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Memory Self-Efficacy is Malleable, but Does it Influence Subsequent Performance on Memory Tasks Involving Suggestion?

DISSERTATION

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for the degree of

DOCTOR OF PHILOSOPHY

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by

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DEDICATION

To all the amazing supportive people in both my professional and personal life—thank you from the bottom of my heart for making this work possible.

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ABSTRACT OF THE DISSERTATION

Memory Self-Efficacy is Malleable, but Does it Influence
Subsequent Performance on Memory Tasks Involving Suggestion?

By

Daniel Fred Bogart

Doctor of Philosophy in Psychology and Social Behavior

University of California, Irvine, 2017

Distinguished Professor Elizabeth F. Loftus, Chair

Within legal settings, the confidence that witnesses express in a specific reported memory is an important piece of information, and one that has been the subject of extensive study. In contrast, the confidence that people have in their *memory ability* prior to witnessing or recalling an event has not received much attention. Work within the self-efficacy literature has demonstrated that beliefs about one's abilities causally influence one's subsequent performance on tasks that involve those abilities. Within a memory context, however, the causal link between self-efficacy and performance has not been well established. Memory studies have reported a positive correlation between memory self-efficacy (MSE) and performance, but published *experimental* manipulations of MSE are rare, and those that have been conducted have not provided a conclusive answer to the question of whether manipulating MSE leads to differences in memory performance. Furthermore, it is an open question whether MSE can affect a particular kind of memory performance, namely, the ability to resist the distortive influences of suggestion. The experiments herein seek to address this gap in the literature. In Experiment 1 we experimentally manipulated witnesses' MSE prior to PEI exposure and examined subsequent memory performance. Experiment 2 was similar, except that MSE was

manipulated prior to event encoding. Experiment 3 manipulated MSE and then assessed memory performance on a different type of memory task: a variation of the imagination inflation procedure that involved suggestion. Aspects of the two suggestive memory tasks differed from each other such that differential relationships between MSE and performance were hypothesized; experimentally raising MSE was expected to lead to a reduced likelihood of false memory development within the misinformation paradigm, but it was expected to lead to an increased likelihood of false memory formation using the suggestive imagination inflation procedure. These differences were predicted due to the two tasks' differential relationship between effort and performance. Overall, however, we did not find that the MSE manipulation influenced performance on the misinformation task (Experiments 1 and 2). There was some indication that MSE influenced performance on the suggestive imagination inflation procedure (Experiment 3), but the mechanism is not yet well understood.

INTRODUCTION

Where were you between 4:15PM and 5:45PM on the night of September 4?

~~~

I see from your phone record that you placed a call to your friend John on that day—how did that conversation go?

~~~

When you saw your neighbor taking his kids to school, was there anything odd about the way he was acting?

~~~

A criminal investigation of either a suspect or an eyewitness might involve asking a number of specific questions about what a person remembers on a particular day and time, perhaps long since passed. Similarly, a patient undergoing psychotherapy might be asked a number of questions regarding events from childhood. If the implicit assumption that accompanies these questions is that they are reasonable, then the person being asked them might feel as though they *should* be able to answer them. If this attribution is made, and the person finds himself or herself struggling to answer the questions posed, it could generate feelings of inadequacy regarding his or her ability to remember past events.

Beyond pure conjecture, there is empirical evidence supporting the idea that people can sometimes misattribute weak performance on a difficult memory task to a judgment that their memory is poor. Seemingly an instance of the fundamental attribution error (Jones & Harris, 1967), when given an effortful memory task, people have been shown to misattribute the cause of their struggles to a judgment about their own internal qualities (i.e., a lack of skill), instead of recognizing the extent to which their poor performance was
~~~

due to the characteristics of the larger situation (i.e., the difficulty of the task itself). For instance, Belli, Winkielman, Read, Schwarz, and Lynn (1998) asked subjects to recall either 4 or 12 instances in which they behaved in a particular manner (e.g., acting assertively) during a narrow timeframe in their childhood (e.g., between the ages of 5-7 years old). From pilot testing, the authors had gathered that recalling 4 instances was relatively easy, whereas recalling 12 was quite taxing. What the researchers found is that when people were asked to recall the burdensome 12 instances, as opposed to the manageable 4, they were subsequently much more likely to rate their memory for their childhood as worse. Specifically, those who were asked to recall 12 events endorsed the item "Regarding childhood memory, are there large parts of your childhood after age 5 which you can't remember" much more often (M = 51%) than did those asked to recall 4 events (M = 35%) (Belli et al., 1998, p. 320).

The broader applications that Belli et al. (1998) highlight from their findings is to argue against the validity of a particular clinical practice. Specifically, they make the case that their results call into question the clinical practice of interpreting self-reported gaps in patients' childhood memories as evidence that the patient endured past abuse. Rather than simply being a symptom of childhood abuse, a patient's perceived gaps in his or her childhood memory can be caused by just the kinds of extensive questioning that a therapist, who is trying to unearth memories of past abuse, might engage in.

Belli et al. (1998)'s results also have other important implications, however. A substantial body of literature on self-efficacy theory, pioneered by Albert Bandura, has found that people's beliefs in their abilities tend to be associated with their subsequent levels of performance (Bandura, 1977). This raises an important question: if people's

perceptions of their memory abilities are malleable, as the results of Belli et al. (1998) suggest, will altering their confidence in their memory abilities lead to differences in subsequent memory performance? And if there is a relationship, for which types of memory performance will it hold? To orient ourselves to these questions, let us first turn to an overview of self-efficacy theory and the work that has been conducted examining how efficacy beliefs relate to actual performance.

Self-Efficacy Theory

Self-efficacy refers to "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). A substantial body of work on self-efficacy has demonstrated that those who are more confident in their ability to carry out a given task consistently outperform those who are less confident. Meta-analyses have confirmed that this relationship holds across a number of domains as varied as sports performance (Moritz, Feltz, Fahrbach, & Mack, 2000), academic functioning (Multon, Brown, & Lent, 1991), and work success (Stajkovic & Luthans, 1998), to name a few. These particular meta-analyses have each reported an identical correlation between perceived self-efficacy and performance (all *r*s = .38), which demonstrates that the association is moderately sized and robust across domains. On average, the more confident people feel in their abilities to perform a task, the better they do.

Self-efficacy as a proxy for past performance. Why is it that perceived self-efficacy in one's capabilities is associated with subsequent performance? One possibility is that self-efficacy merely serves as a proxy for past performance. If a soccer player, for example, has had several games in the past in which he scored multiple goals, he will likely

be drawing upon his past experiences when forming his current perception of his efficacy. In other words, he will perceive himself to be more efficacious in scoring multiple goals during an upcoming game if he has experience accomplishing identical or similar feats in the past.

If this were the entire explanation for the relationship between efficacy beliefs and performance, however, then the observed association between self-efficacy and performance should disappear when earlier performance is statistically controlled for. A number of studies have controlled for initial performance, however, and have found that the relationship between efficacy beliefs and subsequent performance remains significant, even after having done so (Bandura, 1997; Bandura & Locke, 2003; Prussia & Kinicki, 1996). There appears to be more to the story for why efficacy and performance are related than the simple explanation that efficacy beliefs are indicators of previous performance.

Mechanisms through which efficacy beliefs can affect performance. How is it that efficacy beliefs are associated with subsequent behavior even after controlling for previous performance? According to self-efficacy theory, the relationship between efficacy beliefs and performance is mediated by a number of different processes that can be cognitive, motivational, affective, or selective in nature (Bandura, 1997).

Cognitive processes and the selection decision. It is through cognitive processes that anticipated future outcomes can be translated into current mental representations that can serve to guide behavior. Unless one believes in a reversal of cause and effect, future events can only influence current behavior insofar as they are first mentally represented in the minds of present actors (Bandura, 1997).

Several studies have shown that those with higher self-efficacy beliefs are more likely to conceptualize challenging situations as opportunities and to visualize successful performance whereas those with low self-efficacy beliefs more often view those same situations as risks and are more likely to visualize failure (Bandura, 1989; Bandura, Adams, & Beyer, 1977). In this way, efficacy beliefs can contribute to a person's decision about whether or not to engage in an activity in the first place; if a person thinks that he or she is incapable of performing a task well, that person may decide not to even try. Furthermore, cognitive simulations can inform one's present self about the likely future outcomes of different strategies, and can thus help a person settle in on a plan of action.

Motivation: Goal setting and effort persistence. Once people have decided to engage in an activity or undertake a challenge, they may differ from each other in the extent to which they are motivated to persist in the activity when faced with obstacles. Efficacy beliefs are thought to explain some portion of these individual differences. As Bandura puts it:

> "The stronger the belief in their capabilities, the greater and more persistent are their efforts. When they achieve substandard performances, people who have self-doubts about their capabilities slacken their efforts or abort their attempts prematurely, whereas those who have a strong belief in their capabilities exert greater effort to master the challenge." (Bandura, 1989, p. 730).

A greater sense of self-efficacy not only tends to be associated with setting higher performance goals (Berry & West, 1993), but is also associated with how much effort is mobilized when one falls short of achieving his or her goals. In one study, for instance, subjects' effort was measured for a strenuous task on an exercise bike (Bandura & Cervone,

1983). Subjects were tasked with pedaling against resistance during three 5-minute exercise sessions. After the first session, some subjects were randomly assigned to adopt a performance goal that they increase their effort by 40%. Half of these subjects were then given scripted feedback after the second exercise session that their performance had increased by 24%. While this reflects an increase in performance, it was at a level that was lower than subjects' adopted goals. How did subjects respond when they believed they fell short of their goals? The more self-efficacious that subjects perceived themselves to be at attaining the 40% goal, the greater their performance increase from session 2 to session 3. When confronted with a challenge, those with greater self-efficacy mobilized more effort.

While this study is typical in that it demonstrated a positive relationship between self-efficacy and subsequent performance, it did not manipulate efficacy beliefs experimentally and thus cannot support claims that self-efficacy was itself a *cause* of subsequent behavior. In order to address the concern that earlier research either outright neglected to manipulated self-efficacy experimentally, or confounded efficacy manipulations with the provision of task experience or task knowledge, Cervone and Peake (1986) experimentally manipulated efficacy beliefs via adjustment and anchoring (Tversky & Kahneman, 1974). In their experiment, subjects were told that they would be solving a series of 20 anagrams that would become increasingly more difficult, and subjects were informed that they would have 15 seconds to work through each anagram (Cervone & Peake, 1986). At the end of each 15-second interval, they would be given a choice to (a) continue working on the item they were working on, if they had not yet solved it; (b) proceed to the next item; or (c) switch to another type of task. Prior to beginning the task, subjects in the high-anchor condition were asked to indicate whether they would solve

more than, less than, or an amount equal to, 18 anagrams. Then they were asked to indicate the number of anagrams they thought they would be able to solve, which served as the measure of their perceived self-efficacy. Subjects in the low-anchor condition underwent the exact same procedure except that instead of the high anchor of 18, their reference number of anagrams was a lowly 4. Those in the control condition provided an efficacy rating but did not receive any anchor prior to doing so. What the researchers found is that the anchoring procedure was successful in manipulating efficacy beliefs: those in the high anchor condition had higher efficacy beliefs than those in the control condition, who in turn had higher efficacy beliefs than those in the low-anchor condition. Furthermore, those in the high-anchor condition persisted longer on the anagram task than did those in the control condition or those in the low-anchor condition.

These results indicated that efficacy beliefs themselves could be a causal contributor to subsequent effort and persistence. Furthermore, the authors used regression analyses to control for anchoring condition and found that the relationship between efficacy and performance remained significant, but the reverse was not true: the effect of anchor-condition was not significant when controlling for efficacy beliefs (Cervone & Peake, 1986, p. 496). In sum, higher efficacy beliefs led to greater task persistence.

Self-efficacy and memory. A few studies have explored the relationship between efficacy and performance within the memory domain. Many of these examinations have been strictly correlational in nature and have documented positive associations between self-efficacy and subsequent performance on memory tasks. For example, Lachman, Steinberg, and Trotter (1987) asked subjects to memorize two 10-item lists and then, after a brief delay, to recall as many items as they could remember. Prior to the presentation of

each list, subjects were asked to indicate how many words they thought they would be able to commit to memory. The researchers found a significant association between people's performance predictions and their subsequent performance, such that those who felt more efficacious in their ability to remember more words actually went on to remember more words (Lachman et al., 1987). This study, however, did not experimentally manipulate efficacy beliefs and did not control for prior performance.

Consistent with the findings of the study just described, a meta-analysis assessing the relationship between memory self-efficacy (MSE) and memory performance analyzed 673 effect sizes, extracted from data found in 107 studies, and found a statistically significant association between MSE and memory performance (Beaudoin & Desrichard, 2011). As with other domains, correlational examinations of self-efficacy for memory have shown that MSE relates to later memory performance even after controlling for initial memory performance. For example, analyzing a correlation table initially contained within Rebok and Balcerak's (1989) manuscript, Bandura (1989) calculated that perceived efficacy was moderately correlated with later memory performance and that this remained true even after accounting for prior memory performance. These results showed that "perceived self-efficacy contributes unique variance to memory accomplishments" (Bandura, 1989, p. 731). However, it should be noted that since Rebok and Balcerak's (1989) did not isolate and manipulate MSE experimentally one is not entirely able to rule out the possibility that an unmeasured and uncontrolled third variable was driving the relationship between MSE and performance. In order to adequately address the question of whether MSE exerts a causal influence on subsequent memory performance, study designs that experimentally manipulate MSE are needed.

Experimental MSE manipulations. To date, there have not been many investigations within the memory domain that have experimentally targeted self-efficacy for manipulation, and even those that have were largely ill equipped to answer the question of whether MSE plays a causal role in later memory performance. The word "targeted" is used here in order to convey that there have been studies employing an experimental design that have manipulated MSE *in conjunction with other variables* designed to affect memory performance. For example, several studies have manipulated MSE through the use of memory training. In such studies, subjects were either enrolled in a course in which they learned about memory functioning and mnemonic strategies or they were not (e.g., Rebok & Balcerak, 1989; Valentijn et al., 2005). Drawing causal conclusions from studies using this design is problematic because these studies confound the efficacy manipulation with training that is also aimed at enhancing performance. As a result, any performance gains enjoyed by the treatment group cannot be causally attributed to earlier increases in efficacy. It is for this reason that such studies cannot answer the question of whether efficacy beliefs play a causal role in affecting subsequent memory performance.

Other experiments were not suited to address causal influences of MSE for different reasons. For instance, some experiments have successfully manipulated MSE, but have not included a memory task following the manipulation (Sanbonmatsu, Lora, Akimoto, & Moulin, 1994). Still other experiments, such as the one conducted by Nicoson, Dick, Lineweaver, & Hertzog (2008), have manipulated MSE and have observed corresponding changes in subsequent memory performance, but did not include a mediation analysis to examine this relationship (as cited by Beaudoin & Desrichard, 2011, p. 215).

One experiment successfully manipulated efficacy beliefs but did not find subsequent performance differences (Gardiner, Luszcz, & Bryan, 1997). In this experiment, however, MSE was manipulated by telling one group of subjects that the upcoming memory task would be harder than a preceding memory task, while telling another group that the memory task would be the same as the preceding one. Gardiner et al. (1997) found that those who were expecting a harder memory task expected to do worse than those who were not expecting a harder task, but this difference was not associated with actual performance differences. While this study clearly illustrates that task-specific efficacy beliefs can be manipulated by altering people's perceptions of task difficulty, it is not clear whether efficacy beliefs manipulated in this way operate similarly to efficacy beliefs manipulated by altering people's perceptions of their ability relative to other people. Regardless, the fact that null effects were found in one study is hardly reason to abandon the exploration between memory self-efficacy and memory performance altogether.

Encouragingly, findings from at least one experimental study support the notion that MSE can play a causal role in subsequent memory performance. Using an similar approach to the one used in examinations of stereotype threat (Steele & Aronson, 1995), Desrichard and Köpetz (2005) recruited younger and older adults and randomly assigned subsets of each to receive different instructions describing three cognitive tasks. Each of the three tasks depended heavily on both memory ability and another cognitive skill (verbal skills, perception of complex shapes, and orienting ability, respectively). Through random assignment, half of the people in each age group received instructions emphasizing the memory component of the task, whereas the other half received instructions emphasizing the other cognitive component. Prior to beginning the task, all subjects

provided ratings of how efficacious they perceived themselves to be at obtaining high performance levels.

Consistent with stereotype threat findings, the researchers found that older adults, for whom there is a negative stereotype about memory ability, consistently performed better when the memory component of the tasks was not highlighted (Desrichard & Köpetz, 2005). The performance of younger adults, on the other hand, did not systematically differ based on the task instructions. Furthermore, the authors used a mediated moderation model to analyze the findings and found that the older adults' reduction in performance on the memory-emphasized tasks was mediated by a reduction in their perceived self-efficacy for successful task performance (Desrichard & Köpetz, 2005). In sum, this experiment found that task instructions emphasizing the memory component of the task were successful in reducing older adults' perceived efficacy, which in turn led to poorer memory performance.

Self-efficacy findings: Summary and gaps. Overall, the literature on self-efficacy demonstrates that across a broad swath of human behavior and functioning, including memory, perceptions of self-efficacy tend to be positively related to subsequent performance. The majority of studies within the memory domain (and outside of it) examine the relationship between efficacy and performance by simply assessing correlations between the two. While many of these studies demonstrate that the relationship between efficacy beliefs and performance hold even after controlling for initial performance levels, in order to fully answer the question of whether efficacy beliefs play a *causal role* in subsequent performance, they must be altered experimentally using random assignment. Studies that have altered efficacy beliefs experimentally outside of the

memory domain have found that the manipulated beliefs lead to differences in performance. Within the memory domain, however, no conclusive answer to this question has yet been offered, since the number of experimental studies is small and many of them either involve confounds, do not measure memory performance following the efficacy manipulation, or do not test for mediation. At least one study, however, has manipulated memory self-efficacy beliefs experimentally using a stereotype threat approach and has found subsequent differences in memory performance (Desrichard & Köpetz, 2005), providing encouragement for the notion that a causal relationship exists.

In addition to the theoretical importance of examining the relationship between memory self-efficacy and subsequent memory performance in an experimental fashion, this examination also has important real-world implications. As Belli et al.'s (1998) experiment illustrated: being asked to recall a challenging number of past events can lead to a judgment that one's memory is relatively poor. If perceptions of memory ability have the power to influence subsequent performance, this would have valuable implications for settings in which a number of difficult memory questions are posed. Eyewitnesses to, or suspects of, a crime might be asked a number of hard questions regarding past occurrences. Similarly, those seeking out therapy might have many questions posed to them about events from their childhood. If posing difficult questions can cause people to doubt their memory capabilities, which in turn can negatively impact their memory performance, then this knowledge should be espoused to legal professionals and clinicians, as well as to those with whom they interact. Since the mechanism by which efficacy was lowered in the Belli et al. (1998) study presumably involves a misattribution, simply educating people might eliminate, or at least attenuate, the effect. This notion is supported

by the observation that other misattribution-based effects are reduced when the situational factors, which are unknowingly the true causes of the person's emotions or cognitions, are made more salient (e.g., White & Kight, 1984; Schwarz & Clore, 1983).

Suggestion. There is another gap in the MSE literature that has important implications for eyewitness and psychotherapy settings. Specifically, does relationship between MSE and memory performance depend upon how memory performance is defined and measured?[1] Better memory performance is typically operationalized as greater accuracy, but there are several ways to define accuracy. For example, studies that examine episodic memory might have people study a list of words and then recall them. A typical measure of memory accuracy might be the proportion of words correctly remembered. This measure of accuracy leaves out half of the picture, however; memory accuracy should be concerned not just with hits (studied items that are later recognized as having been studied) and misses (studied items that are later unrecognized), but also with false alarms (unstudied items that are later falsely recognized as having been studied) and correct rejections (unstudied items that are later recognized as unstudied). An accurate memory system not only involves *correctly identifying* what one has experienced before, but also *correctly rejecting* what one has not experienced.

The single meta-analysis to date that has been conducted assessing the relationship between MSE and memory performance does not explicitly examine whether different operationalizations of memory performance act as a moderator to the MSE-memory

[1] By this, I am not referring to a separate related question of whether the type of memory being examined—e.g, episodic, semantic, short-term, prospective—moderates the relationship between self-efficacy and performance. Indeed, that question has been examined elsewhere; in their meta-analysis, Beaudoin & Desrichard (2011) determined that efficacy beliefs were positively related to memory performance for tasks involving prospective memory, semantic memory, short term memory, and episodic memory, with episodic memory tasks producing the largest association (pp. 15-16).

performance relationship (Beaudoin & Desrichard, 2011). However, from what can be gleaned from their description of the types of memory tasks included in the meta-analysis, it seems as though the tasks all involved remembering information presented earlier and did not involve testing one's ability to reject information that was not previously studied:

> Various tasks were considered as measuring memory, including classic episodic memory tasks (e.g., word-list recall), as well as less classic tasks (e.g., recalling the content, incidentally encoded, of a just completed questionnaire). Short-term and working memory tasks, such as simple span, backward span, and reading/listening span tasks, were included, along with prospective memory tasks. Tasks considered to measure memory performance include categorical and phonological fluency tasks, as well as tasks sometimes used to assess semantic memory, such as vocabulary tests and general knowledge tasks. (Beaudoin & Desrichard, 2011).

None of these memory tasks appear to be ones that typically include elements of suggestion, and so it seems likely that few, if any, of them used measures of memory performance that included the ability to resist misinformation or other forms of suggestion.

A literature search on Web of Science further supports the notion that the relationship between MSE and memory performance has not yet been adequately examined for memory tasks that involve suggestion. As of the time of this writing, a search using the terms: "memory" AND ("misinformation" OR "suggestion") AND "self-efficacy" produced only two articles. Furthermore, one of the two articles examined the relationship between some forms of self-efficacy and resistance to suggestion on a memory task, but it did not examine self-efficacy for memory ability in particular (Bruck & Melnyk, 2004).

Instead, it looked at self-efficacy within other domains (e.g., academic) and used the phrase self-efficacy to mean more of a global estimate of self-esteem (Bruck & Melnyk, 2004), a conflation which Bandura (1997) has taken pains to caution against: "perceived self-efficacy is concerned with judgments of personal capability, whereas self-esteem is concerned with judgments of self-worth" (p. 11).

The second of the two articles did include a measure of MSE and examined its association with memory performance on a task involving suggestion (Mazzoni, 1998). This study found that, for older children, higher MSE was associated with greater resistance to suggestion: older children who had higher levels of MSE rejected misinformation regarding a witnessed event more often than did those with lower levels of memory self-efficacy. Mazzoni's (1998) results are consistent with the findings within the self-efficacy literature and are the first, and perhaps only, to demonstrate the association for a memory task involving suggestion. However, self-efficacy beliefs were not experimentally manipulated in this study, and so the question remains concerning whether beliefs in one's MSE play a causal role in reducing (or heightening) one's susceptibility to suggestion.

One additional article was located that used different terminology (so it did not appear from the Web of Science search), but that nevertheless included an experimental manipulation of MSE and then assessed memory performance on a misinformation task. Szpitalak and Polczyk (2015) conducted a series of experiments in which they had subjects either: (1) engage in a self-affirmation task in which they wrote about their greatest accomplishments; (2) receive positive feedback about their memory performance on a word-list recall task; or (3) a combination of the two. They found that those who received a

combination of self-affirmation and positive memory feedback tended to be less likely to be misled by misinformation exposure.

While the study is intriguing, some aspects of the design, however, limit the conclusions that can be drawn from the results. The positive feedback that subjects received on the word recall task involved being told that the average number of words recalled was a number 1.5 standard deviations lower than the actual mean found in previous studies using similar materials. Then, the researchers excluded subjects in the positive-feedback condition who scored below the mean presented by the feedback (Szpitalak & Polczyk, 2015, p. 919). This introduces a potential confound, however: by removing those with the weakest memory ability from the positive-feedback condition, any subsequent differences between conditions may be due to differences in actual memory ability, rather than merely differences in memory confidence. Additionally, the researchers examined only the effects of positive feedback versus no feedback, but the possible influences of reducing one's MSE was not assessed. Lastly, subjects were not asked to indicate their MSE following the feedback, so the effect of the manipulation on MSE cannot be independently assessed. Due to this, it is unclear to what extent subjects who received performance feedback on the word-list recall task were influenced to believe that the feedback was diagnostic of their memory abilities more generally, as opposed to being an isolated occurrence.

Memory as a Reconstructive Process

A century of memory research has led to the understanding that memory does not operate like a video recorder, accurately and reliably producing verbatim records of the past. Instead, memory has been shown to decay naturally over time (Ebbinghaus,

1885/1964), and has been recognized as a reconstructive process (Bartlett, 1932). In addition to being influenced by passive factors like time passing, memory is also affected by active factors related to who it is doing the remembering; a person's cognitive schemas, expectations, motivations, and emotional states have all been shown to influence memory. Furthermore, when people change over time, who they are at the present time influences how they remember the past. When people's beliefs and appraisals change over time, for example, their memories of what they believed in the past tend to change to be more consistent with present beliefs (Levine, 1997).

The misinformation effect. Because of the dynamic and reconstructive nature of memory, memories can be distorted either accidentally or intentionally by other people. For example, something as simple as a single word in the way a question is phrased can lead to changes in memory for a witnessed event. Loftus and Palmer (1974) had subjects watch videos of automobile accidents, and then asked some of them afterwards how fast the cars were going when they "hit" each other. For other subjects, the verb in the question was swapped out for another: some were asked how fast the cars were going when they "smashed" into each other. What the researchers found is that memories for the car speed varied with the speeds suggested by the verb used: those who were asked the question with the verb "hit" reported slower speeds than those who read the verb "smashed." Furthermore, a week later those who were asked the question with the word "smashed" were more likely to report having seen broken glass at the crash site, when in fact there had not been any broken glass.

What followed from this seminal experiment that demonstrated the power of suggestion on memory, was the genesis of an experimental paradigm designed to

investigate what is now known as the misinformation effect. The misinformation effect refers to the finding that misinformation, introduced after a witnessed event, often distorts one's memory for that event. The procedure used to study the misinformation effect typically involves the three stages found in the classic Loftus experiments (Loftus, 1977; Loftus, Miller, & Burns, 1978). Namely, subjects first witness an event, are then exposed to post-event information (PEI) that contains several inaccuracies, and are later tested on their memory for the initial event. In one of the first experiments employing this three-stage procedure, subjects witnessed a slideshow event in which a pedestrian was hit by a car (Loftus, 1977). Following the crash, a green car could be seen passing by without stopping. After witnessing the event, subjects were provided with PEI regarding what they witnessed. Specifically, it was suggested to some subjects that the car that passed by the crash was blue, not green. Later, when given a memory test for what was seen in the slideshow, those subjects who read the inaccurate detail tended to report that the car was bluish green in color, seemingly combining the actual car color with the car color suggested in the PEI. Misinformation provided after an event was witnessed distorted memory for that event, a finding that has since been replicated hundreds of times in studies using various event types, presentation modalities, and subject populations.

Imagination inflation. Another experimental paradigm that has been effective at eliciting false memories is the imagination inflation procedure. Like misinformation studies, studies of imagination inflation typically involve three stages. The first stage is the presentation of a Life Events Inventory (LEI). Garry, Manning, Loftus, and Sherman (1996), for example, had subjects indicate whether or not they had experienced, during their childhood, each of 40 described events. For instance, subjects were asked to indicate how

confident they were that they either did or did not fall and break a window with their hand before the age of 10. After providing initial ratings on the LEI, subjects then came into the lab at a later date and were instructed to imagine several of the events. Then, subjects were asked to complete the LEI for a second time. Results from this first experiment indicated that people's confidence that they experienced a past event increased more when they imagined that event occurring than when they did not imagine it. Imagination inflation refers to the finding that imagining an event tends to increase one's confidence that the event actually occurred.

The effect of imagination on false memories has also been found in similar experiments that have incorporated a false suggestion coupled with instructions to imagine. Hyman and Pentland (1996) had their subjects' parents provide accounts of actual events that occurred during their kid's childhoods. The researchers then asked subjects to recall several true events (as reported by the parents) along with one false event (created by the researchers). The false event—that when the subject was 5 he or she was at a wedding and spilled a bowl of punch on the parents of the bride—was presented in the same manner as the true events. As was the case in the lost-in-the-mall experiment that preceded it (Loftus & Pickrell, 1995), this study involved the suggestion that the event being asked about had been reported by members of the subject's family. This type of suggestion is a powerful elicitor of false memories, leading to partial or whole false memories in approximately 30% of subjects (Lindsay, Hagen, Read, Wade, & Garry, 2004). Hyman and Pentland (1996) used this form of suggestion on all subjects, but they randomly assigned half of their subjects to an imagination condition and the other half to a control condition. When those in the imagination condition struggled to remember one of the

events (either one of the true ones or the false one), they were instructed to imagine the event and told that this would help them remember it. By contrast, when control subjects struggled to remember an event, they were told to sit quietly and think about it, and were similarly told that doing so would help them remember it. The researchers found that by the end of the follow up interview, 5 days after the initial one, a significantly higher percentage of those in the imagination condition reported having at least a partial memory for the false event. While 12.1% of those in the control condition developed a partial or complete false memory for the punch-spilling event, a robust 37.5% of those in the imagination condition did so (Hyman & Pentland, 1996, p. 110). Together, these experiments demonstrated that imagination can impact memory for non-experienced events even without suggestion (Garry et al., 1996), but when imagination is paired with suggestion it can lead to even greater rates of false memory development.

Three experiments are presented herein that examine whether experimentally manipulating MSE leads to differences in memory performance for tasks involving suggestion. Experiments 1 and 2 used the misinformation paradigm to assess this question, and Experiment 3 used a suggestive variant of the imagination inflation procedure (i.e., suggestion paired with instructions to imagine).

EXPERIMENT 1

Introduction

Higher confidence in one's abilities is predictive of better performance across a number of domains. Several studies have looked at this association for tasks involving memory ability, but these studies rarely experimentally manipulated confidence in

memory ability,[2] and when they have done so they have generally neglected assessing memory performance on tasks that involve suggestion (cf. Szpitalak & Polczyk, 2015). Experiment 1 will seek to extend the knowledge about how confidence in one's memory abilities affects performance in the memory domain by using a memory task that involves suggestion: namely, the misinformation paradigm. The misinformation paradigm is one in which memory accuracy involves not only correctly identifying what has witnessed before (for control items), but also being able to correctly reject what one has not witnessed (for misinformation items), both of which are important functions of our memory systems.

The findings of Belli et al. (1998) suggest that in important real-world contexts such as forensic interviews, being asked a number of difficult memory questions may have the unintended effect of lowering people's confidence in their memory abilities. If true, this would be especially worrisome if lowered MSE were associated with worse memory performance, as measured either by: remembering less about what was actually witnessed, or being more likely to incorporate suggested misleading details into one's memory.

Experiment 1 was designed to apply to this context. MSE was manipulated after subjects witnessed a mock crime, but before they were exposed to post-event information (PEI).

Methods

Subjects. Subjects participated through the University of California, Irvine's Human Subjects Research Pool in exchange for partial course credit. In order to be eligible, subjects needed to be UCI students, at least 18 years of age, fluent in English, and they

[2] Throughout this work, I use the terms 'confidence in memory ability' and memory self-efficacy (MSE) interchangeably.

could not have previously participated in a false memory study conducted by our research lab. Subjects completed the experiment online. After removing those with incomplete data and those who experienced technical issues, a final sample of 262 subjects remained to be analyzed (81% female; $M_{age} = 20.48$, $SD_{age} = 2.39$). Subjects were randomly assigned to one of three confidence conditions: confidence-boosted (n = 88), confidence-lowered (n = 84), or confidence-nonmanipulated (n = 90).

Measures.

Personality test. Personality was assessed using the Big Five Inventory (BFI; John, Naumann, & Soto, 2008), which is a 44-item survey assessing the trait dimensions of openness to experience, conscientiousness, extroversion, agreeableness, and neuroticism. Subjects were asked to indicate on a 5-point scale ranging from 1 (Disagree strongly) to 5 (Agree strongly) how much each claim accurately described their personality. For example, subjects rated to what extent each of the following was true: "I am someone who" "…is original, comes up with new ideas" (openness); "…does a thorough job" (conscientiousness), "…is talkative" (extroversion); "…is helpful and unselfish with others" (agreeableness); "…is depressed, blue" (neuroticism). Each trait dimension contained 8-10 items, at least 2 of which were reverse-coded. Scores for each trait were calculated by summing responses for all of the items relevant to that dimension.

Personality feedback. After completing the personality test, subjects were provided with accurate feedback about how their personality responses compared with those of others. The norm information by which subjects' responses were compared was derived from an online study of over 100,000 subjects who completed the same personality inventory (Srivastava, John, Gosling, & Potter, 2003). The purpose of providing this

personality feedback was twofold. Firstly, it was intended to establish credibility for the computerized feedback process, which is a crucial component to the believability of the subsequent MSE manipulation (also generated via computer feedback). Secondly, it served to embed the memory feedback within other feedback so as not to arouse undue suspicion about the experiment being primarily interested in subjects' memory performance.

Eyewitness Memory Task (EMT) and Autobiographical Memory Task (AMT). The EMT consisted of viewing a series of facial photographs culled from the *Psychological Image Collection at Stirling* (PICS; http://pics.psych.stir.ac.uk). Subjects viewed a series of 33 faces, viewed one at a time, and were then presented with 33 arrays containing two faces each. Each of the photo arrays contained one studied face and one novel face presented in random order, and for each array subjects were asked to correctly identify the studied face. This task was designed with the goal that, upon completion, it would be unlikely that subjects would have an intuitive sense of how their performance related to others'. This ambiguity was desirable so that the feedback would be considered plausible. The AMT was modeled after the memory task employed by Belli et al. (1998). Subjects were asked to recount four instances in which they behaved mischievously between the ages of 8-12 years old. They were required to spend at least two minutes for each event, and they were instructed to describe it in "as much detail as you can," including things like "Who were you with? Where were you? What time of day did it occur," as well as sensory information.

Memory feedback. Memory self-efficacy (MSE) was manipulated by altering the feedback that subjects received regarding their performance on the EMT and AMT. Subjects assigned to the confidence-boosted condition received feedback that their performance on the two memory tasks was in the top 20%, while those assigned to the

confidence-lowered condition received feedback that their performance was in the bottom 20%. Those in the confidence-nonmanipulated condition did not receive any feedback regarding their memory performance.

Effects of feedback. So as to determine how the personality and memory feedback were received, subjects were asked several questions about the feedback for the personality assessment and the EMT and AMT. Firstly, in order to verify that subjects properly attended to and encoded the feedback, they were asked to reiterate what the feedback was (after which, they were presented with the feedback for a second time). Additionally, they were asked to indicate to what extent the feedback seemed like it accurately described their personality and memory abilities, by having them rate how *they believed* they compared with their peers. Subjects' reactions to the memory feedback was of primary interest; reactions to the personality feedback were only collected so as to reduce the likelihood that subjects deduced the experiment's true purpose.

Misinformation task. The misinformation task consisted of three stages: witnessing a slideshow event, encountering post-event information (PEI), and having one's memory tested for the initial event. The misinformation task materials used in this study were derived from Okado & Stark (2005) and Patihis (2012).

Slideshow event. The slideshow event consisted of 50 color slides depicting a brief story that contained several elements, including the perpetration of a mock crime. Specifically, over the course of the event the protagonist "Jane" has her wallet stolen by a man who bumped into her. Each slide automatically advanced onto the next after 3500 ms, resulting in a total length of just under 3 min.

PEI. After the slideshow event, PEI was presented via a written narrative, which was presented as an account of what occurred during the event. The PEI contained 50 sentences, presented one by one for 5500 ms each, resulting in a total length of approximately 4 min 30 s.

Contained within the PEI narrative were six critical items for which memory would later be tested: three control items and three misinformation items. Each subject encountered three control items, which vaguely described details from the initial event, and three misinformation items, which incorrectly described details from the initial event. Two counterbalances (CB1 and CB2) were created for the PEI narrative, such that the three control items presented to subjects in CB1 were misinformation items for those in CB2, and vice versa. Table 1.1 displays information about the six critical items contained within the PEI.

Cued-recall memory test and recognition memory test. Studies of the misinformation effect usually include only one memory test, typically a forced-choice recognition test. In this study, however, the recognition test was preceded by a cued-recall test. The rationale for including this additional memory test is because one of the mechanisms by which higher MSE is thought to influence memory performance is through greater effort expenditure (Bandura & Cervone, 1983). It seems reasonable on its face that in a cued-recall test, differences in effort might lead to differences in performance, whereas it is not so clear that such a relationship would be found for a recognition memory test.[3] Indeed, at

[3] This line of thinking was also hypothesized by Beaudoin and Desrichard (2011), but while they found mean differences that were in the expected direction, they did not find it to reach statistical significance in their analysis. Nevertheless, the costs of incorporating a cued-recall test before the recognition memory test were low, so it was included.

least one study has been conducted looking at the relationship between effort spent on a recognition memory test and memory performance, and has failed to find a relationship (Shaw & Zerr, 2003).

Social desirability. Despite even the best research designs, it is rarely that case that there is only one explanation capable of accounting for the findings: alternate explanations often exist. One common alternate explanation is that whatever results are obtained might merely be the product of demand characteristics. If subjects are able to sense what the experimenters have hypothesized, then they may feel inclined or pressured to alter their behavior so as to produce the desired results. In order to rule out this potential alternate explanation, the extent to which subjects are inclined to present themselves in a desirable way was assessed. Social desirability scores were collected using the Marlowe-Crowne Social Desirability Scale (MCSDS; Crowne & Marlowe, 1960). The MCSDS is a 33-item measure that asks true/false questions aimed at determining subjects' need for approval. Each of the statements had one response that was consistent with societal ideals for human behavior and/or attitudes, but was such that few people could behave that way every time. Sample items included the statements: "Before voting I thoroughly investigate the qualifications of all the candidates" and "I have never deliberately said something that hurt someone's feelings." Fifteen of the items are reverse-coded such that responding "false" reflected the socially-desirable, but unrealistically obtainable, alternative. Scores were summed so that higher numbers reflected a greater tendency to present one's self in a socially desirable way.

Effort, attention, importance. Since raising MSE is thought to raise motivation to perform well, which in turn should increase effort and attention, measures were collected

to test these as potential mediators of the theorized relationship between MSE and performance. Subjects were asked to provide self-reports regarding how important performing well was to them, how much effort they would be willing to expend in order to perform well, and how much attention they paid during each stage of the misinformation task.

Prior to viewing the slideshow event, subjects were told that they would see a series of images and would later be asked questions about what they saw. They were then asked to indicate how important it was to them that they performed well on the upcoming task, using a 7-point scale ranging from 1 (*not at all*) to 7 (*extremely*). Additionally, they were asked to indicate how much effort they would be willing to exert in order to perform well on the task, using a 7-point scale ranging from 1 (*very little*) to 7 (*as much as it takes*).

Immediately following each of the three stages of the misinformation procedure (i.e., event; PEI; and memory test), subjects were also asked to indicate how much attention they paid while [watching the slideshow] [reading the other witness's account] [taking the memory test]. After each section, they were asked three questions designed to measure attention: "How much attention did you pay during the task;" "How many times did you look away from the screen during the task;" and "How distracted were you by things that were not related to the task."

Anxiety. Another mechanism by which higher self-efficacy is theorized to increase performance is through lowered performance anxiety. If those whose MSE has been boosted are less anxious during the misinformation task, this may free up cognitive resources that can be devoted to memory processes during retrieval. Prior to each stage of

the misinformation task, subjects were asked to indicate how worried they felt about the upcoming task on a 7-point scale ranging from 1 (Not at all) to 7 (Extremely).

Attention check. To determine how carefully subjects were paying attention during other parts of the experiment, an attention check was included that looked on the surface to be a questionnaire assessing their hobbies, but which was, in reality, a means for testing if subjects were attending properly to the instructions (Oppenheimer, Meyvis, & Davidenko, 2009). Subjects saw a questionnaire listing several hobbies (e.g., *baseball, performing arts, cooking*), each accompanied by a 5-point scale ranging from 0 (*not at all*) to 4 (*very much*). Below these options, was a box allowing subjects to specify an additional hobby. It is important to note that without instructions, these response options had no inherent meaning; it is not clear, for example, if subjects were being asked to rate how much they enjoyed each activity, or how frequently they engaged in each activity, or some other question altogether. The instructions that accompanied the response options specified that subjects should "ignore the scale below" because "we are simply interested in whether or not you are paying attention." Subjects were then instructed to enter the phrase "I have read the instructions" in the text-entry box, marked "other," at the bottom of the scale.

Funneled debriefing. After completing the main misinformation task, subjects were given a funneled debriefing. They were first asked the general question of whether anything seemed odd to them about the study. If they responded yes, they were then asked to describe what seemed odd. They were then asked specifically whether anything seemed askew with the feedback they received, and they were given a chance to explain their

response. After these questions, subjects were debriefed in full and given an opportunity to withhold their data since the study involved deception. No subjects chose to do so.

Procedure. A procedural flowchart for Experiment 1 can be found in Figure 1.1. Subjects enrolled in the online study, which was hosted by Qualtrics. They were instructed to use a computer in a distraction-free environment. As with most studies of false memory, the study was not advertised as such; rather, subjects enrolled in a study that was described vaguely as being about personality and learning.

Subjects began the experiment by completing an assessment of their inclination to responds in social desirable ways (MCSDS) as well as a personality test (BFI). They were then provided with accurate feedback regarding how their personality responses compared to those of others who had taken the same assessment.

They then began the misinformation task. They viewed a slideshow event in which a man steals a woman's wallet. Before being presented with PEI, they underwent the MSE manipulation. All subjects completed a pair of memory tasks (AMT and EMT) that were purportedly diagnostic of their memory abilities. Subjects were then presented with performance feedback (or not) depending on the experimental condition to which they were assigned. Those in the confidence-boosted condition received feedback that they performed in the 80th percentile relative to their peers (i.e, their performance was in the top 20 percent). Alternatively, those in the confidence-lowered condition received feedback that they performed in the 20th percentile relative to their peers (i.e, the bottom 20 percent). Those in the confidence-nonmanipulated condition did not receive any feedback regarding their performance on the AMT and EMT. All subjects were then asked to indicate how *they believed* their memory ability compares to that of their peers.

Subjects were then exposed to PEI in the form of a written account of the witnessed event. Contained within the PEI narrative were six critical items consisting of three control items and three misinformation items.

After a brief filler task, subjects then had their memory tested for what they saw in the initial slideshow. They first took a cued-recall test, followed by the same questions asked again in the format of a three-alternative forced-choice recognition test. Subsequent to the memory tests, subjects were given a funneled debriefing and compensated for their time.

Results

Attention check. Overall, 61% of subjects passed the attention check. The proportion of subjects who failed the attention check was not influenced by confidence condition, $X^2(N = 261) = .60$, $p = .74$. Excluding subjects who failed the attention check did not change the pattern of results, so we retained all subjects in the subsequent analyses.

MSE manipulation. Descriptive statistics for MSE are displayed in Table 1.2, and a graphical representation can be found in Figure 1.2.[4]

In order to test whether the experimental manipulation of MSE was successful, a oneway ANOVA was conducted with MSE as the DV and confidence condition as the IV. The omnibus test revealed that there was a significant effect of condition on MSE, $F(2, 258) = 51.13$, $p < .001$. Levene's test for equality of variances indicated that the variances were not equivalent across conditions, $F(2, 258) = 13.07$, $p < .001$, so Games-Howell post-hoc

[4] One subject apparently misunderstood the instructions to indicate what percentile they were in for their memory abilities, indicating a proportion instead (i.e., they responded ".7" instead of 70). For this subject, I converted the MSE belief response from a proportion to a percent, and the percent value was used for all analyses involving MSE.

comparison tests were conducted. These comparisons indicated that subjects in the confidence-boosted condition reported having significantly higher MSE (M = 72.55, SD = 13.63) than those in the confidence-nonmanipulated condition (M = 51.78, SD = 19.86), p < .001, who in turn reported having marginally higher MSE than those in the confidence-lowered condition (M = 44.72, SD = 22.08), p = .07.[5] Thus, the experimental manipulation of MSE was effective.

Memory performance. Did we obtain a misinformation effect? Did confidence condition influence memory accuracy? Was there any interaction between confidence and item type?

Cued-recall memory test. To answer these questions, responses to each cued-recall test question were coded as a "1" if they reflected an accurate account of what occurred during the witnessed event, or a "0" otherwise. Then, an overall accuracy score for control items was calculated by determining what proportion of the three control items subjects gave the correct response (possible range: 0-1). In a similar manner, an overall accuracy score was calculated for the three misinformation items.

A 2 (item type: control; misinformation) x 3 (confidence condition: confidence-boosted; confidence-nonmanipulated; confidence-lowered) mixed-model analysis of variance was then conducted, with item type as a within-subjects variable, and condition as a between-subjects variable. A graphical display of the results can be found in Figure 1.3, and an item-analysis can be found in Figure 1.5. With accuracy as the outcome variable, there was a trend-level misinformation effect on the cued-recall test, $F(1, 259) = 2.81$, p =

[5] When removing those who failed the attention check, the difference in MSE responses between those in the confidence-nonmanipulated condition and those in the confidence-lowered condition was no longer marginally significant, p = .19.

.10, η_p^2 = .011. Subjects were marginally more likely to report the correct response for questions regarding control items than for questions regarding misinformation items.[6] There was no main effect of confidence condition on accurate responses, $F(2, 259) = 1.80$, $p = .17$, nor was there evidence of an interaction between condition and item type, $F(2, 259) < 1$, $p = .79$.

Another way to test for a misinformation effect is to examine whether item type (control vs. misinformation) influenced the proportion of misinformation-consistent responses provided by subjects. In other words, did receiving misinformation about a detail of the witnessed event make it more likely that the misinformation-consisent detail was then reported by the witness, compared to others who were not exposed to that misleading detail? To give a concrete example: all subjects saw Jane take out a white cell phone from her bag during the slideshow, but some subjects were later misled that the phone was blue. Were those misled subjects more likely to report that the phone was blue than subjects who were not misled?

To address this question, a similar analysis was conducted as before, except that this time the DV was the proportion of misinformation-consistent responses provided (rather than the proportion of accurate responses). This analysis revealed a main effect of item type on misinformation responses: subjects were more likely to provide the misinformation-consistent response to questions regarding misinformation items than to questions regarding control items, $F(1, 259) = 26.01$, $p < .001$, $\eta_p^2 = .091$. Subjects who

[6] When removing subjects who failed the attention check, the misinformation effect on the cued-recall test was significant, $F(1, 158) = 4.51$, $p = .04$, $\eta_p^2 = .03$. Subjects who passed the attention check provided the accurate response to 48% of questions about control items, but only 42% of questions about misinformation items.

were misinformed that Jane's phone was blue, were more likely to report that they saw her take out a blue phone compared with subjects who were not misinformed about the color of her phone.

There was no main effect of confidence condition on the likelihood of providing a misinformation-consistent response, $F(2, 259) < 1$, $p = .41$, nor was there any evidence of an interaction between confidence-condition and item type, $F(2, 259) < 1$, $p = .72$. Results can be found in Figure 1.4, and an item analysis is displayed graphically in Figure 1.6.

Recognition memory test. After finishing the cued-recall memory test, subjects were asked the same memory questions in the format of a three-alternative forced-choice recognition memory test. To examine whether accuracy on the recognition test was influenced by item type, condition, or some combination of the two, I conducted a 2 (item type: control; misinformation) x 3 (confidence condition: confidence-boosted; confidence-nonmanipulated; confidence-lowered) mixed-model analysis of variance, with item type as a within-subjects variable, and confidence condition as a between-subjects variable. The analysis revealed a main effect of item type on memory accuracy: subjects were significantly more accurate on questions regarding control items ($M = .56$, $SD = .28$) than for questions regarding misinformation items ($M = .50$, $SD = .30$), $F(1, 259) = 6.36$, $p = .01$, $\eta_p^2 = .024$. This replicates the classic misinformation effect. But was there any effect of confidence condition on memory accuracy? We did not find any main effect of condition on accuracy, $F(2, 259) < 1$, $p = .55$, nor did we find any evidence of an interaction between condition and item type, $F(2, 259) < 1$, $p = .57$. Results are displayed in Figure 1.7.

We also examined whether the likelihood of providing the misinformation-consistent response to recognition memory questions varied as a function of item type or

condition. Indeed, subjects were much more likely to select the misinformation response on test questions asking about items for which they were earlier misled (misinformation items) than for questions asking about items for which they were not misled (control items), $F(1, 259) = 14.43$, $p < .001$, $\eta_p^2 = .053$. There was no effect of confidence condition on the likelihood of providing a misinformation response, $F(2, 259) < 1$, $p = .80$, nor was there evidence of an interaction between condition and item type, $F(2, 259) = 1.58$, $p = .21$, $\eta_p^2 = .012$. Descriptive statistics can be found in Table 1.3.

Correlational analyses between MSE and memory performance. Aside from testing for differences in memory performance across conditions, we could also assess whether reported MSE correlated with memory performance, either within each condition or when collapsing across them. Table 1.4 displays the correlation results for the cued-recall test, and Table 1.5 displays the results for the recognition memory test.

On the cued-recall test: for those in the confidence-lowered condition, higher levels of MSE were associated with being less likely to generate the misinformation-consistent response to questions regarding misinformation items, $r(81) = -.22$, $p = .045$. There were no other associations between MSE and memory outcomes.

On the recognition memory test: for those in the confidence-lowered condition, higher MSE responses were marginally associated with giving more accurate responses to questions regarding misinformation items, $r(81) = .21$, $p = .05$, and with giving more accurate responses to questions regarding control items, $r(81) = .18$, $p < .10$.

Mechanisms. Did being assigned to a confidence condition influence self-reports of: the importance of performing well on the tasks; one's willingness to expend effort; the amount of attention paid on the tasks; and the levels of performance anxiety experienced?

Oneway analyses of variance were conducted with confidence condition as the IV, and each of these theorized mechanisms as the DV. The confidence manipulation did not have any discernable downstream effects on any of these measures, all *p*s > .14. In other words, self-reported task importance, effort-willingness, attention, and worry during the PEI and memory test did not differ across conditions.

Correlational analyses between MSE and importance, effort, attention, and anxiety. Because there were no mean differences across experimental conditions on measures of effort, attention, importance, or anxiety, we next explored whether reported levels of MSE were associated with any of these measures. This data is displayed in Table 1.6.

When collapsing across conditions, MSE ratings were found to be correlated with many of the variables predicted by self-efficacy theory. Higher MSE was at least marginally associated with: placing greater importance in doing well during the PEI task, $r(259) = .10$, $p = .10$; being willing to expend more effort during both the PEI, $r(259) = .14$, $p = .03$, and the memory test, $r(259) = .11$, $p = .09$; and having less performance anxiety during both the PEI, $r(259) = -.11$, $p = .07$, and the memory test, $r(259) = .13$, $p = .03$.

When examining each condition separately, most of the significant associations were observed within the confidence-nonmanipulated condition. For subjects who did not receive pre-scripted feedback regarding their performance on the AMT and EMT, higher MSE was associated with: higher rated importance of doing well on both the PEI, $r(88) = .29$, $p = .005$, and the memory test, $r(88) = .28$, $p = .007$; greater willingness to expend effort on both the PEI, $r(88) = .31$, $p = .003$, and memory test, $r(88) = .31$, $p = .003$; and at least one measure of paying more attention during both the PEI and memory test.

Within the confidence-boosted condition, the only (marginally) significant association was between MSE and *greater* anxiety about performing well on the memory test, $r(259) = .18$, $p = .10$. Within the confidence-lowered condition, the only significant association was between MSE and *less* anxiety about performing well on the memory test, $r(259) = -.23$, $p = .04$.

Correlational analyses between importance, effort, anxiety, attention, and memory performance. Correlations are presented for the cued-recall memory test in Table 1.7 and for the recognition memory test in Table 1.8.

On the cued recall test: when collapsing across experimental conditions, the variable most strongly associated with memory performance was the amount of attention that subjects reported paying. Paying greater attention during both the PEI and the memory test was associated with providing more accurate responses to both control items and misinformation items, all rs > .18, all ps < .05. However, paying greater attention during the PEI was also associated with being *more likely* to provide the misinformation response to cued-recall questions asking about misinformation items, $r(260) = .17$, $p = .01$. This pattern of results can be explained by those who reported paying greater attention during the PEI being more likely to *attempt to* answer cued-recall questions regarding misinformation items. Subjects who left cued-recall questions blank would be less likely to come up with both the correct answer and the misinformation answer relative to those subjects who attempted to answer more questions.

Self-reported willingness to expend effort on the PEI and memory test also displayed a similar pattern of results as attention. Those who reported being more willing to expend effort in order to perform well on both the PEI and memory test were

subsequently more likely to offer accurate responses to cued-recall questions regarding both control and misinformation items, all *r*s > .11, all *p*s < .10. However, there was also a trend-level association between effort-willingness and the number of misinformation responses given to questions asking about misinformation items, $r(260) = .11$, $p = .07$. As with attention, those reporting greater willingness to expend effort during the PEI and test were both more likely to provide the correct answer and more likely to provide the misinformation answer, likely indicating that they were more likely *to attempt* to answer questions compared with those who were less willing to expend effort.

On the recognition memory test: when collapsing across conditions, attention was again the variable most strongly and consistently associated with memory performance. As with the cued-recall test, paying greater attention during both the PEI and memory test was associated with greater accuracy on questions asking about control items, all *r*s > .26, all *p*s < .001. Paying greater attention during the test was also associated with selecting more accurate responses to memory questions asking about misinformation items, $r(260) = .18$, $p < .01$. Furthermore, paying greater attention during each the PEI and memory test was associated with being less likely to select the misinformation response to questions asking about control items, all *r*s > .20, all *p*s < .01, and it was marginally associated with being more likely to provide the misinformation response to questions asking about misinformation items, $r(260) = .11$, $p = .08$.

Detectors. We included a few questions during the funneling debriefing aimed at ascertaining how many people detected the study's true purpose. On the broadest question, we simply asked subjects if anything struck them as odd about the study. Responses to this question did not differ by condition, $X^2(2, N = 262) < 1$, $p = .78$, *Cramer's V*

= .04. Twenty-eight percent of those in the confidence-boosted condition, 24% of those in the confidence-nonmanipulated condition, and 29% of those in the confidence-lowered condition reported something seeming odd. However, when given a chance to describe what they found odd, many subjects mentioned things unrelated to the study deception [e.g., *"It was surprising to be asked to play Pacman"* (Pacman was used as a filler task to increase the retention interval between PEI and test)], so responses to this variable likely represent an inflation of the number of detectors. Nevertheless, these responses are useful in providing an upper-bound estimate, as previous researchers have pointed out (Cochran, Greenspan, Bogart, & Loftus, 2016).

To obtain a more precise estimate of detectors, we told subjects that in an earlier version of the study, there were occasionally errors with the computerized feedback, and we asked them to indicate whether they believed they may have received feedback that was not meant for them. The percentage of subjects who reported being skeptical of the feedback did not differ significantly across condition $X^2(N = 262) = 2.69$, $p = .26$, *Cramer's V* = .10. In the confidence-boosted condition, 14% reported being skeptical of the feedback, whereas 16% did so in the confidence-nonmanipulated condition, and 23% did so in the confidence-lowered condition. When specifying the cause of their skepticism, subjects gave a range of different types of responses, including being skeptical about aspects of the personality feedback (e.g., *"Openness. I am very open to new experiences but it said I had a low openness score."*) We next went through subjects' free responses and coded only those who specifically mentioned memory as the cause for their skepticism. The proportion of subjects who specifically mentioned memory differed across conditions, $X^2(N = 262) = 18.39$, $p < .001$, *Cramer's V* = .27. Nobody in the confidence-boosted condition (0%), and

one person in the confidence-nonmanpulated condition (1%) specified memory as the reason why they were skeptical that the feedback they received was actually theirs. On the other hand, 10 subjects in the confidence-lowered condition (12%) mentioned memory. Even within the 12% of subjects in the confidence-lowered condition, responses ranged from those who were surprised by the memory feedback, but still receptive to its influence (e.g., *"I hope my memory is not as bad as the feedback, but maybe it is…")* to those who outright deduced the manipulation [e.g., *"Because I think it is ramdomly present some percentage in order to test my memory in the later"* (sic)]. Thus, while skepticism regarding the memory feedback was overall higher in the confidence-lowered condition than the other conditions, the vast majority of subjects within the confidence-lowered condition were not skeptical of the manipulation.

Discussion

Overall, the results from Experiment 1 demonstrate that MSE is pliable: false performance feedback on a pair of memory tasks successfully altered subjects' perceptions of their eyewitness and autobiographical memory abilities in general. These findings on the malleability of MSE are in line with the findings of Belli et al. (1998), who used a different approach with a different sample, but also found that subjects' perceptions of their memory abilities/deficiencies could be manipulated. The fact that MSE can easily be altered raises potential concerns if MSE beliefs have the power to influence subsequent memory performance, as postulated by self-efficacy theory.

With that said, we did not find evidence that manipulating MSE had any downstream effects on memory performance in Experiment 1. While being exposed to misleading details in the PEI narrative had a marked effect on accuracy—both increasing

the likelihood of that misleading detail inserting itself into witness's recollections, and decreasing the likelihood of the correct detail being recognized as true—our experimental manipulation of MSE had no discernable effects on subsequent performance.

To understand why we failed to find an effect of the MSE manipulation on subsequent memory performance, we first examined whether the manipulation influenced certain variables that were theorized to be related to self-efficacy: the rated importance of the task at hand; the willingness to expend effort in order to do well; performance anxiety; and attention. Despite our manipulation being successful in raising or lowering MSE, none of these other variables differed across condition.

One explanation for why we might have found condition effects on reported MSE but not any of these other variables, is that subjects may not have been entirely truthful when they reported on their MSE. Perhaps subjects in the confidence-lowered condition merely reported that they believed their memory abilities were subpar not because they were truly influenced by the manipulation, but because they thought that is how we researchers wanted them to respond. Similarly, perhaps those in the confidence-boosted condition were not truly influenced to believe they had better memory abilities than their peers, but they were merely giving the socially desirable response. If subjects' MSE reports were inauthentic, that might explain why they varied based on condition, but none of the other variables thought to be associated with MSE varied along with them.

In order to test this possibility, scores to the Marlowe-Crown Social Desirability Scale (MCSDS) were calculated. MCSDS scores were found to correlate positively with MSE reports in the confidence-boosted condition, $r(86) = .27$, $p = .01$, but not significantly so in the confidence-lowered condition, $r(81) = .14$, $p = .20$. This pattern of results might

support the notion that some portion of subjects were merely responding based on demand characteristics. However, MCSDS scores were also positively correlated with MSE reports in the confidence-nonmanipulated condition, $r(88) = .24$, $p = .02$. Thus, it seems as though some component of MSE is related to the tendency to present oneself in a socially desirable way, regardless of the manipulation procedure employed.

To safely rule out the counter-explanation that subjects were merely posturing about being influenced by the performance feedback, an ANCOVA was conducted with condition as the IV, MSE ratings as the DV, and MCSDS scores entered as a covariate. This analysis revealed that even after statistically controlling for subjects' tendencies to respond in socially desirable ways, the assignment to experimental condition still exerted a large influence on MSE ratings, $F(2, 257) = 55.03$, $p < .001$, $\eta_p^2 = .043$. The demand characteristic account fails as an alternative explanation of why the manipulation affected MSE ratings but not ratings of importance, effort, attention, or anxiety.

In addition to testing for between-condition effects, we also assessed whether MSE ratings correlated with ratings of importance, effort, attention, or anxiety. The majority of significant correlations were found in the confidence-nonmanipulated condition: of those who did not receive performance feedback, MSE was positively associated with self-rated importance of doing well on both the PEI and memory test, greater willingness to expend effort in order to achieve that goal, and paying greater attention during both the PEI and memory test. The existence of these correlations lends some support the relationships between MSE and these variables postulated by self-efficacy theory, and yet it is not clear

why most of these relationships were not observed in the two experimental conditions.[7] One possible explanation is that MSE beliefs are not actually causally influencing these variables, but rather a "third variable" is responsible for influencing MSE as well as these other variables.

MSE was manipulated in Experiment 1 after subjects witnessed an event, but before they were exposed to PEI about what they saw. The timing of the manipulation was meant to approximate real world contexts in which forensic investigators may unwittingly alter witness's MSE while they are interviewing them regarding an event that has already occurred. Belli et al. (1998) demonstrated that being asked a number of difficult memory questions can alter people's perceptions about their memory abilities, and so it is possible that this process takes place during some real-world forensic interviews in which difficult memory questions are posed. Thus, the rationale for the timing of the MSE manipulation in Experiment 1 was to increase the ecological validity of the findings so that they could apply more directly to this important real-world context.

However, from a purely theoretical perspective it can be argued that one's MSE beliefs *prior to witnessing the event* should have a greater potential to influence subsequent

[7] Partial correlations were also run between MSE and these variables while controlling for MCSDS scores. For those in the confidence-boosted condition, the partial correlation between MSE and performance anxiety during PEI was marginally significant, $r(83) = .19$, $p = .08$, as was the one between MSE and anxiety during the memory test, $r(83) = .20$, $p = .07$. Unexpectedly, higher MSE was associated with higher performance anxiety. For those in the confidence-lowered condition, the partial correlation between MSE and having less performance anxiety during the test was significant, $r(80) = -.24$, $p = .03$. None of the other partial correlations between MSE and the other variables were significant in either of the two experimental conditions, all rs < .18, all ps > .13. Within the confidence-nonmanipulated condition, significant partial correlations were observed between MSE and importance at both PEI, $r(87) = .23$, $p = .03$, and test, $r(87) = .22$, $p = .04$, and between MSE and effort at both PEI, $r(87) = .27$, $p = .01$, and test, $r(87) = .26$, $p = .02$. Additionally, there was a marginally significant partial correlation between MSE and being less distracted during PEI exposure, $r(87) = -.21$, $p = .06$. Overall, subjects' inclination to respond in socially desirable ways does not appear to account for why MSE was more consistently correlated with variables for subjects within the confidence-nonmanipulated condition than for subjects in the two experimental conditions.

memory performance than MSE beliefs after the event has already been witnessed. This is because some of the variables thought to be associated with higher MSE (i.e., greater effort and attention, less anxiety and distraction) might lead people to encode the initial event more carefully, which in turn should increase the chances that they notice discrepancies between the event and the PEI narrative that they read afterwards. The greater the likelihood that witnesses detect discrepancies, the less likely they are to be influenced by the misinformation (Tousignant, Hall, & Loftus, 1986).

Experiment 2 sought to answer the question of whether an MSE manipulation that occurred prior to event encoding would influence subsequent memory performance.

EXPERIMENT 2

Introduction

If some forensic investigators are possibly unintentionally altering witnesses' MSE by asking a number of difficult memory questions, this might constitute what eyewitness researchers call a *system variable* (Wells & Olson, 2003). In other words, it would be a variable that is potentially influenced by actors within the legal system. Eyewitness researchers are particularly interested in studying system variables, because understanding these variables can often generate direct recommendations for how to improve certain forensic practices (e.g., in order to increase the likelihood that they obtain accurate witness reports).

Other classes of variables affect eyewitness accuracy independently of the influence of legal system actors. These variables are referred to as *estimator variables,* because their influence on accuracy can only be estimated after the fact, rather than prevented. Examples of estimator variables that influence memory accuracy include factors such as:

the age of the witness (Pozzulo & Lindsay, 1998); whether a weapon was used during commission of the crime (Steblay, 1992); and whether the witness and perpetrator were of the same race or not (Meissner & Brigham, 2001). People's beliefs about their MSE prior to witnessing a crime would be another example of an estimator variable, if those beliefs exert an influence on subsequent memory performance.

While understanding more about estimator variables does not directly lend itself to policy recommendations the way that learning more about system variables does, it is still important to study them so that jurors can make more informed decisions when evaluating the reliability of eyewitness testimony.

Experiment 2 will examine whether a witness's MSE at the time that a crime is commissioned is a variable that influences subsequent memory accuracy, both for details that one is later misled about (misinformation items) and details for which one is not (control items). While this question could potentially be addressed by merely measuring MSE prior to having subjects witness a mock crime, and then assessing correlations between MSE and subsequent accuracy, we opted to maintain the experimental design of the study, so that the presence of a causal relationship could be tested.

Methods

Subjects. Subjects were University of California, Irvine students (86% female) recruited through the Human Subjects Research Pool. They were at least 18 years old, fluent in English, and had not participating in previous false memory studies conducted by our lab. Once subjects who experienced technical issues were removed, a sample of 293 remained to be analyzed ($n_{\text{confidence-boosted}} = 104$; $n_{\text{confidence-lowered}} = 95$; $n_{\text{confidence-nonmanipulated}} = 94$).

Procedure. The procedure for Experiment 2 was identical to Experiment 1, except that subjects in the two experimental conditions received the false feedback about their performance on the AMT and EMT (i.e., the confidence manipulation) prior to viewing the slideshow event, instead of after it. A procedural flowchart for Experiment 2 can be found in Figure 2.1.

Results

Attention check. Overall, 63% of subjects in Experiment 2 passed the attention check. At the trend-level, condition did influence the likelihood of passing the attention check, $X^2(2, N = 293) = 4.55$, $p = .10$, *Cramer's V* = .13. Fifty-seven percent of subjects in the confidence-boosted condition passed the attention check, 62% passed in the confidence-lowered condition, and 71% passed in the confidence-nonmanipulated condition. Excluding subjects who failed the attention check did not change the pattern of results, so we retained all subjects in the subsequent analyses.

MSE manipulation. Descriptive statistics for MSE can be found in Table 2.1. To examine whether condition influenced MSE responses, a oneway analysis of variance was conducted, with condition as the IV and MSE responses as the DV.[8] This analysis revealed that condition significantly influenced MSE responses, $F(2, 289) = 40.94$, $p < .001$. Levene's test for equality of variances indicated that the variances were not equivalent across conditions, $F(2, 289) = 8.26$, $p = .001$, so Games-Howell post-hoc comparison tests were conducted. These comparisons indicated that subjects in the confidence-boosted condition

[8] One subject was excluded from this analysis (and other analyses assessing correlations between MSE and other measures) for giving an impossible MSE rating (i.e., outside of the range of 0-100). An additional subject apparently misunderstood the instructions to indicate what percentile they were in for their memory abilities, indicating a proportion instead of a percentile (i.e., they responded ".4" instead of 40). For this subject, I converted the MSE belief value from a proportion to a percent, and the percent value was used for all analyses involving MSE.

reported having significantly higher MSE (M = 70.53, SD = 15.07) than those in the confidence-nonmanipulated condition (M = 53.72, SD = 20.69), $p < .001$, and those in the confidence-lowered condition (M = 46.28, SD = 22.14), $p < .001$. Furthermore, those in the confidence-lowered condition provided MSE responses that were lower than those in the confidence-nonmanipulated condition, $p = .048$. Thus, as in Experiment 1, the experimental manipulation of MSE was effective.

Memory performance.

Cued-recall memory test. To examine accurate responses on the cued-recall test, a 2(item type: control; misinformation) x 3(confidence condition: confidence-boosted; confidence-nonmanipulated; confidence-lowered) mixed-model analysis of variance was conducted, with item type as a within-subjects variable, and condition as a between-subjects variable. This analysis did not reveal an effect of item type on accuracy, $F(1, 290) = .98$, $p = .32$, $\eta_p^2 = .003$, nor an effect of confidence condition on accuracy, $F(2, 290) = 1.51$, $p = .22$, $\eta_p^2 = .010$, nor an interaction between the two, $F(2, 290) = 1.84$, $p = .16$, $\eta_p^2 = .013$.

We next analyzed whether item type or condition influenced the likelihood that subjects provided the *misinformation* response (rather than the accurate one). Subjects reported the misinformation response more often to cued-recall questions asking about misinformation items (M = .25, SD = .26) than questions asking about control items (M = .14, SD = .19), $F(1, 290) = 33.40$, $p < .001$, $\eta_p^2 = .10$. There was no main effect of condition on the likelihood of providing the misinformation response, $F(2, 290) = .46$, $p = .64$, nor was there an interaction, $F(2, 290) = .54$, $p = .54$.

Recognition memory test. Next, we analyzed accurate responses on the three-alternative forced-choice recognition memory test. On the recognition test, item type

exerted a significant influence on accuracy, such that subjects were significantly more accurate on questions asking about control items (M = .60, SD = .26) than questions asking about misinformation items (M = .53, SD = .27), $F(1, 290) = 9.72$, $p = .002$, $\eta_p^2 = .032$, indicating a replication of the misinformation effect. There was no main effect of confidence condition on accurate responses, $F(2, 290) < 1$, $p = .85$, nor was there an interaction, $F(2, 290) = 1.74$, $p = .18$, $\eta_p^2 = .012$.

When analyzing misinformation-consistent responses on the recognition memory test as the DV, we also found a significant effect of item type, such that subjects were significantly more likely to endorse the misinformation response as being correct on questions asking about misinformation items (M = .37, SD = .29) than on questions asking about control items (M = .28, SD = .27), $F(1, 290) = 14.50$, $p < .001$, $\eta_p^2 = .048$. Once again, there was no main effect of confidence condition on misinformation responses, $F(2, 290) < 1$, $p = .72$, nor an interaction, $F(2, 290) < 1$, $p = 1.00$. Results can be found in Table 2.2.

Correlational analyses between MSE and memory performance. We next examined whether MSE ratings were correlated with memory outcomes. Table 2.3 displays the results for the cued-recall test, and Table 2.4 displays the results for the recognition memory test.

On the cued-recall test, for those in the confidence-lowered condition, MSE ratings were marginally associated with being more likely to provide the accurate response to test questions asking about misinformation items, $r(92) = .20$, $p = .05$. There were no other associations between MSE and memory outcomes for the cued-recall test.

On the recognition memory test, there were no associations between MSE ratings and memory outcomes.

Mechanisms. Did condition influence self-reports of: willingness to expend effort; the amount of attention paid on the tasks; the importance of performing well on the tasks; and levels of performance anxiety experienced? Oneway analyses of variance were conducted with confidence condition as the IV, and each of these theorized mechanism variables as the DV. The confidence manipulation did not have any discernable downstream effects on any of these measures, all *p*s > .16. In other words, self-reported willingness to expend effort, attention, importance, and anxiety did not differ across conditions for the event, PEI, or memory test.

Correlational analyses between MSE and importance, effort, attention, and anxiety. Because there were no mean differences across experimental conditions on measures of effort, attention, importance, or anxiety, we next explored whether reported levels of MSE were associated with any of these measures. This data is displayed in Table 2.5.

Overall, MSE was correlated with many of the theorized variables, and these relationships appeared with similar frequency across each of the three conditions. Of all the theorized relationships, the one between higher MSE and lower performance anxiety was the least frequently observed, only appearing during the memory test for those in the confidence-lowered condition, and even then it only reached marginal significance, $r(92) = -.19$, $p = .07$. All significant relationships that were observed between MSE and these variables were in the theorized direction.

Correlational analyses between importance, effort, anxiety, attention, and memory performance. Correlations are presented for the cued-recall memory test in Table 2.6 and for the recognition memory test in Table 2.7.

Of note, on the cued recall test: attention was the variable most strongly and consistently associated with memory performance. When collapsing across conditions, the more attention that subjects paid during the slideshow event, the more accurate their responses tended to be during the cued-recall memory test for both control items, *r(291) = .28, p* < .001, and misinformation items, *r*(291) = .31, *p* < .001. Additionally, the more attention subjects paid during the PEI, the more accurate they were for both control items, *r*(291) = .17, *p* = .004, and misinformation items, *r*(291) = .25, *p* < .001. And the more attention paid during the test, the greater their accuracy for control items, *r*(291) = .273, *p* < .001, and misinformation items, *r*(291) = .28, *p* < .001. Paying greater attention during the PEI was also associated with being more likely to provide the misinformation-consistent response, however, *r*(291) = .13, *p* = .02.

On the recognition memory test, attention was once again the variable most consistently associated with memory performance. When collapsing across conditions, the more attention that subjects paid during the event, the more likely they were to select the accurate response option for control item questions, *r*(291) = .29, *p* < .001, and misinformation item questions, *r*(291) = .27, *p* < .001. Furthermore, the more attention they paid during the event, the less likely they were to select the misinformation-consistent response on control item questions, *r*(291) = -.17, *p* = .003, and on misinformation item questions, *r*(291) = -.18, *p* = .002. Additionally, the more attention that subjects paid during the PEI, the more often they selected the accurate response to control item questions, *r*(291) = .18, *p* = .002, and to misinformation item questions, *r*(291) = .18, *p* = .002. Lastly, the more attention paid during the memory test, the more accurate subjects' responses were to both control item questions, *r*(291) = .26, *p* < .001, and misinformation item

questions, $r(291) = .12$, $p = .04$, and the less likely they were to provide the misinformation response to control item questions, $r(291) = -.12$, $p = .048$.

Detectors. At the trend level, there was an effect of condition on the proportion of subjects reporting that something was odd, $X^2(2, N = 292) = 5.29$, $p = .07$, *Cramer's V* = .14. Within the confidence-boosted condition, 24% of subjects reported something being odd, whereas 37% of subjects did so in the confidence-lowered condition, and 25% did so in the confidence-nonmanipulated condition.

To obtain a more precise estimate of the number of detectors, I next analyzed how many subjects were skeptical that the feedback they received was meant for them. This did not differ across condition, $X^2(2, N = 292) = 1.74$, $p = .42$. Within the confidence-boosted condition, 18% of subjects reported being skeptical of the feedback, compared with 22% in the confidence-lowered condition, and 15% within the confidence-nonmanipulated condition. Unlike in Experiment 1, the proportion of subjects in Experiment 2 who specifically cited the memory feedback as the cause for their skepticism did not differ by condition, $X^2(2, N = 292) = 4.24$, $p = .12$. Two subjects in the confidence-boosted condition (2%) mentioned memory as a reason for their skepticism, while four subjects in the confidence-lowered condition did so (4%), and no subjects in the confidence-nonmanipulated condition do so (0%). In sum, the overwhelming majority of subjects in each condition believed the false feedback.

Discussion

In Experiment 2, subjects' MSE was manipulated prior to witnessing a mock crime. We once again were able to successfully alter subjects' confidence in their memory abilities: those in the confidence-boosted condition reporting having the greatest

confidence in their abilities, and those in the confidence-lowered condition reported having the least confidence. However, there was no effect of condition on any of the variables theorized to vary alongside MSE. Condition did not influence ratings of task importance, willingness to expend effort, amount of attention paid during the tasks, or levels of performance anxiety.

Even though there was no effect of condition on these variables, MSE did correlate in the expected direction with many of them. Additionally, several of these variables correlated with memory performance. Attention, in particular, was consistently associated with memory performance: at each stage of the misinformation procedure, paying greater attention was associated with responding more accurately for both details for which one was previously misled (misinformation items) and details for which one was not (control items).

EXPERIMENT 3

Introduction

Experiments 1 and 2 explored whether witnesses' MSE would influence how likely they would be to incorporate misleading suggested details into their memories for the witnessed event. This question is an important one not only from a purely theoretical perspective, but also because it has direct real-world relevance to forensic settings involving eyewitnesses (e.g., to events such as crimes or accidents). Given that mistaken eyewitness testimony is the most prevalent contributing cause to wrongful convictions—

involved in 70% of the DNA exoneration cases catalogued by the Innocence Project[9]—it is imperative to study what factors may theoretically increase (or lower) the risks of witnesses developing false memories, so that this substantial problem can be at least partially mitigated.

Experiment 3 was also aimed at exploring the question of whether, and if so how, MSE might influence memory in a scenario involving misleading suggestions. However, Experiment 3 sought to explore this relationship using a procedure designed to be more readily applicable to another type of real-world context in which memory accuracy is of paramount importance: the ability of adults to accurately remember autobiographical events from their childhoods.

During the so called "memory wars" of the 1990s, it became apparent that several risky techniques were being employed by a number of psychotherapists (e.g., hypnosis, guided-imagery). These techniques resulted in hundreds, if not thousands, of patients developing what they believed were previously inaccessible or "repressed" memories of prior abuse from their childhoods. Extensive discussions of the memory wars and the lack of credible scientific evidence supporting the notion of repression can be found elsewhere (McNally, 2003, 2005; Bogart & Loftus, 2015), but most relevant to the present research is the fact that many people in the general public, as well as clinical practitioners, currently believe in the notion of repressed memories. In one recent study, for example, 81% of undergraduates agreed with the statement that "traumatic memories are often repressed,"

[9] The Innocence Project (www.innocenceproject.org) maintains an up to date directory of convictions later overturned by DNA evidence. They allow visitors to their website to filter the cases by contributing cause, and as of the time of this writing, filtering by "Eyewitness Misidentification" returns 244 cases out of a total of 351 (244/351 = 70%).

and greater than 1 in 10 board-certified psychotherapists endorsed the item: "when someone has a memory of a trauma while in hypnosis, it objectively must have occurred." (Patihis, Ho, Tingen, Lilienfeld, & Loftus, 2014, pp. 521, 524).

In light of such beliefs being commonplace even today, and due to the fact that certain risky therapy techniques are still being used, it is crucial to examine the factors that may render those patients who have been exposed to suggestive practices more or less vulnerable to developing false memories. It is with this real-world application in mind, that Experiment 3 was designed.

Theory and Hypothesis. The literature on self-efficacy theory presents evidence for a nearly universal positive relationship between higher self-efficacy beliefs and better subsequent performance. One of the primary mechanisms by which efficacy has been shown to lead to better performance in the literature is through enhanced motivation to succeed, and the greater willingness to persist and expend effort in the face of difficulty. What is currently missing from previous explorations, however, is an examination of efficacy beliefs for settings in which higher effort may actually be *detrimental* to performance. Experiment 3 examined the relationship between efficacy beliefs and performance in just such a setting.

A variation of the imagination inflation paradigm involves suggesting to subjects that certain events occurred in their past (Hyman & Pentland, 1996). If subjects initially report that the events never occurred, they are then asked to imagine how the events would have unfolded if they had occurred. When people are then asked later about the same events, a sizeable minority of people recount (false) memories of those events. It

appears that they may be confusing what they imagined with a recollection of real life events.

In settings such as these, better performance means developing fewer false memories. It is not clear in this context, however, how increased effort or motivation to recall seemingly forgotten past events would lead to better performance, and in fact, it seems reasonable to suspect that within this context we may find a reversal of the efficacy-performance relationship commonly observed. Higher motivation to recover a "forgotten" memory may lead to higher rates of false memory development, and thus *worse* performance.

Hypothesis: In the context of a suggestive imagination inflation procedure, those who are led to feel more efficacious in their ability to remember past events will show *worse* performance than those who are led to feel less efficacious. In other words, there will be a positive relationship between MSE and false memory development. Since false memories are not a desirable outcome, this finding would instantiate a reversal of the typical relationship between self-efficacy and performance, such that higher efficacy beliefs will lead to worse performance. The more effort put into, and time spent on, imagining the suggested events, the greater the likelihood of false memory development should be. This reasoning stems from work within the imagination inflation literature that has shown that false memory development is more likely with repeated imaginings (Goff & Roediger, 1998).

Methods

Subjects. Subjects were recruited through Amazon's Mechanical Turk (MTurk). After removing those with incomplete data, a final sample of 72 subjects remained to be

analyzed (Male = 54%; Female = 40%; Unreported = 6%). Subjects were randomized into one of three conditions: the confidence-boosted condition (*n* = 22), the confidence-lowered condition (*n* = 25), and the confidence-nonmanipulated condition (*n* = 25).

Subjects were only eligible to participate if they were at least 18 years old, fluent in English, and residents of the U.S. Furthermore, all subjects were required to have participated in at least 100 previous Human Intelligence Tasks (HITs) via MTurk and to have been approved for participating in at least 90% of them. Subjects were compensated $5 for their participation in this three-session study.

Procedure. A flowchart illustrating the procedure can be found in Figure 3.1. Subjects were run using MTurk, with the assistance of a researcher-created tool called TurkPrime that enables additional functionality, such as easily managing studies that span across multiple sessions (Litman, Robinson, & Abberbock, 2017).

Session 1. Subjects initially signed up for Session 1 via MTurk, and the session lasted 10 minutes. As with most studies investigating false memories, subjects were not informed at the onset that the study was about false memories; instead, subjects signed up for a vaguely described study on "Personality & Learning." They were further instructed that Session 1 of the study would involve answering some questions about themselves, and that afterwards they would be eligible for additional HITs.

Subjects began Session 1 by filling out the baseline School Experiences Questionnaire (SEQ). This measure asked subjects to indicate their confidence about whether 22 distinct experiences had or had not occurred during their education. For each item, subjects indicated their confidence on a 7-point scale ranging from 1 (*Definitely did not happen*) to 7 (*Definitely did happen*) that they had experienced each event. Some

sample items include experiences such as "I made a goal during a soccer game in PE class" and "I cheated on a test in high school." Embedded within the SEQ were two critical items, about which subjects would later receive a suggestion: "I was badly bullied during 4th and/or 5th grade" and "I was sent to the principal's office in 5th and/or 6th grade."

After the baseline SEQ, subjects completed the Big Five Inventory (BFI) and were then presented with accurate personality results, as with Experiments 1 and 2. They then indicated how they believe their personalities compare to their peers', along each of the Big Five dimensions. Subjects then provided a baseline measure of their MSE, indicating how they deem their eyewitness and autobiographical memory abilities compare with those of their peers. Finally, subjects completed the MCSDS and were then instructed that they would receive notice about Session 2 in the following day or two.

Session 2. One day after completing Session 1, a HIT for Session 2 was activated on MTurk, and subjects were sent a message alerting them of its existence. Session 2 lasted approximately 30 minutes. During Session 2, subjects were asked to complete the HIT within 24 hours, if possible (and if they failed to complete the HIT for Part 2 within 24 hours, they were emailed a second time to remind them of the HIT and to again request that they complete it at their earliest convenience).

Session 2 began with subjects engaging in the eyewitness and autobiographical memory tasks that would serve as the basis for the subsequent MSE manipulation (for those assigned the two experimental conditions). As with Experiments 1 and 2, the Eyewitness Memory Task (EMT) involved studying a slideshow of faces presented one by one and then receiving a memory test in which they needed to distinguish studied faces from novel, unstudied foils. The Autobiographical Memory Task (AMT) involved subjects

recounting details about 4 separate instances in which they behaved mischievously between the ages of 8 and 12 years old.

Subjects were then randomly assigned to one of three conditions: confidence-boosted, confidence-lowered, or confidence-nonmanipulated. Subsequent to completing the EMT and AMT, those in the confidence-boosted condition received pre-scripted feedback that they performed quite well on the memory tasks, achieving better results than 80% of their peers. Those in the confidence-lowered condition, on the other hand, received feedback that they performed quite poorly, achieving worse results than 80% of their peers. Those in the confidence-nonmanipulated condition did not receive any performance feedback. Next, subjects each provided a MSE rating by indicating how they believed their memory ability compares with that of their peers.

After indicating their post-manipulation MSE, it was further suggested to subjects that a computer program had analyzed the responses they had provided during Session 1, and that it had been determined that: (1) they had been bullied between the ages of 7 and 11, and (2) they had been sent to the principal's office in the 5th and/or 6th grade. This type of false and ostensibly computer-generated suggestion has been used successfully in other false memory studies (Bernstein & Loftus, 2009; Laney, Morris, Bernstein, Wakefield, & Loftus, 2008; Morris, Laney, Bernstein, & Loftus, 2006). After reading the "computer generated" suggestions, subjects were asked to indicate whether they possessed a memory of each of the two suggested events. If subjects reported having a memory at this time, they were asked to spend at least a couple of minutes writing down a detailed account of what they remembered. On the other hand, if subjects indicated that they did not have a memory of the event in question, they were informed that it is quite typical for people to

forget events, especially ones from the distant past, and that certain techniques may bolster the remembering process. They were next instructed to spend a couple of minutes imagining how the event may have happened, and then to describe their imagined account in detail.

After writing about their memories or imaginings for the two critical events, subjects were asked to indicate their goals for the coming days, as well as several efficacy beliefs regarding aspects of the remembering process. Specifically, they were asked to indicate how many minutes per day they would aim to spend over the following several days trying to remember (a) the events they do not yet remember and (b) more details concerning the events they already remember. They then indicated how motivated they felt to try and remember (or remember more about) each type of event on a 7-point scale anchored by 1 (*Not at all*) and 7 (*Extremely*). Next, they reported how efficacious they perceived themselves to be at incorporating sensory details into their imaginings for how the non-remembered events might have happened, as well as how able they would be at ultimately remembering (or remembering more about) the suggested events.

Finally, they were told they would be eligible for a third and final session in approximately one week's time, and they were asked not to discuss details of the study with friends or family.

Session 3. One week after completing Session 2, subjects were sent a message alerting them that Session 3 was now active (and a reminder email was sent 24 hours after the initial email, if subjects still had not participated at that time). Session 3 lasted approximately 10 minutes.

Session 3 began with subjects filling out responses from the SEQ for a second time. With this being a repeated measure, Session 3 responses (in the context of the SEQ this will be referred to as Time 2, since it is the second time subjects filled out that form; T2) can be compared with baseline responses (Time 1; T1) to examine memory change over time, and to determine if the experimental MSE manipulation influenced the amount of memory change from T1 to T2.

After filling out the SEQ for a second time, subjects completed a Memory Belief Questionnaire (MBQ) in which they were presented with four events from the SEQ (including two of the critical events for which they received a suggestion), and for each event subjects were asked to indicate an "M" if they had a memory of that event occurring, a "B" if they lacked a distinct memory but had a belief that the event had occurred, or a "P" if they were positive that the event had not occurred. They were then asked to elaborate upon their responses. This form was adapted from other false memory studies that have used a similar computer-generated suggestion (Bernstein, Laney, Morris, & Loftus, 2005).

Upon finishing the MBQ, subjects were given a funneled debriefing, in which they were accorded the opportunity to report any vague or specific aspects of the study that they though were odd. They were subsequently debriefed in full, and, once they were made aware of the deception used in this study, subjects were given the option of having their data stricken from the dataset. No subjects made such a request.

Results

Attention check. Overall, 99% of subjects in Experiment 3 passed the attention check. Only one subject, who was in the confidence-lowered condition, failed. All subjects were retained for subsequent analyses.

Baseline MSE. During Session 1 (pre-manipulation), subjects reported their baseline MSE separately for eyewitness memory ability and autobiographical memory ability, indicating what percentile (0-100%) they ranked their abilities relative to those of their peers (higher numbers indicated more confidence in their abilities).[10] Baseline MSE was calculated by averaging the two domain-specific MSE reports. As expected, baseline MSE did not differ across conditions, $F(2, 68) = .32$, $p = .73$.

MSE manipulation. A pair of analyses were conducted to assess the success of the MSE manipulation. First, a oneway ANOVA was conducted with MSE at T2 (post-manipulation) as the dependent variable, and MSE condition as the independent variable. This omnibus test revealed a significant effect of MSE condition on T2 MSE reports, $F(2, 69) = 10.80$, $p < .001$.

Post-hoc comparisons using a Bonferroni correction (family-wise $\alpha = .05$) revealed that those in the confidence-boosted condition reported higher MSE at T2 ($M = 70.81$, $SD = 14.30$) than did those in the confidence-nonmanipulated condition ($M = 53.98$, $SD = 20.39$), $p = .02$, or those in the confidence-lowered condition ($M = 43.96$, $SD = 23.89$), $p < .001$. While nominally lower, the mean level of MSE in the confidence-lowered condition was not significantly lower than that of the confidence-nonmanipulated condition, $p = .25$.

Because MSE was collected both at baseline and post-manipulation, we were able to test the effectiveness of the experimental manipulation by comparing the amount of MSE change from T1 to T2 across conditions. For each condition, paired *t*-tests were run comparing T2 MSE to T1 MSE. These tests revealed that those in the confidence-boosted

[10] One subject was an outlier on baseline MSE, providing a response that was outside of the possible range (i.e., 0-100), likely indicating a typo. This subject was removed from the analysis of baseline MSE.

condition gave significantly higher MSE ratings at T2 than T1 (M_{change} = 12.38, SD = 15.38), $t(20) = 3.69$, $p = .001$; those in the confidence-nonmanipulated condition did not give T2 MSE ratings that differed statistically from T1 ratings (M_{change} = .38, SD = 21.20), $t(24) = .09$, $p = .93$; and those in the confidence-lowered condition gave significantly lower MSE ratings at T2 compared with T1 (M_{change} = -12.00, SD = 27.29), $t(24) = 2.20$, $p = .04$.

In sum, the MSE manipulation did succeed in both increasing the MSE for those in the confidence-boosted condition and in reducing the MSE for those in the confidence-lowered condition, and the mean magnitude of the change was almost identical in the two experimental conditions. However, when comparing only MSE levels at T2 across the three conditions, the differences between those in the confidence-lowered condition and those in the confidence-nonmanipulated condition were not statistically reliable enough to rule out the null hypothesis. Table 3.1 displays the T1 and T2 MSE results for each condition.

False memories and beliefs. The primary research question explored in Experiment 3 was whether MSE would have an influence on the likelihood of developing a false memory or false belief that the suggested event had occurred. Consistent with previous studies that have employed a computer-generated suggestion about an autobiographical event (Bernstein et al., 2005; Morris et al., 2006), subjects were classified as "believers" in the suggested events if they met all of the following criteria: (1) they were initially more confident than not that the event had never happened to them (i.e., they began on the left side of the scale for that item on the baseline SEQ); (2) they increased by at least one point following the suggestion; and (3) they indicated on the MBF during Session 3 that they either remembered or believed that the event had taken place.

Bullied event. The first step required to examine if the number of "believers" in having been bullied was different across conditions was to conditionalize the analysis on only those subjects who were initially more confident than not that the event had never happened to them. After filtering out subjects who began at or above the midpoint of the scale for the "bullied" item of the baseline SEQ, there was a sample of N = 49 that remained to be analyzed ($n_{\text{confidence-boosted}} = 13$; $n_{\text{confidence-lowered}} = 15$; $n_{\text{confidence-nonmanipulated}} = 21$). Next, a variable was created that reflected whether subjects formed a false memory or belief over the course of the experiment. Subjects were coded with a "1" on this variable if their confidence in being bullied increased from T1 to T2, and if they indicated at T2 having either a memory or a belief that they had been bullied during the 5^{th} or 6^{th} grade. By these criteria, 13 of the 49 subjects (27%) who had started on the left side of the scale for the critical bullying item went on to develop a false memory or belief of having been bullied.

A chi-squared test was then conducted to see if the proportion of those who developed a false memory or belief of having been bullied differed as a function of experimental condition. The analysis estimated a medium-sized effect of condition, but ultimately failed to reach traditional levels of statistical significance, $X^2(2, N = 49) = 4.48$, $p = .11$, *Cramer's V* = .30. Given an effect size of .30, 2 degrees of freedom, and a sample size of 49, however, the study was likely underpowered. A power analysis was conducted using the G*Power 3 software (Faul, Erdfelder, Lang, & Buchner, 2007), which confirmed this suspicion: the analysis revealed an observed power of only .45. In other words, given the study's sample size, effect size, and degrees of freedom, we would only be able to detect a *real effect* 45% of the time. With that power, the probability of committing a Type II error is uncomfortably high.

In light of the study being underpowered, and to reduce the chances of making a Type II error, I next conducted a contrast between only the two conditions that were theorized *a priori* to result in the largest discrepancy in the development of false memories or beliefs. Recall that it was hypothesized that those in the confidence-boosted condition would have the greatest likelihood of false memory development and that those in the confidence-lowered condition would have the lowest likelihood of false memory development. When running a chi-squared test that contrasted only those in these two experimental conditions, a statistically significant effect of condition was revealed, $X^2(1, N = 28) = 4.18$, $p = .04$, *Cramer's V* = .39. In other words, a significantly higher percentage of those assigned to the confidence-boosted condition (38%) developed false memories or beliefs compared with those assigned to the confidence-lowered condition (7%). Table 3.2 illustrates visually how the proportion of "believers" were distributed across experimental conditions.

Principal event. After conditionalizing the analyses to only those who started on the left-side of the confidence scale for the Principal Item ($n_{\text{confidence-boosted}} = 12$; $n_{\text{confidence-lowered}} = 14$; $n_{\text{confidence-nonmanipulated}} = 17$), a chi-squared test was run to determine if the formation of false memories or false beliefs differed across condition. This analysis did not reveal a significant result, $X^2(2, N = 43) = 1.11$, $p = .56$, *Cramer's V* = .16. Only two of the 43 possible subjects (i.e., those who started on the left side of the confidence scale) wound up developing a false memory or false belief that they had been sent to the principal's office: one in the confidence-boosted condition and one in the confidence-nonmanipulated condition.

It is not immediately clear why a floor effect was observed for the Principal Item. We did not suspect *a priori* that the two critical suggested events would function differently. Several *post hoc* explanations, however, will be offered in the discussion section that could potentially explain the differences between the two items.

Combined critical item analysis. To analyze the memory results for both critical items together, a filter was created that removed from the analysis subjects who started at or above the midpoint during T1 for both critical items (i.e., subjects were only included in the analysis if they started below the midpoint on at least one of the two critical items), leaving an N of 62 ($n_{\text{confidence-boosted}} = 18$; $n_{\text{confidence-lowered}} = 22$; $n_{\text{confidence-nonmanipulated}} = 22$). A variable was then created with a value of "1" for subjects who developed a false memory or false belief for at least one of the critical items, and a value of "0" otherwise. A chi-squared test revealed an effect that narrowly missed traditional significance levels, $X^2(2, N = 62) = 5.65$, $p = .06$, *Cramer's V* = .30, but as with the previous analyses, this one was underpowered (Power = .55).

As before, the *a priori* contrast of most interest was between the two experimental groups. As such, we subsequently compared the likelihood of developing a false memory or false belief when confining the analyses to only those in the two experimental groups. When comparing only those subjects in the confidence-boosted and confidence-lowered conditions, the chi-squared analysis revealed a significant difference of false memory or false belief development across experimental conditions, $X^2(1, N = 40) = 4.19$, $p = .04$, *Cramer's V* = .32. Subjects in the confidence-boosted condition were more likely to become "believers" in the suggested events than subjects in the confidence-lowered condition.

Mechanisms. Self-efficacy theory predicts that higher confidence in one's abilities is associated with the setting of higher goals and the mobilization of greater effort in the pursuit of those goals, which in turn are associated with performance outcomes.

During Session 2, subjects reported their goals (post-manipulation) for how many minutes they would aim to spend over the coming days trying to remember the suggested events that they had "forgotten." To see if reported goals differed across condition, a filter was applied that excluded outliers on the goal variable and confined the analyses to only those who started on the left-side of the scale for at least one of the two critical items on the baseline SEQ, leaving an N of 60 ($n_{\text{confidence-boosted}} = 18$; $n_{\text{confidence-lowered}} = 21$; $n_{\text{confidence-nonmanipulated}} = 21$). A oneway ANOVA was then conducted with goal as the DV and confidence condition as the IV; the ANOVA did not reveal any effect of condition on goal levels, $F(2, 57) = .14$, $p = .87$.

Subjects also rated how motivated they were to remember the forgotten memories, but self-reported motivation also did not differ across conditions, $F(2, 57) < 1$, $p = .89$. Condition did, however, influence the confidence that subjects had in their ability to incorporate sensory details into their imaginings about the "forgotten" events, $F(2, 57) = 3.81$, $p = .03$. Bonferonni adjusted post-hoc comparisons indicated that those in the confidence-boosted condition were more confident in their ability to incorporate sensory details into their imaginings ($M = 5.29$, $SD = 1.40$) than were subjects in the confidence-nonmanipulated condition ($M = 4.14$, $SD = 1.28$), $p = .03$. There were no observed differences in subjects' confidence in incorporating sensory details between those in the confidence-lowered condition ($M = 4.38$, $SD = 1.36$) and those in the confidence-boosted condition, $p = .13$, or those in the confidence-nonmanipulated condition, $p = 1.00$.

To further explore the relationship between MSE and subjects' confidence at incorporating sensory details into their imaginings of the "forgotten" events, Pearson correlations were assessed between MSE ratings and confidence at incorporating sensory details. Collapsing across condition, MSE ratings were significantly associated with subjects' confidence in their ability to incorporate sensory details into their imaginings, $r(58) = .28$, $p = .03$.

Lastly, for none of the experimental conditions were subjects any more or less confident in their ability to ultimately remember the "forgotten" memories than subjects in the two other conditions, $F(2, 57) = .20$, $p = .82$.

Detectors. Only two subjects indicated that anything seemed odd about the study (3%), one from the confidence-boosted condition and one from the confidence-nonmanipulated condition. When asked specifically if subjects believed the feedback may have been meant for somebody else, seven (10%) responded in the affirmative (4 from the confidence-lowered condition, 2 from the confidence-boosted condition; and 1 from the confidence-nonmanipulated condition). This proportion did not differ by condition, $X^2(N = 69) = 2.29$, $p = .32$. Three subjects (4%) specifically mentioned memory as the reason for why they were skeptical (1 from the confidence-boosted condition, and 2 from the confidence-lowered condition). This also did not statistically differ by condition, $X^2(2, N = 72) = 2.02$, $p = .37$.

Discussion

Experiment 3 tested the question of whether higher MSE would actually lead to *worse* memory performance in certain memory situations. Specifically, it examined the role of MSE in the context of receiving a suggestion that two events had occurred during one's

childhood, paired with instructions to imagine those events. As was predicted, we did find evidence that higher MSE increased the likelihood of false memories or false beliefs developing during a follow up session one week later; a higher proportion of subjects in the confidence-boosted condition developed false memories/beliefs than did those in the confidence-lowered condition.

While condition did not influence subjects' reported goals for how much time they would spend attempting to recover the forgotten memories, or subjects' confidence that they would ultimately recover the memories, it did influence subjects' confidence that they would be able to incorporate sensory details into their imaginings. Those in the confidence-boosted condition were the most confident that they would be able to do so. Also, when collapsing across conditions, the higher subjects' MSE ratings were, the more confident they were in their ability to incorporate sensory details. If subjects with higher MSE actual were more successful in generating more detailed imaginings than those with lower MSE, this could contribute to them being more likely to commit a source attribution error by confusing their imaginings with memories (Johnson, Hashtroudi, & Lindsay, 1993). However, the mean levels of confidence in incorporating details were similar for those who went on to develop a false memory or belief (M = 4.77, SD = 1.69) and those who did not (M = 4.49, SD = 1.33) and an independent samples t-test was not able to reject the null hypothesis that these two groups had similar levels of confidence in their ability to incorporate sensory details, $t(58) = .63$, $p = .53$. Thus, this mechanism does not seem to be able to account for the higher rate of false memory/belief development for those in the confidence-boosted condition.

Because of this and several additional considerations, we advise that these results should be interpreted cautiously for the time being. For one, the study was underpowered and possibly due to this the differences across conditions only reached traditional levels of significance when the analyses were confined to contrasting the confidence-boosted condition with the confidence-lowered condition, but the results dropped to marginal significance when all three conditions were analyzed together. Secondly, the mechanisms through which higher MSE was predicted to lead to false memory development according to self-efficacy theory (i.e., increased motivation and higher goals) did not differ across conditions.

Lastly, although we did not anticipate that the two critical events would operate differently from one another, the differences in false memory or false belief development across conditions was predominately driven by the Bullied Item, with relatively few people in any condition developing false memories or beliefs for the Principal Item. There are several possible explanations for why different rates of false memories or beliefs were observed for the two items. For one, being bullied is a passive occurrence that does imply any wrongdoing on the part of the person being bullied. On the other hand, being sent to the principal's office, implies that the person was engaged in some wrongdoing. If people are generally motivated to view themselves in a positive light, it might be harder to get them to believe or remember that they did something wrong enough to warrant a trip to the principal (but, for evidence that incriminating false memories do occur, see Russano, Meissner, Narchet, & Kassin, 2005; J. Shaw & Porter, 2015). Alternatively, the prevalence rate of being bullied might be higher than the prevalence rate of people sent to the principal's office. If so, subjects might view it as more implausible that they would have

been sent to the principal's office, which could have made it less likely that false beliefs or memories developed (Scoboria, Mazzoni, Jarry, & Shapero, 2012). Lastly, there might be different meta-memory assumptions for the two types of events. For instance, perhaps subjects believe it to be more likely that they would have "repressed" a memory of them having been bullied as opposed to having been sent to the principal's office, since being bullied fits the cultural script for the type of memory that might be distressing enough to repress. If so, subjects may have interpreted their initial lack of memory for the suggested Principal event as being more indicative that the event never occurred. These are all speculations, of course, and future work should test them empirically.

Overall, confidence in the current findings would be greatly bolstered by being replicated by future research. Additionally, future explorations might consider including additional measures that would allow for the testing of alternative mechanisms to explain the relationship we observed between higher MSE and a greater likelihood of false memories/beliefs developing, since most of those proposed by self-efficacy theory did not adequately do so. Lastly, future researchers would likely benefit from modifying the design of the current study so as to reduce the loss of statistical power that accompanies the need to filter out those subjects who truly experienced the suggested events (i.e., those subjects who started on the right-hand side of the scale for the critical items on the baseline SEQ). One recent study tackled this issue creatively by generating four potential critical items, and subsequently assigning one of them to each subject based upon that subject's initial responses (Howe, Anderson, & Dewhurst, 2017).

GENERAL DISCUSSION

Across three experiments, we experimentally manipulated subjects' MSE and then examined whether there would be downstream consequences on memory performance. We selected two tasks—the misinformation paradigm in Experiments 1 and 2, and a false feedback procedure paired with instructions to imagine in Experiment 3—that allowed us to test whether differences in MSE would be associated with differing levels of success in rejecting misleading suggestions. This is a component of memory accuracy that has been largely neglected in the literature on MSE so far. Theoretically, this work was motivated by self-efficacy theory, which has generally found positive associations between people's confidence in their capabilities and their performance on tasks that involve those abilities. It was also inspired by findings demonstrating that people's perceptions of their memory abilities/deficiencies can be situationally altered (Belli et al., 1998).

In Experiment 1, subjects were witnesses to a mock-crime. After witnessing the crime, their MSE was either experimentally raised, lowered, or non-manipulated, depending on the condition to which they were randomly assigned. While we were successful in altering subjects' perceptions of their memory abilities, there was no effect of confidence condition on subsequent memory performance for either control item questions or misinformation item questions. Since no condition effects were observed on accuracy, we next examined whether subjects' MSE reports correlated with memory outcomes. For the most part, MSE was not correlated with subsequent memory performance, although for those in the confidence-lowered condition only there was a trend-level association between higher MSE and being less likely to provide the misinformation response to cued-recall questions asking about misinformation items,

$r(81) = -.18$, $p = .10$. While this could indicate that higher MSE for those in the confidence-lowered condition was associated with being better able to resist the misinformation, the pattern was not replicated for the recognition memory task, and was not accompanied by greater accuracy for questions about misinformation items.

The reason that MSE was hypothesized to influence later memory performance is because it was theorized to influence other variables such as caring more about the memory tasks, being more motivated to perform well on them, paying closer attention, and having less performance anxiety. Even though condition influenced MSE reports, we did not find any accompanying effects of condition on any of these other variables. However, when collapsing across conditions, many of these variables did show correlations with MSE that were in the predicted directions. Since MSE did correlate with these variables, it is unclear why the assignment to condition would influence MSE but not these other variables. One possible explanation is that MSE might not actually be a causal influence on these variables (which would explain why our manipulation of MSE did not lead to mean differences in them across condition), but rather that both MSE and these variables are influenced by a shared, third variable.

The timing of the confidence manipulation in Experiment 1 was selected so that the results could apply to real-world contexts in which forensic investigators might unwittingly alter witnesses' MSE through their questioning. At the point at which an investigator is questioning a witness, the witness has necessarily already encoded the initial event, and so in Experiment 1 we decided to manipulate MSE after the initial event had been witnessed. However, one's MSE prior to event encoding is theoretically more likely to exert an influence on subsequent memory performance than one's MSE after event encoding.

Experiment 2 was designed to examine whether MSE prior to event encoding would influence later memory performance on a misinformation task.

In Experiment 2 we were again successful in manipulating MSE. Even when MSE was manipulated prior to event encoding, however, there were no effects of condition on subsequent memory outcomes. For the most part, MSE ratings were not correlated with memory outcomes, although for those in the confidence-lowered condition only, higher MSE ratings were marginally associated with providing more accurate answers to cued-recall test questions about misinformation items, $r(92) = .20$, $p = .05$. This relationship was not replicated on the recognition memory test, however, so the robustness of these findings has not yet been demonstrated.

In Experiment 2, as with Experiment 1, we did not find any effect of condition on ratings of task importance, willingness to expend effort, attention paid, or levels of task anxiety. MSE ratings were correlated, however, with many of these variables, and always in the direction predicted by self-efficacy theory. Again, this might indicate that MSE is related to these variables not because it exerts a causal influence, but rather because they are jointly under the influence of another variable (or set of variables).

Experiment 3 was designed to assess whether MSE would exert a causal influence on memory performance in a different context. Perhaps, for example, the short time frame of the misinformation task limited the ability for differences in MSE to present themselves in ways that would lead to performance differences. Experiment 3 examined the effects of MSE on memory performance in a different suggestive task that spanned the course of a week. In this context, we assessed whether differences in MSE would lead to differences in the likelihood that subjects would develop a false memory or false belief about a pair of

suggested autobiographical events. We predicted that if heightened MSE ratings were to be accompanied by a greater motivation to recall seemingly forgotten memories, then in this context higher MSE beliefs would lead to a heightened susceptibility to false memories or false beliefs developing. And, in fact, we observed that those who were in the confidence-boosted condition were more likely to develop false memories or false beliefs than those in the confidence-lowered condition. Those in the confidence-boosted condition did not report being any more motivated, however, than those in the confidence-lowered condition, nor did they report being any more confident in their ability to ultimately remember the "forgotten" events that were suggested. It does not seem likely, then, that the mechanism of increased motivation and effort can explain why those in the confidence-boosted condition were more susceptible to developing false memories or false beliefs. Those in the confidence-boosted condition reported being more confident in their ability to incorporate sensory details into their imaginings of the suggested events, but this variable was not significantly higher for those who ultimately went on to develop a false memory or false belief compared with those who did not.

Overall, we found consistent evidence that MSE was malleable via false feedback across three experiments. We did not, however, find evidence that MSE exerted a causal influence on variables such as motivation, attention, task-importance, and anxiety, and we also did not find evidence that MSE played a causal role in influencing subsequent memory performance on a misinformation task. In Experiment 3, on a false feedback task involving instructions to imagine, we did find that our MSE manipulation led to different rates of false memories or beliefs, but the mechanism by which this process occurred is not yet well understood.

Given the sum of evidence we have accumulated so far, we would continue to advise that risky practices such as guided imagery be avoided in psychotherapy sessions. With that being said, we found no evidence to suggest that those with less confidence in their memory abilities are more likely to develop false memories in such a context, and in fact having greater confidence in one's memory abilities in this context may actually make someone *more* susceptible to suggestion. Additionally, within an eyewitness context, we have found no reason to caution forensic interviewers against posing difficult memory questions to eyewitnesses—even if doing so might temporarily reduce witnesses' confidence in their MSE, we have found no evidence in these studies that this reduction would causally influence their subsequent memory performance.

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Appendix A

Personality Test (Big Five Inventory; BFI; Experiments 1, 2, & 3)

How I Am In General

Please indicate to what extent the following statements describe you.

I am someone who…

	1 Disagree strongly	2 Disagree a little	3 Neither agree nor disagree	4 Agree a little	5 Agree strongly
[1] Is talkative					
[2] Tends to find fault with others					
[3] Does a thorough job					
[4] Is depressed, blue					
[5] Is original, comes up with new ideas					
[6] Is reserved					
[7] Is helpful and unselfish with others					
[8] Can be somewhat careless					
[9] Is relaxed, handles stress well					
[10] Is curious about many different things					
[11] Is full of energy					
[12] Starts quarrels with others					
[13] Is a reliable worker					
[14] Can be tense					
[15] Is ingenious, a deep thinker					
[16] Generates a lot of enthusiasm					
[17] Has a forgiving nature					
[18] Tends to be disorganized					
[19] Worries a lot					
[20] Has an active imagination					
[21] Tends to be quiet					
[22] Is generally trusting					
[23] Tends to be lazy					
[24] Is emotionally stable, not easily upset					
[25] Is inventive					
[26] Has an assertive personality					
[27] Can be cold and aloof					
[28] Perseveres until the task is finished					
[29] Can be moody					
[30] Values artistic, aesthetic experiences					
[31] Is sometimes shy, inhibited					

[32] Is considerate and kind to almost everyone
[33] Does things efficiently
[34] Remains calm in tense situations
[35] Prefers work that is routine
[36] Is outgoing, sociable
[37] Is sometimes rude to others
[38] Makes plans and follows through with them
[39] Gets nervous easily
[40] Likes to reflect, play with ideas
[41] Has few artistic interests
[42] Likes to cooperate with others
[43] Is easily distracted
[44] Is sophisticated in art, music, or literature

Appendix B

Marlowe-Crowne Social Desirability Scale (MCSDS; Experiments 1, 2, & 3)

Please indicate whether the following statements apply to you. Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is true or false as it pertains to you personally.

	True	False
[1] Before voting I thoroughly investigate the qualifications of all the candidates		
[2] I never hesitate to go out of my way to help someone in trouble		
[3] It is sometimes hard for me to go on with my work if I am not encouraged		
[4] I have never intensely disliked anyone		
[5] On occasion I have had doubts about my ability to succeed in life		
[6] I sometimes feel resentful when I don't get my way		
[7] I am always careful about my manner of dress		
[8] My table manners at home are as good as when I eat out in a restaurant		
[9] If I could get into a movie without paying and be sure I was not seen I would probably do it		
[10] On a few occasions, I have given up doing something because I thought too little of my ability		
[11] I like to gossip at times		
[12] There have been times when I felt like rebelling against people in authority even though I knew they were right		
[13] No matter who I'm talking to, I'm always a good listener		
[14] I can remember "playing sick" to get out of something		
[15] There have been occasions when I took advantage of someone		
[16] I'm always willing to admit it when I make a mistake		
[17] I always try to practice what I preach		
[18] I don't find it particularly difficult to get along with loud mouthed, obnoxious people		
[19] I sometimes try to get even rather than forgive and forget		
[20] When I don't know something I don't at all mind admitting it		
[21] I am always courteous, even to people who are disagreeable		
[22] At times I have really insisted on having things my own way		
[23] There have been occasions when I felt like smashing things		
[24] I would never think of letting someone else be punished for my wrongdoings		
[25] I never resent being asked to return a favor		
[26] I have never been irked when people expressed ideas very different from my own		
[27] I never make a long trip without checking the safety of my car		
[28] There have been times when I was quite jealous of the good fortune of others		
[29] I have almost never felt the urge to tell someone off		
[30] I am sometimes irritated by people who ask favors of me		
[31] I have never felt that I was punished without cause		
[32] I sometimes think when people have a misfortune they only got what they deserved		
[33] I have never deliberately said something that hurt someone's feelings		

Appendix C

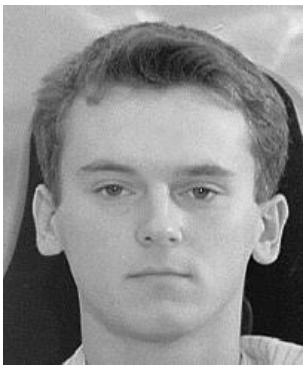
Eyewitness Memory Task (EMT; Experiments 1, 2, & 3)

[Subjects viewed a slideshow of 33 faces, presented one at a time]

Now we'd like to test your memory for the faces you've just seen. You will now be presented with pairs of faces, and for each pair we'd like you to indicate which face is the one from the slideshow you just viewed. If you are unsure about which face was in the slideshow, then give it your best guess. Please press >> to begin the eyewitness memory task.

Sample Test Item (out of 33):

Which face was in the slideshow you just viewed?



How confident are you that the face you selected was the one from the slideshow?

1	2	3	4	5
Not at all	A little	Somewhat	Very	Extremely

Appendix D

Autobiographical Memory Task (AMT; Experiments 1, 2, & 3)

You've just completed the eyewitness memory task. There are other types of memory that may be influenced by personality, however. For this next part we would like to tap into autobiographical memory. You will now be asked to recall several events from your past. Once you go on to the next page, you will be asked to recall 4 past events in which you acted in a particular way. For each event that you are asked about, please describe what was happening at the time using as many details as you can.

Please press the >> button to begin the memory task.

[page break]

Please think back for at least 2 minutes and try to recall an instance in which you acted in a **mischievous** way between the ages of 8-12 years old (which would roughly correspond to 3rd through 7th grade). For example, you might recall a time that you got into trouble for something you did, or a time when you did something you knew was wrong. For each instance, describe in as much detail as you can the situation and how it unfolded. Who were you with? Where were you? What time of day did it occur? What were you thinking and feeling at the time? Describe any sensory information (i.e., sights, sounds, smells, tastes, and touch) that you can remember about each event.

Please write about the event in the text box below. Once you've spent at least 2 minutes and included all that you can remember about it, press >> to move onto the next screen, where you will write about the second event.

Event 1

[page break]

How hard was it to remember the event you just wrote about?

Very easy	Somewhat Easy	Neither easy nor hard	Somewhat hard	Very hard	N/A I couldn't remember any event
○	○	○	○	○	○

Appendix E

Personality Feedback (Experiments 1, 2, & 3)

Your responses to the personality questionnaire have been run through a computer program. Here is how you compare with others who have taken the same survey:

[for scores that were greater than the mean]

You scored in the ____ percentile for extraversion, meaning that you are **more** extroverted than _____ percent of people. Being extroverted is characterized by things like being more outgoing, being less shy, and talking more. People who are more extroverted tend to have more friends and express more positive emotion.

You scored in the ____ percentile for openness to experience, meaning that you are **more** open to experience than _____ percent of people. Being open to experience is characterized by things like being creative, enjoying learning about new things, and looking for ways to break up one's routine. People who are more open to experience tend to finish more years of schooling and enjoy more success in artistic activities.

You scored in the ____ percentile for agreeableness, meaning that you are **more** agreeable than _____ percent of people. Being agreeable is characterized by things like being altruistic, trusting, and modest. People who are more agreeable tend to work better with others and have lower risks for heart disease.

You scored in the ____ percentile for neuroticism, meaning that you are **more** neurotic than _____ percent of people. Being neurotic is characterized by worrying more often, which can also lead to being more prepared for negative outcomes. Some neurotic people benefit by channeling their anxiety into productive behaviors.

You scored in the ____ percentile for conscientiousness, meaning that you are **more** conscientious than _____ percent of people. Being conscientious is characterized by things like planning, organizing, and thinking things through before doing them. People who are more conscientious tend to have higher GPAs in school and tend to live longer.

[for scores that are lower than the mean]

You scored in the ____ percentile for extraversion, meaning that you are **less** extroverted than _____ percent of people. Being less extroverted is characterized by things like being self-reflective, independent, and having a strong ability to concentrate. People who are less extroverted tend to be less likely to engage in risky behaviors.

You scored in the ____ percentile for openness to experience, meaning that you are **less** open to experience than _____ percent of people. Being less open to experience is characterized by things like taking a more straightforward view of things, and preferring

what is familiar to what is novel. People who are less open to experience tend to be more practical in their thinking styles.

You scored in the ____ percentile for agreeableness, meaning that you are **less** agreeable than _____ percent of people. Being less agreeable is characterized by things like being less likely to succumb to peer pressure and being more likely to state one's opinion even if it is not popular. People who are less agreeable also tend to be better able to push for creative ideas even in the face of criticism.

You scored in the ____ percentile for neuroticism, meaning that you are **less** neurotic than _____ percent of people. Being less neurotic is characterized by feeling less negative emotions like anxiety and sadness, and by being more emotionally even-keeled. People who are less neurotic tend to have better coping skills and better responses to illness.

You scored in the ____ percentile for conscientiousness, meaning that you are **less** conscientious than _____ percent of people. Being less conscientious is characterized by things like being less organized, more carefree, and more spontaneous. Some work suggests that people who are less conscientious are more creative.

Appendix F

Memory Feedback (Experiments 1, 2, & 3)

[This feedback was presented to those in the confidence-boosted and confidence-lowered conditions. The memory feedback served as the confidence manipulation]

Earlier you completed a couple of memory tasks. Your responses to those tasks have been run through a computer program. Here is how you compare with others who have completed the same tasks.

[for those in the confidence-boosted condition]

You scored in the 80th percentile for memory ability. This means that your eyewitness memory and autobiographical memory ability are **better than** 79% of people. Better eyewitness memory ability is related to being better able to witness an event and remember details from that event later on. Better autobiographical memory ability is related to remembering details from events in your own life.

[for those in the confidence-lowered condition]

You scored in the 20th percentile for memory ability. This means that your eyewitness memory and autobiographical memory ability are **worse than** 79% of people. Better eyewitness memory ability is related to being better able to witness an event and remember details from that event later on. Better autobiographical memory ability is related to remembering details from events in your own life.

Appendix G

MSE Ratings

[For those in the confidence-boosted and confidence-lowered conditions]

You were recently provided with information about how your eyewitness and autobiographical memory ability compared with others. Approximately what percentile did the computer say you were in for your memory ability?

What percentile did the computer determine you were in for your memory ability?

	Percentile
Memory Ability	

[page break]

Below you will see again how your memory ability compared with others

You scored in the 80th [20th] percentile for memory ability.

Now we'd like you to indicate how you believe your memory ability compares with others.

Please mark how **you believe** that you compare with others. If you think the computer feedback describes you perfectly, then indicate the same percentile score as you see above. If you think you are higher in memory ability than the feedback indicated, then write a higher number in the text box below to reflect that. If you think you are lower in memory ability than the feedback indicated, then write a lower number in the text box below.

How do you believe that your memory ability compares with your peers? Please indicate below what percentile you believe you are in for your memory ability.

	Percentile
Memory Ability	

[for those in the confidence-nonmanipulated condition]

Although you were not provided with feedback about how your memory ability compares with others, we're interested in knowing how you think your eyewitness and autobiographical memory ability compares to that of your peers.

How do you believe that your memory ability compares with your peers? Please indicate below what percentile you believe you are in for your memory ability.

	Percentile
Memory Ability	

Appendix H

Attention Check (Experiments 1, 2, & 3)

Please answer the following questions about your hobbies below. The following statements ask about some extracurricular activities. Several sports and other activities are listed. Please ignore the scale below; we are simply interested in whether or not you are paying attention. If you have read these instructions, please enter "I have read the instructions" in the box marked "Other (please specify)".

- ☐ Baseball
- ☐ Basketball
- ☐ Tennis
- ☐ Student Clubs
- ☐ Charity Events
- ☐ Cooking
- ☐ Performing Arts
- ☐ Board Games
- ☐ Reading
- ☐ Other (please specify)

Appendix I

Misinformation Task Slideshow Event (Experiments 1 & 2)





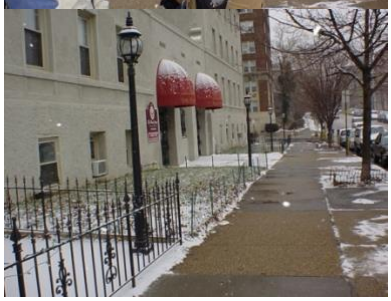






Gordon Florist



Appendix J

Misinformation Task PEI Materials (Experiments 1 & 2)

[Each sentence was displayed for 5500ms. There were two counterbalanced versions of the PEI narrative, that differed in their descriptions of the six critical items (three misinformation and three control). Italics are added here to indicate a misleading description.]

Now we will show you a description of the slideshow you saw earlier about the woman called Jane.

Please read each sentence carefully as it appears, you will have a few seconds on each sentence before the next one appears.

This description will last about 5 minutes.

Please stay focused on reading and following the story for the whole time.

[1.] Jane was walking down Main Street in Baltimore.
[2.] She was window shopping and continued walking.
[3.] Jane stopped to look at a video store after passing a hair salon.
[4.] She went inside.
[5.] Jane bought something inside, and left the video store.
[6.] On her way up the stairs from the store, she saw a friend.
[7.] Jane waved hello, and he smiled.
[8.] The two friends hugged.
[9.] They chatted for a little while.
[10.] Jane indicated that she had bought something from the video store.
[11.] *[CB1:] She showed her friend the new Simpsons DVD.*
[CB2:] She showed her friend the new DVD.
[12.] Her friend did not approve of her selection.
[13.] They continued to talk.
[14.] They then hugged goodbye.
[15.] They walked in opposite directions.
[16.] Jane continued down Main Street, passing by a woman on a cell phone.
[17.] A man was walking across the street towards Jane.
[18.] The man was headed directly towards the girl, who was oblivious to him.
[19.] The man bumped into Jane from behind.
[20.] This bump caused her bag to fall to the ground.
[21.] Her new DVD, sunglasses, mirror and other things fell out of the bag.
[22.] After he bumped into her, she felt sore and rubbed her arm.
[23.] The man apologized for running into her.
[24.] She was angry because all of her items were wet and on the ground.
[25.] Both of them stooped to the ground to pick up the items.
[26.] He placed her mirror back in the plastic bag, while she picked up her tape dispenser.

[27.] The girl stood up and turned around to make sure nothing else had fallen out.
[28.] [CB1:] While her back was turned, the man reached with his hand into her pocketbook.
[CB2:] While her back was turned, the man reached with his right hand into her pocketbook.
[29.] *[CB1:] He took her wallet and hid it in his pants pocket.*
[CB2:] He took her wallet and hid it in a pocket.
[30.] He helped her with her plastic bag that had a yellow smiley face on it.
[31.] They put the plastic bag back inside her other bag.
[32.] Jane shook his hand to thank him for helping her out.
[33.] The man headed back towards the street, first watching a man who was getting something out of his
car trunk.
[34.] The man crossed the street.
[35.] As Jane continued down the street, the woman talking on her cell phone was finishing her conversation.
[36.] [CB1:] Jane took out her cell phone.
[CB2:] Jane took out her blue cell phone.
[37.] Suddenly Jane realized that her wallet was missing.
[38.] She searched frantically in her bag for her wallet.
[39.] The woman who had been on the cell phone called out to Jane.
[40.] *[CB1:] The woman had a green backpack on.*
[CB2:] The woman had a backpack on.
[41.] The woman explained what she had seen the man do and pointed towards the direction the man headed.
[42.] Jane looked across the street to see if he was there.
[43.] Unfortunately, the man had already disappeared.
[44.] Jane turned back to the woman with a disappointed look.
[45.] Jane shrugged her shoulders, realizing that she would not be able to catch up to him now.
[46.] Jane thanked the woman for trying to help her.
[47.] The two headed in opposite directions.
[48.] Jane turned a corner and disappeared.
[49.] The other side of the street still looked empty.
[50.] [CB1:] The man, who had been watching them, came out from his hiding place.
[CB2:] The man, who had been watching them, came out from behind a tree.

Appendix K

Misinformation Task Cued-Recall Memory Test (Experiments 1 & 2)

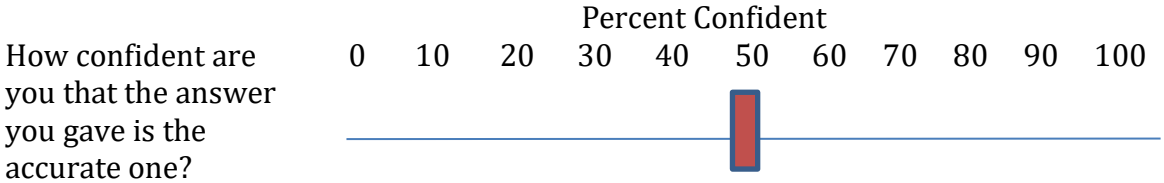
[The test contained 9 questions: 3 questions about control items; 3 questions about misinformation items; and 3 filler questions that were not analyzed. After each question, subjects indicated their confidence in their response. The confidence question is only displayed for question 1 here, in the interest of conserving space.]

For each of the following questions, select the answer based on what you remember seeing in the slideshow about Jane. If you're not sure about an answer, just give it your best guess, and don't worry about spelling things exactly correct.

[1.] What is the name of the video store that Jane entered?

[page break]

How confident are you that the answer you gave is the accurate one? If you didn't provide an answer, or if you know that your answer is wrong, please select "0." If you are completely positive, please select 100%. Otherwise please select a number in between 0 and 100.



[page break]

[2.] After Jane leaves the video store, how does she greet her friend?

[3.] Which DVD does Jane show her friend?

[4.] How does her friend react to her DVD selection?

[5.] Which hand did the man use to take Jane's wallet out of her bag?

[6.] After he takes her wallet out of her purse, where does he hide it?

[7.] What color is the cell phone Jane takes out of her purse?

[8] What color backpack did the other woman have on?

[9] What hiding place does the man come out from after the girl is gone?

Appendix L

Misinformation Task Recognition Memory Test (Experiments 1 & 2)

[After the cued-recall test, subjects were asked the same questions in a recognition test format. After each question, subjects indicated their confidence in their response. The confidence question is only displayed for question 1 here, in the interest of conserving space. Responses have been bolded here to indicate the correct answer. Italics have been added to indicate the misinformation response.]

For each of the following questions, select the answer based on what you remember seeing in the slideshow about Jane. If you're not sure about an answer, just give it your best guess.

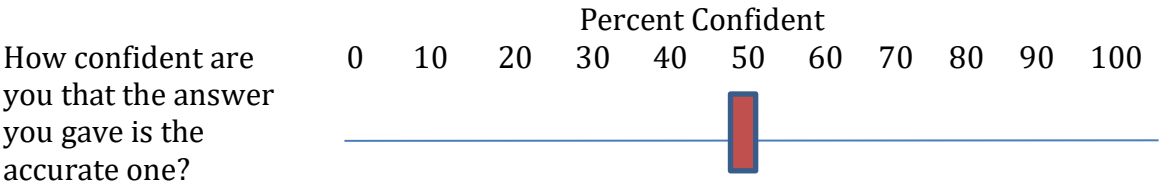
These questions are the same as the ones you've just answered, except that they are in multiple choice format this time.

[1.] What is the name of the video store that Jane entered?

- ○ Video Internationale
- ○ Video Starrz
- ○ **Video Americain**

[page break]

How confident are you that the answer you gave is the accurate one? If you didn't provide an answer, or if you know that your answer is wrong, please select "0." If you are completely positive, please select 100%. Otherwise please select a number in between 0 and 100.



[page break]

[2.] After Jane leaves the video store, how does she greet her friend?

- ○ **She hugs him**
- ○ They shake hands
- ○ They give each other a high five

[3.] Which DVD does Jane show her friend?

- The X-Files
- **South Park**
- *The Simpsons [CB1 received this as misinformation]*

[4.] How does her friend react to her DVD selection?

- He seems pleased
- **He seems displeased**
- He seems neutral

[5.] Which hand did the man use to take Jane's wallet out of her bag?

- **Left**
- *Right [CB2 received this as misinformation]*
- He did not use any hand to take her wallet from her bag

[6.] After he takes her wallet out of her purse, where does he hide it?

- *In his pants pocket [CB1 received this as misinformation]*
- In his backpack pocket
- **In his jacket pocket**

[7.] What color is the cell phone Jane takes out of her purse?

- *Blue [CB2 received this as misinformation]*
- **White**
- Red

[8] What color backpack did the other woman have on?

- **Red**
- *Green[CB1 received this as misinformation]*
- Blue

[9] What hiding place does the man come out from after the girl is gone?

- Inside a car
- *Behind a tree [CB2 received this as misinformation]*
- **Behind a doorway**

Appendix M

Self-Reported Importance, Willingness to Expend Effort, Attention, and Worry (Experiments 1 & 2)

[Task importance, willingness to expend effort, and levels of task anxiety were reported immediately prior to each of: the slideshow event; the PEI; the memory test. The three attention measures were collected immediately after each of those tasks].

[Prior to: the slideshow event; the PEI; the memory test]

How important is it to you that you do well on the upcoming task?

Not at all						Extremely
1	2	3	4	5	6	7
○	○	○	○	○	○	○

How much effort would you be willing to put into the task in order to do well?

Very little						As much as it takes
1	2	3	4	5	6	7
○	○	○	○	○	○	○

How worried are you feeling about performing well on the upcoming task?

Not at all						Extremely
1	2	3	4	5	6	7
○	○	○	○	○	○	○

[Immediately following: the slideshow event; the PEI; the memory test]

How much attention did you pay [during the slideshow / while reading the other witness's account / while answering questions about what you saw in the slideshow]?

None at all						Very much
1	2	3	4	5	6	7
○	○	○	○	○	○	○

How many times did you look away from the screen [during the slideshow / while reading the other witness's account / while answering questions about what you saw in the slideshow]?

0	1	2	3	4	5	6+
○	○	○	○	○	○	○

While [viewing the slideshow / reading the other witness's account / answering questions about what you saw in the slideshow], how distracted were you by things not related to [what you saw in the slideshow / the other witness's account / what you saw in the slideshow]

Not at all						Extremely
1	2	3	4	5	6	7
○	○	○	○	○	○	○

Appendix N

Funneled Debriefing (Experiments 1 & 2)

[after answering several questions about whether subjects experienced any technical difficulties, they were asked the following]

Did anything strike you as odd about the study?

- ○ Yes
- ○ No

→[if subjects answered yes to the previous question] What did you find odd about the study?

While we were in the initial stages of testing out this study, there were a few times that the computer program that analyzed the personality responses and memory ability had a glitch where it presented a different person's feedback by mistake. We believe we have fixed the issue, but we'd like to be sure about it.

Do you believe that this happened to you?

- ○ Yes
- ○ No

→[if subjects answered yes to the previous question] Why do you believe the computer feedback was someone else's and not your own?

Appendix O

School Experiences Questionnaire (SEQ; Experiment 3)

Below is a list of events that may or may not have happened to you in school. Please read each event and rate on a 7-point scale how certain you are that the event did or did not happen to you by selecting one of the numbers to the right of the item. Select the '1' only if you are <u>completely confident</u> that the event **did not** happen to you. Select the '7' if you are <u>completely confident</u> that the event **did** happen to you. And, if you are not completely confident, choose one of the middle numbers.

	Definitely did not happen 1	2	3	4	5	6	Definitely did happen 7
1. I got caught smoking cigarettes on school property							
2. I sat next to my best friend in 4th grade							
3. I cheated on a test in high school							
4. I attended sex education classes during 7th or 8th grade							
5. I participated in a food fight in a school cafeteria							
6. I won a spelling bee in elementary school							
7. I went to the school nurse and had my temperature checked							
8. I got an 'A' in math class in 9th grade							
9. I was forced to repeat a grade							
10. I was badly bullied during 4th and/or 5th grade							
11. I took driver's education during high school							
12. I made a goal during a soccer game in a PE class							
13. I spent time finger painting during kindergarten							
14. I ate a 'hot lunch' in high school							
15. I was sent to the principal's office in 5th and/or 6th grade							
16. I was suspended from school							
17. I kissed a member of the opposite sex on a school playground							
18. I was put in detention more than once during high school							
19. I befriended a school librarian							
20. I made the honor roll							
21. I was the best long-jumper in my class at a track and field day in elementary school							
22. I won a coveted prize at a school carnival							

Appendix P

Baseline MSE Ratings (Experiment 3)

You've just received feedback about how aspects of your personality compare with those of your peers. Next, we'd like you to indicate how you believe your **memory ability** compares to your peers.

Eyewitness memory ability involves being able to witness an event and then recall details about what you saw at some later date.

Compared to your peers, what percentile do you think you rank in, in terms of your eyewitness memory ability? In other words, you have better eyewitness memory ability than ____% of your peers?

Autobiographical memory ability involves being able to remember accurate and detailed memories from personally experienced events from your past.

Compared to your peers, what percentile do you think you rank in terms of your autobiographical memory ability? In other words, you have better autobiographical memory ability than ____% of your peers?

Appendix Q

Suggested Events via False Feedback (Experiment 3)

During Session 1 that you completed online recently, you filled out personality questions and were given feedback about how your personality compares with that of your peers. After you submitted your responses online, we entered your responses to the personality and childhood events questionnaires into our computer and generated a personality profile for you. Our computer has processed thousands of responses like yours. It uses a standard program to look for specific personality types and indicators of some 87 important childhood incidents that are correlated with these personality types. It then matches the types and incidents with long-term consequences based on the research literature. From the data ***you*** provided, the computer generated the following profile

- You are a motivated individual, and this disposition has helped you to do well in your academic pursuits and progress at a solid pace.
- Your personality contributed to you being bullied by other children between the ages of 7 and 11.
- You were sent to the principal's office in 5th and/or 6th grade

Appendix R

Suggested Events Follow Up Questions (Experiment 3)

Do you remember **being bullied by other children between the ages of 7 and 11?**

- ○ Yes
- ○ No

→[if subjects answered yes to the previous question] Please close your eyes and spend a couple of minutes trying to remember what you can about **being bullied by other children between the ages of 7 and 11.** Once you've done that please write down as much as you can remember in the text box below.

→[if subjects answered no to the previous question] People commonly forget events, especially from the distant past. That said, there are techniques that are known to help people remember things they have temporarily forgotten.

One technique involves using imagination. When we can't remember something, often the memory will come back to us over time when we try to imagine how the event *may have happened*. You may be thinking that it sounds a little weird, but it works for many people.

Given this, close your eyes and imagine how the event of you **being bullied by other children between the ages of 7 and 11** could have happened. For instance, kids often make fun of other people's appearance, behaviors, and family life. Imagine one of the kids in your school intentionally said something to embarrass you in front of a group of people. Think about people you knew back then who may have been around you. Imagine what the bully might have said about you and how the others and you would have reacted. How would the bully's remarks have made you feel?

Please close your eyes and spend at least two minutes imagining this event. After a scene has come to mind, please write down an account of what you imagined, as if you were describing a memory for the event.

Do you remember **being sent to the principal's office in 5th and/or 6th grade?**

- ○ Yes
- ○ No

→[if subjects answered yes to the previous question] Please close your eyes and spend a couple of minutes trying to remember what you can about **being sent to the principal's office in 5th and/or 6th grade.** Once you've done that please write down as much as you can remember in the text box below.

→[if subjects answered no to the previous question, but answered yes that they remembered having been bullied] People commonly forget events, especially from the distant past. That said, there are techniques that are known to help people remember things they have temporarily forgotten.

One technique involves using imagination. When we can't remember something, often the memory will come back to us over time when we try to imagine how the event *may have happened*. You may be thinking that it sounds a little weird, but it works for many people.

Given this, close your eyes and imagine how the event of you **being sent to the principal's office in 5th and/or 6th grade** could have happened. For instance, kids sometimes hear profanities and repeat what they hear without fully understanding it. Imagine you heard a bad word or phrase from some other kids, and then repeated it in one of your classes. To make it more realistic, think about people you knew back then who may have been around you. Think about what you might have said and how others around you would have reacted. How would it have made you feel?

Please close your eyes and spend at least two minutes imagining this event. After a scene has come to mind, please write down an account of what you imagined, as if you were describing a memory for the event.

→[if subjects answered no to the previous question, and also had answered that they had no memory of having been bullied] You've just read that it is quite common for people to forget events, especially from the distant past, and that imagining how the event *may have happened* is a technique that is known to help people remember things they have temporarily forgotten.

Please again use this technique to try and remember. Close your eyes and imagine how the event of you **being sent to the principal's office in 5th and/or 6th grade**

could have happened. For instance, kids sometimes hear profanities and repeat what they hear without fully understanding it. Imagine you heard a bad word or phrase from some other kids, and then repeated it in one of your classes. To make it more realistic, think about people you knew back then who may have been around you. Think about what you might have said and how others around you would have reacted. How would it have made you feel?

Please close your eyes and spend at least two minutes imagining this event. After a scene has come to mind, please write down an account of what you imagined, as if you were describing a memory for the event.

Appendix S

Goals, Motivation, and Efficacy Ratings (Experiment 3)

Thank you for reporting on your memories and/or imaginings regarding the events from your personalized report.

For the last part of today's session, we ask that you set some goals for the next few days. Specifically, we ask that you spend some time over the next few days thinking more about the events that the computer analysis determined you experienced in your past. For the event(s) that you already remember, please try and set aside some time to think more about them and see if any additional details come back to you. For the event(s) that you don't yet remember, we ask that you set aside some time over the next few days to continue imagining how the event(s) may have occurred.

[page break]

I will aim to spend at least _____ minutes during each of the next 3 days trying to imagine how the event(s) I don't yet remember occurred (e.g., 5 min/day; 10 min/day)

[page break]

How able do you think you will be, over the next few days, at setting aside the amount of time you indicated above as your goal?

Not at all			Somewhat			Extremely
1	2	3	4	5	6	7
○	○	○	○	○	○	○

[page break]

I will aim to spend at least _____ minutes during each of the next 3 days trying to remember more details about the event(s) I already remember (e.g., 5 min/day; 10 min/day)

[page break]

How able do you think you will be, over the next few days, at setting aside the amount of time you indicated above as your goal?

Not at all			Somewhat			Extremely
1	2	3	4	5	6	7
○	○	○	○	○	○	○

[page break]

How motivated are you to remember the event(s) you don't yet remember?

N/A I remember all of the events	Not at all 1	2	3	Somewhat 4	5	6	Extremely 7
○	○	○	○	○	○	○	○

[page break]

How motivated are you to remember more about the event(s) you already remember?

N/A I don't remember any of the events	Not at all 1	2	3	Somewhat 4	5	6	Extremely 7
○	○	○	○	○	○	○	○

[page break]

How able do you think you will be, over the next few days, at incorporating sensory details (i.e., details about the look, sounds, feel, etc.) into your imaginings about the event(s) that you don't yet remember?

N/A I remember all of the events	Not at all 1	2	3	Somewhat 4	5	6	Extremely 7
○	○	○	○	○	○	○	○

[page break]

How able do you think you will be, over the next few days, at incorporating more sensory details (i.e., details about the look, sounds, feel, etc.) into your memory about the event(s) you already remember?

N/A I don't remember any of the events	Not at all 1	2	3	Somewhat 4	5	6	Extremely 7
○	○	○	○	○	○	○	○

[page break]

How able do you think you will be, over the next few days, at ultimately remembering the event(s) you don't yet remember?

N/A I remember all of the events	Not at all 1	2	3	Somewhat 4	5	6	Extremely 7
○	○	○	○	○	○	○	○

Appendix T

Memory/Belief Form (MBF; Experiment 3)

We'd like to get a few more details about your past experiences. For each of the following items:

- If you have a specific memory pertaining to the item, write '**M**' in the box, and then give as many details as possible about the memory
- If you believe that the event happened to you, but do not have a specific memory, write '**B**' in the box and then explain why you think the event happened to you.
- If you are positive that the event did not happen to you, write '**P**' in the box, and then explain how you are so sure that the event didn't happen.

1. I made a goal during a soccer game in a PE class

2. I was badly bullied during 4th or 5th grade

3. I felt an earthquake during high school

4. I was sent to the principal's office in 5th or 6th grade

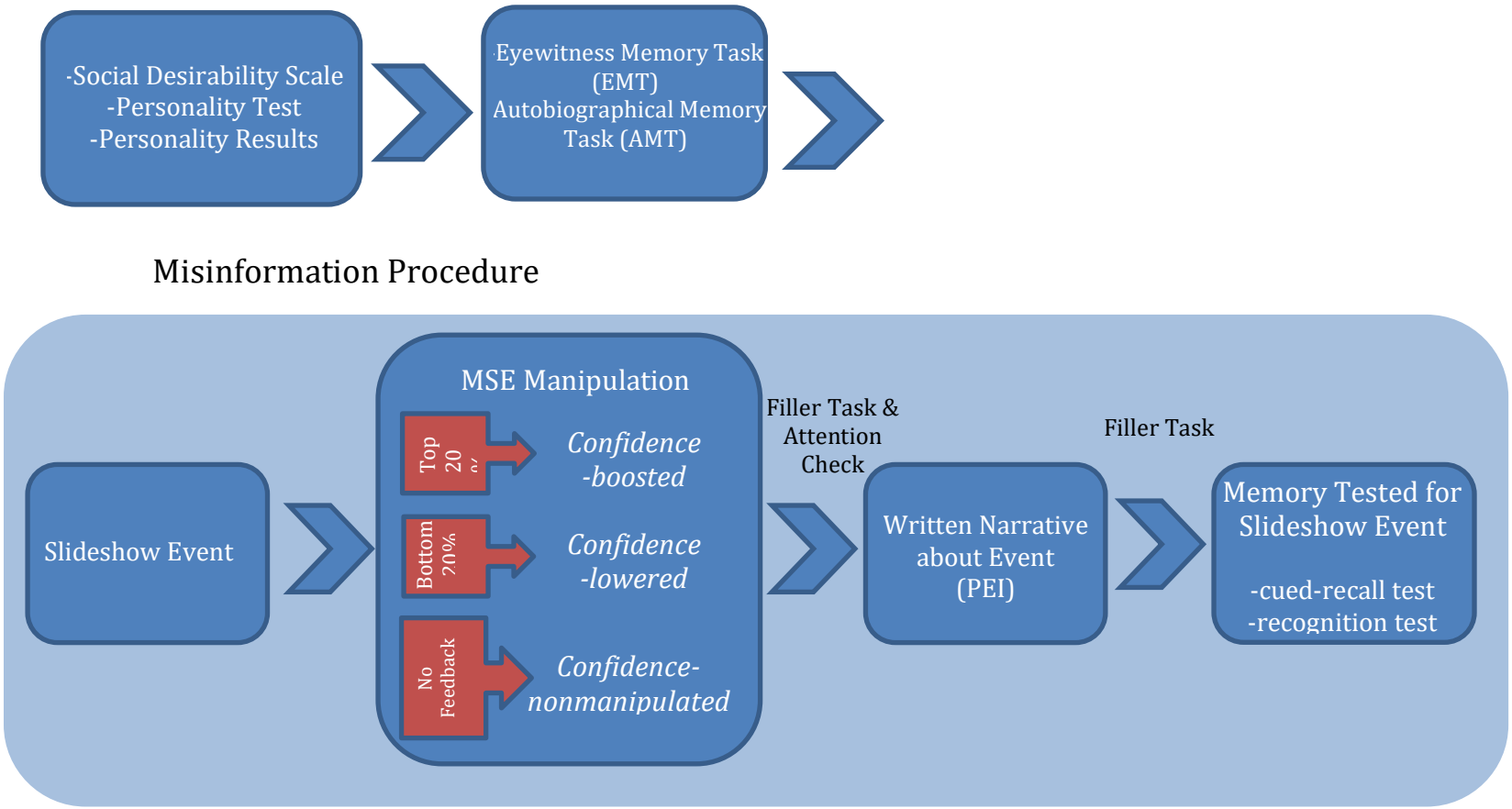


Figure 1.1. Procedural flowchart for Experiment 1.

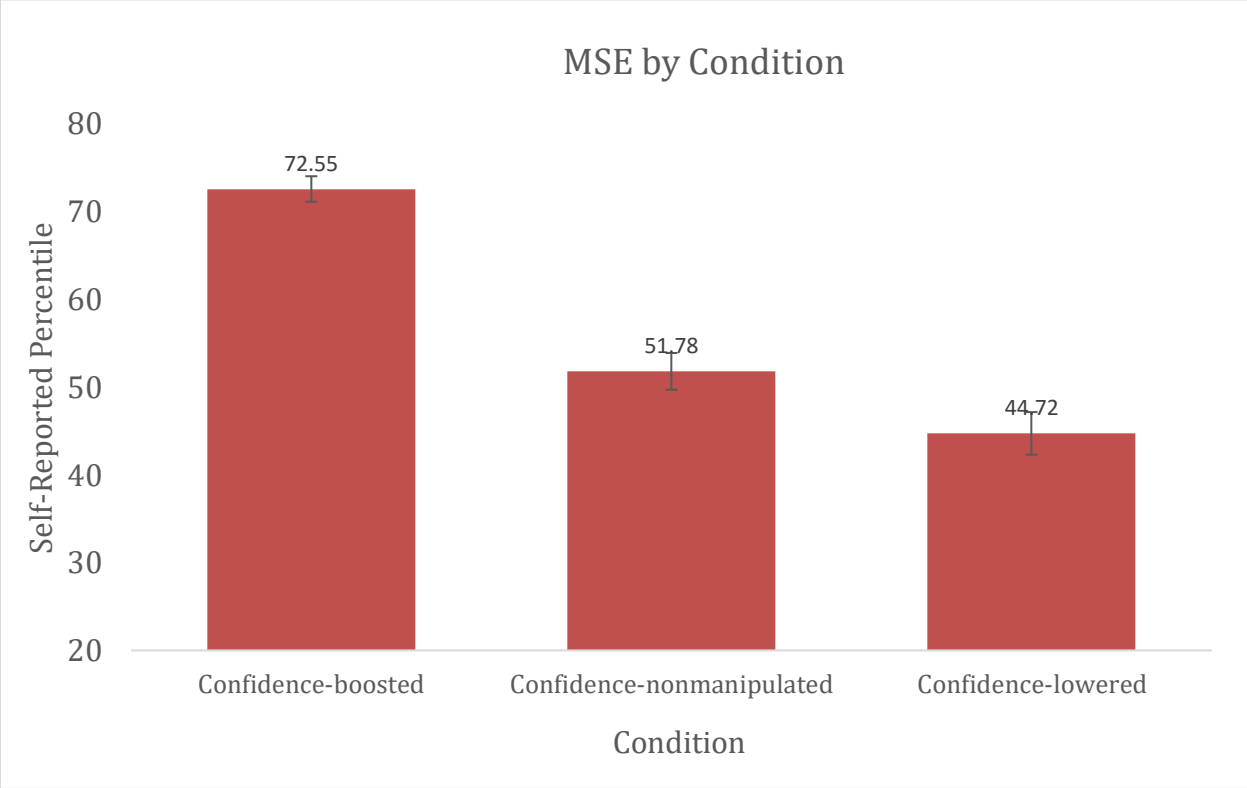


Figure 1.2. Experiment 1 Memory Self-Efficacy (MSE) Separated by Condition

Note: Error bars represent the Standard Error of the Mean. There was a significant effect of confidence condition on self-reported MSE, p *< .001. Those in the confidence-boosted condition reported significantly higher MSE than those in either of the other two conditions,* p*s < .001. Additionally, those in the confidence-lowered condition reported marginally lower MSE than those in the confidence-nonmanipulated condition,* p *= .07.*

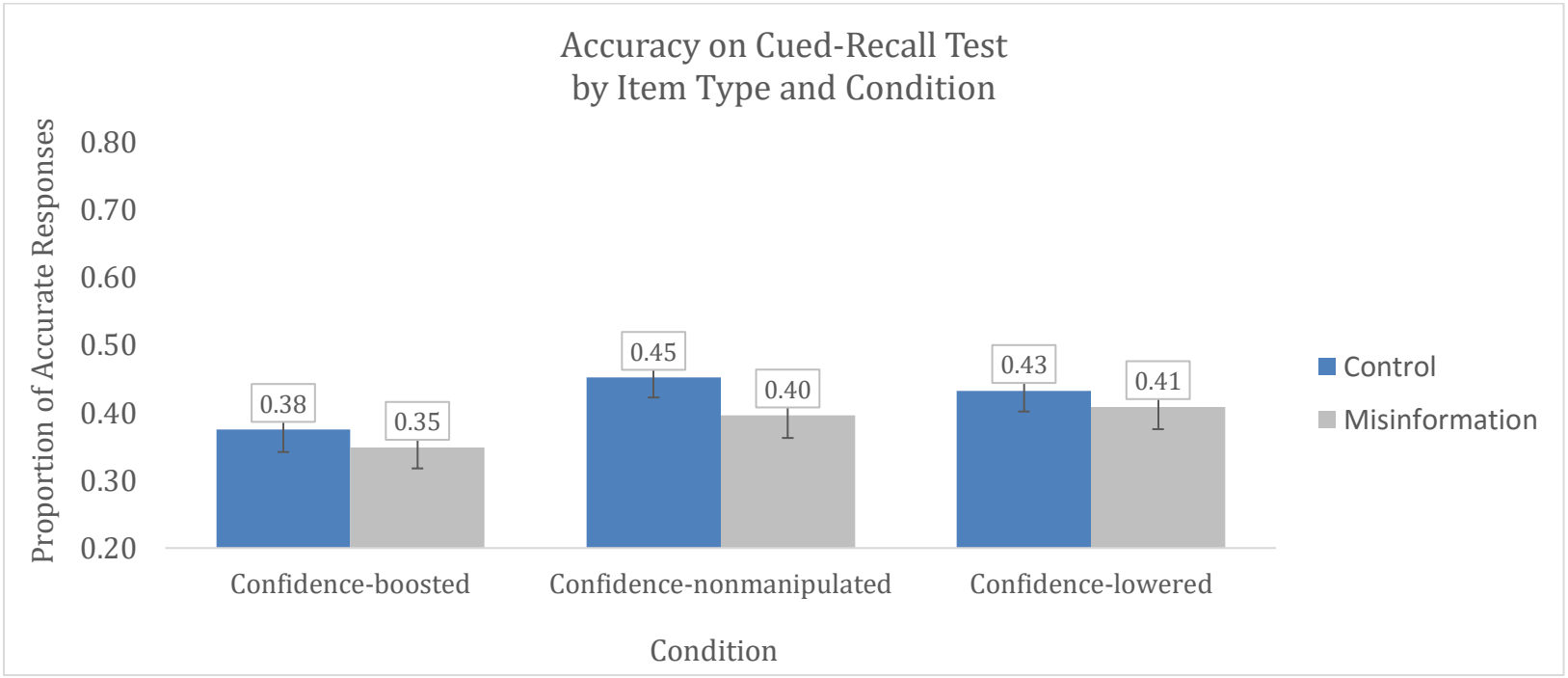


Figure 1.3. Experiment 1 Accuracy on Cued-Recall Test by Item Type and Condition

Note: Error bars represent the Standard Error of the Mean. With accuracy as the DV, the misinformation effect did not reach traditional levels of significance, but there was a marginal effect. On average, subjects gave marginally more accurate responses to questions regarding control items than questions regarding misinformation items, p *= .10. There was no main effect of condition, nor was there an interaction.*

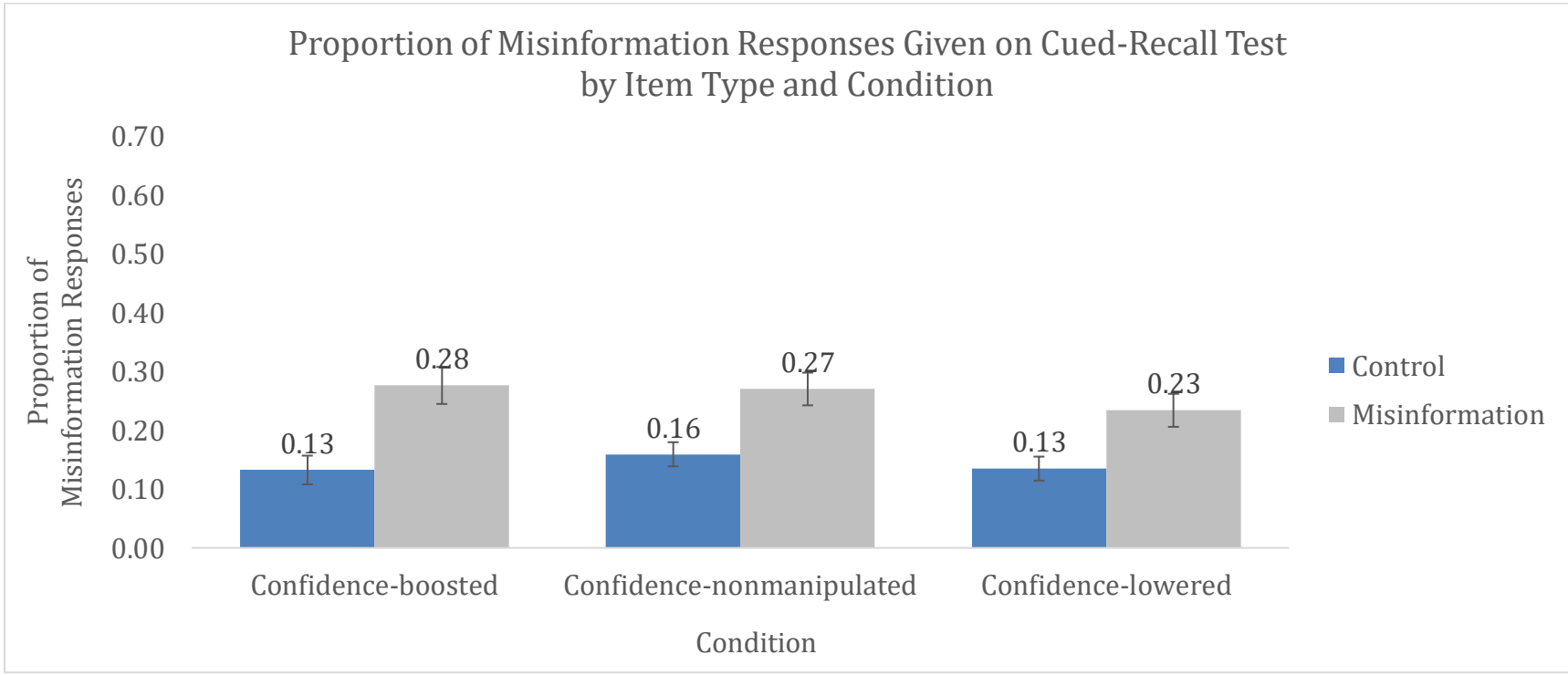


Figure 1.4. Experiment 1 Misinformation-Consistent Responses Given on Cued-Recall Test by Item Type and Condition

Note: Error bars represent the Standard Error of the Mean. With misinformation responses as the DV, a misinformation effect was observed. On average, subjects provided misinformation responses more often to questions regarding misinformation items than questions regarding control items, $p < .001$. *There was no main effect of condition, nor was there an interaction.*

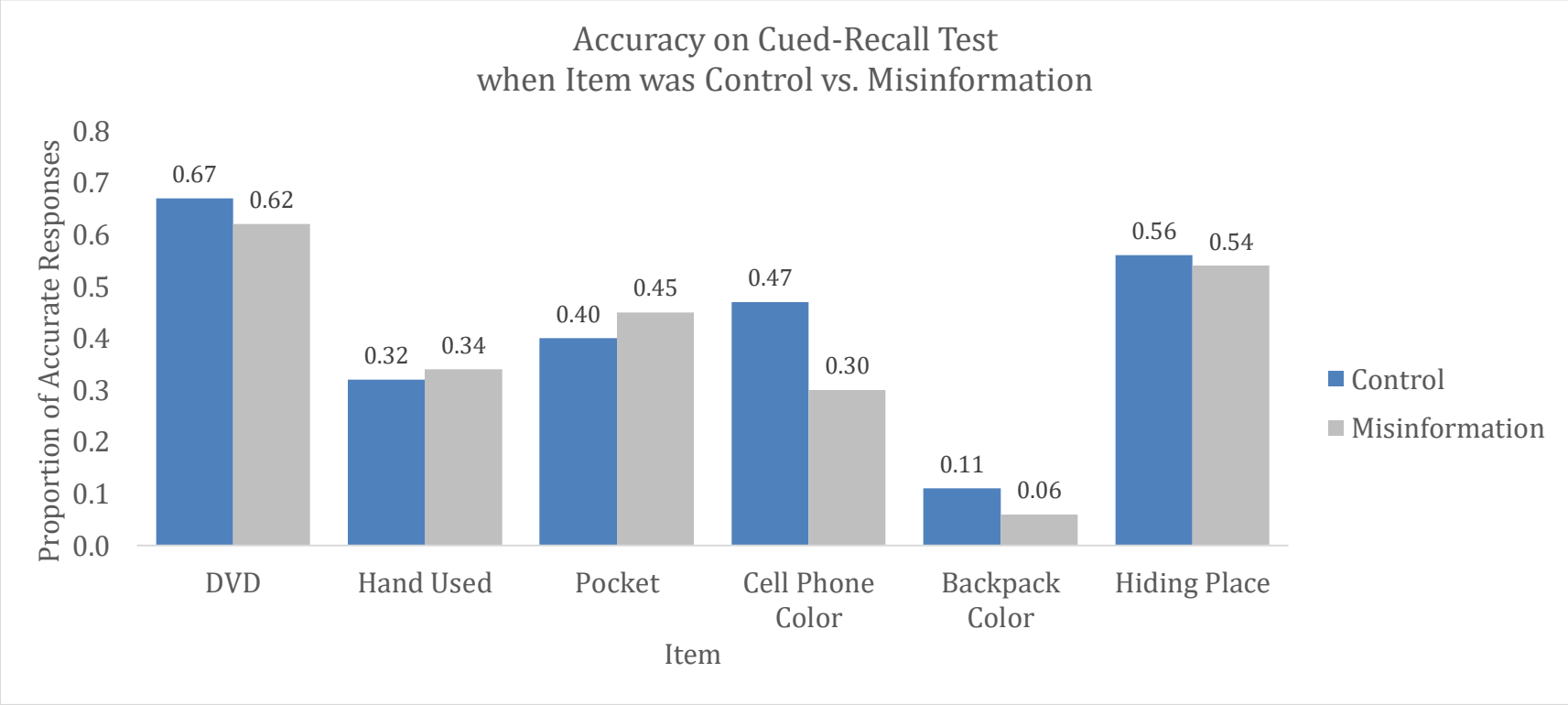


Figure 1.5. Experiment 1 Item Analysis for Accuracy on the Cued-Recall Memory Test.

Note: There was no main effect of condition on accuracy (nor was there an interaction), so the item-level analysis was conducted after collapsing across confidence conditions.

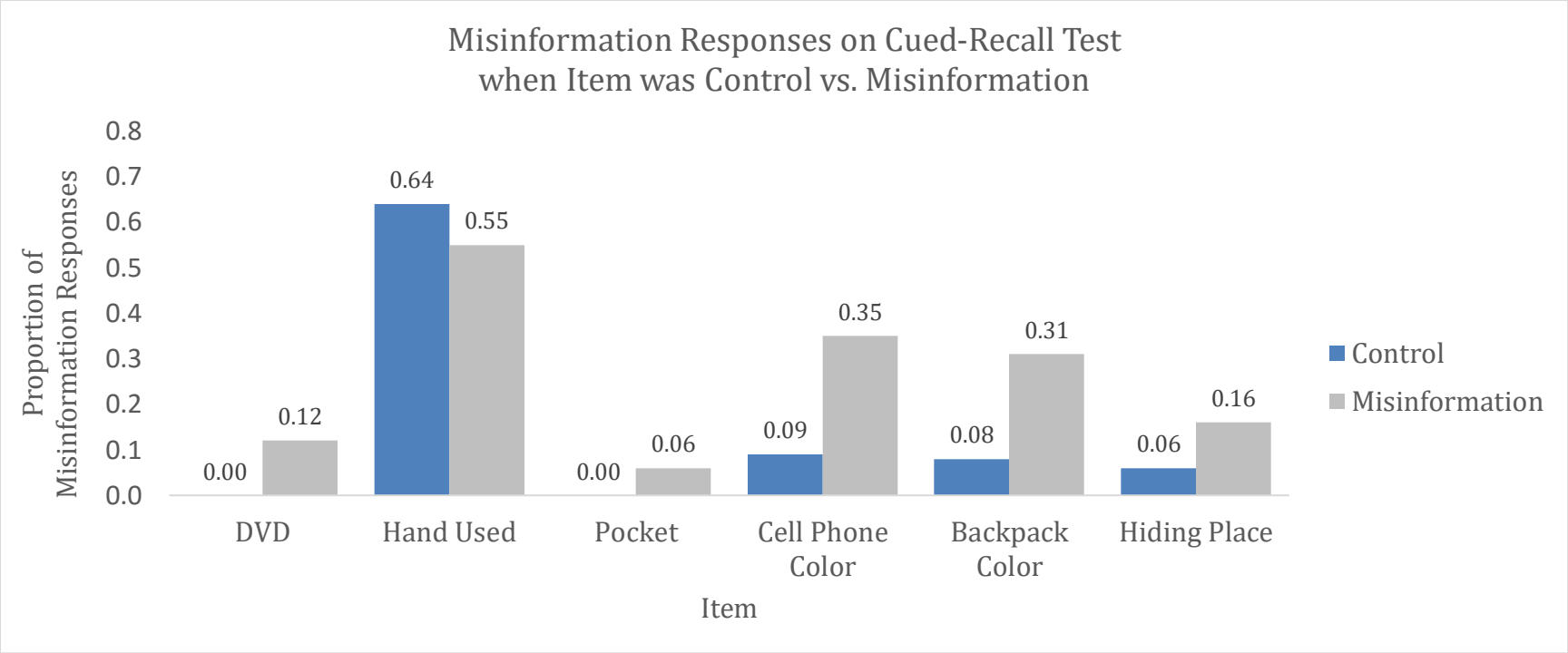


Figure 1.6. Experiment 1 Item Analysis for Misinformation Responses on Cued-Recall Memory Test.

Note: There was no main effect of condition on misinformation responses (nor was there an interaction), so the above item-level analysis was conducted after collapsing across confidence conditions.

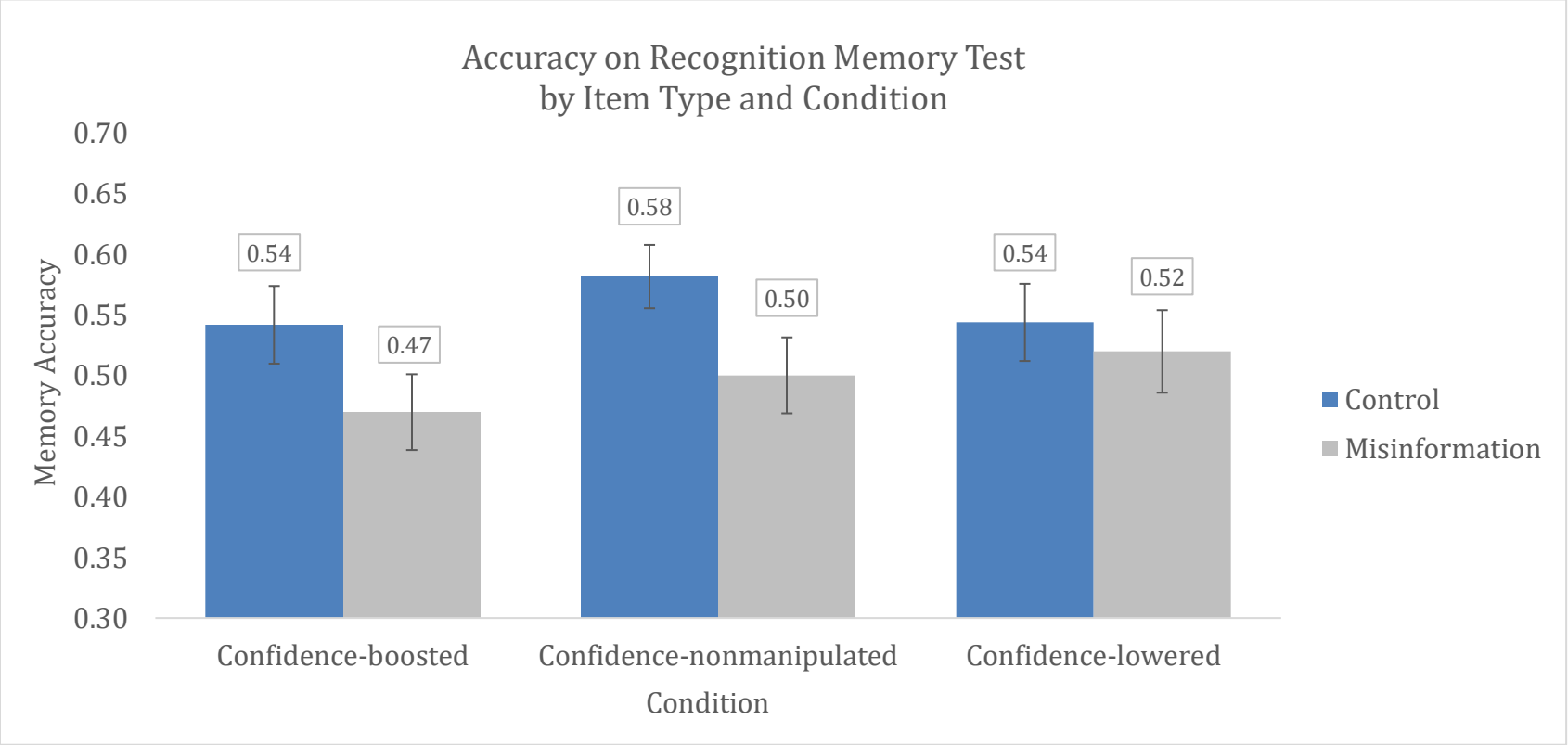


Figure 1.7. Experiment 1 Accuracy on Recognition Memory Test by Item Type and Condition

Note: Error bars represent the Standard Error of the Mean. Overall, subjects were more accurate on questions regarding control items than questions regarding misinformation items, p = .01. There was no main effect of confidence condition on memory accuracy, nor was there an interaction between condition and item type.

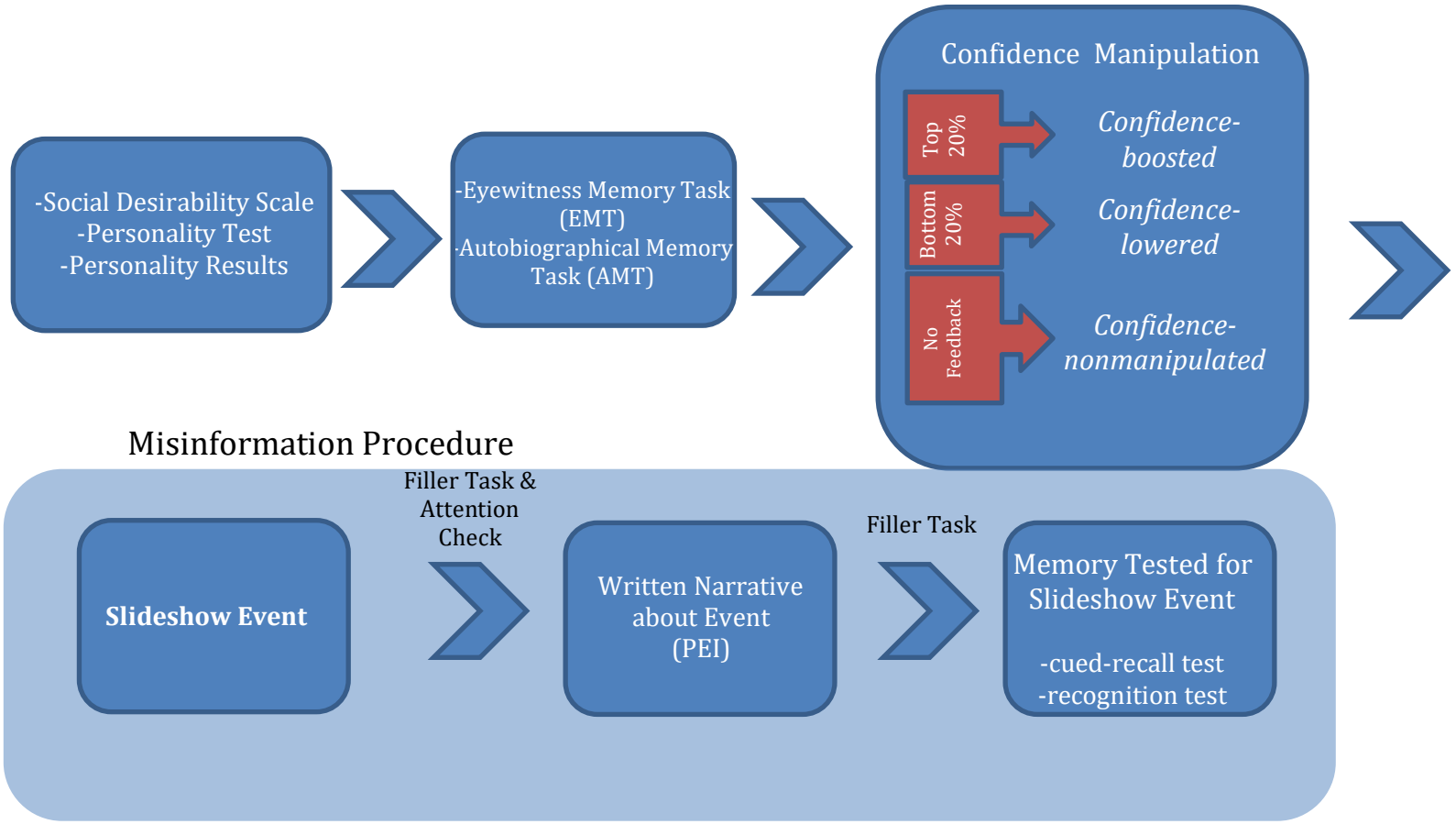


Figure 2.1. Procedural flowchart for Experiment 2.

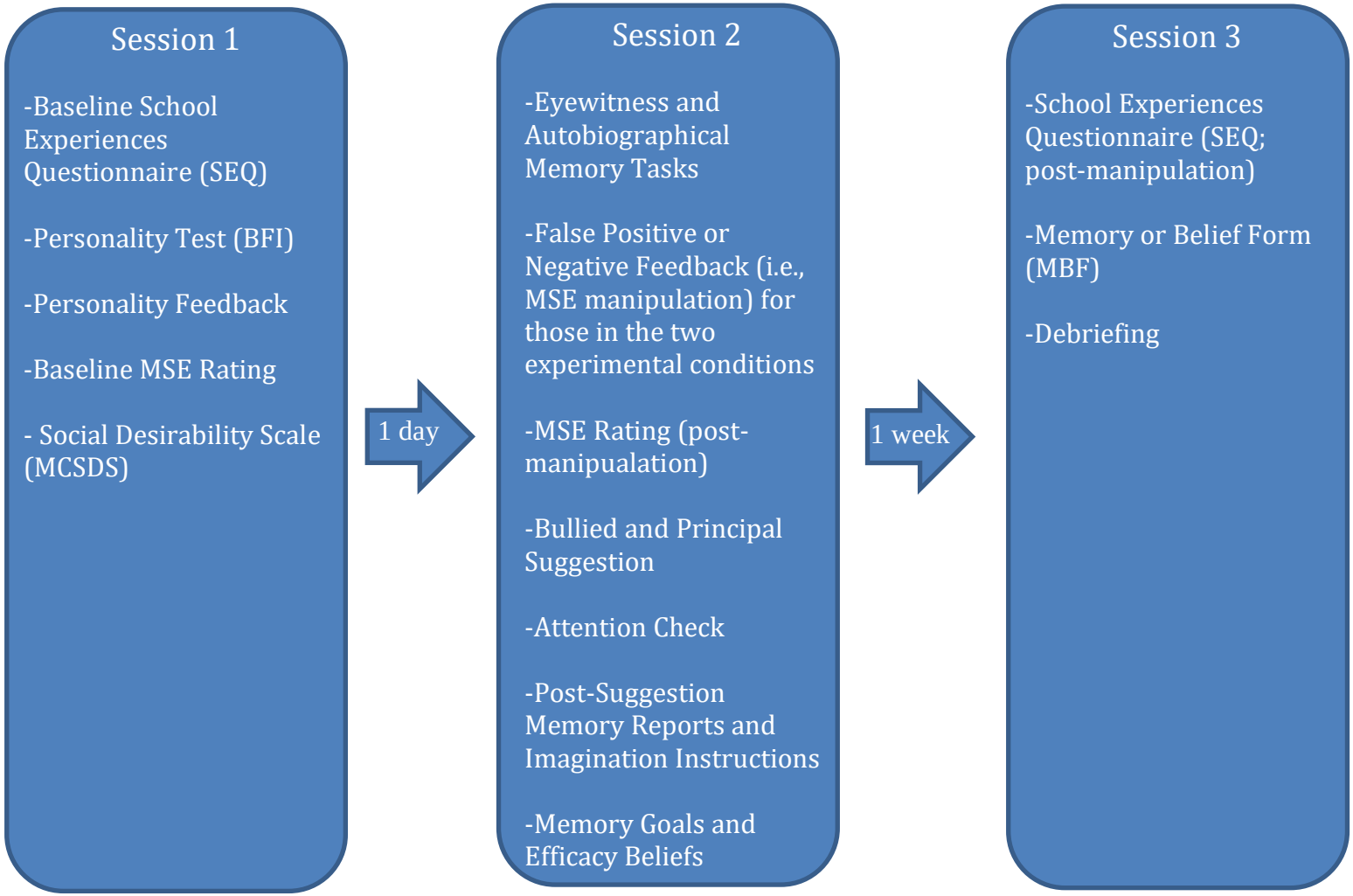


Figure 3.1. Procedural flowchart for Experiment 3

Table 1.1. Critical Items: Correct Details and Descriptions when Encountered as a Control Item or Misinformation Item.

Critical Items	Correct Detail Shown in Slideshow	Narrative Description when Control Item	Narrative Description when Misinformation Item
Which DVD does Jane show her friend?	South Park	She showed her friend the new DVD	She showed her friend the new **Simpsons** DVD
Which hand did the man use to take Jane's wallet?	Left	The man reached with his hand into her pocketbook	The man reached with his **right hand** into her pocketbook
After he takes her wallet out of her purse, where does he hide it?	Jacket pocket	He took her wallet and hid it in a pocket	He took her wallet and hid it in his **pants pocket**
What color is the cell phone Jane takes out of her purse?	White	Jane took out her cell phone	Jane took out her **blue** cell phone
What color backpack did the other woman have on?	Red	The woman had a backpack on	The woman had a **green** backpack on
What hiding place does the man come out of after the girl is gone?	Behind a doorway	The man, who had been watching them, came out from his hiding place	The man, who had been watching them, came out from **behind a tree**

Note: All subjects viewed the same slideshow. Each subject was then presented with a PEI narrative containing three control descriptions and three misinformation descriptions. Narratives were counterbalanced such that control items for those in CB1 were misinformation items for those in CB2, and vice versa.

Table 1.2. Experiment 1 Self-reported Memory Self-Efficacy (MSE) across Confidence Condition.

Condition	MSE
Confidence-boosted	72.55 (13.63)
Confidence-nonmanipulated	51.78 (19.86)
Confidence-lowered	44.72 (22.08)

Note: Higher MSE values reflect that subjects believe they have better memory abilities relative to their peers (e.g., an MSE of 75 reflects a subject's belief that she has better memory abilities than 74% of her peers). Standard Deviations are reported in parentheses.

Table 1.3. Experiment 1 Proportion of Accurate and Misinformation Responses on the Recognition Memory Test by Item Type and Condition

	Proportion of Accurate Responses		Proportion of Misinformation Responses	
	Control	Misinformation	Control	Misinformation
Confidence-boosted	.54 (.30)	.47 (.29)	.27 (.26)	.42 (.31)
Confidence-nonmanipulated	.58 (.25)	.50 (.30)	.31 (.27)	.40 (.31)
Confidence-lowered	.54 (.29)	.52 (.31)	.35 (.29)	.39 (.30)
All Conditions	.56 (.28)	.50 (.30)	.31 (.27)	.41 (.30)

Note: Standard deviations are displayed parenthetically. On average, subjects gave the accurate response to 56% of questions regarding control items and to 50% of questions regarding misinformation items. This reflected a statistically significant difference in accuracy based on item type, $p < .001$. *On average, subjects gave the misinformation-consistent response to 31% of questions regarding control items, and to 41% of questions regarding misinformation items. This reflected a statistically significant difference in misinformation responses based on item type,* $p < .001$. *There was no main effect of condition (nor an interaction) on either accurate responses or misinformation responses.*

Table 1.4. Experiment 1 Correlations between MSE and Cued-Recall Memory Performance, by Item Type and Condition.

	Accurate Responses		Misinformation Responses	
	Control Items	Misinformation Items	Control Items	Misinformation Items
Confidence-boosted	.15	-.01	.09	-.05
Confidence-nonmanipulated	-.06	.15	.11	.03
Confidence-lowered	.13	.06	.00	**-.22***
All Conditions	.00	.02	.04	-.04

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. For those in the confidence-lowered condition, there was a significant inverse relationship between MSE ratings and the number of misinformation responses given to cued-recall questions regarding misinformation items, p = .045. No other association between MSE and memory performance was found on the cued-recall test.*

Table 1.5. Experiment 1 Correlations between MSE and Recognition Memory Performance, by Item Type and Condition.

	Accurate Responses		Misinformation Responses	
	Control Items	Misinformation Items	Control Items	Misinformation Items
Confidence-boosted	.15	-.02	-.04	-.03
Confidence-nonmanipulated	.00	.08	.04	.01
Confidence-lowered	**.18**†	**.21**†	-.13	-.17
All Conditions	.08	.06	-.10	-.03

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. For those in the confidence-lowered condition, MSE was marginally associated with providing more accurate responses to control items, p = .099, and misinformation items, p = .05.*

Table 1.6. Experiment 1 Correlations between MSE and Ratings of Importance, Effort, Worry, and Attention During PEI and Memory Test, by Condition.

	PEI						Memory Test					
	Importance	Effort	Worry	Attention			Importance	Effort	Worry	Attention		
				A1	A2	A3				A1	A2	A3
Confidence-boosted	.17	.08	.14	.08	-.07	-.01	.12	.05	**.18†**	-.03	-.12	.01
Confidence-nonmanipulated	**.29****	**.31****	-.13	**.21***	**.24****	.11	**.28****	**.31****	-.12	**.28****	.10	.09
Confidence-lowered	.03	.06	-.16	.09	.07	-.02	-.03	.09	**-.23***	-.07	-.05	-.01
All Conditions	**.10†**	**.14***	**-.11†**	.08	.03	-.04	.08	**.11†**	**-.13***	.05	-.05	.01

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. Importance ratings were made prior to the PEI and memory tests. Effort ratings reflect how much effort subjects were willing to expend in order to do well on the task, and ratings were made prior to the PEI and memory test. There were three measures of attention, each made immediately after the PEI and memory tests: A1 was self-reported attention paid during the task; A2 was how distracted subjects reported being by thoughts unrelated to the task; A3 was how many times subjects reported looking away from the computer screen during the task. A2 and A3 were reverse coded so that higher ratings indicate that more attention was paid (i.e., being less distracted and looking away fewer times). Collapsing across conditions, higher MSE was at least marginally associated with: increased importance of doing well on the PEI task, p = .10, greater willingness to expend effort during the PEI narrative, p = .03, and test, p = .09, and having less performance anxiety during both PEI, p = .07, and test, p = .03.. Most of the significant relationships involving MSE were observed in the confidence-nonmanipulated condition.*

Table 1.7. Experiment 1 Correlations between Importance, Effort, Worry, and Attention, During PEI and Memory Test, and Memory Outcomes on the Cued-Recall Memory Test.

		Accurate Responses		Misinformation Responses	
		Control	Misinfo.	Control	Misinfo.
Confidence-boosted (n = 88)					
Importance	PEI	.11	.03	-.04	.17
Effort	PEI	**.21***	.07	-.05	.08
Worry	PEI	-.01	.00	-.12	.17
Attention	PEI	**.23***	.09	-.16	**.25***
Importance	Test	.07	.03	-.01	.16
Effort	Test	.13	.02	-.06	.15
Worry	Test	.07	.05	-.02	.14
Attention	Test	**.29****	.13	**-.20**†	**.25***
Confidence-nonmanipulated (n = 90)					
Importance	PEI	.02	.06	**.21***	**.20**†
Effort	PEI	.00	.13	**.21***	**.20**†
Worry	PEI	-.10	-.16	-.05	.12
Attention	PEI	.00	**.21***	.06	.14
Importance	Test	.06	.06	.16	**.18**†
Effort	Test	.09	**.18**†	.16	.12
Worry	Test	-.05	-.15	.00	.13
Attention	Test	**.29****	**.36*****	.03	-.01
Confidence-lowered (n = 84)					
Importance	PEI	**.27***	.06	-.02	.08
Effort	PEI	**.31****	.15	-.03	.05
Worry	PEI	.01	-.15	.04	.15
Attention	PEI	**.32****	**.22***	**-.21**†	.09
Importance	Test	.12	.09	.02	.03
Effort	Test	**.23***	.17	-.04	.06
Worry	Test	-.14	.01	**.19**†	.02
Attention	Test	**.35****	**.39*****	-.07	-.11
All Conditions (N = 262)					
Importance	PEI	**.14***	.06	.05	**.15***
Effort	PEI	**.18****	**.11**†	.04	**.11**†
Worry	PEI	-.02	-.09	-.05	**.14***
Attention	PEI	**.19****	**.18****	-.09	**.17****
Importance	Test	.08	.07	.05	**.12***
Effort	Test	**.15***	**.13***	.02	**.11**†
Worry	Test	-.03	-.03	.05	.09
Attention	Test	**.31*****	**.29*****	-.08	.07

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. In the interest of conserving space, an attention-composite variable is presented here. The composite was created by averaging the three attention variables. In creating this composite, reports of distraction and number of times subjects looked away from the screen were reverse coded, such that higher values on the composite variable reflect that greater attention was paid.*

Table 1.8. Experiment 1 Correlations between Importance, Effort, Worry, and Attention During PEI and Memory Test, and Memory Outcomes on the Recognition Memory Test.

		Accurate Responses		Misinformation Responses	
		Control	Misinfo.	Control	Misinfo.
Confidence-boosted (n = 88)					
Importance	PEI	**.23***	-.07	-.10	.07
Effort	PEI	**.25***	-.08	-.16	.13
Worry	PEI	.13	-.07	-.17	.11
Attention	PEI	**.31****	-.01	**-.22***	.14
Importance	Test	.16	-.07	-.06	.11
Effort	Test	**.20**†	-.06	-.11	.13
Worry	Test	.13	-.02	-.10	.06
Attention	Test	**.35*****	.04	**-.26***	.08
Confidence-nonmanipulated (n = 90)					
Importance	PEI	.05	.02	.04	.09
Effort	PEI	.09	.06	**.06**	.12
Worry	PEI	.14	-.06	-.08	-.01
Attention	PEI	.08	.04	-.10	.16
Importance	Test	-.04	-.06	.08	.17
Effort	Test	.02	.06	.06	.10
Worry	Test	.02	-.02	.03	.03
Attention	Test	**.27***	**.20**†	**-.20**†	-.13
Confidence-lowered (n = 84)					
Importance	PEI	.16	.04	**-.18**†	-.08
Effort	PEI	.12	.12	-.14	-.13
Worry	PEI	-.09	-.10	.05	.08
Attention	PEI	**.37*****	.04	**-.34****	.04
Importance	Test	.00	.09	-.03	-.11
Effort	Test	.09	.15	-.12	-.13
Worry	Test	-.13	.00	.15	.00
Attention	Test	**.33****	**.31****	**-.29****	**-.25****
All Conditions (N = 262)					
Importance	PEI	**.16****	.00	-.09	.03
Effort	PEI	**.16****	.03	-.09	.04
Worry	PEI	.06	-.07	-.06	.06
Attention	PEI	**.26*****	.03	**-.20****	**.11**†
Importance	Test	.05	-.01	.00	.06
Effort	Test	**.11**†	.05	-.05	.04
Worry	Test	.01	-.01	.04	.03
Attention	Test	**.32*****	**.18****	**-.24*****	-.09

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. In the interest of conserving space, an attention-composite variable is presented here. The composite was created by averaging the three attention variables. In creating this composite, reports of distraction and number of times subjects looked away from the screen were reverse coded, such that higher values on the composite variable reflect that greater attention was paid.*

Table 2.1. Experiment 2 Self-reported Memory Self-Efficacy (MSE) across Confidence Condition.

Condition	MSE
Confidence-boosted	70.53 (15.07)
Confidence-nonmanipulated	53.72 (20.69)
Confidence-lowered	46.28 (22.14)

Note: Higher MSE values reflect that subjects believe they have better memory abilities relative to their peers (e.g., an MSE of 75 reflects a subject's belief that she has better memory abilities than 74% of her peers). Standard Deviations are reported in parentheses.

Table 2.2. Experiment 2 Proportion of Accurate Responses and Misinformation Responses Given on the Recognition Memory Test by Item Type and Condition

	Proportion of Accurate Responses		Proportion of Misinformation Responses	
	Control	Misinformation	Control	Misinformation
Confidence-boosted	.56 (.26)	.55 (.23)	.27 (.26)	.35 (.27)
Confidence-nonmanipulated	.60 (.27)	.52 (.29)	.29 (.27)	.38 (.29)
Confidence-lowered	.62 (.26)	.52 (.29)	.28 (.26)	.37 (.31)
All Conditions	.60 (.26)	.53 (.27)	.28 (.27)	.37 (.29)

Note: Standard deviations are displayed parenthetically. On average, subjects gave the accurate response to 60% of questions regarding control items and to 53% of questions regarding misinformation items. This reflected a statistically significant difference in accuracy based on item type, $p = .002$. *On average, subjects gave the misinformation-consistent response to 28% of questions regarding control items, and to 37% of questions regarding misinformation items. This reflected a statistically significant difference in misinformation responses based on item type,* $p < .001$. *There was no main effect of condition (nor an interaction) on either accurate responses or misinformation responses.*

Table 2.3. Experiment 2 Correlations between MSE and Cued-Recall Memory Performance, by Item Type and Condition.

	Accurate Responses		Misinformation Responses	
	Control Items	Misinformation Items	Control Items	Misinformation Items
Confidence-boosted	.15	-.04	-.11	.06
Confidence-nonmanipulated	.05	-.06	.01	.07
Confidence-lowered	.08	**.20**†	.15	-.11
All Conditions	.02	.05	.04	.01

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. For those in the confidence-lowered condition, there was a marginally significant association between MSE and the proportion of accurate responses for cued-recall questions asking about misinformation items, p = .05. No other significant or marginally significant associations were observed.*

Table 2.4. Experiment 2 Correlations between MSE and Recognition Memory Performance, by Item Type and Condition.

	Accurate Responses		Misinformation Responses	
	Control Items	Misinformation Items	Control Items	Misinformation Items
Confidence-boosted	.02	.00	-.05	.04
Confidence-nonmanipulated	.03	-.06	-.06	.14
Confidence-lowered	-.13	.11	.11	-.03
All Conditions	-.07	.04	-.01	.03

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. There were no significant or marginally significant associations between MSE ratings and any of the memory outcomes on the recognition memory test.*

Table 2.5. Experiment 2 Correlations between MSE and Ratings of Importance, Effort, Worry, and Attention During Event, PEI and Memory Test, by Condition.

	Event						PEI						Test					
	I	E	W	A			I	E	W	A			I	E	W	A		
				A1	A2	A3				A1	A2	A3				A1	A2	A3
1	**.22***	**.31****	-.06	.13	.07	.08	**.25***	**.26****	.05	.14	-.09	.02	**.21***	.16	.03	**.19***	.07	.04
2	**.23***	**.27****	-.03	**.23***	.04	.14	**.20**†	.14	.00	.01	.03	.07	.10	**.24***	.03	.15	.15	.10
3	**.18**†	.15	-.10	.16	.14	.10	**.21***	**.19**†	-.11	**.25***	**.25***	**.24***	**.23***	.15	**-.19**†	**.19**†	**.27****	**.34****
All	**.15***	**.18***	-.06	**.15****	.08	**.11**†	**.17***	**.15***	.00	.09	.05	**.11**†	**.16***	**.13***	-.02	**.12***	**.16****	**.15****

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. Condition: 1 = confidence-boosted; 2 = confidence-nonmanipulated; 3 = confidence-lowered. I = importance; E = effort; W = worry; A = attention.*
There were three measures of attention, each made immediately after the PEI and memory tests: A1 was self-reported attention paid during the task; A2 was how distracted subjects reported being by thoughts unrelated to the task; A3 was how many times subjects reported looking away from the computer screen during the task. A2 and A3 were reverse coded so that higher ratings indicate that more attention was paid (i.e., being less distracted and looking away fewer times).

MSE was correlated with higher ratings of importance for both the slideshow event and PEI in all conditions, and was positively related to rated importance of the memory test for those within the confidence-boosted and confidence-lowered conditions. MSE was also associated with subjects' willingness to expend effort during the slideshow (for those in the confidence-boosted and confidence-nonmanipulated conditions) and PEI (for those in the confidence-boosted and confidence-lowered conditions), as well as for the memory test (for those in the confidence-nonmanipulated condition). MSE was less consistently associated with levels of performance anxiety, although this relationship reached marginal significance during the memory test (for those in the confidence-lowered condition). MSE was positively associated with at least one of the attention variables during the event (for those in the confidence-nonmanipulated condition), the PEI (for those in the confidence-lowered condition), and the test (for those in the confidence-boosted and confidence-lowered conditions). Overall, MSE was associated with many of the variables predicted by self-efficacy theory, and whenever the relationships were significant they were in the predicted direction.

Table 2.6. Experiment 2 Correlations between Importance, Effort, Worry, and Attention During Event, PEI, and Memory Test, and Memory Outcomes on the Cued-Recall Memory Test.

		Accurate Responses		Misinformation Responses	
		Control	Misinfo.	Control	Misinfo.
Confidence-boosted (n = 104)					
Importance	Event	.11	-.01	.02	.05
Effort	Event	**.27****	.11	.08	-.02
Worry	Event	.04	.09	.05	-.05
Attention	Event	**.39*****	**.34*****	**.23***	-.04
Importance	PEI	.12	-.02	.06	.03
Effort	PEI	**.23***	.03	.05	.08
Worry	PEI	.06	.06	.03	-.09
Attention	PEI	**.25***	**.21***	**.20***	.07
Importance	Test	.07	-.01	-.01	.02
Effort	Test	.16	.06	-.01	.04
Worry	Test	.00	.04	.00	-.11
Attention	Test	**.35*****	**.25***	.08	.04
Confidence-nonmanipulated (n = 94)					
Importance	Event	.10	.08	.02	.07
Effort	Event	.14	.06	.02	.11
Worry	Event	-.01	.04	.15	-.02
Attention	Event	**.27****	**.26***	-.02	-.10
Importance	PEI	.00	.03	-.08	.14
Effort	PEI	.09	.08	-.11	.04
Worry	PEI	.00	**.17**†	.11	-.08
Attention	PEI	.10	**.26****	.05	-.01
Importance	Test	.15	.17	-.05	.02
Effort	Test	.07	**.23***	-.01	.04
Worry	Test	.12	**.20**†	.11	-.16
Attention	Test	.16	**.32****	.10	.03
Confidence-lowered (n = 95)					
Importance	Event	.06	-.03	-.09	.15
Effort	Event	.09	.10	-.07	.13
Worry	Event	-.03	-.03	**-.22***	.03
Attention	Event	**.21***	**.34*****	.03	.01
Importance	PEI	.08	.01	-.09	**.18**†
Effort	PEI	.07	.12	-.04	**.18**†
Worry	PEI	-.07	-.10	**-.23***	.09
Attention	PEI	.15	**.28****	.14	-.03
Importance	Test	**.21***	.09	-.14	-.01
Effort	Test	.11	.15	-.02	.03
Worry	Test	-.11	-.06	**-.21***	-.03
Attention	Test	**.20**†	**.26***	.00	**.20***
All Conditions (N = 293)					
Importance	Event	.09	.01	-.03	.09
Effort	Event	**.17****	.09	.01	.07
Worry	Event	.00	.03	-.01	-.01
Attention	Event	**.28*****	**.31*****	.09	-.04
Importance	PEI	.07	.00	-.04	**.12***
Effort	PEI	**.12***	.08	-.03	**.10**†
Worry	PEI	-.02	.04	-.02	-.03

Attention	PEI	**.17****	**.25*****	**.13***	.01
Importance	Test	**.15***	.09	-.07	.01
Effort	Test	**.12***	**.14***	-.02	.04
Worry	Test	-.01	.06	-.03	**-.10**†
Attention	Test	**.23*****	**.28*****	.06	.09

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. In the interest of conserving space, an attention-composite variable is presented here. The composite was created by averaging the three attention variables. In creating this composite, reports of distraction and number of times subjects looked away from the screen were reverse coded, such that higher values on the composite variable reflect that greater attention was paid.*

Attention paid during the slideshow event was the variable most consistently associated with memory performance on the cued-recall test: attention during the slideshow was associated with memory accuracy for both misinformation items and control items (for subjects in each of the three conditions). Most of the significant associations between variables and memory outcomes followed the pattern of higher levels of these variables predicting more accurate responses (of the 29 significant or marginally significant associations found within each separate condition, 21 of them were between the variables and more accurate responses; the remainder were between the variables and the likelihood of providing a misinformation response).

Table 2.7. Experiment 2 Correlations between Importance, Effort, Worry, and Attention During Event, PEI, and Memory Test, and Memory Outcomes on the Recognition Memory Test.

		Accurate Responses		Misinformation Responses	
		Control	Misinfo.	Control	Misinfo.
Confidence-boosted (n = 104)					
Importance	Event	**.20***	.06	**-.21***	.03
Effort	Event	**.24***	**.18**†	-.13	-.08
Worry	Event	.09	.10	-.11	.02
Attention	Event	**.33*****	**.22***	-.15	**-.19***
Importance	PEI	**.19***	.04	-.11	.02
Effort	PEI	**.36*****	.10	**-.24***	-.05
Worry	PEI	.03	.11	-.07	-.04
Attention	PEI	**.27****	**.17**†	-.09	-.09
Importance	Test	**.29****	.05	**-.24***	.02
Effort	Test	**.33*****	.03	**-.20***	.04
Worry	Test	.12	.08	**-.18**†	-.03
Attention	Test	**.31****	.06	**-.17**†	-.03
Confidence-nonmanipulated (n = 94)					
Importance	Event	.01	.16	.04	.03
Effort	Event	.04	.01	.01	.11
Worry	Event	-.14	-.03	**.23***	.02
Attention	Event	**.31****	**.25***	**-.19**†	-.08
Importance	PEI	-.02	.07	-.03	.11
Effort	PEI	.12	.00	-.14	.11
Worry	PEI	-.01	**.18**†	.06	-.12
Attention	PEI	**.18**†	**.23***	-.13	-.07
Importance	Test	**.18**†	**.18**†	-.13	-.03
Effort	Test	**.18**†	.15	-.12	.03
Worry	Test	.01	**.20***	.03	-.15
Attention	Test	**.34*****	.16	-.16	.07
Confidence-lowered (n = 95)					
Importance	Event	.08	.00	-.09	.05
Effort	Event	.04	.11	-.05	-.03
Worry	Event	.08	.16	**-.18**†	-.07
Attention	Event	**.25***	**.34*****	**-.18**†	**-.27****
Importance	PEI	.06	-.02	-.09	.07
Effort	PEI	.02	.07	-.07	-.02
Worry	PEI	.12	.05	**-.20**†	.02
Attention	PEI	.07	.16	.02	-.09
Importance	Test	.06	.14	-.12	-.08
Effort	Test	.00	**.22***	-.02	-.13
Worry	Test	-.02	.09	-.14	-.06
Attention	Test	.12	.14	.00	-.04
All Conditions (N = 293)					
Importance	Event	**.10**†	.06	-.09	.04
Effort	Event	**.11**†	.09	-.05	.00
Worry	Event	.01	.07	-.01	-.01
Attention	Event	**.29*****	**.27*****	**-.17****	**-.18****
Importance	PEI	.08	.03	-.07	.07
Effort	PEI	**.16****	.05	**-.15***	.02
Worry	PEI	.04	**.12***	-.06	-.05

Attention	PEI	**.18****	**.18****	-.07	-.08
Importance	Test	**.18****	**.13***	**-.16****	-.03
Effort	Test	**.17****	**.13***	**-.11**†	-.03
Worry	Test	.03	**.13***	**-.10**†	-.08
Attention	Test	**.26*****	**.12***	**-.12***	.00

*Note: †p < .10, *p < .05, **p < .01, ***p < .001. In the interest of conserving space, an attention-composite variable is presented here. The composite was created by averaging the three attention variables. In creating this composite, reports of distraction and number of times subjects looked away from the screen were reverse coded, such that higher values on the composite variable reflect that greater attention was paid.*

Attention paid during the slideshow event was the variable most consistently associated with memory performance on the recognition memory test: attention during the slideshow was associated with memory accuracy for both misinformation items and control items (for subjects in each of the three conditions), and it was also associated with being less likely to provide the misinformation response to questions asking about misinformation items (for subjects in the confidence-boosted and confidence-lowered conditions) . Most of the significant associations between variables and memory outcomes followed the pattern of higher levels of these variables predicting more accurate responses (of the 38 significant or marginally significant associations found within each separate condition, 25 of them were between the variables and more accurate responses; the remainder were between the variables and the likelihood of providing a misinformation response). The vast majority of associations were between higher levels of the variables assessed and a beneficial memory outcome (i.e., a greater proportion of accurate responses or a lesser proportion of misinformation responses).

Table 3.1. Experiment 3 Self-reported Memory Self-Efficacy (MSE) across Confidence Condition.

Condition	T1 MSE	T2 MSE
Confidence-boosted	58.43 (18.69)	70.81 (14.30)
Confidence-nonmanipulated	53.60 (19.49)	53.98 (20.39)
Confidence-lowered	55.96 (22.61)	43.96 (23.89)

Note: Higher MSE values reflect that subjects believe they have better memory abilities relative to their peers (e.g., an MSE of 75 reflects a subject's belief that she has better memory abilities than 74% of her peers). Standard Deviations are reported in parentheses. Paired sample t-tests revealed that T2 MSE was significantly higher than T1 MSE for those in the confidence boosted condition, p = .001. T2 MSE was significantly lower than T1 MSE for those in the confidence-lowered condition, p = .04. T2 and T1 MSE did not differ for those in the confidence-nonmanipulated condition, p = .93.

Table 3.2. Distribution of "Believers" in the Bullied Item for the Two Experimental Conditions.

	"Believers"	Non-Believers	Total
Confidence-boosted	5 (39%)	8 (62%)	13
Confidence-lowered	1 (7%)	14 (93%)	15

Note: Raw counts are displayed first, followed by within-condition percentages in parentheses. A higher proportion of those in the confidence-boosted condition developed false memories or beliefs in having been bullied than those in the confidence-lowered condition, $X^2(1, N = 28) = 4.18$, $p = .04$, *Cramer's* $V = .39$