa (Dunne et al., 2021). In an assessment of memory, Brown et al. (2016) found that higher levels of state mindfulness correlated with higher performance on a memory task. This finding in particular has motivated the present research in the relationship between mindfulness and memory.

While the term "mindfulness" is used frequently and loosely in conversation, mindfulness is defined in specific ways by experts in the field. A common conceptualization among scholars is that mindfulness involves two essential components: the "self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present moment" and "adopting a particular orientation toward one's experiences in the present moment, an orientation that is characterized by curiosity, openness, and acceptance" (Bishop et al., 2004). Someone who self-regulates their attention on immediate experience is able to maintain attention to their own thoughts, feelings, and sensations as they experience them. They also exhibit a skill called "switching," which allows a person engaged in mindfulness to switch attention back to their breath after they have acknowledged a thought, feeling, or sensation (Bishop et al., 2004). Mindfulness also requires skills in sustained attention, defined as the ability to "maintain the direction of their attention toward a stimulus even in the presence of distractors" (Parasuraman, 2000). Many mindfulness exercises entail sustained attention on one's

breath. This is because keeping attention on the breath secures an individual's attention to the moment, allowing them to notice each mental event as it comes. Because mindful people engage in these particular skills, some consider it to be a "metacognitive skill" – that is, cognition about one's cognition (Flavell, 1979). Understanding mindfulness as a metacognitive process implies that both control of cognitive processes (observing thoughts and feelings and letting them pass without ruminating over them) and monitoring the stream of consciousness are required to engage in mindfulness.

Monitoring one's stream of consciousness can be confusing to consider. Essentially, this involves the second component of mindfulness: orientation toward one's experiences with curiosity, openness, and acceptance. One must make a commitment to curiosity about where the mind might go whenever it loses focus from the breath (Bishop et al., 2004). In other words, a mindful individual is not self-critical or judgmental about where the mind might wander; rather, they are curious about what mental events may arise. They must also be open to whatever may come: any thought, feeling, or sensation they have should be seen as subject to observation. And lastly, the person must be accepting of the reality of each moment. They abandon any expectation or agenda they had for how the moment should play out and rather accept it for how it is. It is a process of simply letting things play out in one's mind instead of trying to control their experiences – monitoring their stream of consciousness, as opposed to judging or controlling it. This process, combined with self-regulation of attention, captures the process of mindfulness: attending to the present moment without judgment and bringing attention back to the present if it wanders.

Trait vs. State Mindfulness

There are two main types of mindfulness: trait (an individual's personal disposition), and state (a temporary state of being). Trait (or dispositional) mindfulness can be defined as a person's innate capacity to attend to and maintain attention on present experiences with a non-judgmental and passive attitude (Brown & Ryan, 2003). People who exhibit trait mindfulness tend to be naturally mindful. Conversely, state mindfulness is an induced state of mind that one can intentionally cultivate through a variety of practices (Ford et al., 2020). Essentially, a person with trait mindfulness is always mindful, or is more inclined to be mindful, whereas a person inducing state mindfulness is only in this state for a finite period. While they differ by definition, these two types of mindfulness are often related. For instance, there is evidence that continued practice in state mindfulness over time may lead to increased trait mindfulness (Kiken et al., 2015). So, while mindfulness itself can look different depending on whether it is trait or state, the two forms are still related to one another.

Benefits of Trait Mindfulness

Most relevant to the present study is the literature on trait mindfulness. Mindfulness as a quality has been studied in a number of domains and is generally shown to relate to positive outcomes in various aspects of life. For example, greater levels of dispositional mindfulness correlate with greater overall well-being (Yu & Clark, 2015) as well as a higher quality of life (Marzabadi & Mills, 2021). Trait mindfulness is negatively associated with substance use behaviors, particularly tobacco and alcohol use behaviors (Karyati et al., 2014). Interestingly, individuals with higher levels of trait mindfulness report lower levels of stress and anxiety related to the COVID-19 pandemic (Dillard & Meier, 2021).

Trait mindfulness has also been studied in the context of cognition. For instance, greater long-term mindfulness practice aimed to increase trait mindfulness has been shown to associate with greater attention performance (Verhaeghen, 2020). Further, Ford et al. (2020) looked at the relationship between trait mindfulness and selective visual attention. Selective visual attention refers to "the tendency of visual processing to be confined largely to stimuli that are relevant to behavior" (Moore & Zirnsak, 2017). In simpler terms, it is the process of narrowing down which visual information we take in is important enough to require our attention. We take in so much visual information that it would be impossible to attend to each and every stimulus; selective visual attention allows us to weed out which of those stimuli we should pay attention to and essentially ignore the stimuli we deem unimportant. Research suggests that our attention is drawn to emotionally salient information (Lang et al., 1997) and, as mentioned above, mindful individuals are better able to recognize their present feelings (Bishop et al., 2004). As such, Ford et al. (2020) hypothesized that more mindful participants would selectively attend to emotionally valenced images. Ford et al. (2020) measured trait mindfulness via the MAAS, the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), and the Cognitive and Affective Mindfulness Scale – Revised (CAMS-R; Feldman et al., 2007). Multiple measures of mindfulness were used to capture the various conceptualizations of mindfulness. Participants sat at a computer and were presented with four images at a time, consisting of one sad, one threatening, one neutral, and one happy image. Visual attention was measured via dwell time (defined in this study as the total amount of time participants fixated on an area of the screen) on each image category using an eye tracker. Ford et al.'s findings showed a positive correlation between trait mindfulness and dwell time on images, particularly threatening and happy ones. The established relationship between mindfulness traits and attention processes suggests that trait

mindfulness could play a part in memory, as selective visual attention is important in establishing long-term memory for events, such as in an eyewitness memory situation.

The Importance of Eyewitness Memory Research

Event memory can be defined as "the mental construction for a scene, real or imagined, for the past or future" (Rubin & Umanath, 2015). This particular type of memory is a key factor in contexts like eyewitness testimonies, which can have significant impacts on not just one's own life, but others' as well. In eyewitness situations, individuals may be exposed to details from other witnesses, may be asked leading or suggestive questions, or discuss the situation with first responders and other individuals at and beyond the scene. Notably, the leading cause for wrongful convictions in the United States today is faulty eyewitness testimony (Innocence Project, 2023), which can often arise from memory suggestibility. On average, wrongly convicted individuals spend almost 14 years in prison for crimes they did not commit (Innocence Project, 2023), some of these individuals on death row. The issue of faulty event memory is extremely prevalent in broad contexts like this one, which has motivated a large body of research examining how exposure to external suggestions can impact event memory accuracy.

Eyewitness suggestibility is typically studied in a controlled laboratory setting, where researchers can have control over the circumstances surrounding a witnessed event. In a standard variation of one of these paradigms, the misinformation effect paradigm (Loftus et al., 1978), participants witness and event which is usually simulated through the presentation of a video or photographs or a crime or accident. Following the event, they are exposed to misleading details through verbal summaries or leading questions about the event. These misleading details typically replace a true detail; for example, a summary point might mention a truck when the real detail was a van. A typical finding is that participants falsely remember the suggested details on

later tests of recall and recognition (e.g., Gordon & Shapiro, 2012). Other paradigms have focused on how memory can be contaminated through interactions with other eyewitnesses. For example, in the social contagion of memory paradigm (Roediger et al., 2001), participants study images of neutral household items (such as a kitchen or bathroom setting) and then are exposed to information not present in the scenes via social interaction. This will usually entail the participant joining with an actor (posing as another participant) to take a collaborative recall test, where they take turns listing objects from the photographs they studied. During this phase of the paradigm, the actor intentionally lists incorrect item for some of the photos. Then, actors and participants split up so that participants can take an individual free recall and recognitions tests. The typical findings are that participants exposed to misleading information via this paradigm are more likely to report the suggested items on the recall test (Roediger et al., 2001), and more likely to falsely recognize these items in the recognition task (Meade & Roediger, 2002). Recently, other researchers have modified the social contagion paradigm so that the live actor is not necessary to introduce suggestive details to participants. For instance, Huff et al. (2013) had participants study the six household scenes developed by Roediger et al. (2001). Participants were then exposed to misinformation via fabricated recall tests containing a handful of incorrect items, which they were told had been completed by previous participants of the same study. The researchers informed participants that an additional purpose of the study was to examine how the pleasantness of an item could potentially influence memory performance. Participants were asked to rate each item on the fabricated tests in terms of how pleasant they found it to be. A pleasantness rating task ensures good attention to items because it requires participants to use semantic encoding, where they may visualize each item and analyze its meaning to answer the prompt (cf. Craik & Lockhart, 1972). This type of task has been used as a manipulation in other

false memory studies to promote encoding of specific verbal content (e.g., Gordon & Shapiro, 2012). They were then instructed to read each item from these fabricated recall tests and circle each item they found to be pleasant. Huff et al. (2013) found that even when the live actor is removed, and suggested items are introduced through another method, false memories persist for the suggested details.

Researchers have used the social contagion paradigm in a number of studies designed to examine factors that may relate to both event memory accuracy and social contagion effect rates, or the likelihood of falsely reporting or recognizing suggested items. For example, one study in particular found that when participants were warned they may have been exposed to misinformation from an external source, their performance on the final memory test in the paradigm improved (Echterhoff et al., 2005). Another study found that when participants felt pressured or anxious to do well on a memory task, they experienced decreased memory performance and greater susceptibility to the social contagion effect (Andrews-Todd et al., 2021).

Memory and Mindfulness

Previous work suggests a link between mindfulness and attentional processes (Ford et al., 2020; Verhaeghen, 2020). Qualities that assist in monitoring and control of memories that could come from different sources could be important for distinguishing between witnessed information and suggested information during a memory test. As such, researchers have begun to explore how mindfulness might relate to false memory susceptibility in different eyewitness paradigms. Some of this work examines whether induced states of mindfulness could have a protective effect on memory. For example, Alberts et al. (2017) found a positive relationship between brief mindfulness exercises and source monitoring, a specific test of memory. Source

monitoring is the skill of identifying the "source" of a particular memory. This involves identifying various characteristics that specify the context of where and when the memory was formed. Examples of such characteristics include the spatial, temporal, and social context of the witnessed event, or whether they witnessed the event via a picture or a video (Johnson et al., 1993). It is possible that a more mindful individual who keeps attention secured on the present moment may be better at distinguishing between sources because they pay more attention to their experiences as they happen.

Gordon & Price (2023) explored the impact of brief mindfulness exercises on susceptibility to misinformation. Participants in the mindfulness group listened to a mindfulness recording prior to encoding, whereas participants in the control group did not. State mindfulness levels were measured via the Toronto Mindfulness Scale (TMS; Lau et al., 2006). The memory task, consisting of three elements, followed the mindfulness exercise. In the first element, participants watched a 22-minute excerpt from a black and white silent film depicting four men committing a burglary in the middle of the night – this served as the witnessed event. Participants then listened to an audio narrative containing 24 sentences containing consistent, neutral, and misleading information about the video. Finally, participants took a recall test in which they were asked 24 questions about specific details presented in the manipulated narrative series. Results showed that within the mindfulness group, participants who self-reported higher levels of mindfulness were less susceptible to the negative effects of misinformation (i.e., reporting fewer misleading items on the recall test). However, a limitation of this work is that existing levels of mindfulness prior to the induction task were not measured. The authors concluded that it was important to examine baseline measures of trait mindfulness in future studies, as mindfulness exercises may impact individuals differently. The present study expands

upon these findings to see if individual differences in trait mindfulness relate to memory suggestibility.

There is some related research on trait mindfulness and memory outside of the eyewitness suggestibility literature. In a multi-part study, Brown et al. (2016) found that self-reported mindful attention correlated positively with better recognition performance in the Remember-Know paradigm. Their task involved participants studying pictures of everyday items, followed by a memory test in which they were presented with all the same pictures mixed with new pictures. They were asked to indicate whether each item was old (the item was studied) or new (the item was not studied). For each item they marked as old, they were asked to indicate if they *remembered* it (e.g., they had a vivid memory of seeing it), or if they simply *know* they saw it (e.g., no vivid memory, more familiar). Participants could also report that they had guessed that it was an old item. In the first study, Brown et al. found a positive relationship between levels of state mindfulness measured just before the R-K task and improved recognition performance specifically on the "remember" response accuracy. This means that individuals with higher levels of mindfulness may remember more detailed information about studied items, as they were better at having vivid memories of items than less mindful participants.

In the second study, Brown et al. also found that brief training in a focused attention type of mindfulness also predicted better recognition performance on the same paradigm. Compared to a control group, participants who engaged in this brief mindfulness training showed consistently greater accuracy in overall recognition performance (Brown et al., 2016). This second study established more of a causal relationship between mindfulness meditation and better memory performance on a recognition task. Collectively, past research has shown state mindfulness to consistently relate to or result in better memory performance. However, because

limited research exists on trait mindfulness as it relates to memory performance (and more specifically in the social contagion paradigm, used in the present study), it will be beneficial to add to this area of research. Based on the existing research and the interplay between trait and state mindfulness, there is reason to believe that a relationship exists between trait mindfulness and performance on the current study's memory task involving recall and recognition after exposure to misleading information. It is also particularly interesting to understand how individuals who are inclined toward mindfulness may engage with information in the environment in different contexts. For instance, a more mindful individual might make a better eyewitness if they can accurately assign memories to the correct source or recall their memories more accurately due to better mindful attention while the memory is being encoded.

Trait mindfulness has also been examined in the context of a different type of false memory procedure, the Deese-Roediger-McDermott (DRM) paradigm (Roediger et al., 1995). The DRM paradigm examines memory suggestibility, but not via exposure to direct suggestions such as in the misinformation or social contagion paradigms. The DRM paradigm begins with an encoding phase in which subjects are told to study a list of semantically related words (e.g., nurse, hospital, etc.) and asked to recall and recognize these words after a delay (Roediger et al., 1995). After recalling as many words as possible, during the recognition task, participants are asked if they remember the previously presented words, and also items termed critical lures. Critical lures are semantically related words that were not present during the encoding phase (e.g., doctor). In a typical DRM paradigm, participants are likely to recall and recognize critical lures with high confidence. While the exact mechanisms that underlie these false memories are not understood, there is general agreement that the errors result from automatic associative processes in memory influencing familiarity and fluency of information (Gallo, 2010 for review).

Importantly, Wilson et al. (2015) found participants exposed to critical lures in the DRM paradigm falsely recalled significantly more items after a mindfulness induction task, suggesting that mindful individuals may be more influenced by associative memory errors. This evidence gives reason to believe that more mindful participants in the present study may falsely recall more critical items after exposure to them.

Yeh and Lu (2017) had participants complete a version of the DRM task and also measured trait mindfulness. They found that individuals with higher levels of trait mindfulness recognized fewer critical lures. Something to remember when considering these results is the relevance of the fuzzy-trace theory (FTT; Reyna & Brainerd, 1995), an important theoretical framework of false memory in the DRM paradigm. This theory poses two different types of information that can be encoded into memory: gist and verbatim. Gist refers to the semantic information shared by common items, or the general information one can remember about an item. Conversely, verbatim information consists of the perceptual details of an item, or the more precise characteristics one remembers, like its shape, size, or surrounding objects. Yeh and Lu articulated that more mindful participants were more likely to use verbatim information to decrease false recognition of critical lures. When calling on verbatim information, participants were required to remember physical characteristics about the item and/or its surroundings that they would not have in their memory without having seen the item. So, they used increased mindful attention (present-centered awareness) during encoding and increased source monitoring abilities during retrieval, which are both characteristic of more mindful individuals (Alberts et al., 2017), to remember detailed information. It was also shown in Brown et al. (2016) that more mindful individuals could remember more detailed information about studied items, in line with their increased ability to remember verbatim information in Yeh et al. (2017). Taken together,

these skills may result in lowered recognition of suggested contagion items in the present study for more mindful individuals because they may better remember both detailed features of an item (verbatim information) and where the item came from (source monitoring).

Trait mindfulness has not been studied in the specific context of the social contagion paradigm. The present study looks to fill that gap in the research. The results from this study will help to understand whether trait mindfulness relates to memory, and thus whether trainings designed to enhance mindfulness could be useful in different careers in which event memory is critical (e.g., first responders who go into a situation knowing that they will have to report on what they see). Kiken et al. (2015) showed that continued training in state mindfulness over time can increase levels of trait mindfulness. If trait mindfulness does correlate positively with memory performance, it may be worth considering mindfulness training modules to increase memory performance for career paths in which an accurate memory is vital.

In order to replicate previous social contagion work (e.g., Huff et al., 2013; Meade & Roediger, 2002), I first predicted that false memories would be demonstrated in the present study. That is, participants would be more likely to recall critical items after exposure to them on the pleasantness task compared to spontaneously recalling them without any exposure. In addition, I predicted participants would be more likely to misattribute suggested items to the study phase than to misattribute control items to the study phase. The primary predictions of interest regarded how individual levels of self-reported trait mindfulness would relate to both accurate recall and recognition, and false recall and recognition rates. In terms of accurate memory, I predicted that participants higher in trait mindfulness would show more accurate recall and recognition. In terms of false memory, I predicted that participants reporting higher

levels of trait mindfulness would show higher levels of false recall but lower levels of false recognition.

Methods

Participants

Assumption University students (N = 73) participated for either a $10 gift card or credit toward a research requirement for class. Participants were 27% male, 71% female, and 1% non-binary/third gender. Their ages ranged from 18 to 30 (M = 20.25, SD = 2.34). Participants were mostly White (73%) and non-Hispanic or non-Latino (85%).

Materials

Encoding Materials

Stimuli used for encoding materials consisted of images of six common household scenes, adapted from Huff et al. (2016). The six scenes consisted of a toolbox, a bathroom, a kitchen, a bedroom, a closet, and a desk, and they were presented to all participants in this order. An average of 23.8 items were present in each scene. A sample scene is shown in Figure 1.

Contagion Materials

A set of falsified recall tests were constructed to introduce suggested details to participants. There were two versions of these 'partner tests' for each of the six scenes, and containing an average of eight responses that participants were told were provided by a previous participant. In the control version, the tests listed items that were all present in the corresponding scene. The contagion version of each test contained items from the corresponding scene, and importantly, two suggested items that were not present in the scene. These suggested items were items that were likely to be in the scene but were not actually present in the studied scenes. For

example, in the *kitchen* scene, the suggested items were *knives* and *towel.* There was a total of 12 suggested items on the contagion tests, two for each of the six scenes depicted in the images.

Trait Mindfulness

The Mindfulness Attentional Awareness Scale (MAAS; Brown & Ryan, 2003) was used to measure participants' individual frequencies of mindfulness states over time. The MAAS is an instrument focused on the presence or absence of attention and awareness of present experiences. It is a 15-item questionnaire which asks participants to indicate how often they have the experience described in each statement using a 6-point Likert scale ranging from 1 (*almost always*) to 6 (*almost never*). Higher scores on the MAAS indicate higher levels of mindfulness.

Additional Measures

Toronto Mindfulness Scale. The Toronto Mindfulness Scale (TMS; Lau et al., 2006) is a 14-item questionnaire that was used to measure state mindfulness of each participant at the time of the study.

Frequency of Forgetting Scale. (FoF-10; Zelinski & Gilewski, 2004) is a measure of state (present-moment) levels of self-efficacy—that is, a participant's self-reported measure of how well their memory works. A higher score on the FoF-10 indicates lower rates of forgetting, or a worse self-perceived memory self-efficacy.

Procedure

The main components of the procedure are outlined in Figure 2. After providing informed consent, participants began the study by completing an easy Sudoku puzzle for three minutes. Half of these participants, randomly selected, were told that the puzzle would help them prepare for the upcoming task (there is no factual basis to this statement). This manipulation was not relevant to any hypothesis in this thesis and is important to comparisons made against additional

groups planned for a larger study that this thesis was a part of. Following the Sudoku task, participants were asked to report how confident they felt about the upcoming task on a scale of 1 (not at all confident) to 5 (very confident) and also completed the TMS. Importantly, participants who were presented with false information about the puzzle did not differ from participants who did not receive this information in either confidence levels, $t(71) = .485$, $p = 0.629$, $d = .121$, 95% CI of M_d [-.609, .368], or TMS scores, $t(71) = .858$, $p = .394$, $d = .214$, 95% CI of M_d [-.277, .703]. Thus, participants were treated as a single group for the remainder of the study.

All participants then proceeded to the encoding phase of the study, where they viewed the six images of household scenes. Each picture was displayed for 15 seconds, and the participants were instructed to study them to the best of their ability for an upcoming memory test. After the encoding phase, participants completed a demographic questionnaire which asked about age, gender, race, and ethnicity. This was followed by basic math problems as a filler task to allow for the scenes to be stored in their memory. All participants were timed while they completed the math problems and were asked to stop after three minutes. Next, participants experienced the social contagion phase of the study. In order to introduce suggested items, participants were told that one of the purposes of the study was to examine how the pleasantness of an item related to memory, and they were being randomly assigned the memory tests of a previous participant to evaluate the responses for pleasantness. Asking participants to rate items on pleasantness ensures good attention to items because participants must rely on semantic encoding to visualize each item and analyze its meaning (cf. Craik & Lockhart, 1972). Each participant was given three control tests and three contagion tests containing suggested items. The scenes serving as contagion scenes were counterbalanced across participants. Participants were instructed in the following way: “In this study we are interested in factors that influence attention and memory for

items in scenes. You have been randomly paired up with a previous participant who completed this same study already. In this phase of the study, you will see their responses to a recall test on items from each of the studied household scenes. We would like you to go through the responses on your partner's lists and rate each item in terms of how pleasant you find it to be on a scale of 1 (not at all pleasant) to 5 (very pleasant). A pleasant item is something that might give you a sense of happy satisfaction or enjoyment. Do you have any questions?".

Following the pleasantness rating task, participants completed a two-part memory test. The first part was a free recall test, in which participants spent two minutes listing as many items as they could remember from each scene. They were allotted two minutes per scene. The second part was the recognition test which presented several types of items: items that were previously studied, completely new items, and importantly the critical items. Half of these items had been suggested on the pleasantness task (contagion items) and half had not been suggested (control items). During the test, participants viewed each item and indicated where they had previously encountered the items—while studying the scenes, on their partner's memory tests during the pleasantness task, in both places, or they had not encountered the item at all. Lastly, the participants took the MAAS and the FoF-10. The order of these items was counterbalanced for participants. The MAAS was important as it served as the measure of trait mindfulness. The FOF-10 scale was not relevant to any current hypotheses, however it was included in the correlations reported in Table 1.

Results

Recall

Accurate Recall

The average number of items correctly recalled on contagion and control scenes is reported in Figure 3. As per Huff et al. (2016), correct recall was a proportion, calculated by dividing the number of correct items recalled in a given scene by the total number of items present in that scene. A paired-samples t-test was performed to compare proportions of correct recall of items in control scenes (M = .23, SD = .29) with correct recall of items in contagion scenes (M = .24, SD = .29). There was no significant difference in correct recall between the two scene types, $t(72) = 1.142$, $p = .257$, $d = .134$, 95% CI of M_d [-.09, .03].

False Recall

The average number of items falsely recalled on contagion and control scenes is reported in Figure 3. False recall was also a proportion, calculated as the number of critical items reported in a scene divided by the number of critical items possible (two). A paired-samples t-test compared average false recall of critical that were suggested compared to false recall of critical items when they served as control items. Participants falsely recalled more items when they served as contagion items (M = .46, SD = .22) compared to control (M = .33, SD = .22), $t(72) = 3.939$, $p < .001$, $d = .461$, 95% CI of M_d [.06, .20].

Recognition

Accurate Recognition

Accurate recognition was defined as the average number of studied items correctly attributed to the scenes, out of the total number possible. On average, participants correctly recognized .45 of studied items (SD = .20).

False Recognition

As in Huff et al. (2016), false recognition was operationalized as the proportion of contagion items recognized by participants as being from the scenes, collapsing across ‘scene

only' and 'both' responses on the source test. A paired-samples t-test was conducted on false recognition rates of critical items when they had served as contagion items (M = .62, SD = .27) compared to when they served as control (M = .59, SD = .27) items. A significant finding was not present, $t(72) = 1.218$, p = .227, 95% CI of M_d [-.02, .09]. These results are reported in Figure 4.

Correlations

A descriptive analysis was run to observe overall MAAS scores. Participants' scores ranged from 26.00 to 76.00, and reported a mean score of 53.90 (SD = 10.88).

A series of one-tailed bivariate correlations were conducted to find the predicted relationships between trait mindfulness levels (MAAS scores) and performance on the recall and recognition tests. The analyses showed a positive correlation between MAAS scores and accurate recognition, $r(71) = .207$, p = .039, 95% CI [-.022, .437]. MAAS scores, however, did not correlate with accurate recall, $r(71) = -.034$, p = .386, 95% CI [-.275, .227]. A positive relationship was shown between MAAS scores and false recall, $r(71) = .160$, p = .088, 95% CI [-.102, .369], but this did not reach significance. Lastly, no relationship was observed between MAAS scores and false recognition rates, $r(71) = .015$, p = .448, 95% CI [-.205, .224].

In addition to the correlations for the hypotheses of interest, I also explored whether scores of the Frequency of Forgetting scale related to any measure of interest. FoF scores showed a strong positive relationship with MAAS scores, $r(71) = .581$, $p < .001$, 95% CI [.401, .730]. All correlations are reported in Table 1.

Discussion

The purpose of this study was to better understand how trait mindfulness relates to memory performance in a paradigm used to study eyewitness suggestibility. Specifically, I

expanded on the findings of Gordon and Price (2023), who found that participants who self-reported higher levels of state mindfulness after a mindfulness induction task had better memory on a task designed to examine eyewitness memory errors. Their work was limited because they neglected to measure existing levels of mindfulness prior to the mindfulness induction task. This limitation drove the present work because there may be value in considering baseline differences in mindfulness traits or characteristics. In the present work, I adapted the social contagion paradigm procedure from Huff et al. (2013) and added a trait mindfulness measure. Based on the findings of Huff et al. (2013) and Roediger et al. (2001), I predicted participants to exhibit a social contagion effect by recalling and recognizing more contagion items after exposure compared to control. Further, past research (Alberts et al., 2017; Yeh et al., 2017) found more mindful individuals to show heightened source monitoring and use of verbatim information during retrieval processes, which motivated my predictions that higher trait mindfulness would relate to higher accurate recall and accurate recognition, as well as lower false recognition. Research showing more mindful individuals to perform worse on recall tasks (Wilson, 2015) led to the hypothesis that more mindful individuals would falsely recall more items than less mindful individuals.

Consistent with previous research using similar methodologies (Huff et al., 2016; Roediger et al., 2001), participants demonstrated typical memory suggestibility. That is, participants falsely recalled more critical items when they served as contagion compared to control. In addition, I used individual false memory rates to examine the primary hypotheses of interest. The data supported the prediction that trait mindfulness would positively relate to accurate recognition. There was a positive relationship observed between mindfulness and false recall, but it did not quite reach significance. These findings provide supporting evidence that

more mindful individuals may show better source monitoring skills but are more susceptible to misleading information when tasked with a recall test. The ability of more mindful participants to accurately attribute items to their respective sources during the recognition test may be due to increased source monitoring skills, perhaps because of increased attention to the present moment during encoding. When they are more attentive during encoding due to higher mindfulness, it may be easier to correctly attribute items they studied to the scenes. Conversely, their increased susceptibility to misleading information when tasked with a recall test could be accredited to their tendency to take in more information due to a metacognitive awareness characteristic of mindfulness, possibly allowing them to take in more information. In other words, when they are hyper-aware of their present experiences, they may take in more information, both from the scenes and from the pleasantness task; then, when tasked with a recall test and asked to simply report as many items as they can remember without giving it too much thought, they may accidentally report a misleading item from the pleasantness task simply because they remember seeing it. This differs from the recognition task because it doesn't require as much careful consideration of each individual item as in the recognition task.

An increase in recognition performance in relation to higher mindfulness levels could also be attributed to emotion regulation in mindful individuals. Previous research has shown individuals higher in mindfulness to recognize their present feelings (Bishop et al., 2006) and regulate their emotions (Desrosiers et al., 2013) better than less mindful individuals. Relatedly, Andrews-Todd et al. (2021) found that participants who felt pressured or anxious to do well on a memory task showed decreased memory performance and greater susceptibility to the social contagion effect. Perhaps this increased ability for more mindful participants to recognize and recognize their emotions acted as a protective factor against feelings of anxiety or pressure

heading into the study; as such, future studies may add a self-report measure of these feelings at the beginning of the study to assess whether a relationship exists between anxiety/pressure, mindfulness, and susceptibility to the social contagion effect.

This pattern of results is also consistent with Brown et al. (2016), who found more mindful individuals to perform better on a recognition test in the Remember-Know paradigm. While this study observed state mindfulness in a different memory paradigm than the present study, it found mindfulness to help participants accurately recognize studied items more consistently. It is known that consistent practice in mindfulness leads to an increase in trait mindfulness over time (Kiken et al., 2015). There may be merit in creating mindfulness training modules for individuals in career paths that may require accurate recognition, such as police officers or first responders.

The present findings are inconsistent with Yeh et al.'s (2017) work dealing with susceptibility to misleading information in the DRM paradigm, which found that more mindful participants recognized fewer misleading items. This inconsistency is particularly interesting because of how more mindful individuals have performed in previous studies dealing with cognitive process important in memory, such as attention and source monitoring. This divergence from literature may actually make some sense, as more mindful participants did show higher levels of accurate recognition; however, this rise in mindfulness may not translate to more or less susceptibility to misleading information. This could be due to a heightened awareness to the present as participants encoded the items from both the scenes and the pleasantness ratings, which simply resulted in greater intake of information in general but did not impact whether participants created those false memories.

My findings highlight the existing effect of misleading information on memory performance in the social contagion paradigm. They also highlight the relationship between trait mindfulness and memory performance in this memory paradigm. However, it is interesting that the results did not support the prediction that trait mindfulness would negatively correlate with false recognition. This may be explained by the use of only the MAAS as a measure of trait mindfulness in this study. Trait mindfulness is a very open-ended phenomenon with various definitions, so only taking on a single measure may have been too narrow to get a full picture of the participants' true mindfulness levels. While there is a general agreement among scholars that mindfulness consists of a certain present-centered awareness, there is much discourse on what that exactly entails; for instance, the MAAS was created to assess only the presence or absence of attention to and awareness of the present moment and omits the relevance of mindful attributes signature of other research in mindfulness, such as acceptance, trust, empathy, or gratitude (Shapiro & Schwartz, 1999). Other studies (Ford et al., 2020; Berry et al., 2018) use two or more measures of dispositional mindfulness when considering it as a variable. One common measure is the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), which measures five narrow facets of mindfulness: Observing, Describing, Acting with Awareness, Nonjudging of Experience, and Nonreactivity to Inner Experience. The MAAS and the FFMQ are commonly used together, and occasionally in conjunction with the CAMS-R.

There are at least two potential limitations concerning the results of the present study. A first limitation concerns the lack of sufficient measurement of trait mindfulness. This may have prevented the ability to get a full picture of mindfulness among the participants. A second potential limitation concerns generalizability of the participants. Having participants that are mostly White, female, and in their early to mid-twenties does not accurately reflect the general

population. Anyone can experience mindfulness, though at varying levels (Brown et al., 2007). As such, it is crucial to obtain a more diverse demographic of participants so that these results may be more generalizable.

Despite these limitations, the results of the present study have various theoretical and practical implications. Primarily, they add to existing research that the social contagion paradigm is a reliable and predictable paradigm (Roediger et al., 2001). The findings also add to the reliability of the updated version of the paradigm by Huff et al. (2013), in which the live actor is not necessary. Practically speaking, these findings also add implications to the area of eyewitness memory. It was predicted that participants with higher trait mindfulness would show lower levels of false recognition. If this prediction had been met, it would indicate that when exposed to misinformation, more mindful eyewitnesses may falsely recognize such misinformation when presented with it on the stand. However, because the prediction that mindfulness would positively relate to accurate recognition was met, it can be posed that eyewitnesses who show higher levels of dispositional mindfulness may recognize true information more accurately. On the other hand, more mindful individuals showed higher levels of false recall; taken together, these results indicate that when an individual showing higher levels of mindfulness is exposed to misinformation, their recall performance may decrease, but their recognition performance may increase. This becomes complicated when considering eyewitnesses because both types of memory are relevant. Lastly, trait mindfulness may have implications in areas outside of eyewitness testimonies in which accurate memory is important. For instance, perhaps mindfulness may help in test-taking skills, where more mindful individuals may be better equipped to perform well on recognition tasks, such as multiple-choice questions. Some careers may require individuals to remember information more accurately, such as first-responders who

must be able to report on incidents after the fact. However, this tends to require more recall than recognition skills, and the present findings show more mindful individuals to be worse at recall abilities; in this case, it may be beneficial to be *less* mindful.

Future research might follow Ford et al. (2020) or Berry et al. (2018) by using more than one measure of trait mindfulness in order to capture the various dimensions of mindfulness in participants. Common measures of trait mindfulness include the FFMQ, the Cognitive and Affective Mindfulness Scale Revised (CAMS-R; Feldman et al., 2007), the Developmental Mindfulness Survey (DMS; Salloway & Fischer, 2007), and the Freiburg Mindfulness Inventory (FMI; Buchheld et al., 2001), among many others. The most frequently used measures in present-day mindfulness research are the MAAS, the FFMQ, and the CAMS-R. Future studies may replicate the present study and incorporate these additional measures in order to get a more complete understanding of mindfulness levels among participants. Further, future studies may seek out a more diverse demographic of participants in order to achieve more generalizable results.

References

Alberts, H. J., Otgaar, H., Kalagi, J. (2017). Minding the source: The impact of mindfulness on source monitoring. *Legal & Criminal Psychology, 22*(2), 302–313. https://doi.org/10.1111/lcrp.12102

Andrews-Todd, J., Salovich, N., & Rapp, D. (2021). Differential effects of pressure on social contagion of memory. *Journal of Experimental Psychology: Applied, 27*(2), 258–275. https://doi.org/10.1037/xap0000346

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Botha, D. (2022). Mental suffering: Buddhism, a post-modernist Western view, and the mutual "path to happiness". *Psychological Thought, 15*(2), 18–39. https://doi.org/10.37708/psyct.v15i2.480

Brown, K. W. & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K. W., Goodman, R. J., Ryan, R. M., & Anālayo, B. (2016). Mindfulness enhances episodic memory performance: Evidence from a multimethod investigation. *PLOS ONE, 11*(4). https://doi.org/10.1371/journal.pone.0153309

Carlson, L. E., Speca, M., Patel, K. D., & Goodey, E. (2003). Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress, and immune parameters in breast

and prostate cancer outpatients. *Psychosomatic Medicine, 65*(4), 571–581. https://doi.org/10.1097/01.psy.0000074003.35911.41

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Desrosiers, A., Vine, V., Klemanski, D. H., & Nolen-Hoeksema, S. (2013). Mindfulness and emotion regulation in depression and anxiety: Common and distinct mechanisms of action. *Depression and Anxiety, 30*(7), 654–661. https://doi.org/10.1002/da.22124

Dillard, A. J. & Meier, B. P. (2021). Trait mindfulness is negatively associated with distress related to Covid-19. *Personality and Individual Differences, 179.* https://doi.org/10.1016/j.paid.2021.110955

Dunne, J. P., Shindul-Rothschild, J., White, L., Lee, C. S., & Wolfe, B. E. (2021). Mindfulness in persons with anorexia nervosa and the relationships between eating disorder symptomology, anxiety and pain. *Eating Disorders: The Journal of Treatment & Prevention, 29*(5), 497–508. https://doi.org/10.1080/10640266.2019.1688009

Echterhoff, G., Hirst, W., & Hussy, W. (2005). How eyewitnesses resist information: Social postwarnings and the monitoring of memory characteristics. *Memory & Cognition, 33*(5), 770–782. https://doi.org/10.3758/BF03193073

Feldman, G., Hayes, A., Kumar, S., Greeson, J., & Laurenceau, J-P. (2007). Mindfulness and emotion regulation: The development and initial validation of the cognitive and affective mindfulness-scale revised (CAMS-R). *Journal of Psychopathology and Behavioral Assessment, 29*(3), 177–190. https://doi.org/10.1007/s10862-006-9035-8

Flavell, J. H. (1979). Metacognition and metacognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34,* 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Ford, C. G., Haliwa, I., & Shook, N. J. (2020). Mind your gaze: Examining the relation between trait mindfulness and visual attention to valenced images. *Behavioural Brain Research, 401,* 1–5. https://doi.org/10.1016/j.bbr.2020.113063

Gallo, D. A. (2010). False memories and fantastic beliefs: 15 years of the DRM illusion. *Memory & Cognition, 38*(7), 833–848. https://doi.org/10.3758/MC.38.7.833

Gordon, L. T., & Price, L. (2023). State mindfulness and misinformation susceptibility. *Psychological Reports.*

Gordon, L. T., & Shapiro, A. M. (2012). Priming correct information reduces the misinformation effect. *Memory & Cognition, 40*(5), 717–726. https://doi.org/10.3758/s13421-012-0191-7

Huff, M. J., Davis, S. D., & Meade, M. L. (2013). The effects of initial testing on false recall and false recognition in the social contagion of memory paradigm. *Memory & Cognition, 41*(6), 820–831. https://doi.org/10.3758/s13421-013-0299-4

Huff, M. J., Weinsheimer, C. C., & Bodner, G. E. (2016). Reducing the misinformation effect through initial testing: Take two tests and recall me in the morning? Protecting memory from misinformation. *Applied Cognitive Psychology, 30*(1), 61–69. https://doi.org/10.1002/acp.3167

Innocence Project. (2023). *Eyewitness identification reform.* Innocence Project. https://innocenceproject.org/eyewitness-identification-reform/

Johnson, M. K., Hashtroudi, S., & Lindsey, D. S. (1993). Source monitoring. *Psychological Bulletin, 114*(1), 3–28. https://doi.org/10.1037/0033-2909.114.1.3

Karyati, A. A., VanderVeen, J. D., & Cyders, M. A. (2014). A meta-analysis of the relationship between trait mindfulness and substance use behaviors. *Drug Alcohol Depend, 143,* 1–10. https://doi.org/10.1016/j.drugalcdep.2014.07.014

Kiken, L. G., Garland, E. L., Bluth, K., Palsson, O. S., & Gaylord, S. A. (2015). From a state to a trait: Trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Personality and Individual Differences, 81,* 41–46. https://doi.org/10.1016/j.paid.2014.12.044

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated attention: Affect, activation, and action. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and emotion: Sensory and motivational processes* (pp. 97–135). Mahwah, NJ: Lawrence Erlbaum Associates.

Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., Shapiro, S., Carmody, J., Abbey, S., & Devins, G. (2006). The Toronto Mindfulness Scale: development and validation. *Journal of Clinical Psychology, 62*(12), 1445–1467. https://doi.org/10.1002/jclp.20326

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory, 4*(1), 19–31. https://doi.org/10.1037/0278-7393.4.1.19

Marzabadi, E. A., Mills, P. J., & Valikhani, A. (2021). Positive personality: Relationships among mindful and grateful personality traits with quality of life and health outcomes. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues, 40* (3), 1448–1465. https://doi.org/10.1007/s12144-018-0080-8

Meade, M. L., & Roediger, H. L. (2002). Explorations in the social contagion of memory. *Memory & Cognition, 30*(7), 995–1009. https://doi.org/10.3758/BF03194318

Miller, K. (2019). The mindful attention awareness scale (MAAS). *Positive Psychology.* https://positivepsychology.com/mindful-attention-awareness-scale-maas/

Moore, T. & Zirnsak, M. (2017). Neural mechanisms of selective visual attention. *Annual Review of Psychology, 68*(1), 47–72. https://doi.org/10.1146/annurev-psych-122414-033400

Parasuraman, R. (2000). *The attentive brain.* MIT Press.

Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences, 7*, 1–75. https://doi.org/10.1016/1041-6080(95)90031-4

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*(4), 803–814. https://doi.org/10.1037/0278-7393.21.4.803

Roediger, H. L., Meade, M. L., & Bergman, E. T. (2001). Social contagion of memory. *Psychonomic Bulletin & Review, 8*(2), 365–371. https://doi.org/10.3758/BF03196174

Rubin, D. C., & Umanath, S. (2015). Event memory: A theory of memory for laboratory, autobiographical, and fictional events. *Psychological Review, 122*(1), 1–23. https://doi.org/10.1037/a0037907

Segal, Z., Williams, M., & Teasdale, J. (2018). *Mindfulness-based cognitive therapy for depression, second edition.* Guilford Publications.

Stadler, M. A., Roediger, H. L., & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition, 27*(3), 494–500. https://doi.org/10.3758/BF03211543

Verhaeghen, P. (2020). Mindfulness as attention training: Meta-analyses on the links between attention performance and mindfulness interventions, long-term meditation practice, and trait mindfulness. *Mindfulness, 12,* 564–581. https://doi.org/10.1007/s12671-020-01532-1

Wilson, B. M., Mickes, L., Stolarz-Fantino, S., Evrard, M., & Fantino, E. (2015). Increased false-memory susceptibility after mindfulness meditation. *Psychological Science, 26*(10), 1567–1573. https://doi.org/10.1177/0956797615593705

Wright, D. B., Gabbert, F., Memon, A., & London, K. (2008). Changing the criterion for memory conformity in free recall and recognition. *Memory, 16*(2), 137–148. https://doi.org/10.1080/09658210701836174

Yeh, L. H. & Lu, A. (2017). Relationship between trait mindfulness and false memory: A bilingual Deese-Roediger-McDermott paradigm. *Universal Journal of Psychology, 5,* 105–113. https://doi.org/10.13189/ujp.2017.050302

Yu, M. & Clark, M. (2015). Investigating mindfulness, borderline personality traits, and well-being in a nonclinical population. *Psychology, 6*(10), 1232–1248. https://doi.org/10.4236/psych.2015.610121

Zelinski, E. M. & Gilewski, M. J. (2004). A 10-item Rasch modeled memory self-efficacy scale. *Aging & Mental Health, 8*(4), 293–306. https://doi.org/10.1080/13607860410001709665

Table 1

Correlations between Trait Mindfulness and Memory Measures

	1	2	3	4	5	6
1. MAAS	-					
2. Frequency of Forgetting	.581**	-				
3. False Recall	.160	.129	-			
4. False Recognition	.015	.120	.325**	-		
5. Accurate Recall	-.034	-.014	.000	-.019	-	
6. Accurate Recognition	.207*	.035	.044	-.101	.343**	-

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

Figure 1

Example of Household Scene

Figure 2

Main Components of Methodology

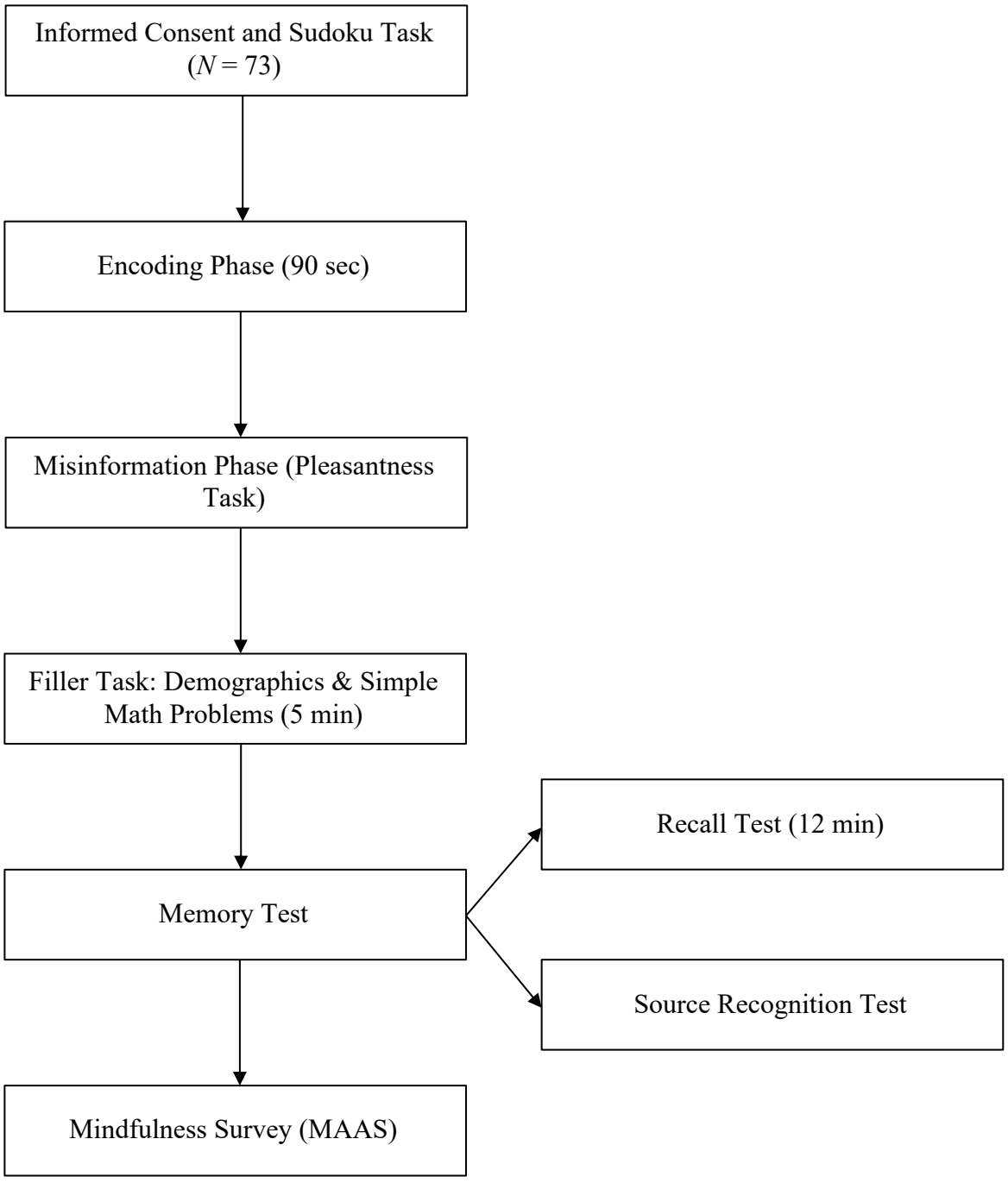

Figure 3

Accurate and False Recall for Contagion and Control Scenes

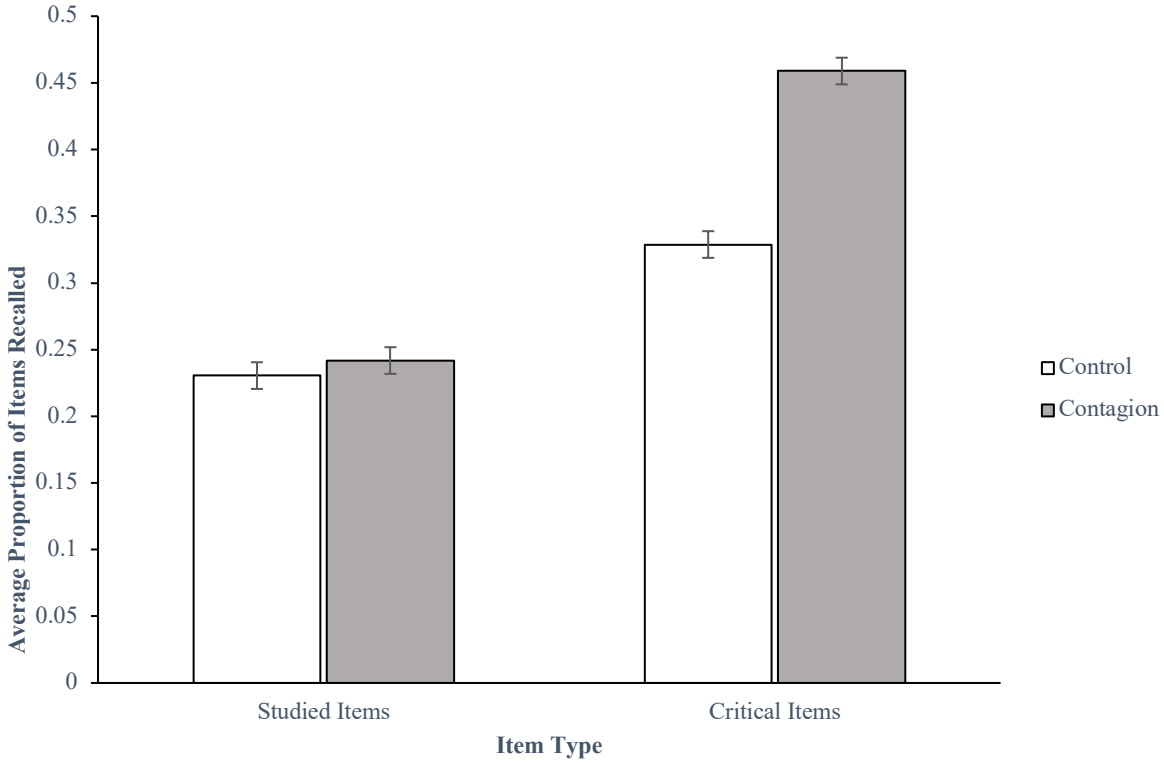

Figure 4

Recognition for Contagion and Control Scenes