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Evaluating Suggestibility to Additive and Contradictory Misinformation Following Explicit Error Detection in Younger and Older Adults

Mark J. Huff
The University of Southern Mississippi

Sharda Umanath
Claremont McKenna College

In 2 experiments, we assessed age-related suggestibility to additive and contradictory misinformation (i.e., remembering of false details from an external source). After reading a fictional story, participants answered questions containing misleading details that were either additive (misleading details that supplemented an original event) or contradictory (errors that changed original details). On a final test, suggestibility was greater for additive than contradictory misinformation, and older adults endorsed fewer false contradictory details than younger adults. To mitigate suggestibility in Experiment 2, participants were warned about potential errors, instructed to detect errors, or instructed to detect errors after exposure to examples of additive and contradictory details. Again, suggestibility to additive misinformation was greater than contradictory, and older adults endorsed less contradictory misinformation. Only after detection instructions with misinformation examples were younger adults able to reduce contradictory misinformation effects and reduced these effects to the level of older adults. Additive misinformation however, was immune to all warning and detection instructions. Thus, older adults were less susceptible to contradictory misinformation errors, and younger adults could match this misinformation rate when warning/detection instructions were strong.

Keywords: misinformation, suggestibility, aging, warning, error detection

Memory researchers have long sought successful techniques to enhance overall memory accuracy. These techniques generally target one of two domains through methods designed to (a) improve veridical memory for a past event or (b) reduce memory errors that may subsequently occur at retrieval. Techniques such as deep levels-of-processing and retrieval practice are hallmark examples of techniques that have successfully enhanced veridical memory (Craik & Lockhart, 1972; Huff & Bodner, 2013; Hunt & Worthen, 2006; Roediger & Karpicke, 2006). In contrast, giving participants warnings, penalties for guessing, and tests requiring them to remember the source of their retrievals have all been fruitful in reducing memory errors (Chambers & Zaragoza, 2001; Huff, Meade, & Hutchison, 2011; Lindsay & Johnson, 1989; Zaragoza, Lane, Ackil, & Chambers, 1997). The present article focuses on the latter of these two approaches by utilizing a misinformation paradigm that elicits high rates of two fundamentally different types of misinformation errors in older and younger adults.

Misinformation paradigms generally follow a three-step procedure. First, participants are presented with an original event. Second, participants are exposed to specific misleading details about the original event, and finally, memory for the original event is tested. The *misinformation effect* refers to the finding that participants often report or endorse misleading details more frequently at test than conditions in which misleading details are absent (Loftus, Miller, & Burns, 1978; see Davis & Loftus, 2007; Zaragoza, Belli, & Payment, 2007, for reviews). The misinformation effect is robust: It occurs when misleading details are embedded in narratives (Takarangi, Parker, & Garry, 2006), questions (Saunders & Jess, 2010), and in more ecologically valid materials such as photographs (Schacter, Koutstaal, Johnson, Gross, & Angell, 1997) and postevent interviews (Mueller-Johnson & Ceci, 2004; Sutherland & Hayne, 2001). Findings from misinformation paradigms are applicable to eyewitness events as exposure to false details using methods designed to mimic real life sources have similarly resulted in memory distortion.

Misinformation Types

Despite the wealth of research conducted using the misinformation paradigm, less is known about how different types of misleading details may affect the probability with which misinformation is subsequently reported. That is, how misleading details relate to the original event may affect the potency of the subsequent misinformation effect. For example, research has shown that false details do not need to follow an originally studied event as in the traditional misinformation paradigm, to produce errors. Specifically, when participants are presented with initial details (e.g., paints were stored in a closet) that are then followed by informa-

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Mark J. Huff, Department of Psychology, The University of Southern Mississippi; Sharda Umanath, Department of Psychology, Claremont McKenna College.

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Correspondence concerning this article should be addressed to Mark J. Huff, Department of Psychology, The University of Southern Mississippi, 118 College Drive #5025, Hattiesburg, MS 39406. E-mail: mark.huff@usm.edu

tion to retract those details (e.g., the closet was empty), the presentation of those initial details are often falsely reported as occurring despite their retraction (Ecker, Lewandowsky, Swire, & Chang, 2011; Johnson & Seifert, 1994). Thus, false details can continue to impair memory accuracy even when those details have been dismissed.

In addition to the timing of exposure to erroneous details, qualitative attributes of *how those details relate* to specific details from an original event can also affect misinformation rates. As an early example, Loftus (1979) presented participants with misleading details that either blatantly contradicted details from an original event or contradicted peripheral, nonfocal, details of the event. On a final test, blatant contradictions were correctly rejected far more frequently than nonfocal contradictions as participants were more likely to detect and reject more discernible contradictions relative to those that were more peripheral. Thus, the qualitative features of suggested misleading details can impact their later endorsement.

It is important to note, however, that not only contradictions produce a misinformation effect. In some cases, misleading details may be additive in nature by introducing false information that supplements an original event rather than directly contradicting any specific item (Tousignant, Hall, & Loftus, 1986). Although not termed "additive," Loftus (1975) reported a study that includes such misinformation. Participants were initially presented a film of an auto accident that occurred on a country road. Later they were exposed to false information suggesting that a barn was presented in the film when no information regarding a building was originally observed. After a week delay, participants were more likely to incorrectly report that a barn occurred in the film than those who were not exposed to information about the barn, demonstrating that additive details can similarly produce a misinformation effect.

More recently, Roediger, Meade, & Bergman (2001; see too, Meade & Roediger, 2002) have shown strong additive misinformation effects using the *social contagion of memory paradigm*. In this paradigm, participants studied a series of static household images containing a variety of common objects. After study, participants then completed a collaborative recall test in which a social other (in reality, a confederate) introduces a set of schematically plausible, but nonpresented contagion items that do not contradict any original items from the scenes (e.g., falsely suggesting a toothbrush was presented in the bathroom). On final free recall and source-monitoring tests, participants were more likely to report and misattribute contagion items as studied, again demonstrating suggestibility effects of supplementary details.

A critical question is whether the qualitative differences between additive and contradictory misleading details also produce differences in subsequent misinformation rates. Loftus (2005) theorized that suggestibility to misinformation was based on the *Discrepancy Detection* principle, in which misinformation endorsement was related to whether an individual could recollect discrepancies between the misinformation detail and the original event. Based on this principle, one may expect that successful rejection of misleading information would be more likely for contradictory items as memory for an original item would be available with which to contrast misleading details. Contradictory misinformation may, therefore, instantiate a detect-and-reject memory process, a strategy that has been fruitful in reducing memory errors in other paradigms where error detection is successful (cf. Gallo, 2004, 2013). Additive misinformation however, does not contrast any one specific detail and, thus, may increase the probability of misinformation errors. Alternatively, additive misinformation might produce lower error rates than contradictory if supplementary details are seen as distinctive because these details do not contradict any one specific detail from the original event. If so, additive details might be better remembered, leading to greater discrepancy detection and rejection on a final test.

Despite the distinction between additive and contradictory misinformation and the potential impact on susceptibility to misinformation, only a few studies have directly contrasted the two types. In one demonstration, Frost (2000) compared additive and contradictory misinformation on a crime depicted on a slide show and measured the effects following either 10-min or 1-week retention intervals. Contradictory misinformation rates were found to be lower than additive, but only after the shorter 10 min retention interval and not the 1-week delay in which both misinformation types were equivalent. Akin to a detect-and-reject process, Frost reasoned that for contradictory items, participants must have noticed discrepancies with the original event at some level and were, therefore, less likely to report misinformation after a short delay when the contradiction was still available in memory. Separately, Nemeth and Belli (2006) also compared additive and contradictory misinformation effects using a variant of the social contagion paradigm. Unlike Frost, their experiment yielded no difference between additive and contradictory rates; however, overall misinformation rates were at floor, making it impossible to determine whether additive and contradictory misinformation effects could have differed. Thus, it is unclear whether the difference reported between additive and contradictory misinformation types are reliable and can be found using other materials when overall misinformation rates are off floor.

In the present work, we sought to directly compare and evaluate additive and contradictory misinformation type differences, including their respective potential for error detection. More important, we also contrast their effects in younger and healthy older adults, a discussion to which we now turn.

Aging and Suggestibility

It is well documented that, relative to younger adults, older adults show episodic memory deficits, especially on tasks that require self-initiated retrieval processes such as free recall (Balota, Dolan, & Duchek, 2000; Healey & Kahana, 2016; Wahlheim & Huff, 2015). Further, older adults show an inhibitory deficit in attention (Hasher & Zacks, 1988), which often accounts for deficits in encoding and retrieval processes in memory. In a misinformation paradigm, episodic deficits in older adults may compromise the integrity of the memory for the original event, which is then compounded by inhibitory deficits that may diminish the ability to dismiss falsely suggested details affecting suggestibility. Further, older adults are more likely to misattribute misleading postevent information as occurring from the original event (Henkel, Johnson, & De Leonardis, 1998; Lindsay & Johnson, 1989). Yet, despite these clear age-related differences in episodic memory, inhibitory control, and source-monitoring ability, misinformation studies evaluating age effects have been relatively mixed. Studies have found misinformation effects to be greater in older adults (Cohen & Faulkner, 1989; Loftus, Levidow, & Duensing,

1992; Ross, Spencer, Blatz, & Restorick, 2008), equivalent between age groups (Coxon & Valentine, 1997; Dodson & Krueger, 2006; Gabbert, Memon, Allan, & Wright, 2004), and greater in younger adults (Holliday et al., 2011; Marche, Jordan, & Owre, 2002). In a recent meta-analysis, Wylie et al. (2014) showed that despite the variability across individual studies, older adults generally show a greater misinformation effect than younger adults with a medium weighted effect size.

What remains unclear, however, is whether age-related misinformation differences are moderated by additive versus contradictory misinformation types. In the Wylie et al. (2014) meta-analysis, additive and contradictory misinformation types were not evaluated as a moderator, though the overall analysis included studies that included both additive (Ross et al., 2008) and contradictory (Roediger & Geraci, 2007) misinformation. Age differences and their relative magnitude may depend upon the type of misinformation that participants are exposed to. For instance, research has shown that older adults are less likely to update inferences about story plots when exposed to new information that change that inference (Hamm & Hasher, 1992), though it is unclear whether this updated information conflicts or supplements the initial story. Understanding older adults' susceptibility to these different misinformation types and the underlying mechanisms behind that susceptibility could shed some light on the mixed literature as well as inform the ways in which older adults' suggestibility might be reduced.

To our knowledge, only one study has included both misinformation type and participant age as variables in an experiment. Saunders and Jess (2010, Experiment 1) presented younger and older adults with a short video that depicted a crime scene followed by a series of postevent questions containing additive and contradictory misleading details. On a final cued-recall test, older adults were found to be more suggestible to both types of misinformation, consistent with the Wylie et al. (2014) meta-analysis. Additive misinformation was proportionally greater than contradictory; however, the authors did not statistically compare their effects nor the interaction with age, preventing any firm conclusions regarding the effects of misinformation type and age.

Further, Saunders and Jess (2010) utilized different items in order to engineer additive and contradictory misinformation types. For example, contradictory misinformation was presented by misleading participants that the burglar's bike had a blue basket attached (vs. black basket) and additive misinformation would mislead participants that a motorcycle drove by, when originally, there was no motorcycle at all. These misleading details were not counterbalanced, so differences in misinformation rates may reflect differences in the potency of each of the individual items rather than the way in which misleading information was introduced. For instance, misinformation about a motorcycle may naturally be more potent than that of a suggested color and not because of *how* the misinformation interacts with the original event. Thus, it is critical to contrast the suggestibility of both items when they are presented in both additive and contradictory contexts. Given this shortcoming, and the importance of understanding age-related differences in different types of misinformation, we sought to delineate misinformation type suggestibility differences in older and younger adults while counterbalancing misleading items in both additive and contradictory misinformation contexts to control for potential item differences.

Experiment 1

In Experiment 1, younger and older adults studied a fictional story and then completed a cued-recall test that contained both additive and contradictory misleading details. Immediately after the cued-recall test, participants completed a final three-alternative-forced-choice (3-AFC) test that was used to determine both the correct memory of story plot details and the suggestibility effects on memory for the fictional story. More important, all items were counterbalanced to occur in all misinformation conditions. We expected that across age groups, contradictory misinformation would be falsely reported less frequently than additive misinformation as a discrepancy between the original detail and the misinformation is more likely under contradictory than additive conditions (cf. Frost, 2000; Tousignant et al., 1986). The notion is that noticing a contradiction will draw attention to this discrepancy that in turn will be deemed erroneous.

Regarding age differences, we expected that overall, correct memory for the original story would be greater for younger than older adults on both the misleading cued-recall test and the final 3-AFC test, consistent with episodic memory deficits typically found in older adults. For misinformation, we expected that across misinformation types, older adults would report a greater number of suggested misleading details as having been studied in the original story, consistent with the Wylie et al. (2014) meta-analysis. More important, however, we also expected that the age-related misinformation difference would depend on misinformation type. Specifically, we predicted that for older (vs. younger) adults, misinformation errors would be particularly great for additive items because successful detection and subsequent rejection of these details is difficult given the absence of a clear contradiction. Because contradictory misinformation makes discrepancies between the original event and the misleading details more salient, we expected that the age differences would be reduced.

Method

Participants. Thirty-two Washington University in St. Louis undergraduates (M_{age} = 19.63, *range* = 18–22) and 29 community dwelling older adults (M_{age} = 71.73, *range* = 65–87) were recruited for participation. Younger adults participated for course credit. Older adults were compensated $15 for their participation. Younger adults reported fewer years of formal education than older adults (13.07 vs. 16.89, respectively), $t(53) = 7.01$, $SEM = .55$, $p < .001$, which was not surprising as younger adults were primarily enrolled in first- and second-year course work. Education was not reported by one older and five younger adults.

Materials. During the study phase, participants read a fictional story entitled *The Art Thief* (modified from Marsh, 2004) that depicted a tourist in a fictional land engaging in a conversation with an art thief at a local pub. The story contained characters, an active dialogue, and a plot involving a thief's plans to steal art work from a nearby museum. The story was approximately 2,000 words in length that was broken down into 201 lines for study. Embedded within the story were 36 critical statements that would later be used to present misinformation. These statements were taken from Berger, Hall, and Bahrick (1999) that contained fictional statements with several plausible target details that could fit within that statement. For example, the fictional statement "*Bumbaru* palace in Zambari is where the Monarch Konkali lives" contains the name of the palace as a target detail that could later be

contrasted with a plausible misleading detail (i.e., *Simfara*) to produce a misinformation item. Notably, all information in the story, such as the above example, was entirely fictional to remove the influence of prior knowledge on participants' performance (older adults in particular; see Umanath & Marsh, 2014). The critical statements were then split into three groups of 12 for the delivery of additive, contradictory, or no misinformation (i.e., neutral) that are further discussed below. The critical statements occurred within the story at a rate of approximately one every six lines and the ordering of these statements was once randomized and counterbalanced into three separate versions such that across versions, each statement would occur in the additive, contradictory, or neutral conditions (see Appendix A for the full story and suggested misinformation items used in both additive and contradictory conditions).

A series of 36 cued-recall questions were then created to deliver misinformation to participants. Of these questions, 24 were misleading, split evenly between additive and contradictory misinformation types. The remaining 12 questions were neutral, presenting no misinformation. Each of these questions inquired about a specific piece of information from the story. More important, for misinformation questions, misleading details were embedded within the cued-recall questions (see Table 1). These details were always peripheral to the information targeted by the question, meaning that the misleading detail was not focal and had no impact on the correct target answer for the question. For example, the question "In what city was the palace where the monarch from Konkali lives?" would serve as a neutral question, providing no misleading information. However, for misleading questions, false information about the palace name would also be provided (e.g., Simfara). The misleading questions were, therefore, constructed to present a specific type of false detail about the original story (additive, contradictory, or none). As shown in Table 1, additive misinformation questions presented false details that were absent from the original story but did not contradict any specific detail. Contradictory misinformation questions presented false details that directly contrasted to a specific detail presented in the original story. Neutral items did not present any false details about the original story. The 36 cued-recall questions were presented in a newly randomized order for each participant.

A 48-item 3-AFC test was then used to evaluate memory for the original story based on the presence of interfering misinformation (see Table 1). It comprised of 12 items that tested for additive misinformation, 12 for contradictory misinformation, 12 neutral items, and 12 story comprehension items to gauge memory for correct plot details. For additive, contradictory, and neutral items, a line was presented from the original story with a blank where the misinformation could have been presented. Three response options were provided. Two of the options were concrete responses that could potentially fit within the blank. For additive items, one response was the suggested misinformation and the other was a foil item not presented in the experiment. For contradictory items, one response was the correct detail that was studied in the original story, but the other was the previously suggested misinformation from the misleading question phase. For neutral items, because no detail was presented in either the original story or the cued-recall questions, both items were new foils. In addition to the two details, all item types included a "I don't know/Neither" response option to be used if neither of the responses were deemed correct or if the correct option was unknown. Comprehension questions inquired about a specific plot detail from the story (e.g., The protagonist was staying at a _____.) and with the answer options as follows: correct (e.g., a hostel), foil (e.g., a hotel), or "I don't know/Neither." Comprehension questions always included a correct response and a plausible distractor.

Procedure. Participants were tested at individually partitioned computer stations using E-Prime software (Schneider, Eschman, & Zuccolotto, 2002) with all responses made on a keyboard. Younger adults were tested in groups of up to 4. Older adults were always tested individually. An experimenter was present during testing for all participants. After consent, all groups received written instructions that they would be presented with a fictional story on the computer screen and that their memory for the story would be tested later. Participants were further informed that the story would be presented line-by-line and that study was self-paced and required pressing the spacebar to advance to each subsequent line. Participants took approximately 10–15 min to read/study the story. Immediately after study, participants completed a paper and pencil arithmetic filler task for 3 min.

Table 1
Sample Additive, Contradictory, and Neutral Item Types Across Study, Misleading Question, and Final 3-Alternative-Forced-Choice (3-AFC) Test Phases in Experiments 1 and 2

Phase/item type	Study phase	Misleading cued-recall question	Final 3-AFC test options
Additive	"Especially because he looked remarkably like the former dictator of Adonia."	"What kind of ruler was Rafiki, the former dictator of Adonia?"	"Taruba" "Rafiki" "I don't know/Neither"
Contradictory	"Especially because he looked remarkably like Taruba the former dictator of Adonia."	"What kind of ruler was Rafiki, the former dictator of Adonia?"	"Taruba" "Rafiki" "I don't know/Neither"
Neutral	"Especially because he looked remarkably like the former dictator of Adonia."	"What kind of ruler was the former dictator of Adonia?"	"Taruba" "Rafiki" "I don't know/Neither"

Note. Test question for final 3-AFC test was "Especially because he looked remarkably like _____ the former dictator of Adonia."

Following the filler task, participants completed the misleading question phase. Participants were instructed that they would be presented with a series of cued-recall questions and that they were to answer these questions with information from the studied story. Answers were to be typed into the computer, and participants were to press the "Enter" key when ready to submit their answer. The test was self-paced, and participants were not warned about the misinformation embedded within the questions. Additionally, participants were told that if they did not know the correct information they could enter the letters "IDK" for "I don't know."

Immediately after the misleading question phase, participants completed the final 48-item 3-AFC test. Participants were presented with written instructions indicating that they would be presented with a line from the original story with a blank space and were to select one of three response options to complete the line to reflect what was originally studied. They were further informed that two of the response options would be concrete options and a third option corresponding to "I don't know/Neither" that could be used if they simply did not know the answer to the question or if neither of the response options were correct. The three response options were displayed on the computer screen under each question and were each yoked to a specific key on the keyboard. Participants were to press the key that corresponded to the correct response from the story. As in the misleading cued-recall test, the final test was also self-paced. Participants were then debriefed after completion of the final test. The experiment required approximately 45 min to complete.

Results

For all results reported, a $p < .05$ significance level was used except as noted. Effect sizes for significant comparisons were calculated using partial eta squared (η_p^2) for analyses of variance (ANOVAs) and using Cohen's d for t tests.

Cued-recall test: Misleading question phase. Table 2 reports mean proportions of correct recall on the cued-recall test in the misleading question phase as a function of age group. Note that these questions served as the potential vehicle for misinformation. Correct cued recall was computed by taking the total number of correct responses divided by the total number of questions. Responses of "I don't know" were counted as incorrect. A lenient scoring criterion was adopted such that misspellings of correct responses were counted as correct. An independent-samples t test revealed that younger adults recalled more correct details than older adults (.41 vs. .30, respectively), $t(59) = 2.80$, $SEM = .04$, $d = 0.73$—consistent with typical age-related episodic memory declines.

Table 2
Mean (SD) Proportions of Correct Cued-Recall and Correctly Selected Alternatives and Falsely Selected Additive and Contradictory Misinformation for Younger and Older Adults in the 3-Alternative-Forced-Choice (3-AFC) Test in Experiment 1

Age group/test type	Younger adults	Older adults
N	32	29
Correct cued-recall	.41 (.17)	.30 (.12)
3-AFC test		
Correctly selected alternatives		
Comprehension	.93 (.06)	.90 (.09)
Additive	.26 (.25)	.21 (.25)
Contradictory	.44 (.25)	.59 (.15)
Neutral	.43 (.29)	.42 (.35)
Falsely selected misinformation		
Additive	.52 (.21)	.57 (.25)
Contradictory	.40 (.22)	.28 (.14)

Final 3-AFC test. Table 2 reports mean proportions of correctly selected alternatives for plot comprehension, additive, contradictory, and neutral items, and the proportions of falsely selected misinformation alternatives for additive and contradictory items for younger and older adults. Correct alternative selection was computed differently for neutral, additive, and contradictory items. For additive and neutral items, a response was counted as correct when the "I don't know/Neither" option was selected because neither option was presented in the original story, whereas, for contradictory items, a response was counted as correct when the item from the original story was selected. For misinformation responses, additive and contradictory misinformation rates were computed as the proportion of questions in which the misleading detail was selected. Note that neutral items were not included in this analysis as falsely suggested details were not presented for these items.

Beginning with correctly selected alternatives for plot comprehension items, younger and older adults selected correct details at a similar high rate (.93 vs. .90), $t(59) = 1.51$, $SEM = .02$, $p = .14$; thus, both age groups could retrieve basic plot details with high acuity.

Proportions of correctly selected alternatives for additive, contradictory, and neutral items were then compared as a function of age group using a 3 (Item Type: Additive vs. Contradictory vs. Neutral) × 2 (Age: Younger vs. Older) mixed ANOVA. A significant effect of Item Type was found, $F(2, 118) = 25.75$, $MSE = .05$, $\eta_p^2 = .30$, which indicated that the selection of the correct alternative was greatest for contradictory items (.51), followed by neutral (.42) and additive items (.24)—a pattern likely because of contradictory test items presenting the original studied item as an alternative, enhancing discrimination for the correct response. The effect of Age was not significant, $F < 1$; however, a significant Item Type × Age interaction was found, $F(2, 118) = 3.52$, $MSE = .05$, $\eta_p^2 = .05$. Follow-up comparisons revealed that the proportion of correctly selected alternatives between younger and older adults did not differ on either neutral (.43 vs. .42), $t < 1$, or additive items (.26 vs. .21), $t < 1$, but interestingly, for contradictory items, younger adults showed lower correct selection than that of older adults (.44 vs. .59), $t(59) = 2.82$, $SEM = .05$, $d = 0.73$. Thus, older adults were more likely to select the correct detail from memory when conflicting alternatives were available at test.

Turning to the false selection of suggested misinformation details, a 2 (Item Type: Additive vs. Contradictory) × 2 (Age: Younger vs. Older) mixed ANOVA was used to compare misinformation effects between the two age groups. An effect of Item Type, $F(1, 59) = 42.99$, $MSE = .03$, $\eta_p^2 = .42$, reflected greater selection of false additive than contradictory alternatives (.54 vs. .34), but again, the Age effect was not significant, $F < 1$. A reliable Item Type × Age interaction was found, $F(1, 59) = 6.67$, $MSE = .03$, $\eta_p^2 = .10$, which revealed a similar selection of false items between younger and older adults on additive items (.52 vs. .57), $t < 1$, but for contradictory items, younger adults were more

likely to select the false suggested detail than older adults (.40 vs. .28), $t(59) = 2.18$, $SEM = .04$, $d = 0.57$. Thus, older adults showed a memory accuracy benefit through a reduction in suggestibility to contradictory misinformation.

Discussion

The results of Experiment 1 revealed important novel differences in the selection of correct and misinformation alternatives based on the type of misinformation participants were exposed to and their age group. Consistent with our prediction, correct response selection for additive items was impaired relative to contradictory items as shown by a decrease in correct alternative selection and a concomitant increase in the selection of additive misinformation. We argue that the reduction in memory accuracy for the additive items is because of a greater difficulty in detection and rejection of the misinformation alternative. We argue that this pattern occurs because of the absence of conflicting information from the original event in which no clear discrepancy is available to facilitate monitoring at test. For contradictory items, a discrepancy was more likely, and thus, participants were less likely to select the contradictory misinformation alternative.

In contrast to our prediction, however, older and younger adults showed equivalent misinformation rates on additive items, but older adults were *less* likely to report falsely suggested contradictory items on the final test than younger adults. This latter result, though not entirely unheard of (e.g., Holliday et al., 2011; Marche, Jordan, & Owre, 2002), is rather surprising given older adults show deficits in controlled retrieval processes (Craik, 1986) and show impoverished source monitoring abilities (Hashtroudi, Johnson, & Chrosniak, 1989), both of which would likely impair their ability to successfully detect and reject misinformation. Further, this difference occurred even though memory for plot details in the original event was equivalent between both age groups.

One account for this pattern may be because of qualitative differences in how older adults approach a misleading cued-recall test that contains a high degree of errors. Perhaps older adults are more motivated to attend to potential errors and thus are more cautious about incorporating erroneous details into memory when those details contradict details from the original event. That is, older adults may be more vigilant regarding contradictory error detection during the misleading question phase and subsequently are better able to reject the misinformation answers on the final test. For additive misinformation, however, error detection is likely more difficult and thus suggestibility to those errors is age invariant. Consistent with this possibility, older adults have shown intact error detection capacities in a variety of stimuli and circumstances from marking misspelled words (MacKay, Abrams, & Pedroza, 1999), correcting their mistakes in identifying target digits on a screen (Rabbitt, 1979), and noticing errors in rhythm synchronization (Turgeon, Wing, & Taylor, 2011). Older adults have also been shown to be as good as (Umanath & Marsh, 2012) and sometimes better than younger adults at detecting errors that contradict prior knowledge (Schwartz, 2002). Therefore, in our experiment, if older adults naturally direct themselves to be on guard for errors, they may be more effective at spontaneously detecting them and mitigating their later suggestibility.

An additional reason for increased vigilance toward error detection may be because of increased motivation because of age-related differences in personality. Older adults may have increased motivation in the task because of age-related differences in conscientiousness—a personality factor that involves increased carefulness and vigilance when completing daily tasks. Cross-sectional evidence shows that older adults report greater conscientiousness than typical university-aged younger adults (see Donnellan & Lucas, 2008 for a review) and this personality difference may be related to cognition. As an example, there is evidence of a relationship between conscientiousness and performance on an attentional task. Jackson and Balota (2012) showed a negative relationship between conscientiousness factor on the NEO-FFI (Costa & McCrae, 1992) and errors and subjective reports of mind-wandering for younger and older adults on a sustained attention task. Older adults, who are more vigilant when making responses on the sustained attention task may, therefore, be less likely to show attentional lapses that include errors and off-task thoughts.

If older adults respond with greater vigilance during the cued-recall test because of exposure to several errant items that, in turn, reduces contradictory misinformation on the final test, it is possible that younger adults could as well, but require additional instruction to do so. As an example, research in the discourse-processing literature has shown that when high school and university students are given instructions to process important text information more deeply, they are slower to read this information and show better memory for it at test (Jetton & Alexander, 1997; McCrudden, Magliano, & Schraw, 2010). To the extent that when participants are provided with instruction to deliberately process errors, memory for these errors may be enhanced, facilitating rejection on the final test. Therefore, in Experiment 2, we evaluated the effects of three different types of warnings on additive and contradictory misinformation rates in younger and older adults. The purpose of these instructions was to contrast instructions with increasing emphasis toward error detection to determine the point in which error detection is effective at reducing suggestibility to misleading information, particularly in younger adults. We predicted that younger adults would similarly be able to reduce contradictory misinformation to that of older adults, but only under strong detection instructions that included examples of misinformation types.

Experiment 2

Given reduced contradictory misinformation rates found in older adults, Experiment 2 sought to evaluate whether warning instructions—that should enhance how participants scrutinize their responses on the final test—may lead younger adults to respond similarly to older adults. Previous research has shown that warning participants about misinformation exposure can be effective in reducing misinformation rates both when warnings are presented pre- and post-exposure to misinformation (Chambers & Zaragoza, 2001; Eakin, Schreiber, & Sergent-Marshall, 2003; see Blank & Launay, 2014, for a meta-analysis of postexposure warnings) and when the misleading details are both additive (Meade & Roediger, 2002) and contradictory (Wright, 1993), though these item types have not been compared within the same experiment.

In Experiment 2, we examined the effects of different types of warnings on misinformation in older and younger adults by manipulating the strength of warning using an error detection instruction that required participants to specify those errors encountered

in the misleading question phase. Before the cued-recall test, participants were given either a general warning about misleading errors (Warning group), a general warning and asked to detect each error encountered (Detection group), or a general warning with examples of both misinformation types and asked to detect these errors (Detection + Examples group). We hypothesized that if older adults were naturally more vigilant toward detecting (and subsequently rejecting) errors, additional instruction to detect errors would not procure further reduction in contradictory misinformation on the final test. In contrast, if younger adults are not as vigilant toward errors, instructions that emphasize error detection will be necessary to produce a reduction in contradictory misinformation.

Method

Participants. Ninety-two Washington University in St. Louis undergraduates (M_{age} = 19.28, *range* = 18–22) and 87 community-dwelling older adults (M_{age} = 71.21, *range* = 65–86) were recruited for participation. Younger adults received course credit for participation and older adults were compensated $15. Both age groups were randomly assigned to the Warning, Detection, and Detection + Examples groups. The assignment of participants in each group was relatively evenly distributed and is reported in Table 3. Younger adults again reported fewer years of formal education than older adults (13.15 vs. 16.52), $t(170) = 11.25$, $SEM = .30$, $p < .001$. Within each of the younger and older adult groups, there were no differences in age or education across the three instruction groups, $ts < 1.63$, $ps > .11$. Education was not reported by one older and seven younger adults.

Materials and procedure. Experiment 1 materials and procedure were used with the following modifications. Before the misleading question phase, participants received an additional set of condition-specific instructions that provided information about the upcoming misinformation. The Warning group was informed that while answering the questions they may encounter false information that was not originally presented in the story but were to try to answer the questions as accurately as possible. The Detection group was informed that in addition to the possibility of encountering false information, they were also to report any errors that might be embedded in the cued recall questions. Specifically, for each error detected on the cued-recall test, they were to enter an "e" for error rather than answering the question. The Detection + Examples group was instructed to similarly report all detected errors as the Detection group, but provided with concrete examples of additive and contradictory misinformation errors that were unrelated to the story to emphasize detection during this phase. Participants were instructed to be vigilant for either error type as they were completing the test. During the cued-recall questions, the Detection and Detection + Examples groups were presented with a cue of "E = Error" on the computer screen beneath each question as a reminder to report detected errors. The condition-specific warning or detection instructions were not mentioned again after the misleading question phase.

Results and Discussion

Cued-recall test: Misleading question phase. Mean proportions of correct recall on the misleading cued-recall test are reported in Table 3 as a function of age and warning instructions. Correct cued-recall was computed in an identical fashion to Experiment 1 with the exception that items denoted as containing an error in the Detection and Detection + Examples groups were omitted from computing the proportion correct. Thus, only those items that were given a memory response or "I don't know" were included in the calculation. As in Experiment 1, an effect of Age was found, $F(1, 173) = 14.80$, $MSE = .03$, $\eta_p^2 = .21$, that reflected greater correct recall for younger than older adults (.40 vs. .31). Neither the effect of Warning Instructions nor the interaction were significant, $Fs < 1.74$, $ps > .18$, demonstrating that instructing participants to report detected errors did not affect the correct recall rate for either younger or older adults.

Error detection. We examined successful misinformation detection rates for the two detection groups during the cued-recall test (see Table 3). A 3 (Item Type: Additive vs. Contradictory vs. Neutral) × 2 (Detection Group: Detection vs. Detection + Examples) × 2 (Age: Younger vs. Older) mixed ANOVA yielded a significant main effects of Item Type, $F(2, 232) = 97.77$, $MSE = .02$, $\eta_p^2 = .46$, Detection Group, $F(1, 116) = 21.05$, $MSE = .06$, $\eta_p^2 = .15$, and a numeric trend of Age, $F(1, 116) = 3.04$, $MSE = .06$, $p = .08$, $\eta_p^2 = .03$. Critically, these effects were qualified by a significant three-way interaction, $F(2, 232) = 3.73$, $MSE = .02$, $\eta_p^2 = .03$. Follow-up comparisons revealed that this interaction was because of age differences in detection rates between the two detection groups. Specifically, younger adults showed an increase in detection rates in the Detection + Examples group for both additive (.47 vs. .18), $t(59) = 5.21$, $SEM = .05$, $d = 1.36$, and contradictory items (.44 vs. .26), $t(59) = 3.35$, $SEM = .05$, $d =$

Table 3
Mean (SD) Proportions of Correct Cued-Recall and Misinformation Detected as a Function of Warning Group for Younger and Older Adults in Experiment 2

	Younger adults			Older adults		
Group/variable	Warn group	Detection group	Detection + Examples group	Warn group	Detection group	Detection + Examples group
N	31	31	30	28	29	30
Correct cued-recall	.39 (.17)	38 (.16)	.43 (.20)	.26 (.14)	.35 (.19)	.31 (.14)
Misinformation detected						
Additive	—	.18 (.16)	.47 (.26)	—	.36 (.19)	.42 (.24)
Contradictory	—	.26 (.20)	.44 (.22)	—	.33 (.20)	.43 (.22)
Neutral	—	.08 (.10)	.11 (.11)	—	.12 (.11)	.15 (.16)

Note. Proportions of errors detected for neutral items are false alarms because no misinformation was presented in these question types.

0.87, but not for neutral items (.11 vs. .08), $t < 1$. The increase in correct detection rate for younger adults from the Detection to the Detection + Examples groups demonstrates that younger adults could improve successful detection of both misinformation types, but only with the strong warning presented in the Detection + Examples instructions. Older adults, however, showed equivalent detection rates in both the Detection and Detection + Examples groups, ts < 1.80, ps $> .08$.

Final 3-AFC test. Proportions of correctly selected alternatives for comprehension, additive, contradictory, and neutral items as a function of age and warning group are reported in Table 4. Starting with comprehension items, an effect of Age was found, $F(1, 173) = 7.13$, $MSE = .01$, $\eta_p^2 = .04$, which reflected greater correct alternative selection of plot details for younger than older adults (.91 vs. .88). The effect of Warning Group and the interaction failed to reach significance, Fs < 1.38, ps $> .25$, showing that warning instructions did not differentially affect memory rates for correct plot details.

Turning to correctly selected alternatives for additive, contradictory, and neutral items, a 3 (Item Type: Additive vs. Contradictory vs. Neutral) × 3 (Warning Group: Warning vs. Detection vs. Detection + Examples) × 2 (Age: Younger vs. Older) mixed ANOVA was used. Proportions of correctly selected alternatives were computed as in Experiment 1. An effect of Item Type was found, $F(2, 346) = 87.60$, $MSE = .05$, $\eta_p^2 = .34$, which reflected greater correct alternative selection for contradictory items than either additive (.56 vs. .27), $t(178) = 12.46$, $SEM = .02$, $d = 1.32$, or neutral items (.56 vs. .48), $t(178) = 2.97$, $SEM = .03$, $d = 0.30$, and greater selection of correct alternatives for neutral than additive items (.48 vs. .27), $t(178) = 12.67$, $SEM = .02$, $d = 0.77$. An effect of Warning Group was also found, $F(2, 173) = 4.45$, $MSE = .10$, $\eta_p^2 = .05$. Follow-up comparisons revealed that correct alternative selection was greater in the Detection + Examples group than both the Warning (.49 vs. .42), $t(117) = 2.30$, $SEM = .03$, $d = 0.43$, and Detection groups (.49 vs. .40), $t(118) = 2.78$, $SEM = .03$, $d = 0.51$. No difference was found between the Warning and Detection groups (.42 vs. .40), $t < 1$. Therefore, providing examples of errors during the misleading question phase produced a memory benefit on the final test by increasing the selection of the correct alternative that the detection instructions alone did not provide.

A significant effect of Age was also found, $F(1, 173) = 7.12$, $MSE = .10$, $\eta_p^2 = .04$, in which older adults showed greater correct alternative selection than younger adults. All interactions including the three-way interaction failed to reach significance, all Fs < 1.26, ps $> .28$. Thus, in departure from Experiment 1, older adults showed greater correct alternative selection across item types and not solely for contradictory items, which may be because of participants receiving a warning across all groups.

Proportions of falsely selected misinformation details were then compared using a 2 (Item Type: Additive vs. Contradictory) × 2 (Age: Younger vs. Older) × 3 (Warning Group: Warning vs. Detection vs. Detection + Examples) ANOVA (see Table 4). Significant effects of Item Type, $F(1, 173) = 146.78$, $MSE = .04$, $\eta_p^2 = .46$, and Age were found, $F(1, 173) = 9.99$, $MSE = .04$, $\eta_p^2 = .06$, and the effect of Warning Group was trending, $F(2, 173) = 2.34$, $MSE = .04$, $p < .10$, $\eta_p^2 = .06$.

Critically, these main effects were qualified by a three-way interaction right at the significance level, $F(2, 173) = 2.87$, $MSE = .04$, $p = .05$, $\eta_p^2 = .06$. Consistent with our predictions, follow-up tests revealed that the Detection + Examples group was beneficial in reducing misinformation selection, but only for younger adults and only for contradictory items. Specifically, younger adults showed lower suggestibility to contradictory misinformation in the Detection + Examples group than either the Warning (.26 vs. .40), $t(59) = 2.96$, $SEM = .05$, $d = 0.77$, or Detection groups (.26 vs. .41), $t(59) = 3.17$, $SEM = .05$, $d = 0.83$, with no difference between the Warning and Detection groups (.40 vs. .41). No instruction differences were found for younger adults with additive misinformation, and no effects for either misinformation type were found for older adults, ts < 1.01, ps $> .31$.

In summary, warning instructions appear to show age-specific effects in reducing misinformation suggestibility. When detection instructions provide examples of additive and contradictory misinformation types, younger adults show a reduction in misinformation selection, but only for contradictory details. This pattern is consistent with our predictions that older adults are spontaneously more vigilant toward detecting contradictory errors than younger adults and, therefore, show reduced misinformation effects on a final test. Because of this general detection process, older adults are unaffected by instructions that emphasize error detection and show no further reductions in contradictory misinformation.

Table 4
Mean Proportions (SD) of Misleading Questions Correctly Detected in the Misleading Question Phase, Comprehension Questions Correctly Recognized, and Additive and Contradictory Misinformation Questions Falsely Recognized in the Final 3-Alternative-Forced-Choice (3-AFC) Test in Experiment 2

Group/variable	Younger adults			Older adults		
	Warn group	Detection group	Detection + Examples group	Warn group	Detection group	Detection + Examples group
Correctly selected alternatives						
Comprehension	.91 (.09)	.94 (.06)	.89 (.09)	.89 (.09)	.87 (.10)	.87 (.11)
Additive	.23 (.20)	.20 (.21)	.30 (.25)	.28 (.22)	.30 (.23)	.34 (.21)
Contradictory	.47 (.26)	.47 (.21)	.62 (.18)	.61 (.16)	.59 (.22)	.61 (.16)
Neutral	.47 (.27)	.34 (.33)	.62 (.17)	.46 (.33)	.53 (.30)	.56 (.30)
Falsely selected misinformation						
Additive	.55 (.23)	.58 (.19)	.56 (.21)	.54 (.22)	.55 (.20)	.50 (.17)
Contradictory	.40 (.22)	.41 (.22)	.26 (.15)	.26 (.14)	.24 (.15)	.26 (.15)

Younger adults on the other hand, are less vigilant towards detecting contradictions, but can improve their detection under strong detection instructions. Note that their improvement in the detection of errors and subsequent reduction in suggestibility to contradictory misinformation brings them to the level of older adults' performance on these tasks.

We further conducted a series of analyses comparing misinformation rates on the final test conditionalized as a function of successful and unsuccessful detection on the misleading cued-recall test. These results closely parallel the unconditionalized results above and have relegated these results and their discussion to Appendix B.

General Discussion

The purpose of our study was to provide a direct comparison between additive and contradictory misinformation types and their suggestibility in younger and older adults. In two experiments, we demonstrated that suggested additive details that supplement an original event were falsely recognized at a greater rate than contradictory details that conflicted with specific details in the original event. This pattern was found in both younger and older adults, demonstrating that the effects of additive misinformation are costly across age groups. We argue that differences in misinformation types reflect a detect-and-reject process whereby discrepancies between contradictory details and those in the original event increase the likelihood that misinformation is subsequently rejected at test (see Huff, Davis, & Meade, 2013; Loftus, 2005; Tousignant et al., 1986, for discussion). The higher rate of additive misinformation provides evidence against the possibility that these supplementary details are more memorable, and in turn, better rejected at test. Thus, qualitative features of how false details impact original event details can influence their later endorsement.

Our comparison of additive and contradictory misinformation effects in younger and older adults was designed to address important limitations reported in other experiments. First, our study statistically compared the two types of misinformation and their magnitude—comparisons absent in previous studies (Saunders & Jess, 2010; Tousignant et al., 1986). Second, we were also able to compare misinformation types when their rates were off floor (cf. Nemeth & Belli, 2006). Finally, and most importantly, we controlled for possible item differences in previous work (e.g., Saunders & Jess, 2010) by counterbalancing the specific items used to create additive and contradictory items. Thus, we can have more confidence that differences in additive and contradictory misinformation rates are because of qualitative aspects of how falsely suggested details impacted memory for the original event and not because of the suggestibility of a particular item.

Although younger and older adults were both less susceptible to contradictory versus additive misinformation, older adults showed a *greater* reduction in suggestibility to contradictory misinformation, a finding demonstrating greater accuracy for older adults on an episodic memory task. We suggest that older adults may be spontaneously more vigilant and likely to notice errors during the misleading question phase, possibly because of differences in conscientiousness and, therefore, more likely to reject these errors on the final test. In Experiment 2, we evaluated this possibility by comparing three separate types of warning instructions: A general warning, a warning with instructions to report all detected errors, and Detection + Examples instructions that provided specific examples of additive and contradictory misinformation types. We expected that if older adults were spontaneously more vigilant toward error detection, then additional instruction to explicitly detect errors would procure no greater reduction in contradictory misinformation at test. Consistent with our prediction, older adults showed no differences in contradictory misinformation rates across increasing levels of warning and detection instructions, whereas younger adults successfully reduced contradictory misinformation to the same level as older adults following Detection + Examples instructions. An interesting find was that additive misinformation was immune to the increasing strength of warning, consistent with the notion that the supplementary nature of additive misinformation is less likely to be detected and rejected at test, even under conditions in which error detection is prioritized.

The use of three different types of warnings in Experiment 2 provides additional information regarding the effectiveness of warnings in misinformation paradigms and how these warnings differentially affect younger and older adults. To our knowledge, our study is the first to compare the effectiveness of increasing strengths of warnings in younger and older adults, though comparisons were not made to a nonwarning control. Therefore, we conducted a series of cross-experimental comparisons between additive and contradictory misinformation types between younger and older adults in Experiment 1 and the warning groups in Experiment 2 to evaluate whether warning and detection instructions were effective at reducing misinformation relative to a nonwarning control. This analysis revealed that, for younger adults, only the Detection + Examples group reduced misinformation for contradictory items relative to all instructions, ts > 2.96, ds > 0.76, with all other comparisons being nonsignificant, including those with additive items, ts < 1. For older adults, there were no differences for either misinformation type across warning instructions, ts < 1. Thus, even relative to a nonwarning control, warning and detection instructions appear to be largely ineffective at reducing misinformation effects, except for younger adults in the Detection + Examples group for contradictory items.

Regarding age-related differences in error detection, our results showed that the strong Detection + Examples instructions did not reliably increase detection rates for older adults but did lead to an increase in younger adults. As mentioned above, older adults' similar error detection rates in the Detection and Detection + Examples groups and subsequently low suggestibility across all conditions indicate that the low contradictory misinformation rate may be because of their spontaneous monitoring of errors during the misleading question and final test phases. For younger adults, however, successful detection rates under Detection + Examples instructions did increase, which led to a reduction in contradictory misinformation on the final test. Of course, because participants only reported whether an error was present in a specific sentence, it is unclear whether participants were successfully detecting exact errors or instead fail to remember the original story but do notice a difference in the question. Determining the specific errors that participants detect by having them explicitly report the exact errors they think they found ("it was X, not Y" instead of simply marking "error") in future work could provide additional evidence that participants are rejecting those errors that are initially detected.

Detection instructions in Experiment 2 further allowed for a comparison of the rates of detected errors between misinformation

types. Across both detection instructions, rates of successful detection of additive and contradictory errors were higher than false alarms to neutral items, though no differences between the two misinformation types were found. The equivalence between misinformation types may appear surprising because (a) discrepancies are more concrete with contradictory items and arguably easier to identify and (b) there is a difference between the types for subsequent suggestibility. One possible reason for this similarity is that the detection instructions themselves did not require that participants specify exact errors they thought were embedded within the questions. It is, therefore, unclear as to whether participants detected the precise error successfully, critical component of the Discrepancy Detection principle (Loftus, 2005; Tousignant et al., 1986).

Another possibility is that the task of detecting additive versus contradictory details during the misleading question phase is not all that different. That is, detection of a specific contrast from the original story may not be necessary to detect an error. When a new detail is presented during the misleading question phase, this detail may be just as anomalous to participants regardless of its relationship to details in the original event simply because of its novelty. Thus, the detection of novelty from the suggested details themselves could be the feature that participants are reporting when detecting an error, not because they are noticing a discrepancy with the original event. The results may then suggest that only when the differences are accessible during the final test does one see the effects on suggestibility. For contradictory details, memory for the exposures to (if not the content of) both the original and contradictory details are needed to inoculate against contradictory misinformation. For additive details, however, these details have become familiar and fluent because of recent exposure and come to mind more easily than the memory for a lack of an original detail. Errors then become more likely, and additive misinformation is endorsed at a high rate. Thus, for both types of misinformation, the detection process during the misleading question phase may occur similarly (i.e., detection of novelty), but the *rejection* process on the final test is more difficult for additive than contradictory details. Determining whether the detection process that occurs during the misleading question phase is the same or different processes that is occurring during the final test that is leading to the rejection is an important step for future work.

The misinformation rates found in our experiments are consistent with the notion that misinformation responses reflect a source-monitoring error in which participants become confused regarding the correct source of falsely suggested details (Lindsay & Johnson, 1989). Source confusions can account for both additive and contradictory misinformation effects, though source confusions are less likely for contradictory items as the original event sources are easier to recollect. In general, older adults are more likely to commit source errors (Hashtroudi et al., 1989) and struggle with inhibiting irrelevant information (Hasher & Zacks, 1988), which may account for the relative increase in misinformation effects generally found in older adults (Wylie et al., 2014). In our experiments, however, older adults did not show an increased misinformation effect for either item type. We note that this pattern is not unheard of (e.g., Holliday et al., 2011; Marche et al., 2002) and may reflect an age-related propensity to spontaneously monitor for suggested errors (Schwartz, 2002). This age difference does not appear to be consistent with the either the source-monitoring or inhibitory deficit accounts. Given that older adults show a reduction in contradictory misinformation, our data suggest that older adults may be better at monitoring for and then rejecting more recently encountered information that is false.

Our experiments also employed an entirely fictional story and primarily used proper nouns as the vehicle for misinformation. The purpose of these materials was simply to equate (by removal) possible age differences in prior knowledge as older adults tend to have more prior knowledge (Park, 2000) and rely on it more than younger adults (Umanath & Marsh, 2014). In applied scenarios, such as eyewitness events, witnesses are likely accompanied by a degree of prior knowledge that can impact information that is attended to and retrieved. In our paradigm, age differences in schematic information (i.e., knowledge of car accidents or crimes) or other types of knowledge (i.e., facts or vocabulary) could not have affected misinformation responses because suggested items were novel fake facts. Indeed, by eliminating the possibility for use of schematic knowledge, older adults may have been disproportionately encouraged to be more vigilant regarding the accuracy of information to which they were exposed. Systematically examining the accessibility and use of prior knowledge to assist in monitoring for memory accuracy could be fruitful area of research when evaluating age-related differences.

The use of a fictional story may have also led to differences in how participants evaluated information within the story because of how individuals tend to "suspend their disbelief" when reading fictional narrative information. Suspension of disbelief refers to how individuals reduce their monitoring for accuracy to transport themselves into a narrative (Green, Garst, & Brock, 2004). In doing so, participants may actually become more susceptible to suggestibility (vs. a nonfictional narrative) because accuracy of information is de-emphasized in favor of immersion in the narrative world. To our knowledge, there has been no study that has evaluated the extent to which younger and older adults suspend (or are able to suspend) their disbelief in such contexts; thus, it is unclear to what extent suspension of disbelief may have influenced age-related differences in suggestibility.

Finally, while our paradigm was not designed to mimic eyewitness scenarios in materials (e.g., narrative vs. crime scene), it does share many of the same elements. First, misinformation tends to be stronger for peripheral details relative to focal plot points (e.g., Heath & Erickson, 1998; Loftus, 1979), such as our use of names and proper nouns that were not needed to comprehend the narrative. Second, misinformation regarding proper nouns is a likely source in eyewitness scenarios given that names and locations often accompany these events. Names and locations that are supplementary are particularly harmful to memory in younger and older adults, and despite the fact that older adults show impairments in name recognition (Barresi, Obler, & Goodglass, 1998), they were not more suggestible to these details. Third, a fictional story mimics narrative information in eyewitness events and fits with other laboratory-based paradigms that have shown misinformation effects using a variety of materials (e.g., slide sequences, videos, etc., see Zaragoza et al., 2007, for review). Finally, our use of a 3-AFC test is likely similar to many of the direct questioning methods used on eyewitnesses. Although there are many benefits to using free-recall type questioning in forensic settings such as the cognitive interview (Fisher & Geiselman, 1992), we note that this type of questioning is not practiced universally (e.g., Brunel & Py,

2013; Wells, Memon, & Penrod, 2006) and may leave witnesses with tests/questioning procedures that require discrimination of correct and incorrect information like the 3-AFC. Thus, our paradigm shares many similarities with eyewitness events and laboratory-based paradigms and even offers advantages of using names and locations as misinformation that are often critical details.

Conclusions

The present study was designed to evaluate misinformation effects in younger and older adults for two fundamentally different types of suggested details—those that are supplementary (i.e., additive) to the original event, and those that are contradictory. The results of the study are noteworthy in that additive details were falsely recognized at a greater rate than contradictory in both age groups. We argue that this difference represents a detect-and-reject process that is more successful for contradictory items whereby participants can detect a memory discrepancy between the original and suggested details at test and select the correct detail. In addition, it was found that, except for younger adults with strong detection instructions, contradictory misinformation was lower for older adults, which may suggest an overall increased vigilance toward the detection of memory discrepancies making older adults more successful rejecting errors at test. Consistent with this possibility, only younger adults could reduce errors caused by contradictory misinformation under conditions designed to encourage error detection. The present experiments, therefore, provide evidence for the detect-and-reject process for contradictory items and show age-related differences in how groups implement error detection processes—processes that provide important information about how memory accuracy can be improved.

More broadly, understanding how strongly and in what ways different types of misinformation affect individuals, both young and old, is becoming more and more critical as people are constantly inundated with information—much of which they may have little to no prior related knowledge of. The finding that additive misinformation is not only more potent than contradictory misinformation but also resistant to heightened monitoring is disconcerting but critical to further understand. Determining whether or not susceptibility to additive misinformation can be reduced will only come from investigating why people are suggestible to it in the first place. Similarly, delving into the mechanisms that drive older adults' reduced suggestibility here to contradictory misinformation with and without any warning or vigilance instructions may allow us to discover ways in which we may reduce suggestibility for everyone. A hint of what might inoculate against suggestibility is seen in the very strong detection instructions with examples condition wherein younger adults were finally able to reduce their susceptibility to at least contradictory misinformation. Future work should be aimed at a deeper understanding of these misinformation types, how suggestibility can be reduced for each, and what we can learn from older adults' reduced suggestibility to benefit everyone.

References

Balota, D. A., Dolan, P. O., & Duchek, J. M. (2000). Memory changes in healthy young and older adults. In E. Tulving & F. Craik (Eds.), *Oxford handbook of memory* (pp. 395–410). Oxford, UK: Oxford University Press.

Barresi, B. A., Obler, L. K., & Goodglass, H. (1998). Dissociation between proper name and common noun learning. *Brain and Cognition, 37,* 21–23.

Berger, S. A., Hall, L. K., & Bahrick, H. P. (1999). Stabilizing access to marginal and submarginal knowledge. *Journal of Experimental Psychology: Applied, 5,* 438–447. http://dx.doi.org/10.1037/1076-898X.5.4.438

Blank, H., & Launay, C. (2014). How to protect eyewitness memory against the misinformation effect: A meta-analysis of post-warning studies. *Journal of Applied Research in Memory & Cognition, 3,* 77–88. http://dx.doi.org/10.1016/j.jarmac.2014.03.005

Brunel, M., & Py, J. (2013). Questioning the acceptability of the cognitive interview to improve its use. *L'Année Psychologique, 113,* 427–458. http://dx.doi.org/10.4074/S0003503313003059

Chambers, K. L., & Zaragoza, M. S. (2001). Intended and unintended effects of explicit warnings on eyewitness suggestibility: Evidence from source identification tests. *Memory & Cognition, 29,* 1120–1129. http://dx.doi.org/10.3758/BF03206381

Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: Effects on reality monitoring and on eyewitness testimony. *Psychology and Aging, 4,* 10–17. http://dx.doi.org/10.1037/0882-7974.4.1.10

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and the NEO Five-Factory Inventory (NEO-FFI) Professional Manual*. Odessa, FL: Psychological Assessment Resources.

Coxon, P., & Valentine, T. (1997). The effects of age on eyewitness on the accuracy and suggestibility of their testimony. *Applied Cognitive Psychology, 11,* 415–430. http://dx.doi.org/10.1002/(SICI)1099-0720(199710)11:5<415::AID-ACP469>3.0.CO;2-A

Craik, F. I. M. (1986). A functional account of age differences in memory. In F. Klix & H. Hagendorf (Eds.), *Human memory and cognitive capabilities* (pp. 409–422). Amsterdam, the Netherlands: Elsevier.

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

Davis, D., & Loftus, E. F. (2007). Internal and external sources of misinformation in adult witness memory. In M. P. Toglia, J. D. Read, D. F. Ross, & R. C. L. Lindsay (Eds.), *The handbook of eyewitness psychology: Volume I. Memory for events* (pp. 195–237). Mahwah, NJ: Erlbaum.

Dodson, C. S., & Krueger, L. E. (2006). I misremember it well: Why older adults are unreliable eyewitnesses. *Psychonomic Bulletin & Review, 13,* 770–775. http://dx.doi.org/10.3758/BF03193995

Donnellan, M. B., & Lucas, R. E. (2008). Age differences in the Big Five across the life span: Evidence from two national samples. *Psychology and Aging, 23,* 558–566. http://dx.doi.org/10.1037/a0012897

Eakin, D. K., Schreiber, T. A., & Sergent-Marshall, S. (2003). Misinformation effects in eyewitness memory: The presence and absence of memory impairment as a function of warning and misinformation accessibility. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29,* 813–825. http://dx.doi.org/10.1037/0278-7393.29.5.813

Ecker, U. K. H., Lewandowsky, S., Swire, B., & Chang, D. (2011). Correcting false information in memory: Manipulating the strength of misinformation encoding and its retraction. *Psychonomic Bulletin & Review, 18,* 570–578. http://dx.doi.org/10.3758/s13423-011-0065-1

Fisher, R. P., & Geiselman, R. E. (1992). *Memory enhancing techniques for investigative interviewing: The cognitive interview*. Springfield, England: Charles C Thomas.

Frost, P. (2000). The quality of false memory over time: Is memory for misinformation "remembered" or "known"? *Psychonomic Bulletin & Review, 7,* 531–536. http://dx.doi.org/10.3758/BF03214367

Gabbert, F., Memon, A., Allan, K., & Wright, D. B. (2004). Say it to my face: Examining the effects of socially encountered misinformation. *Legal and Criminological Psychology, 9,* 215–227. http://dx.doi.org/10.1348/1355325041719428

Gallo, D. A. (2004). Using recall to reduce false recognition: Diagnostic and disqualifying monitoring. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30,* 120–128. http://dx.doi.org/10.1037/0278-7393.30.1.120

Gallo, D. A. (2013). Retrieval expectations affect false recollection: Insights from a criterial recollection task. *Current Directions in Psychological Science, 22,* 316–323. http://dx.doi.org/10.1177/0963721413481472

Green, M. C., Garst, J., & Brock, T. L. (2004). The power of fiction: Determinants and boundaries. In L. J. Shrum (Ed.), *The psychology of entertainment media: Blurring the lines between entertainment and persuasion* (pp. 161–176). Muhwah, NJ: Erlbaum.

Hamm, V. P., & Hasher, L. (1992). Age and the availability of inferences. *Psychology and Aging, 7,* 56–64. http://dx.doi.org/10.1037/0882-7974.7.1.56

Hasher, L., & Zacks, R. T. (1988). Working memory, comprehension, and aging: A review and a new view. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 193–225). New York, NY: Academic Press. http://dx.doi.org/10.1016/S0079-7421(08)60041-9

Hashtroudi, S., Johnson, M. K., & Chrosniak, L. D. (1989). Aging and source monitoring. *Psychology and Aging, 4,* 106–112. http://dx.doi.org/10.1037/0882-7974.4.1.106

Healey, M. K., & Kahana, M. J. (2016). A four-component model of age-related memory change. *Psychological Review, 123,* 23–69. http://dx.doi.org/10.1037/rev0000015

Heath, W. P., & Erickson, J. R. (1998). Memory for central and peripheral actions and props after varied post-event presentation. *Legal and Criminological Psychology, 3,* 321–346. http://dx.doi.org/10.1111/j.2044-8333.1998.tb00369.x

Henkel, L. A., Johnson, M. K., & De Leonardis, D. M. (1998). Aging and source monitoring: Cognitive processes and neuropsychological correlates. *Journal of Experimental Psychology: General, 127,* 251–268. http://dx.doi.org/10.1037/0096-3445.127.3.251

Holliday, R. E., Humphries, J. E., Milne, R., Memon, A., Houlder, L., Lyons, A., & Bull, R. (2011). Reducing misinformation effects in older adults with cognitive interview mnemonics. *Psychology and Aging, 27,* 1191–1203. http://dx.doi.org/10.1037/a0022031

Huff, M. J., & Bodner, G. E. (2013). When does memory monitoring succeed versus fail? Comparing item-specific and relational encoding in the DRM paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 39,* 1246–1256. http://dx.doi.org/10.1037/a0031338

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

Huff, M. J., Meade, M. L., & Hutchison, K. A. (2011). Age-related differences in guessing on free and forced recall tests. *Memory, 19,* 317–330. http://dx.doi.org/10.1080/09658211.2011.568494

Hunt, R. R., & Worthen, J. B. (2006). *Distinctiveness and memory*. New York, NY: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780195169669.001.0001

Jackson, J. D., & Balota, D. A. (2012). Mind-wandering in younger and older adults: Converging evidence from the sustained attention to response task and reading for comprehension. *Psychology and Aging, 27,* 106–119. http://dx.doi.org/10.1037/a0023933

Jetton, T. L., & Alexander, P. A. (1997). Instructional importance: What teachers value and what students learn. *Reading Research Quarterly, 32,* 290–308. http://dx.doi.org/10.1598/RRQ.32.3.4

Johnson, H. M., & Seifert, C. M. (1994). Sources of the continued influence effect: When misinformation in memory affects later inferences. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 1420–1436. http://dx.doi.org/10.1037/0278-7393.20.6.1420

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition, 17,* 349–358. http://dx.doi.org/10.3758/BF03198473

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology, 7,* 560–572. http://dx.doi.org/10.1016/0010-0285(75)90023-7

Loftus, E. F. (1979). Reactions to blatantly contradictory information. *Memory & Cognition, 7,* 368–374. http://dx.doi.org/10.3758/BF03196941

Loftus, E. F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory, 12,* 361–366. http://dx.doi.org/10.1101/lm.94705

Loftus, E. F., Levidow, B., & Duensing, S. (1992). Who remembers best? Individual differences in memory for events that occurred in a science museum. *Applied Cognitive Psychology, 6,* 93–107. http://dx.doi.org/10.1002/acp.2350060202

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

MacKay, D. G., Abrams, L., & Pedroza, M. J. (1999). Aging on the input versus output side: Theoretical implications of age-linked asymmetries between detecting versus retrieving orthographic information. *Psychology and Aging, 14,* 3–17. http://dx.doi.org/10.1037/0882-7974.14.1.3

Marche, T. A., Jordan, J. J., & Owre, K. P. (2002). Younger adults can be more suggestible than older adults: The influence of learning differences on misinformation reporting. *Canadian Journal on Aging, 21,* 85–93. http://dx.doi.org/10.1017/S0714980800000660

Marsh, E. J. (2004). Story stimuli for creating false beliefs about the world. *Behavioral Research Methods, Instruments & Computers, 36,* 650–655.

McCrudden, M. T., Magliano, J. P., & Schraw, G. (2010). Exploring how relevance instructions affect personal reading intentions, reading goals and text processing: A mixed methods study. *Contemporary Educational Psychology, 35,* 229–241. http://dx.doi.org/10.1016/j.cedpsych.2009.12.001

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

Mueller-Johnson, K., & Ceci, S. J. (2004). Memory and suggestibility in older adults: Live event participation and repeated interview. *Applied Cognitive Psychology, 18,* 1109–1127. http://dx.doi.org/10.1002/acp.1078

Nemeth, R. J., & Belli, R. F. (2006). The influence of schematic knowledge on contradictory versus additive misinformation: False memory for typical and atypical items. *Applied Cognitive Psychology, 20,* 563–573. http://dx.doi.org/10.1002/acp.1207

Park, D. C. (2000). The basic mechanisms accounting for age-related decline in cognitive function. In D. C. Park & N. Schwarz (Eds.), *Cognitive aging: A primer* (pp. 3–21). Philadelphia, PA: Psychology Press.

Rabbitt, P. (1979). How old and young subjects monitor and control responses for accuracy and speed. *British Journal of Psychology, 70,* 305–311. http://dx.doi.org/10.1111/j.2044-8295.1979.tb01687.x

Roediger, H. L., III, & Geraci, L. (2007). Aging and the misinformation effect: A neuropsychological analysis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33,* 321–334. http://dx.doi.org/10.1037/0278-7393.33.2.321

Roediger, H. L., III, & Karpicke, J. D. (2006). The power of testing memory: Basic research and implications of educational practice. *Perspectives on Psychological Science, 1,* 181–210. http://dx.doi.org/10.1111/j.1745-6916.2006.00012.x

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

Ross, M., Spencer, S. J., Blatz, C. W., & Restorick, E. (2008). Collaboration reduces the frequency of false memories in older and younger adults. *Psychology and Aging, 23,* 85–92. http://dx.doi.org/10.1037/0882-7974.23.1.85

Saunders, J., & Jess, A. (2010). The effects of age on remembering and knowing misinformation. *Memory, 18,* 1–11. http://dx.doi.org/10.1080/09658210903376268

Schacter, D. L., Koutstaal, W., Johnson, M. K., Gross, M. S., & Angell, K. E. (1997). False recollection induced by photographs: A comparison of older and younger adults. *Psychology and Aging, 12,* 203–215. http://dx.doi.org/10.1037/0882-7974.12.2.203

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-prime reference guide*. Pittsburg, PA: Psychology Software Tools, Inc.

Schwartz, B. L. (2002). *Tip-of-the-tongue states: Phenomenology, mechanism, and lexical retrieval*. Mahwah, NJ: Erlbaum.

Sutherland, R., & Hayne, H. (2001). The effect of postevent information on adults' eyewitness reports. *Applied Cognitive Psychology, 15,* 249–263. http://dx.doi.org/10.1002/acp.700

Takarangi, M. K. T., Parker, S., & Garry, M. (2006). Modernising the misinformation effect: The development of a new stimulus set. *Applied Cognitive Psychology, 20,* 583–590. http://dx.doi.org/10.1002/acp.1209

Tousignant, J. P., Hall, D., & Loftus, E. F. (1986). Discrepancy detection and vulnerability to misleading postevent information. *Memory & Cognition, 14,* 329–338. http://dx.doi.org/10.3758/BF03202511

Turgeon, M., Wing, A. M., & Taylor, L. W. (2011). Timing and aging: Slowing of fastest regular tapping rate with preserved timing error detection and correction. *Psychology and Aging, 26,* 150–161. http://dx.doi.org/10.1037/a0020606

Umanath, S., & Marsh, E. J. (2012). Aging and the memorial consequences of catching contradictions with prior knowledge. *Psychology and Aging, 27,* 1033–1038. http://dx.doi.org/10.1037/a0027242

Umanath, S., & Marsh, E. J. (2014). Understanding how prior knowledge influences memory in older adults. *Perspectives on Psychological Science, 9,* 408–426. http://dx.doi.org/10.1177/1745691614535933

Wahlheim, C. N., & Huff, M. J. (2015). Age differences in the focus of retrieval: Evidence from dual-list free recall. *Psychology and Aging, 30,* 768–780. http://dx.doi.org/10.1037/pag0000049

Wells, G. L., Memon, A., & Penrod, S. D. (2006). Eyewitness evidence: Improving its probative value. *Psychological Science in the Public Interest, 7,* 45–75. http://dx.doi.org/10.1111/j.1529-1006.2006.00027.x

Wright, D. B. (1993). Misinformation and warnings in eyewitness testimony: A new testing procedure to differentiate explanations. *Memory, 1,* 153–166. http://dx.doi.org/10.1080/09658219308258229

Wylie, L. E., Patihis, L., McCullen, L. L., Davis, D., Brank, E. M., Loftus, E. F., & Bornstein, B. H. (2014). Misinformation effects in older adults versus younger adults: A meta-analysis and review. In M. P. Toglia, D. F. Ross, J. Pozzulo, & E. Pica (Eds.), *The elderly eyewitness in court* (pp. 38–66). New York, NY: Psychology Press.

Zaragoza, M. S., Belli, R. F., & Payment, K. E. (2007). Misinformation effects and the suggestibility of Eyewitness Memory. In M. Gary & H. Hayne (Eds.), *Do justice and let the sky fall: Elizabeth Loftus and her contributions to science, law, and academic freedom* (pp. 35–63). Mahwah, NJ: Erlbaum.

Zaragoza, M. S., Lane, S. M., Ackil, J. K., & Chambers, K. L. (1997). Confusing real and suggested memories: Source monitoring and eyewitness suggestibility. In N. Stein, P. A. Ornstein, B. Tversky, & C. Brainerd (Eds.), *Memory for everyday and emotional events* (pp. 401–428). Mahwah, NJ: Erlbaum.

Appendix A

Fictional Story Used in Experiments 1 and 2

"The Art Thief" fictional story adapted from Marsh (2004) with misinformation items in parentheses.

People are always asking you questions like "How are you?" or "Having a nice day?" for which they do not really want the real answers. Instead they want stock, short, acceptable answers.

I'm sitting in this seedy little bar near (Bumbaru Palace/Simfara Palace), the palace in Zambari where the Monarch of Konkali lives, and you've just asked me why I've chosen to hang out in this particular bar. I cannot just answer "Because it's close to my hostel" or "because they have the best (Modicum/Venton) burgers, the kind made from aged deer meat", because neither is true and there's a story to be told . . . I meet people wherever I go—at parties, on planes, in bookstores. I get some great stories that way. Not to brag, but I once even met the cousin of the guy whose next door neighbor was friends with (Charles Tomelroy/Charles Greene) the man who created the "Barney the Alley Cat" comic strip.

And, believe it or not, I shared a beer with a great-great-great-grandson of (the DeWhits/Keatings) the New England family who had the famous feud with the VanPattersons.

But nothing compares to the story I'm about to tell you—it's about a guy I met last year when I was here in Zambari for spring break, after a stop-over at (the Widow's Cliff/Tavern of Eternity), the famous prehistoric structure on the Devil's Coast. So I wandered into this little hole-in-the-wall kind of bar, because I was lost, and I wanted someplace to read my guidebook away from the pickpockets. I sat down next to this kinda scruffy looking guy who had obviously had way too much to drink, and he just started talking!

"Ah, my friend, the city! The lights! The people! My American friend, can you believe we are in Zambari? I just came from a fairly impressive city, (Alondaro/Constanago) the capital of Twonkali—but compared to this—nothing!"

I glanced over at the guy, it was dark in the bar, like it is today. I couldn't really see him, and frankly, I was not very interested in what he had to say. Why would I want to talk to an American in Zambari? A drunk, old American who looked like he hadn't showered in a few days? Especially because he looked remarkably like (Rafiki/Taruba) the former dictator of Adonia.

I was not in the mood. The guy caught my glance.

"So, little American, you think I am nothing but a silly, pathetic tourist? You look at me like I'm (Kintu/Shama) a legendary two-headed horse from Indian mythology! No, you are the tourist—you are a student, correct? Well, listen to me, and you can learn a thing or two."

I glanced around the bar, thinking maybe I should switch to the only open seat I could see, but just then, a lady entered the bar. My sense of (Cavaldry/Paprin) the ancient code of ethics practiced by kings and emperors, wouldn't let me expose a woman to this crazy old American. I braced myself and felt like just by staying put, I was (Olloeus/Omicon) the man in Eskimo mythology that rescues the magic harp from the sea dragon. Who knew what this guy was going to say next? It wouldn't have surprised me if he tried to tell me that he was (Sir Vansplaken/Sir Amants) the leading general of the Resistance, come back to life.

"So, what do you do?" he asked me.

"Is your daddy paying for your trip? Do you ever make any money for yourself? Do you ever live dangerously, or do you just go to all the tourist sites and check things off your itinerary?"

He polished off another vodka shot and banged his glass down onto the bar. I decided that maybe if I just ignored him he'd stop talking, and meanwhile I'd just look up things in my guidebook while finishing my drink.

Earlier, I had noticed a page or two about how the Campaigns of (Frederick/Teutonic) Expansion, wars waged by the "German Colonials" had influenced life in Zambari and was eager to find out more. This was when I realized I had accidentally swapped my guidebook for a book by (J. R. Duke/J. R. McCormick) the author of "The Kavanaugh Adventures." Since I didn't have my guidebook to hide behind, I resigned myself to listening to what the old American had to say.

"Me, I am an art connoisseur. I am like the Angelican warrior who met his death because of his vulnerable arm; art is my arm. I do whatever it takes to get myself pretty, interesting paintings. Once I even ended up with (amilinosis/syndaria) the sailor's disease that results from a deficiency in beta carotene, in pursuit of a painting—do not ask me how. Once I get them, I appreciate them fully, unlike all those silly people who go to the museums just because they feel like they should. And, you know, I want to be the first at something like (John Anderson/John Reynolds) the first person to set foot in Tanzania. Or, do something really special like (Alfred Yates/Alfred Roberts) the person who proposed the Theory of Maladaptability. Well, except I intend to be infamous instead . . .

"You have heard of the disappearance of the original clothes pin (Matthew Delbason/Matthew Vankirk) that was invented? A little outside of my traditional art taste but it looks so nice by my fireplace, really gives the room that vintage look . . . you look uneasy, my friend. Do not worry. I am not a thief. I am not about to pick your pocket. What, you compare me to a swindler who convinces an old man that he's selling him (Oswald/Victor) King Gregory's shield?"

Definitely crazy, I decided. Just my luck, to meet a crazy American in Zambari.

"But what is the most beautiful painting of them all? (Andrew Carlton's/Andrew Moore's) Monticello: Home of Jefferson, of course, and that is why I must have it for my home."

He laughed at my look of disbelief.

"You don't believe me? But you see, it was surprisingly simple. There are natural tunnels under the museum. I just dug into one of

(*Appendices continue*)

them from the basement of a nearby building. The hard part, my friend, was getting the painting off the wall. What made it all possible, though, was that no one believed that anyone would ever try to steal the Monticello—and when people assume something is impossible, they are bound to overlook something. It's the same basic principle that got (Florence/Gwendolyn) the nymph who got caught in a golden net by a young woodsman—she thought she would never be caught!"

The drunkard paused and considered me.

"You want to make some real money? By yourself?"

He leaned closer and whispered into my ear. His breath was foul.

"See what I will give you if you help me . . ." with that, he reached into his pocket and produced a blue stone, which glistened even in the dim light of the bar. It was as big as a (Gesmetite/Sinaium) the legendary jewel from which people can see their future.

"It's a sapphire."

I think he misinterpreted my silence as some kind of agreement or interest. He grinned like (a flamingo/cockatoo) the bird that spoke to Amelia in "Over the Rainbow."

"Here's what I need you to do. Go to the airport and use my plane ticket to fly back home. That's all. I just need it to look as if I left Zambari. Then, if anyone should even think to track me, the last place they will look for me is here. Or maybe I will travel around the Continent. There is so much beautiful art on the Continent to see . . . I would like to see the Inn with the famous Impressionist artwork of San Pedro."

He ended his reverie and looked sharply at me.

"What say you? You want the sapphire?"

By this point in time, I had finished my drink, settled my check, and figured out where I was headed next. I had decided to go see an exhibit on (Robelor/Froka), the Dutch god of blood and carnal sin. There was also an exhibit on (a black wolf/speckled coyote) the canine that ancient Mayans held sacred, that looked interesting. I had no more reasons to sit and listen to a crazy guy.

So I stood up, made sure I had all my things, and started toward the door. But for a drunk, the old guy moved quickly—before I was two steps away, he had an incredibly firm grip on my upper right arm.

"You arrogant little American" he hissed.

"You don't believe a word I've said. You probably think I'm a crazy person carting around a blue paperweight. I was being nice—offering you a chance for a little excitement, and you walk out on me."

His grip on my arm tightened, it was actually painful. It felt like (centrifugal syringe/platelet filter) the instrument which stops the flow of plasma in the blood during operations.

"Before you go, my friend, I ask you to look in this shopping bag, but don't say a word! Don't be like (Jacob Blackburn/Thomas Landon) the infamous Australian traitor in the 12-years war! Don't make me yell 'Why me, my friend?' like (Prince Michael/Lady Marie!)"

Reminiscent of (Behemad/Raheb) the magician from King Tut's era, he produced a dirty shopping bag out of nowhere.

I shook his grip off, and just so he'd leave me alone, I looked in the shopping bag. What I saw was a wrench. As bizarre as that was, I was thankful that it was just a regular kind of wrench, not something crazy like a (diploid/tapper) a mallet fastened to the end of a wrench so it can be used as a hammer. After I stared at that for 30 s, I realized he actually wanted me to look at something else—a rolled up piece of parchment. All I could see was that it was an oil painting, with greeny-gold at the edges. But surely it couldn't be . . .

I do not know how long I just stood there with the open shopping bag in my hands. Suddenly the air was pierced with the sound of sirens, the old man brusquely grabbed the shopping bag away from me, and I was alone. The next day I eagerly bought a newspaper—no art theft. Nor the next day, nor the day after that. Like (a withholder/noncontributory) someone who does not participate in government but does not protest its establishment, I was feeling skeptical. I didn't want to unnecessarily panic art lovers over something that was not true, the way a rash of suicides followed the publication of the book "Plague of Fears."

I had classified it all in mind as a hoax on the old man's part until I got home. Waiting on my doorstep was a box addressed to me, and it contained the paperweight with a note attached:

"I forgive you, my friend, for your lack of imagination. Thanks for listening to an old man. Now do something exciting with this cat's eye. I've given you the real thing. Guess what my next adventure is going to be? I'm off to find (Tomad/Waterston) the legendary city that floated off into space."

I do not know how the old man got my address or even my name. I do not know what to think about the Mona Lisa currently sitting in the Louvre. All I know for sure is that he sent me a sapphire that I sold for $50,000—enough to pay off the rest of my college tuition, but instead I used it to take a trip around the world. I saw it as an opportunity to be (a silvery lynx/oriental tiger) the cat that sprang to life from its own grave and resurrect my former self. I'm doing something exciting like the old guy said—and that's how I've come to be here in this bar talking to you. Revisiting the scene of the crime, so to speak.

Next stop, I think I'll take a little trip to (Tapie/Contu) the top of the largest plateau in Namibia.

(*Appendices continue*)

Appendix B

Misinformation Conditionalized on Successful Detection

Since both detection groups noted which items they thought contained errors during the misleading question phase, we can examine whether errors that were successfully (vs. unsuccessfully) detected were subsequently rejected on a final test. We, therefore, conditionalized misinformation selection on the final test based on successful or unsuccessful detection during the cued-recall phase for each of the misinformation types as a function of age and detection instructions (Table B1). A 2 (Item Type: Additive vs. Contradictory) × 2 (Detection Type: Successful vs. Unsuccessful) × 2 (Detection Instructions: Detection vs. Detection + Examples) × 2 (Age: Younger vs. Older) mixed ANOVA was used to evaluate these effects. A main effect of Item Type was found, $F(1, 101) = 118.15$, $MSE = .07$, $\eta_p^2 = .54$, revealing that misinformation rates were greater for additive than contradictory items (.57 vs. .29) consistent with nonconditionalized misinformation rates. Effects of Detection Type, Detection Instructions, and Age were all nonsignificant, Fs < 3.01, ps $> .09$, as were all interactions except for the four-way interaction that reached conventional significance, $F(1, 101) = 4.00$, $MSE = .05$, $\eta_p^2 = .04$.

To follow-up on the four-way interaction, separate three-way analyses were conducted by conducting separate analyses on additive and contradictory misinformation types. Beginning with additive misinformation, effects of Detection Type, Instructions, and Age failed to reach significance as did all interactions, Fs $<$ 2.84, ps $> .10$, except for the marginal three-way interaction, $F(1, 105) = 3.39$, $MSE = .06$, $p = .07$, $\eta_p^2 = .03$. This interaction reflected nonsignificant numeric reduction in additive misinformation for younger adults in the Detection + Examples group when items were successfully detected versus unsuccessfully detected (.53 vs. .63), $t(27) = 1.80$, $SEM = .06$, $p = .08$, $d = 0.36$, with all other comparisons nonsignificant, ts < 1. Therefore, except for this marginal pattern, the effects of additive misinformation appear to be relatively immune to whether these details were detected initially across age groups and detection instructions.

Turning to contradictory misinformation, nonsignificant tends were found for Detection Type, $F(1, 110) = 2.94$, $MSE = .04$, $p = .09$, $\eta_p^2 = .03$, and Detection Instructions, $F(1, 110) = 4.72$, $MSE = .08$, $p = .06$, $\eta_p^2 = .04$, but a significant effect of Age was found, $F(1, 110) = 8.87$, $MSE = .07$, $\eta_p^2 = .08$. The effects of Age and Detection Instructions were qualified by a significant interaction, $F(1, 110) = 4.72$, $MSE = .08$, $\eta_p^2 = .04$. In parallel to the nonconditionalized analyses above, follow-up tests revealed that contradictory misinformation was significantly reduced for younger adults in the Detection + Examples group relative to the Detection group (.28 vs. .42), $t(55) = 2.50$, $SEM = .06$, $d = 0.67$, whereas for older adults, their lower misinformation selection was equivalent between both detection groups (.25 vs. .23), $t < 1$. All other interactions, including the three-way interaction were not significant, Fs < 1.

The conditionalized analyses, therefore, reveal that, consistent with a detect-and-reject process, contradictory, but not additive misinformation that was successfully detected during the misleading question phase was less likely to be falsely remembered on the final 3-AFC test for both younger and older adults and in both detection groups. Thus, both age groups derive similar benefits from both detection instructions.

Table B1
Mean Proportions (SD) of Misinformation Falsely Recognized on the Final 3-Alternative Forced-Choice Recognition Test Conditionalized Based on Error Detection During the Misleading Question Phase in Experiment 2

	Additive		Contradictory	
Item type/group	Successful detection	Unsuccessful detection	Successful detection	Unsuccessful detection
Detect group				
Younger adults	.63 (.36)	.57 (.23)	.39 (.36)	.44 (.23)
Older adults	.53 (.30)	.58 (.23)	.22 (.26)	.25 (.17)
Detect + Group				
Younger adults	.53 (.30)	.63 (.25)	.25 (.26)	.31 (.20)
Older adults	.50 (.32)	.48 (.20)	.24 (.23)	.28 (.21)

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