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Consequences of Choice Blindness on Memory: Altered Self-Reports Cause Memory-Blindness Distortion

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ABSTRACT OF THE THESIS

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By

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Master of Arts in Social Ecology

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Professor Elizabeth F. Loftus, Chair

Previous research on the misinformation effect has demonstrated that memory for events can be distorted by suggestive information presented after the fact. A separate line of research on choice blindness has shown that after making a choice between multiple alternatives, if people are told they chose something different from what they actually chose, they often fail to notice the discrepancy. In a methodological marriage of these two paradigms, participants first witnessed an event, and were then asked ten memory questions about what they saw. Later, their responses were presented back to them for review; half of the participants were told that these responses were their own reports from earlier, and half were told that they were responses from another subject. Importantly, three of the ten responses shown during this review were systematically altered from what the participants had originally said. At a final test, participants answered the initial memory questions a second time. Repeated measures ANOVAs revealed that viewing manipulated reports caused participants' memories to change in ways consistent with the

misinformation. This effect was stronger when the misinformation was presented as "what another participant had said" than when it was presented as "what you previously said." This "memory-blindness" finding represents an important avenue for future research on the accuracy of eyewitness reports.

Introduction

What happens when witnesses review their own statements? For a number of reasons, reviewing witness statements already made to the police could be problematic for the legal system. Research has shown that repeated questioning can inflate witnesses' confidence in their responses with no parallel increase in accuracy (Shaw & McClure, 1996). Another issue is that the information contained in one's own statement should be highly persuasive. When their memories are hazy or ambiguous, people might infer their true memories from the information presented externally in their reports (Bem, 1972). Even when the witness's memory is not ambiguous, that witness's own statement should still be persuasive, and highly persuasive messages can have great efficacy in distorting memory (Leding, 2012).

Given that witnesses' statements could influence their memories, an important question concerns what happens when the information contained in a witness statement does not reflect the witness's true memory. There are at least three reasons why a statement might be a poor representation of the true memory. First, the witness might be unsure of his memory, and report one possible version of the event while entertaining other possible versions. Secondly, the information might be recorded incorrectly (due to misunderstandings between the witness and the police, or even clerical errors). Finally, the statement might be deliberately altered by a third party. In all of these cases, the witness's own memory is in conflict with the information in the statement. In this type of scenario, merely reviewing their own persuasive (but misleading) statements might cause witnesses to come to remember the event differently, and the witnesses might also fail to realize that their memories had changed (Nisbett & Wilson, 1977). One might suspect that witnesses would be astute at detecting differences between the information present in their memories and the information contained in their memory reports, but research on the

phenomenon of choice blindness has demonstrated that in many domains, people often fail to notice such inconsistencies.

Chapter 1: Choice Blindness and False Memories

Choice Blindness: Choice blindness refers to a finding wherein people are first given a choice between options. Then, they are told they selected an option that they did not actually select. The phenomenon of interest is that people will often fail to notice this manipulation (Hall, Johansson, & Strandberg, 2012). In addition, people often endorse the option they initially rejected, and even confabulate reasons why they may have chosen it. In an excellent demonstration of this phenomenon, Hall et al. (2012) asked people on a survey form to rate their levels of agreement with various political and moral statements, such as "Large scale governmental surveillance of e-mail and Internet traffic ought to be forbidden as a means to combat international crime and terrorism." Participants were unaware that the prompts they were responding to were only lightly attached to the survey and were hiding a second set of prompts. The survey was attached to a clipboard and continued onto a second page. When participants flipped the page, a sticky pad on the back of the clipboard lifted the prompts off of the survey, revealing a new set of statements, some of which were reversed versions of the original prompts. If someone had rated themselves as "strongly agreeing" that government surveillance should be forbidden, suddenly the survey indicated that they strongly agree that governmental surveillance should be *permitted*. The researchers then asked participants to explain for several items why they had responded the way that they did. Since the manipulation had occurred covertly right in front of participants, there was no great suspicion of foul play on the part of the experimenter.

The researchers found that the manipulation was detected in less than half of trials, and that 69% of participants accepted at least one manipulation. What is more, when participants were asked about their reasons for rating critical items the way they did, many participants began expressing the attitude opposite of what they originally reported, with 53% arguing unequivocally for the opposite of their original position. This research suggests that people can often fail to notice a discrepancy between their own beliefs and the polar opposite of their beliefs, even for moral and political beliefs that people might be expected to value. The findings further suggest that, at least in the short term, being exposed to the misleading information inherent in a choice blindness study can cause a shift in subjects' attitudes. A caveat from this study, however, is that 31% of participants rejected both manipulated items—while many trials went unnoticed, many were also detected, so research on the longer-term effects of exposure to a choice blindness manipulation will have to contend with this potential limit to effect sizes.

Often in choice blindness research, the dependent variable of interest is merely how frequently people fail to detect the manipulation, whereas less work has whether the choice-blindness manipulation might have longer-term effects on participants in addition to causing apparent short-term attitude change. One study examined whether succumbing to the choice blindness phenomenon would change peoples' preferences at a later time (Johansson et al., 2013). Participants completed 15 trials where they first chose which of two faces they found most attractive. Next, in a "review phase," they were shown the face they picked and were asked to explain why they chose it, and to rate how attractive it was. Unknown to participants, on some trials (manipulated trials), the face they were shown was actually the face they did not pick. When participants were later subjected to the same 15 trials a second time, and asked to indicate their preference and rate the attractiveness of each face, their preferences remained consistent on

93% of control trials, but only 57% of manipulated trials, and only 43% of manipulated trials that remained undetected. Put differently, if, during the review phase, participants were given the face they had truly chosen, their preferences did not usually change at a later time. But when they were exposed to misleading information about the face they had chosen, often times (43%) their preferences at a later time shifted to be consistent with what they were told they had chosen rather than what they had actually chosen. This was especially true (the rate rose to 56%) when participants failed to notice the discrepancy during the initial trial. In addition, participants' ratings of attractiveness followed a similar pattern; their attractiveness ratings rose for the faces they had initially rejected but had been told they chose. The choice blindness manipulation can thus influence future choices: when people are led to believe they selected an option that they actually rejected, they are more likely to select that option in the future. Importantly, this study only assessed whether choice blindness would influence subjects' preferences, not their memories; in the second test phase, subjects were asked which face they currently preferred, not which face they had initially preferred. Nevertheless, by demonstrating that choice blindness can lead to preference change, this study showed the lasting effects of choice blindness manipulations, and raised the question of whether choice blindness might lead to memory change as well.

The Misinformation Effect: It has long been known that a person's memory can be influenced by suggestive information (Loftus, 2005). After witnessing an event, if people receive misleading information about that event, they will often incorporate that misinformation into their original memory. This process is known as the misinformation effect, and it has been studied in a variety of contexts (Betz, Skowronski, & Ostrom, 1996; Henkel & Mather, 2007; Loftus & Palmer, 1974; Meade & Roediger, 2002; Merckelbach, Jelicic, & Pieters, 2011; Ost &

Granhad, 2006). In a seminal study of memory distortion, participants viewed video clips depicting automobile accidents, and were then asked about the speed of the two cars at the time of the accident (Loftus & Palmer, 1974). The critical manipulation was the wording of the question: participants asked "how fast were the cars going when they smashed into each other" estimated higher speeds than participants asked how fast the cars were going when they "hit" each other (p. 586). When asked one week later, participants who had read the version of the question with the more intense verb were more likely to report that they had seen broken glass at the scene, even though there was none. This study provided the experimental groundwork for decades of research on false memories by showing that a person's memory for an event can be biased in ways consistent with leading or misleading post-event information he receives.

The misinformation effect has been replicated and extended in myriad studies. One moderator that these studies often explore is the source of the misinformation. While misinformation often takes the form of written accounts or is embedded in the questions posed to participants, other sources have been used. Meade and Roediger (2002), for example, had participants view scenes with one other participant, who was actually a confederate of the experiment. Participants then took turns with the confederate recalling items present in the scenes, but the confederate would sometimes recall "lure" items that had not actually been present. When participants were later asked questions about their memories for the scenes, many of them remembered the lure items, and this was true even when they were given the opportunity to attribute their memory for the lure to the confederate instead of the scene. Peers, then, can be useful vehicles for the types of misinformation that lead to false memories.

As long as participants have access to the information contained in "other participants'" reports, those "other participants" do not even need to be physically present in order to provide

misinformation. Betz et al. (1996) had participants first read a story, and then answer multiple-choice questions about the story. Participants were then shown a fabricated tally of responses that "other participants" gave. When later asked about the story again, many participants changed some of their answers to those responses most chosen by "other participants". Thus, merely being told how other putative research subjects responded is sufficient to elicit memory distortion.

While many studies have used real or putative other subjects as sources of misinformation, less work has been done using participants themselves as potential sources of misinformation. In one study, participants first made choices between two alternatives that both had positive and negative features; for example, a red car with a number of features like good handling but high mileage versus a black car with a similar list of features like a powerful engine but no warranty. (Henkel & Mather, 2007). One week later, participants were "reminded" which choices they had made, although some of these reminders were false. For the memory test, participants were asked to match the positive and negative features to their respective options. Participants attributed more positive qualities to the option they were told they picked, whether they had truly picked that option or not. Furthermore, some of the qualities presented during the memory test were completely novel. Of these features, participants attributed more positive qualities to the option they were told they picked (whether they had truly picked that option or not), and more negative qualities to the option they were told they rejected. These results were among the earliest to demonstrate that people could be misled about their own prior choices.

Participants have even been misled about their own past symptom reporting (Merckelbach et al., 2011). In this study, participants first completed a 90-item checklist of psychological symptoms. One item, for example, asked how often participants experienced

repeated unpleasant thoughts, from 0 (not at all) to 4 (all the time). For each participant, the experimenters manipulated two responses by moving them 2 points on the 5-point scale, and then asked participants to elaborate on their responses for those symptoms. For example, if a participant had given a 2 (occasionally) for experiencing unpleasant thoughts, they were misinformed that their prior score was a 4 (all the time). 63% of participants were blind to the manipulation, meaning they accepted the misinformation for both items during this stage. Participants who accepted the misinformation (blind) did not differ from those who did not accept the misinformation (non-blind) on symptom reporting at baseline. However, at both an immediate follow-up and a 1-week follow-up, blind participants scored significantly higher on misinformation items than control items, whereas there were no differences for non-blind participants. This experiment advanced the use of people as sources for their own misinformation by demonstrating that, to the extent that they do not detect the discrepancy between their actual reports and their manipulated reports, they will tend to adopt the responses of the fabricated reports. Furthermore, this study demonstrated that people could be misled about substantial, self-relevant matters, as opposed to trivial preferences.

The use of participants' own reports as sources of misinformation raises two competing hypotheses. On the one hand, once people report their memories, they should view those reports as accurate accounts. They may even view those reports as more accurate than their memory at a later time, since their memories will continue to degrade over time, but the reports will remain unchanged. Thus, the misinformation will be highly believable and persuasive, which could lead to higher rates of false memories (Leding, 2012). On the other hand, to the extent that people detect the changes made to their reports, they should be less susceptible to misinformation

(Merckelbach et al., 2011; Johansson et al., 2013), and may even be more vigilant in noticing "errors" in the future.

Self-Sourced Misinformation: If peoples' attitudes and preferences can be influenced by manipulating their reports, can a similar effect be found for eyewitness memories? In other words, if people first witness an event, report their memories for the event, and later receive a falsified version of their reports, will their memories change in ways consistent with the misleading information they receive? As previously discussed, this could be an important question for the legal system; people are often shown a summary of what is supposed to be their own witness statements. If those statements contain any sort of misleading information—either as the result of the witness's own errors, clerical errors, or deliberate manipulation—those statements could represent a route to the inception of false memories.

The present study sought to test this question. Participants first watched a slideshow depicting a crime. Next, they were asked memory questions about the slideshow, and they responded on 15-point continuous scales. They then reviewed their responses and were asked follow-up questions. Unbeknownst to participants, for three of the questions, their responses had been changed by four points on the scale; this constituted the misinformation. Finally, participants were asked the original memory questions a second time. In order to compare this self-sourced misinformation to a more traditional misinformation effect, participants in a second condition were told during the "review" stage that the responses given were elicited from another participant. We predicted that for manipulated items, participants' reports on the final test would have changed from their initial reports in ways consistent with the misinformation they received, while their responses for control items would remain the same. Given that the issue of people detecting the discrepancies between their initial reports and their manipulated reports is unique to

the self-sourced misinformation group we further predicted that this effect would be somewhat stronger for the traditional misinformation group. This prediction is also consistent with several studies document that people often detect choice blindness manipulations (Johansson et al., 2013; Hall, et al., 2012), and if participants recognize the discrepancy between what they reported and what they are told they reported, they may be more resistant to the misinformation (Johansson et al., 2013).

Chapter 2: Methodology and Procedure

Participants

The participants were 186 students at a university in southern California who received partial course credit for their time. Six participants failed to complete the experiment, yielding a final sample of 180. Of the sample, 81% were female. Ages ranged from 18-36, with a mean age of 20.6. 46% of the sample identified as Asian, 24% as Hispanic/Latino, 16% as Caucasian, and 11% as other, with 3% of participants preferring not to state their ethnicity.

Design

The present study consisted of two experimental conditions. In both conditions, participants received falsified versions of their own memory reports. In the "Self-Sourced" condition, these reports were presented as the true account the participant had reported. In the "Other-Sourced" condition, these reports were presented as the account another participant had reported in a previous trial.

The memory reports in this study consisted of ten items. For each subject, three of those items, chosen at random, were manipulated (misinformation items), while the other seven items were not manipulated (control items). Thus, the present study was a 2 (self-sourced vs. other-sourced, between subjects) x 2 (misinformation vs. control, within subjects) mixed design.

There were two dependent variables of interest: the difference between participants' reports of their memories between the baseline test and the final test, and the direction of those differences (consistent with or inconsistent with the misinformation).

The event participants witnessed was depicted by a slideshow involving a female character interacting with three other characters, one of whom steals her wallet. This slideshow was adapted from Okado and Stark (2005). The slideshow consisted of 50 images, each presented for 3.5 seconds. Thus, the length of the slideshow was 2 minutes and 55 seconds.

Procedure

The present study was conducted online. Participants enrolled in a study called "Visual Perception and Learning," and were told before beginning the experiment that the study was designed to investigate how one's personality affects the way one perceives visual stimuli. Participants were also asked to participate in a distraction-free environment, to maximize their browser window for the study, and not to engage in other tasks.

Exposure: In the "exposure" phase of the experiment, participants were shown the slideshow. They were instructed to pay attention to the events depicted because they would be asked questions about the events later. To ensure that all subjects received equal exposure to the materials, the options to pause, rewind, or skip through the slideshow were disabled.

The next phase of the experiment was the first retention interval. This phase lasted approximately 15 minutes, during which participants responded to personality questionnaires. The purposes of this phase were to increase the time between when participants encoded the slideshow and when they were asked to retrieve information, and to distract participants from rehearsing the events in the slideshow. This helped ensure that participants were not perfectly accurate for the memory test.

Baseline Test: Next, participants were asked about their memories for the slideshow (Test 1). Each participant was asked the same ten questions, but they were displayed one at a time, in a random order. One question, for example, asked "How tall was the thief?" with answers ranging from five-feet, seven inches to six-feet, two inches. The ten memory questions were all presented on 15-point Likert-type scales (see Appendix). This was done so that each item would approximate a continuous variable, in line with previous research (Hall et al., 2012; Merckelbach et al., 2011). After Test 1, participants were given a second retention interval similar to the first.

Misinformation: The participants then entered the misinformation stage. They were shown their responses to the memory questions, but three of their responses (chosen randomly) had been altered. For these three items, the participants' answers were shifted four steps along the Likert scales. The direction each response was moved was randomized, unless the initial responses were too close to the endpoints of the scale to allow for a shift of four steps. For example, if a participant had reported that the thief was 5'10", they were told that they had previously said he was either 6'0" or 5'8" (see Figure 1).

In order not to arouse suspicion when the misinformation was presented (and to minimize demand characteristics), participants were given a cover story that they were being presented with previous responses because these responses could serve as retrieval cues, which have been shown to aid in remembering information. For each critical question, a difficult or impossible follow-up was developed; participants were shown their previous responses, presented either as their own reports or another participant's reports, and then asked the follow-up question. For example, one page read "In a previous trial, another participant said that the thief's jacket was the color indicated," and on the next page they were asked "What brand was it?" In this way, participants were required to engage with the misinformation. To further ensure participants

reviewed the misinformation, they were prevented from clicking through the pages of the survey that contained misinformation for four seconds. The ten items were randomized, and the misinformation appeared for the fourth, sixth, and ninth items. Non-misleading items were presented first and spaced throughout the misinformation phase in order to reduce participant suspicion and to lure participants into believing the information presented was accurate. After the misinformation stage, participants entered the final retention interval, which was similar to the first two.

Final Test: The final stage of the experiment involved participants responding to the same ten memory questions for a second time. The questions were displayed in the same order as they were for the misinformation stage.

Debriefing: In the debriefing stage, participants were first asked what they thought the study was about in a multiple-choice question with four possible options: How your personality affects your visual perception; How your personality affects your memory; How misleading information affects your memory; and The difference between short-term and long-term memory. They were then asked if anything in the experiment seemed odd to them, and given room to explain their choice. Demographic information, such as age, race, and gender, was requested last. Afterwards, participants were fully debriefed about the purpose of the study, and due to the deceptive nature of the experiment, they were given the opportunity to withdraw their responses from the data set (though no participant did).

Attention Checks: Because this study was conducted entirely online, there was some concern that participants would not devote their full attention to it. Thus, three attention checks were used: each attention check was inserted as an item in a personality scale during each of the three retention intervals. The attention checks were all similar in form and not especially

stringent, e.g., “This question is to see if you are paying attention. If you are paying attention, choose ‘Strongly Agree’ as your answer.”

Data Analysis Plan

The design of the present study lends itself to several types of analyses. In order to test whether participants were seduced by the misinformation, two different analyses were used. The first, termed “magnitude of memory distortion,” measures the size of the change in participants’ memory reports from test 1 to test 2. This analysis is advantageous in its fidelity to the variability in participant responses to control items, but it is disadvantageous is that it does not account for the direction that participants were misled. In other words, this analysis treats participants who changed their responses in line with the misinformation the same as participants who changed their responses in ways opposite the misinformation. The magnitude of memory distortion analysis is sensitive to the magnitude of memory change, but not the direction.

The second data analysis method, termed “change in memory in predicted direction,” differs from the above analytic method by taking into account the direction of the misinformation. It is essentially a measure of mean differences; when participants change their responses in ways congruent with the misinformation, they receive positive scores, and when their responses change away from the misinformation, they receive negative scores. This type of analysis, used by Merckelbach et al. (2011), is advantageous in that it specifically measures the efficacy of the misinformation. This analysis is sensitive to the direction of the change in memory (i.e., consistent or inconsistent with the misinformation). Because they complement each other well, both analyses are presented.

Chapter 3: Results

Attention Checks: Of the 180 participants who completed the study, 15 failed at least 1 attention check. These participants were excluded from the analyses. Including these participants did not alter the general pattern of findings.

Blindness to Hypotheses: When asked in a four option multiple-choice question what they thought the experiment was about, 24% of participants selected the true purpose of the experiment; 76% of participants responded incorrectly. While 24% of participants choosing the correct response could be interpreted as a chance-level finding, the most conservative approach is to assume that all of these participants understood the true purpose of the study.

When asked whether anything in the experiment struck participants as odd, only 18% of participants reported finding anything odd, and only 7 participants (4% of the sample) mentioned anything specifically related to the purpose of the study (e.g., "Unless I was correct on half or more of my guesses; it seemed like the parts where it said; another person reported X height; weight; or clothing color were identical to my responses. It made me wonder if you were testing changes in confidence in our response if "another witness" reported the same thing vs. a different thing"). The remaining 14% did not mention anything specifically related to the hypotheses of the study (e.g., "I wonder what the thief bought with the victims wallet at the store?").

The broadest measure of the number of participants who detected the purpose of the study is calculated by combining those who guessed the purpose in the multiple-choice question, those who reported finding something odd about the study, and those who did both. This measure almost certainly overestimates the true number of detectors, but is useful nevertheless to bound estimates of participant detection. By this measure, 60 participants, or 36% of the sample, were suspicious of the purpose of the study on some level. By contrast, the narrowest measure of detectors is the percent of subjects who specifically mentioned something directly related to

the hypotheses of the study when asked if anything about the study struck them as odd. By this measure, 7 participants, or 4% of the sample detected the purpose of the study. The percent of participants who truly detected the hypotheses of the study is likely between these two extremes.

The 7 participants who identified something specifically related to the hypotheses of the study were included in the below analyses. To exclude the participants who seemed to detect the purpose of the study is to exclude those who would be most likely to falsify the study's primary hypotheses. Furthermore, it remains an important empirical question whether those who detect the choice blindness manipulation might still be affected on a less immediate timescale (Johansson et al., 2013). Finally, the general pattern of results remained the same whether these participants were included in the analyses or not.

Magnitude of Memory Distortion: The magnitude of change in memory reports was calculated by finding the absolute value of the difference between reports at test 1 and test 2 and averaging these values within participants. This allowed for an examination of the absolute size of change from test 1 to test 2 of misinformation and control items, not accounting for the direction of this change.

As can be seen in Figure 2, misinformation items elicited greater levels of memory distortion than control items. People changed their responses more from test 1 to test 2 when they were shown misleading information. In addition, this effect was stronger in the other-sourced group than in the self-sourced group.

A 2 (self-sourced vs. other-sourced) by 2 (misinformation vs. control) repeated measures analysis of variance (ANOVA) was used to conduct this analysis. Results revealed a significant main effect for misinformation, such that participants' memories changed more for misinformation items than for control items, $F(1, 163) = 27.62$, $p < .001$, $\eta_p^2 = .15$. In addition,

there was a significant interaction between misinformation source and misinformation, such that this effect was stronger for participants in the other-sourced condition than those in the self-sourced condition, $F(1, 163) = 4.58$, $p = .03$, $\eta_p^2 = .03$.

Figure 4 displays how frequently participants changed their answers in the direction predicted by the misinformation versus in the opposite direction. As the figure shows, for misinformation trials, when participants changed their reports from test 1 to test 2, 81.5% of the time those changes occurred in the direction of the misinformation; participants only changed their reports in ways inconsistent with the misinformation they received on 18.5% of trials. Thus, overwhelmingly, when participants changed their responses, those changes occurred in the direction of the misinformation. Additionally, there were no differences in the direction of change between the groups, $\chi^2(1) = .98$, $p = .32$.

For control trials, when participants changed their reports from Test 1 to Test 2, 49.8% of the time those changes occurred to the left on the scale, and 50.2% of the time those changes occurred to the right. In other words, there was no pattern of changes in memory for the control items. However, for the majority of control trials (58.7% of them), the change in memory from Test 1 to Test 2 was zero, whereas misinformation trials only resulted in zero change 39% of the time.

Change in Memory Reports in the Predicted Direction: The above analysis has two weaknesses. First, it inflates memory distortion for control items; a change in one response of one scale point to the left and a change in a second response of one scale point to the right both count as a one point change, rather than averaging to zero. Second, it does not account for the direction participants were misled. For example, consider a participant who initially responded with a "7," and was later told they had responded with an "11." Analyses of the overall change

in memory reports would code that participant's memory distortion equally whether their final response was a "3" or an "11". In other words, it does not consider the direction of the misinformation. The present analysis accounts for both issues. It is worthwhile to note that Merckelbach et al. (2011) used this type of analysis with their data.

In the present analysis, all misinformation items are treated as though participants were misled positively – that is, to the right on the scale. Trials in which participants were misled negatively were reverse coded. Thus, for this analysis, a positive change represents change in the direction of the misinformation, and a negative change represents change inconsistent with the misinformation. It would therefore be predicted that misinformation items produce a positive change and control items produce zero change.

Figure 4 illustrates the results of this analysis. As the figure shows, there is no difference from Time 1 to Time 2 for control items. However, the bars for critical items reveal that for both groups, responses changed by roughly one point on the scale in the direction of misinformation.

To analyze these average differences in memory reports from Test 1 to Test 2, a 2 (self-sourced vs. other-sourced) by 2 (misinformation vs. control) by 2 (Test 1 vs. Test 2) repeated measures ANOVA was used. Analyses revealed a significant main effect for misinformation items, $F(1, 163) = 9.89$, $p = .002$, $\eta_p^2 = .06$. There was also a significant effect for time, $F(1, 163) = 94.61$, $p < .001$, $\eta_p^2 = .37$. Finally, there was a significant time by misinformation interaction, $F(1, 163) = 78.88$, $p < .001$, $\eta_p^2 = .33$. For misinformation items but not control items, participants' memories at time 2 were shifted in the direction of the misinformation. No effects were found for misinformation source, all ps $> .05$.

Chapter 4: Discussion and Conclusions

The major finding in this research is that participants exposed to altered versions of their own memory reports for episodic details of a witnessed event exhibited changes in their memories consistent with those altered reports. Manipulated items led to a greater magnitude of memory change than control items, and this change was overwhelmingly in the direction of the misinformation (Magnitude of Memory Distortion). This was true even when the variables were analyzed in terms of mean differences (Change in Memory Reports in Predicted Direction). As predicted, one of the present analyses suggested a stronger effect for participants in the other-sourced group than in the self-sourced group when the data were analyzed in terms of the magnitude of memory distortion, as revealed by a significant condition by misinformation interaction.

Perhaps one reason why the self-sourced group exhibited a less strong misinformation effect has to do with their rates of detection. While only 4% of the sample indicated knowledge of the hypotheses of this study, up to 36% were somewhat aware as indicated by their responses to the questions probing their knowledge of the study's hypotheses. In previous studies of choice blindness (e.g., Johansson et al., 2013), the experimental design allowed for a measure of "spontaneous detection" – that is, participants could report detecting the manipulation during the procedure rather than at the end of the study. Johansson and colleagues (2013) found that participants who were blind to the manipulation changed their preferences to the faces they initially rejected more than detectors did. Put differently, the choice blindness manipulation can have some effect when subjects detect it, but its effect is stronger when they do not, and this difference would only be apparent in the self-sourced group. This may account for why the self-sourced group exhibited a less strong misinformation effect.

The present study is the first to examine the choice blindness phenomenon as applied to eyewitness memory. Research on the misinformation effect has shown how suggestive influences can lead to false memories (e.g., Betz et al., 1996), and work on choice blindness how people often fail to detect changes to their own reports (e.g., Johansson et al., 2013). The present study represents a marriage of these two phenomena by demonstrating that when eyewitnesses are exposed to altered versions of their own reports of a witnessed event, this exposure can cause changes in their memories. This phenomenon is referred to as memory-blindness.

While the memory-blindness finding is exciting, little is known about the possible mechanisms for these effects. One possible effect involves cognitive consistency. In the cognitive dissonance phenomenon, when people are made to behave in ways inconsistent with their attitudes, they experience internal conflict, and their attitudes tend to change in order to match up with their behavior (Festinger & Carlsmith, 1959). To the extent that memory and attitudes are comparable, a similar phenomenon may be occurring with memory-blindness. People have an internal memory (the "attitude") for an event, and are presented with evidence in the form of a bogus report (the "behavior") that they actually hold a different memory. Then, to reduce dissonance, their internal memory changes to be more in line with the external representation of their memory. This explanation for the present findings appears less parsimonious at face-value than an explanation based on the misinformation effect, but it has been discussed in previous studies of choice blindness (Johansson et al., 2006), and is perhaps worth pursuing in future studies.

Limitations and Future Directions

One limitation of this study involved the difficulty of measuring when participants detected the choice blindness manipulation. Typically, choice blindness studies are conducted

in-person (e.g., Meckelbach et al., 2011; Hall et al., 2012; Johnasson et al., 2013), which allows participants to voice their detections both *concurrently* (as the manipulation occurs) and *retrospectively* (at some point in the debriefing process). The present research was only able to measure retrospective detection, and since it was conducted online, many participants who truly did detect the manipulation may have "clicked through" the open-ended question asking whether participants found anything odd in order to finish faster. However, all participants had to respond to the multiple-choice question asking what they thought the purpose of the study was, so for that question, it would not have saved participants any time not to be forthcoming. In addition, a measure of retrospective detection should capture all of the participants who detected concurrently as well. The present study, then, while unable to establish a precise measure of the number of concurrent detectors, nevertheless established a reliable upper-bound of the number of retrospective detectors (and thus concurrent detectors). Other researchers have discussed the limitations of the current measures of detection in choice blindness paradigms (Taya et al., 2014), and perhaps the field needs a new, less ambiguous measure. On the other hand, many studies have shifted their foci from participants' detection of the manipulation to the longer-term effects of the manipulation (Taya et al., 2014; Johansson et al., 2013, Merckelbach et al., 2008), so perhaps measuring whether participants detect the manipulation will become a less critical task in the future.

Several other important questions remain. The present study used continuous critical items in line with previous research (e.g., Merckelbach, et al., 2011; Hall et al., 2012). It remains for future research to examine whether memory-blindness will be found for discrete items. For example, a witness could report seeing a suspect in a green jacket, and later be told they said he wore a blue jacket. Such a manipulation would likely be less subtle, and the dependent variable

would have less variability, but memory-blindness assessed this way could have broader implications. The present study also raises an interesting avenue for future research. During the misinformation stage, participants were given consistent information for control items, rather than no information or irrelevant information. Consistent information has the greatest ecological validity as a control group, since an eyewitness would review her entire statement rather than merely the parts that had been altered. Nevertheless, a consistent report of those items could have served as a reminder of what participants had said, and disrupted the ordinary forgetting process. Future research should investigate the use of different controls, such as "consistent information," "irrelevant information," and "no information".

A final question concerns the initial accuracy of participants' reports. The present study demonstrated that when people are given manipulated versions of their own memory reports, their memories change in ways consistent with those manipulated reports. But since the direction of the misinformation was randomized, for some items, some participants received "misinformation" that actually led them toward the correct response. This methodological issue raises an important empirical question: is the misinformation effect stronger when the "misinformation" leads participants toward the correct answer than when it leads participants toward an incorrect answer? This question is relevant in other legal domains, and may help to explain the puzzling finding that biased lineup administrators can cause witnesses to have greater correct identification rates with little parallel increase to false alarm rates (Clark 2005). If it is easier to mislead people toward what they actually saw than toward a foil response, then a lineup administrator who tries to lead witnesses toward the true perpetrator will have a relatively larger increase in correct identifications (compared to an unbiased administrator), whereas a lineup administrator who tries to lead witnesses toward a different suspect will have a relatively smaller

increase in false alarms. The difference in efficacy of *leading* information versus *misleading* information presents an interesting avenue for future research. Nevertheless, such an interpretation of the present findings is inherently consequentialist. In the course of an investigation, if the police contaminate a witness's memory, even with accurate information, that witness's account is no longer her own. If a witness's memory is the product of external suggestions rather than natural memory processes, the veracity of that memory might be high, but the fidelity will be low. The present findings demonstrate that when people are exposed to bogus versions of their own memory reports, their memories change in reflection of those reports. The issue of untangling how misinformation might be used to "repair" memories or make them more accurate is left to future studies.

Conclusion

The present study empirically examined whether showing participants falsified versions of their own memory reports could alter how they remembered an event. When participants were presented with manipulated versions of their own memory reports, their memories changed to reflect those bogus reports. These findings suggest that if a witness's written report contains errors – either as a result of the witness's own mistakes in reporting, the police's deliberate manipulation of the report, or even innocuous clerical errors – merely viewing that report may cause a witness's memory to change to reflect the report, rather than the true memory.

The present study sought to expand the research on choice blindness by applying it to the novel domain of eyewitness memory. Choice blindness has also been applied to preference change (Johansson et al., 2013), and symptom reporting (Merckelbach et al., 2011), but countless other applications remain. Merckelbach and colleagues (2011) found that telling people they had reported more adverse symptoms than they truly did increased their subsequent levels of

symptom reporting, but is the reverse true? Can choice blindness be used to decrease the number or degree of symptoms people experience? In the realm of health behaviors, Clifasefi et al. (2013) input information about participants' life histories and histories with different foods and beverages into a bogus computer program, which informed participants that they had gotten sick from drinking too much of a specific liquor. Later, participants reported lower preferences for that liquor. Perhaps choice blindness can similarly be used to reduce peoples' preferences for alcohol, or to decrease preferences for unhealthy foods and increase it for healthy foods (Bernstein et al., 2005). The present study has made clear that choice blindness can have lasting effects on peoples' memories; the implications for this result and applications for future choice blindness research are diverse and exciting.

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Figure Captions

Figure 1a. Example baseline test item. Participants were asked ten questions about their memories for the slideshow.

Figure 1b. Misinformation. Participants were shown their responses to the baseline test questions, but three of their responses were altered. Their responses for these misinformation items were shifted four points along the scale. The participant from Figure 1a would have been shown this misinformation.

Figure 2. Mean magnitude of memory distortion for misinformation items and control items across both experimental groups. Participants' memories changed significantly more between the two memory tests for misinformation items than for control items. This main effect was qualified by a significant misinformation by group interaction, such that the effect of misinformation was greater for participants in the other-sourced misinformation group than for the self-sourced misinformation group.

Figure 3. Direction of memory change in relation to the misinformation. For both the self-sourced group and the other-sourced group, when a subject's memory changed for an item between the two memory tests, the majority of the time (roughly 80%), that change occurred in the direction of the misinformation. Only on a minority of trials did subjects' memories change in the direction opposite the misinformation.

Figure 4. Changes in mean scores by item type. For control items, there were no significant changes in mean memory ratings between the two memory tests for either

group. For misinformation items, there was a significant change in memory ratings in the direction of the misinformation (of approximately 1 scale point) between the two memory tests for both groups. There was no significant group by item type interaction.

Figure 1a

"What color was the female friend's backpack?"

Figure 1b

"Earlier, you said the female friend's backpack was the color indicated."

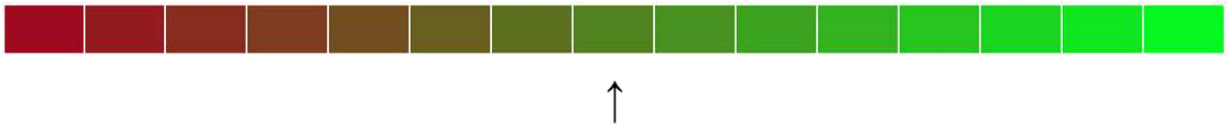


Figure 2

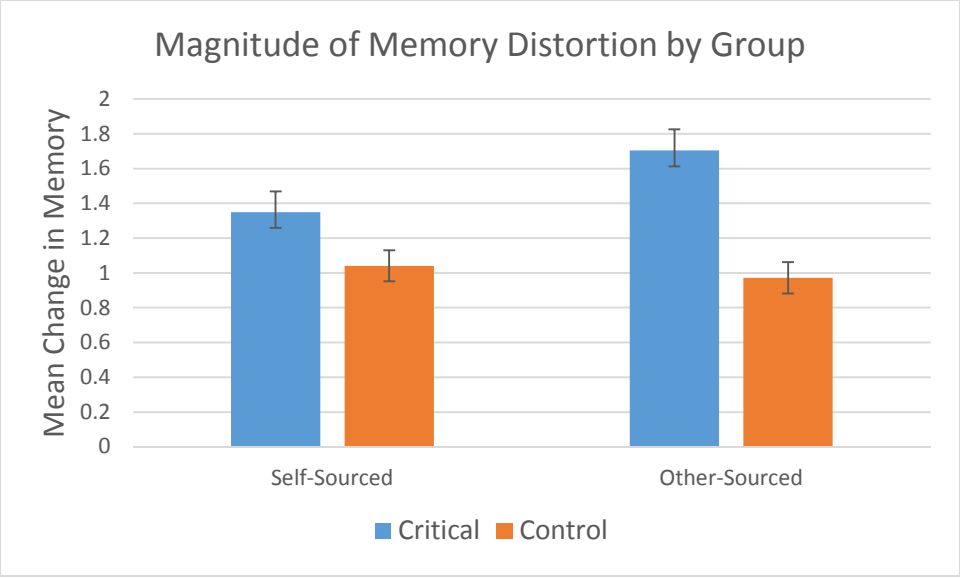


Figure 3

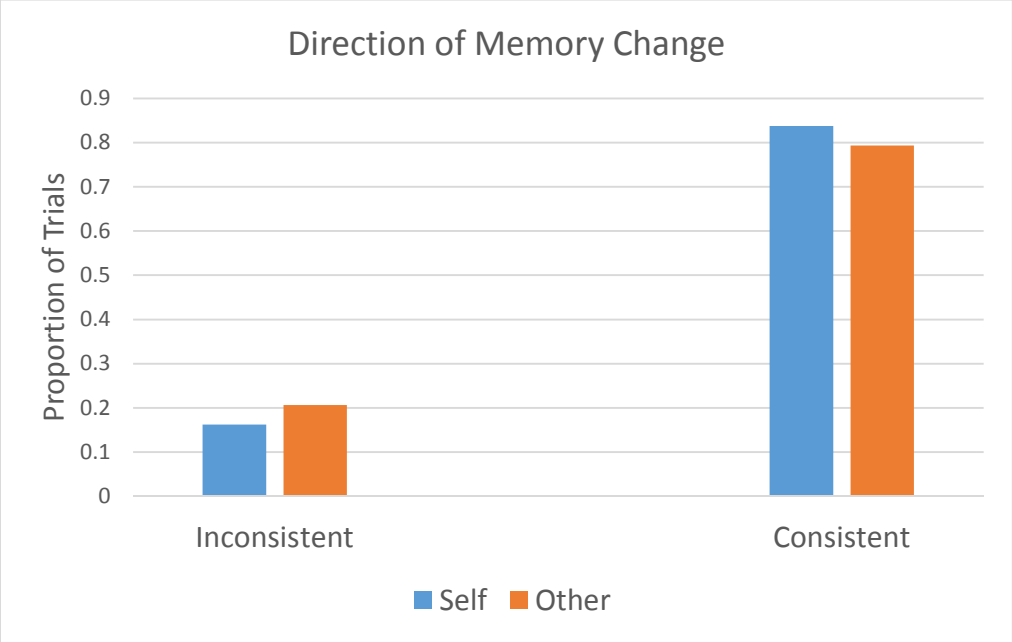
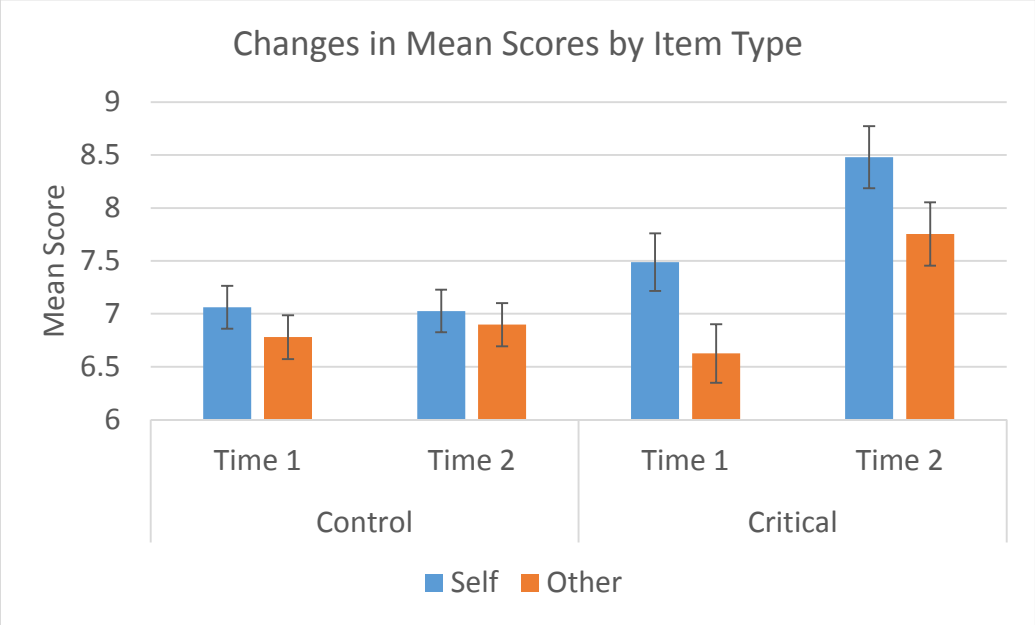


Figure 4



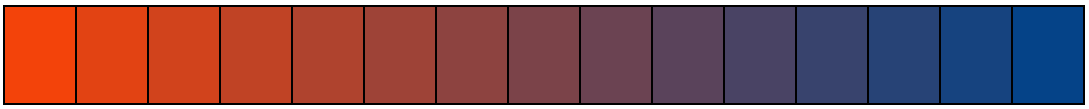
Appendix

Memory Questions

Q0) What color was the thief's jacket?

Q1) What color was the female friend's backpack?

Q2) What was the main color of the victim's bag?



Q3) How many centimeters (cm) of snow were on the ground?

0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7

Q4) How tall was the victim?

5'0"	5'½"	5'1"	5'1½"	5'2"	5'2½"	5'3"	5'3½"	5'4"	5'4½"	5'5"	5'5½"	5'6"	5'6½"	5'7"

Q5) How tall was the thief?

5'7"	5'7½"	5'8"	5'8½"	5'9"	5'9½"	5'10"	5'10½"	5'11"	5'11½"	6'0"	6'½"	6'1"	6'1½"	6'2"

Q6) How tall was the victim's male friend?

5'7"	5'7½"	5'8"	5'8½"	5'9"	5'9½"	5'10"	5'10½"	5'11"	5'11½"	6'0"	6'½"	6'1"	6'1½"	6'2"

Q7) How much did the victim weigh (in pounds)?

112	113	114	115	116	117	118	119	120	121	122	123	124	125	126

Q8) How much did the thief weigh (in pounds)?

153	154	155	156	157	158	159	160	161	162	163	164	165	166	167

Q9) How much did the victim's male friend weigh (in pounds)?

153	154	155	156	157	158	159	160	161	162	163	164	165	166	167