

5-2015

The Effect of Forewarning on Suggestibility: Does it Depend on Working Memory Capacity?

William Barrett Corley

Western Kentucky University, william.corley187@topper.wku.edu

Follow this and additional works at: <http://digitalcommons.wku.edu/theses>



Part of the [Cognitive Psychology Commons](#), and the [Experimental Analysis of Behavior Commons](#)

Recommended Citation

Corley, William Barrett, "The Effect of Forewarning on Suggestibility: Does it Depend on Working Memory Capacity?" (2015). *Masters Theses & Specialist Projects*. Paper 1497. <http://digitalcommons.wku.edu/theses/1497>

This Thesis is brought to you for free and open access by TopSCHOLAR®. It has been accepted for inclusion in Masters Theses & Specialist Projects by an authorized administrator of TopSCHOLAR®. For more information, please contact topscholar@wku.edu.

THE EFFECT OF FOREWARNING ON SUGGESTIBILITY:
DOES IT DEPEND ON WORKING MEMORY CAPACITY?

A Thesis
Presented to
The Faculty of the Department of Psychological Sciences
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
William Barrett Corley

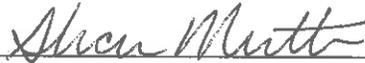
May 2015

THE EFFECT OF FOREWARNING ON SUGGESTIBILITY:
DOES IT DEPEND ON WORKING MEMORY CAPACITY?

Date Recommended 03/23/15



Qin Zhao, Director of Thesis



Sharon Mutter



Jenni Redifer

 4-20-15

Dean, The Graduate School

I dedicate this thesis to my parents, John and Teresa Corley, for always showing tremendous support of my academic endeavors and for always inspiring me.

ACKNOWLEDGMENTS

This project was supported by a research grant from The Graduate School at Western Kentucky University awarded on September 9, 2014. Additionally, I would like to thank my entire thesis committee, especially my thesis chair, for supporting and challenging me throughout the duration of this project.

TABLE OF CONTENTS

Introduction.....	1
Method	11
Results	17
Discussion	18
References	23
Appendix A	27
Appendix B	30
Appendix C.1	31
Appendix C.2	32
Appendix C.3.....	33

THE IMPACT OF FOREWARNING ON SUGGESTIBILITY: DOES IT DEPEND ON WORKING MEMORY CAPACITY?

William Corley

May 2015

33 Pages

Directed by: Qin Zhao, Sharon Mutter, and Jenni Redifer

Department of Psychological Sciences

Western Kentucky University

Suggestibility occurs when inaccurate information is incorporated into currently existing memories. The present study examined the effect of forewarning on suggestibility, including the influence of working memory capacity (WMC). The main hypotheses are that forewarnings will reduce suggestibility compared to the control group and that high-WMC will yield lower suggestibility compared to medium- and low-WMC. The final hypothesis is that WMC and forewarning will interact such that low-WMC individuals will benefit more than high-WMC individuals from the forewarning. A sample of 123 college students was recruited. Participants watched a clip of the TV-show *24*. WMC was then assessed followed by the presentation of a misleading narrative. Prior to listening to the narrative, they read a set of instructions that sometimes contained the forewarning. After listening to the misleading narrative, participants took a test over their memories of the film. A 2 X 3 ANOVA was conducted and found a main effect for forewarning. No other effect was significant. The current results only support the first main hypothesis that forewarning reduces suggestibility. These results could be used to help prepare eyewitnesses to resist misinformation in the period between witnessing an event and reporting the event during a later trial.

Introduction

What leads people to remember inaccurate information about a particular event, especially an event that they witnessed in person? One reason this occurs is known as suggestibility, which occurs when people incorporate incorrect information into their memory system. Understanding the causes and remedies of suggestibility is relevant to everyone. All people will experience the effects of suggestibility several times over the course of their lifespan. Most of the time, the outcome of a moment of suggestibility in a person's life does not have many negative consequences because most moments of memory failure occur during trivial social conversations and other reflective moments. The problem arises when a moment of suggestibility occurs during an important event, such as an exam, interview, or the identification of a person or item of interest. These situations are usually the most conducive to suggestibility because these are when people are under the most stress or pressure to report accurate information (Bjorklund et al., 2000). This study seeks to help clarify the effects of forewarning on suggestibility and potential individual differences in benefiting from forewarning given before being subjected to any form of misinformation. A theoretical background for suggestibility, forewarnings, and working-memory capacity will be explored in detail. The practical and theoretical implications of this line of research will also be explored further.

One of the worst times that suggestibility can strike is during the interview and cross-examination of witnesses to alleged criminal activity. Suggestibility occurring during the interview process is most likely not primed by the nature of

the questioning because initial interviewers are simply gauging the amount of information the witness may have and do not involve pressuring the witness very much. If the witness has enough information to convict the suspect of the crime they witnessed, usually a court case will follow. Suggestibility is more likely to occur once the court case has begun (Bjorklund et al., 2000). A witness in a court case is scrutinized in many ways. First, there is a large jury, a judge, an audience, and attorneys listening to their testimony. This situation puts the witness under a degree of pressure. They also only get one chance to report accurately their account of what happened. Second, they are cross-examined by an opposing attorney attempting to break down their credibility, usually through misleading questions. Before the witness is cross-examined, his/her attorney will usually try to prepare him/her for the misleading questions by forewarning them of what is to come. How well these forewarnings work and what type of situations they work best in are still issues that legal and cognitive psychologists are trying to discover.

Suggestibility

Unfortunately, suggestibility is only one of many failures to which the human memory system can be subject. Schacter (2001) describes suggestibility as one of seven memory failures, also known as the “Seven Sins of Memory.” Other examples of these “sins” include bias, misattribution, and blocking (Schacter, 2001). Additionally, these phenomena can be classified as omission or commission errors (Schacter, 2001). Omission errors involve not having the ability to remember the information at all. This type of error is commonly reported

as a form of forgetting because the information needed is not readily available for retrieval. Commission errors involve remembering, and oftentimes reporting, information incorrectly. Suggestibility is a prime example of how a commission error can manifest. Additionally, suggestibility is a cause for concern because most people are susceptible to its effects, and most people are not even aware they are experiencing it once their memories have been altered (Roper & Shewan, 2002).

There are many factors that can lead to an individual's suggestibility, such as testing effects, repeated-recall, misleading questions, and a variety of other factors (Chan, Thomas, & Bulevich, 2009; Eakin, Schreiber, & Marshall, 2003; Roediger, Jacoby, & McDermott, 1996; Zaragoza & Lane, 1994). Testing effects occur when an individual is given any type of test prior to reporting on a witnessed event (Chan et al., 2009). This finding is similar to that of Roediger et al. (1996) and Wilford, Chan, and Tuhn (in press) because testing a person on an event followed by recall is a form of repeated recall. Typically, when recalling a memory, there are going to be gaps in the reported information. The first time the memory is reported, individuals usually do not notice the gaps in their information. With each additional re-reporting of the information, they may notice multiple gaps in their memory and inadvertently fill these gaps with inaccurate information, also known as hypercorrection.

Source Misattribution Effect is a phenomenon frequently observed in relation to suggestibility (Zaragoza & Lane, 1994). This occurs when participants are unable to report whether information in their memory was present in a

witnessed event or in the questions they were asked about the event. Questions that lead to inaccurate information to being stored in memory are defined as misleading questions. In Zaragoza and Lane (1994), participants viewed a slideshow describing a series of events involving theft within an office setting. They then answered a set of misleading questions involving the replacement of important information with an incorrect piece of information. Following the set of questions, participants were asked where they remembered hearing certain pieces of information about the event in question. Participants who were misled by questions reported that they learned the inaccurate information in the narrative they read instead of in the questions. The answers provided by participants indicated to the researcher the source of their reported memory. If the participants reported correct information, their memory could be attributed to the original narrative. If the participants reported the misinformation, their memory could be attributed to the misleading question. This outcome is indicative of the Source Misattribution Effect. This effect is strongly associated with suggestibility and indicates that misleading questions alone can sharply increase the occurrence of suggestibility in a person's memories. Potential remedies for the effects of misleading questions need to be explored further.

Forewarning

Forewarning someone of upcoming, potentially misleading information could seem like a good idea. These forewarnings are meant to improve the other person's accuracy at answering the subsequent memory questions, usually because the person being warned does not have any experience with the

misleading information. There are some studies that have examined the effect of forewarnings as well as the different ways a person can be forewarned about misleading information (Chambers & Zaragoza, 2001; Ecker, Lewandowsky, & Tang, 2010).

Ecker et al. (2010) reported that explicit warnings are better at reducing participant suggestibility compared to general forewarnings. In this experiment, participants received a folder containing a textual version of police radio chatter about a bus fire. The text contained misinformation that contradicts with important information presented earlier in the text. The main conditions of interest were the general and specific forewarnings. In the general forewarning condition, participants just received a warning that not all of the information in the textual radio chatter came from a reliable source, and some may be inaccurate. In the specific forewarning, participants received the same information presented in the general forewarning along with information that indicated the nature of how misleading information would be presented. Participants in this condition were told that some important information may be mixed up with inaccurate, alternative information. Additionally, participants in the specific forewarning condition were given more information about suggestibility and the misinformation effect to make them more aware of how the wording of the statements in the radio chatter could lead them to make mistakes when reporting their memories of the information in the memory questions. After the forewarning and presentation of textual radio chatter, participants were later asked a series of non-misleading memory questions about the events depicted in the radio chatter. The results indicated

that general forewarnings provided a slight benefit and that explicit forewarnings provided a significant benefit to participant accuracy on the memory questions. However, neither forewarning was able to completely eradicate the misinformation effect, in that neither forewarning type completely eliminated participant answers related to previous misinformation.

Chambers and Zaragoza (2001) also conducted a study aimed at using warnings to reduce suggestibility. In this study, participants were presented with a police training video depicting a dramatized bank robbery. After watching the film, participants received a set of misleading questions with important information about the film replaced with misleading information. Following this set of questions participants were then presented with a non-misleading set of questions. At some point during the study, participants were presented with an explicit warning. Some participants were presented with a pre-warning, i.e., the warning was presented before the misleading questions. Some were presented with a post-warning: the warning was presented after the misleading questions and before the non-misleading questions. Participants that received neither warning typically provided answers to the non-misleading questions that could be attributed to the misleading questions, meaning that the participants “learned” the information they reported in the final set of questions from the misleading set of questions. Participants that received either the pre-warning or the post-warning substantially reduced their source monitoring errors, in that they provided more answers to questions that could be attributed to the film and not the misleading set of questions. There was not a significant difference between the pre-warning

and post-warning groups. Both of these studies make a strong case that forewarnings could be effective in reducing suggestibility, especially if forewarnings are explicit.

Working Memory Capacity

Working memory capacity (WMC) is the ability to accurately store and process information in memory while facing other activities or distractors (Miyake & Shah, 1999). Individuals regularly use this active memory system, and the ability to use working memory to accomplish learning varies from person to person. WMC has been shown to have predictive capacity in various domains of performance such as mathematic tasks, reading comprehension, and speech production, to name a few (Ashcraft & Krause, 2007; Daneman & Carpenter, 1980; Fortkamp, 1999).

Several studies have indicated that WMC can also predict susceptibility to misinformation (Bixter & Daniel, 2013; Gerrie & Garry, 2007; Jaschinski & Wentura, 2002; Leding, 2012). For example, Leding (2012) found that individuals with high WMC, based on a dichotomized comparison of span scores, are less likely to be susceptible to false information related to lists of words and argued that this occurs because high-WMC individuals are better able to engage in source monitoring. This argument is in line with research evidence that poor source monitoring leads to the incorporation of misinformation, as indicated previously by Zaragoza and Lane (1994). Bixter and Daniel (2013) also found that high-WMC individuals are able to resist misinformation when tested with the Deese/Roediger-McDermott (DRM) paradigm relative to low-WMC participants.

This paradigm relates more to semantic memory, because participants memorized word lists and were asked if they recognized words from the list at a later time. Critical lures were used as misinformation. These refer to words that belong in the same category as the words on the list but were not actually present on the original list.

Jaschinski and Wentura (2002) conducted a study on suggestibility and WMC that is more relevant to eyewitness testimony. In this study, participants were asked to watch a short film depicting a bank robbery. Afterwards, they were given a scrambled narrative of the events depicted in the film and were asked to unscramble the information correctly. Finally, the participants were asked a series of recall questions, with misleading and non-misleading information, about the events depicted in the film. Misleading questions were created by replacing important information with inaccurate information. Suggestibility in this study was operationalized by subtracting the number of incorrect responses to non-misleading questions from the number of incorrect responses to misleading questions. This differs from other studies because it is a more direct testing of suggestibility in episodic memory as opposed to just suggestibility in semantic memory. In studies that examine suggestibility in episodic memory, the primary interest is in the number or percentage of “misled” or “suggested” answers provided by participants. These answer types are usually characterized as the answers that are attributed to the misleading source and not the original witnessed event. In the study, WMC was assessed using an Operation Span (OSPAN) task, involving the remembering of letters in chronological order while

judging the accuracy of math problems. The study found a strong negative correlation between WMC and suggestibility, in that as WMC increases, suggestibility decreases in individuals.

Despite what we know so far concerning the effects of forewarning on suggestibility and the correlation between WMC and suggestibility, it is unclear how these two variables would interact to influence the extent of suggestibility. Examining the interactive effects of forewarning and WMC is imperative because the potential findings could illuminate who would benefit the most from explicit forewarnings in situations conducive to suggestibility.

Present Study

The present study thus examined the effects of explicit forewarnings on suggestibility across different levels of WMC. This was done by having the participants watch an episode of the television show *24* followed by a pre-recorded, misleading narrative about the film, after a fixed 15-minute interval of time between the film and the narrative. During the time interval, participants were administered the OSPAN task and reported their demographic information, similar to the procedure used by Chan et al. (2009). The 15-minute interval prevented participants from relying on their short-term memory. Additionally, given the demanding nature of the OSPAN task, participants were unable to rehearse any information from the film while completing the task. The narrative was used to simulate the misleading information that people may encounter after witnessing a particular event. Prior to receiving the narrative about the film, the participants may or may not have received a forewarning that the narrative they

listened to was misleading in nature. The memory questions they subsequently received were recognition-based questions directly related to the film and the misleading narrative. After data collection, a tertiary split was applied to the WMC scores to divide the sample into high, medium, and low-WMC groups.

Based on the studies presented earlier (Chambers & Zaragoza, 2001; Ecker et al., 2010; Greene, Flynn, & Loftus, 1982), the first hypothesis (H1) of the current study was that forewarnings should reduce the suggestibility induced by the misleading narrative. Based on the design of the study, suggestibility was operationally defined as the number of misled answers, that is, incorrect answers that matched the misleading narrative. The forewarning group should select fewer misleading responses based on the narrative. The second hypothesis (H2) was that as WMC increases, suggestibility to the misleading narrative should also decrease. This should happen because individuals with higher-WMC are likely going to be better at source monitoring as a result of better ability of maintaining the original information presented in the film through the 15-minute interval. Individuals with lower-WMC are more likely to lose the original information in their working memory and thus will be more susceptible to interference from the narrative.

To date, no studies examining the effects of forewarning on suggestibility have included WMC as a variable. Based on the literature on WMC, the third hypothesis (H3) was that lower WMC individuals should benefit more from forewarnings, relative to higher WMC individuals. Specifically, lower-WMC individuals are expected to select more misleading answers that match the

misleading narrative when there is no forewarning, thus having greater room for improvement than higher-WMC individuals, as measured by a greater difference between the low-WMC group and the high-WMC group regardless of forewarning condition. The forewarning should prevent them from too heavily relying on the information in the narrative to answer the subsequent memory questions.

The findings of the study could prove useful in determining when it is appropriate to warn someone of upcoming, potentially misleading information. This information could also help people determine whether certain individuals, if their WMC is known, may see more or less of a benefit if they are forewarned about upcoming misinformation.

Method

Participants and Design

Participants were undergraduate students from Western Kentucky University in Bowling Green, Kentucky. All participants were recruited through StudyBoard, an online participant sign-up service, and were compensated with course credits and \$10 for participation. A sample of 123 participants aged 18-24 were recruited for the experiment (35 males and 88 females; M_{age} : 19.2). An a priori power analysis for ANOVA (effect size = .40, α =.05, power=.95, number of groups = 6) produced a suggested number of 130 participants. No one under the age of 18 was allowed to participate. Other demographics such as ethnicity and major were also requested from participants to provide information about the representativeness of the sample. The OSPAN task results were also used to determine if the obtained sample was representative of the population.

The study consisted of a 2 (forewarning vs. non-forewarning) X 3 (high vs. medium vs. low WMC) between-subjects design. Participants were randomly assigned to one of the two forewarning conditions, and a tertiary split was applied to the WMC scores to divide the sample into high-, medium-, and low-WMC groups. The main dependent variable - suggestibility - was operationalized as the number of misleading answers selected in response to the memory questions. If the participants selected answer choices that matched the misinformation presented in the narrative, the answers were scored as “misled answers or misinformation.” In addition to this main dependent variable, the number of accurate answers and other incorrect answers was measured. Answers that matched the original film were scored as “correct,” while any other answers (e.g., those that did not match the film or narrative) were scored as “other.”

Materials

All aspects of the experiment took place on a basic desktop computer using MediaLab (version 2012) and E-Prime (version 2.0) software. MediaLab allowed the programming of the questionnaires, video, narrative, and instructional manipulations within the software. E-Prime was solely used for the assessment of WMC. Additionally, participants were asked to bring their own set of earphones for the viewing of the video. This eliminated the need for maintaining and cleaning sets of earphones that belong in the laboratory.

The witnessed event was the first episode aired in the first season of the television show *24* on FOX Broadcasting Channel (Chan et al., 2009). The video was 40 minutes in length and allowed for many witnessed events in a relatively

short period of time. Several of the scenarios portrayed in the film were similar to crime-like situations that could occur in real life and were non-violent in nature. This provided for more realistic situations for participants to retain in their episodic memory and strengthened the external validity of the experiment. Prior to beginning the experiment, participants were asked if they had ever watched any episodes of the television show. If they had watched any of the show, they were excluded from the study and were compensated with partial course credit. Because this is an older television show, the researcher did not anticipate needing to terminate many experiment sessions, and only three participants were excluded.

The narrative that was used can be found in Appendix A (Chan et al., 2009). The information provided in the narrative chronologically follows the storyline of the episode that was shown to participants during the experiment. The narrative presented information about the episode with some pertinent information being removed and replaced with misleading information. The narrative was presented to participants in the form of a recorded voice played through their earphones during the experiment.

The memory questions were multiple-choice, recognition-based questions modified based on previous research (Appendix B; Chan et al., 2009). Chan et al. used the same question items, but they were free recall questions as opposed to multiple-choice, as was used in the present study. As each question about the narrative was presented, the correct answer and the misleading answer were among the answer choices. Some filler questions were also included so that the

participants did not discover that the questions were assessing whether their memories about the witnessed event were attributed to the film or the narrative. There were 24 questions involving the narrative and the film and 12 filler questions. The filler questions were generated by the researcher and were not scored.

WMC was assessed using an automated OSPAN task, which requires participants to judge whether simple math problems are correct followed by recalling a previously presented set of letters in chronological order. After the completion of a series of trials, a basic recall test is given. The maximum number of correct letters recalled by a participant indicated their operation span, which can be used to infer their WMC. The OSPAN was administered during the 15-minute interval between the film and the narrative using E-Prime software on the same computer the participants used for the other portions of the experiment (Unsworth, Heitz, Schrock, & Engle, 2005).

Participants were administered a variety of questionnaires throughout the experiment. Participants were also asked to self-report how well they paid attention to the film and how well they believed they would be able to remember details about the events in the film. This helped assess the reliability of the data from each participant.

Procedure

Prior to being allowed to sign up for participation in the study, participants were prescreened using the StudyBoard system operated by Western Kentucky University to ensure that they were at least 18 years of age. Once they arrived in

the laboratory, participants received a basic informed consent prior to being allowed to participate in the experiment on the computer. Afterwards, the participants were able to move through the different sections of the experiment at their own pace while being supervised by the researcher. The researcher was available to answer any questions and made sure that the participants were following all of the instructions accordingly. The participants were also randomly assigned to experimental conditions and assigned participant ID numbers using an autostart file that was paired with the MediaLab software and the experiment file. Prior to proceeding with the basic steps of the experiment, participants were asked if they had ever watched the television show 24. If they responded 'yes' to the question, MediaLab automatically terminated the experiment and the participant was compensated accordingly.

Once the participants began the experiment, they immediately began watching the video. After they finished the video, they were asked a series of follow-up questions. The follow-up questions asked the participants about how well they paid attention to the film and about how well they thought they could remember the events depicted in the film. The narrative can be found in Appendix A.

After filling out the questionnaire, the participants were administered the OSPAN task and reported their demographic information during a fixed 15-minute interval. Next, they received a set of instructions about the narrative related to the film that they listened to next. The set of instructions they received were randomly assigned and either contained or did not contain a forewarning

that the information in the narrative was misleading. In addition to general instructions, the instructions in the forewarning condition included the following statement:

Please note: This narrative was not provided by a reliable source. Some of the important information has been mixed up with incorrect information about the film. Please pay close attention when listening to the statements you are about to hear.

Participants in the forewarning condition also read a statement about suggestibility and the misinformation effect. This statement made the forewarning presented in the instructions more explicit. Participants in the non-forewarning condition were presented with a statement about memory transience, an omission error unrelated to suggestibility, in addition to the general instructions for the memory task. Following the instructions containing the manipulation, the participants were presented with questions about the instructions they received to ensure they read them thoroughly. The follow-up questions were mainly used to help determine which cases, if any, needed to be excluded from data analysis.

Following the narrative, participants received the recognition-based questions about the film (see Appendix B). The questions were multiple-choice and contained the correct answer and the misleading answer (i.e., the misinformation from the narrative) in the answer choices, along with two other answer choices not found in the narrative or the film. Participants received 24 questions related to the narrative and film and 12 filler questions that were not scored.

At the end of the experiment, the participants received their compensation and were thanked for their participation. They were also debriefed and allowed to ask final questions during this time.

Results

A tertiary split was applied to the distribution to group the participants into three equal groups based on their OSPAN score (i.e., 33rd percentile: 50, 66th percentile: 61). A 2 (forewarning vs. no forewarning) X 3 (high vs. medium vs. low WMC) between-subjects ANOVA was then conducted on the suggestibility variable, and a main effect for forewarning was found, $F(1,122) = 5.74, p = .02$, such that participants in the forewarning condition ($M = 5.20, SE = .41$) selected fewer suggested answers than did participants in the non-forewarning condition ($M = 6.55, SE = .39$). An additional 2 X 3 between-subjects ANOVA was conducted on the number of correct answers selected and also found a main effect for forewarning, $F(1,122) = 4.12, p = .05$, such that participants in the forewarning condition ($M = 15.20, SE = .51$) selected more correct answers than did participants in the non-forewarning condition ($M = 13.77, SE = .49$). No main effect was found in either model for WMC, $p > .10$, and no interactions were detected, $p > .10$. Bar graphs of these results can be found in Figures 1, 2, and 3.

In addition, an ANCOVA was conducted on the effect of forewarning on suggestibility, controlling for the continuous version of the WMC variable to determine whether the effect of forewarning would persist in the face of WMC. The covariate, WMC, was marginally significant, $F(1,122) = 3.09, p = .08$. The effect of forewarning was statistically significant, $F(1,122) = 6.93, p = .01$,

indicating that the forewarning was effective despite the influence of individual WMC. The same ANCOVA was conducted with correct answers as the dependent variable. Again, WMC was marginally significant, $F(1,122) = 2.86$, $p = .09$. The effect of forewarning was statistically significant, $F(1,122) = 5.17$, $p = .03$, indicating that the forewarning also improved participants' selection of correct answers in the face of individual WMC.

Finally, for the sake of examining the trend in the continuous version of the WMC variable, the correlation between WMC and suggestibility was calculated and was weak and non-significant, $r(121) = -.13$, $p = .15$. It should be noted, however, that the trend in the relationship between the continuous WMC and suggestibility scores is consistent with previous literature, even though it is non-significant.

Discussion

Summary

Overall, the results indicate that providing an explicit forewarning to someone after they have witnessed an event but immediately prior to presenting them with misinformation will help them resist the effects of misleading information, confirming H1. Additionally, these findings are consistent with the previous results of Chambers and Zaragoza (2001), as well as Ecker et al. (2010). This study builds on the work of these two previous studies because of the use of multiple-choice questions as opposed to free recall. The use of multiple choice questions made the memory test more difficult because the correct answer and the suggested answer were both presented at the same time.

This makes the questions even more suggestive than they would have been had they been open-ended. WMC capacity had no effect on suggestibility when treated as a quasi-independent variable, which fails to support other previous findings on the effect of WMC on suggestibility (Jaschinski & Wentura, 2002; Leding, 2012), as well as failing to support H2. It should be noted, however, that previous studies examining the effect of WMC treated WMC as a continuous variable and were mainly correlational. Also, the lack of any interactions between WMC and forewarning in the data fails to support H3. These findings indicate that the effects of forewarning, even explicit forewarning, may not depend on WMC.

While there was not a statistically significant interaction between the forewarning and WMC, there was a trend in the data approaching that of a statistically significant interaction. Had this interaction been significant, it would have still failed to support H3 because the reduction in suggestibility would have been greater for the high-WMC group instead of the low-WMC group. This trend is likely due to the reduced ability of individuals with low-WMC to retain instructional information in their memory (Kane, Bleckley, Conway, & Engle, 2001). Based on current data, it appears that forewarning influences source monitoring while WMC is more associated with attentional control.

WMC only had a marginally significant effect on suggestibility as a control variable, and after controlling for WMC, the forewarning pattern did not change or disappear. The finding regarding WMC suggests that whereas WMC may be associated with the rejection of false semantic memories, as suggested by Leding (2012), it may not have a strong influence over episodic memory as

previously hypothesized by Jaschinski and Wentura (2002). Although the current data regarding WMC do not demonstrate a significant association between WMC and suggestibility, the direction of the WMC effect is consistent with the findings of Jaschinski and Wentura (2002) as indexed by the weak, negative correlation between WMC and suggestibility.

Implications

The current results could indicate the need for legal professionals to warn an eyewitness about the potential effects of misinformation, as explicitly as possible, as soon as the eyewitness has encountered an event they will be required to recall at a later time. Examples of ways to make the forewarnings explicit for eyewitnesses include: telling them that listening to media coverage, engaging in discussions about the event, particularly with someone who has strong opinions about what happened, and talking to other witnesses about their perspective could bias their memory. These factors are particularly important if they encounter information that is inconsistent with their memory about the event. This way, even if the witness is presented with inconsistent information, they can better resist the effects of the new information while clinging to the information they initially held in their memory.

Additionally, this information should be of interest to college students as well. In particularly information-heavy courses, it is not uncommon for students to hold group study sessions to review the information as a group. Unfortunately, inaccurate information can be discussed in these study groups. This requires the students to monitor multiple sources of information, much like the participants in

this study had to do. Without a forewarning that misinformation may be present in study groups, students may not source monitor the information in their memory related to the class and could see reduced accuracy on exams because of the suggestibility that could occur while they are in a study group.

Future Directions

There are a variety of ways that research on this aspect of suggestibility could be expanded or extended. One interesting line of research could examine how many instances of misinformation it takes for a person's memory to become suggestible. The narrative used in the current study contained 24 instances of misinformation about the witnessed event. An interesting future study could be to examine, without forewarning, how many instances of misinformation it takes for a participant to detect that a narrative is misleading. This type of study could help determine how many instances of misinformation in suggestibility studies could be considered appropriate or even excessive. Additionally, suggestibility may be related to the number of salient or non-salient instances of misinformation presented.

An additional direction this research could proceed in would be to examine the effect of cognitive load during a witnessed event on suggestibility, even with a forewarning manipulation and while measuring WMC. Cognitive load refers to the amount of mental effort being used. Including the cognitive load variable could produce an effect for WMC, as it involves retaining information in the face of some sort of distractor. Specifically, WMC may play a more important role in suggestibility when participants are under high cognitive load. Cognitive load

during the presentation of the witnessed event may prevent the information from being encoded properly leading the misinformation presented later to have a stronger influence over suggestibility.

Conclusion

The results of the current study support the use of explicit forewarning as a tool to prevent misinformation from infiltrating currently existing memories about an event. The results are in line with a body of research endorsing the use of forewarning to reduce suggestibility. There is a lack of strong support for the effect of WMC on suggestibility. It is hoped that future research will determine the conditions under which WMC influences suggestibility and the resistance of misinformation after witnessing a specific event.

References

- Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review*, *14*, 243-248.
doi:10.3758/bf03194059
- Bixter, M. T., & Daniel, F. (2013). Working memory differences in illusory recollection of critical lures. *Memory & Cognition*, *41*, 716-725.
doi:10.3758/s13421-013-0293-x
- Bjorklund, D. F., Williams, C. S., Bjorklund, B. R., Brown, R. D., Park, C. L., Ernst, K., & Owen, F. A. (2000). Social demand characteristics in children's and adults' eyewitness memory and suggestibility: The effect of different interviewers on free recall and recognition. *Applied Cognitive Psychology*, *14*, 421-433. doi:10.1002/1099-0720(200009)14:5<421::AID-ACP659>3.0.CO;2-4
- 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.
doi:10.3758/bf03206381
- Chan, J. C., Thomas, A. K., & Bulevich, J. B. (2009). Recalling a witnessed event increases eyewitness suggestibility: The reversed testing effect. *Psychological Science*, *20*, 66-73. doi:10.1111/j.1467-9280.2008.02245.x
- Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, *19*, 450-466. doi:10.1016/s0022-5371(80)90312-6

- Eakin, D. K., Schreiber, T. A., & 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. doi:10.1037/0278-7393.29.5.813
- Ecker, U. K., Lewandowsky, S., & Tang, D. T. (2010). Explicit warnings reduce but do not eliminate the continued influence of misinformation. *Memory & Cognition*, *38*, 1087-1100. doi:10.3758/mc.38.8.1087
- Fortkamp, M. B. M. (1999). Working memory capacity and aspects of L2 speech production. *Communication & Cognition: Monographies*, *32*, 259-296. doi:10.5216/sig.v20i2.6085
- Gerrie, M. P., & Garry, M. (2007). Individual differences in working memory capacity affect false memories for missing aspects of events. *Memory*, *15*, 561-571. doi:10.1080/09658210701391634
- Greene, E., Flynn, M. S., & Loftus, E. F. (1982). Inducing resistance to misleading information. *Journal of Verbal Learning and Verbal Behavior*, *21*, 207-219. doi:10.1016/s0022-5371(82)90571-0
- Jaschinski, U., & Wentura, D. (2002). Misleading postevent information and working memory capacity: An individual differences approach to eyewitness memory. *Applied Cognitive Psychology*, *16*, 223-231. doi:10.1002/acp.783

- Kane, M. J., Bleckley, M. K., Conway, A. R., & Engle, R. W. (2001). A controlled-attention view of working-memory capacity. *Journal of Experimental Psychology: General*, *130*, 169-183.
- Leding, J. K. (2012). Working memory predicts the rejection of false memories. *Memory*, *20*, 217-223. doi:10.1080/09658211.2011.653373
- Miyake, A., & Shah, P. (Eds.). (1999). *Models of working memory: Mechanisms of active maintenance and executive control*. New York, NY: Cambridge University Press. doi:10.1017/cbo9781139174909
- Roediger, H. L., Jacoby, J. D., & McDermott, K. B. (1996). Misinformation effects in recall: Creating false memories through repeated retrieval. *Journal of Memory and Language*, *35*, 300-318. doi:10.1006/jmla.1996.0017
- Roper, R. & Shewan, D. (2002). Compliance and eyewitness testimony: Do eyewitnesses comply with misleading 'expert pressure' during investigative interviewing? *Legal and Criminological Psychology*, *7*, 155-163. doi:10.1348/135532502760274765
- Schacter, D. L. (2001). *The seven sins of memory*. New York: Houghton Mifflin Company. doi:10.1196/annals.1279.012
- Unsworth, N., Heitz, R. P., Schrock, J. C., Engle, R. W. (2005). An automated version of the operational span task. *Behavior Research Methods*, *37*, 498-505. doi:10.3758/bf03192720
- Wilford, M. M., Chan, J. C. K., & Tuhn, S.J. (in press). Retrieval enhances eyewitness suggestibility to misinformation in free and cued recall. *Journal of Experimental Psychology: Applied*. 81-93. doi:10.1037/xap0000001

Zaragoza, M. S., & Lane, S. M. (1994). Source misattributions and the suggestibility of eyewitness memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20, 934. doi:10.1037/0278-7393.20.4.934

Appendix A

Misleading Narrative

Misinformation is underlined

12:00A.M. Victor Rovner transmits from Kuala Lumpur, Malaysia that a shooter is coming into town to target Senator Palmer. Agent Richard Walsh, a high ranking Counter Terrorist Unit (CTU) officer, is alerted.

12:01A.M. Senator David Palmer, an African-American running for President, writes his speech for the next day's California primary election. When we first see him, he is wearing a grey shirt. His wife, Sheri, is working on campaign staff appointments.

12:03A.M. We then cut to a ranch home in the hills of Los Angeles. Jack Bauer plays dominos with his daughter Kim in their home. Jack is wearing a black shirt and Kim is wearing a bathrobe. Before going to bed, she tells him that she's glad he moved back in. Jack then has a short conversation about Kim with his wife, Teri. Teri is wearing a yellow shirt. During their conversation, Jack takes a soda from the refrigerator. Jack and his wife Teri then go to Kim's room to find she has snuck out the window. Nina Myers, Jack's chief- of-staff at CTU, calls him into the office because Richard Walsh is in town. Jack says that he expects to be gone for about 2 hours. Jack phones Kimberly's ex-boyfriend Xander, but he doesn't know where she is. Jack drives to CTU in his van.

12:06A.M. Kim and her friend Janet York are on their way to meet up with some guys named Dan and Rick. Janet informs Kim that Dan and Rick are sophomores in college. Janet has fuzzy dice on the dashboard of her car.

12:09A.M. Jack arrives at CTU headquarters and calls his wife to alleviate her fears. He greets Nina who is wearing a brown shirt. Turning back to work, Jack gathers his team and suggests that perhaps Senator Palmer is the reason they have been called in. He asks them to start pulling together information on the candidate. Along with Nina are CTU employees Jamey Farrell and Tony Almeida. Meanwhile, Kimberly and Janet arrive at a furniture store where they meet the guys. The guys are waiting outside in their black van.

12:14A.M. Jack asks a friend at the LAPD to keep a lookout for his daughter. Walsh arrives and briefs Jack's team about an expected attempt on Palmer's life. Walsh privately tells Jack that there may be a leak within CTU involved in the hit. Jack argues he may not be the best person for this investigation since he previously investigated 3 corrupt agents.

Appendix A (Continued)

Misleading Narrative

12:22A.M. Martin Belkin, a foreign photographer, calls Palmer campaign manager Patty Brooks from an airplane bound for Los Angeles. He is scheduled to meet Palmer for breakfast the next morning at 8:00 AM. Mandy, the woman in the seat next to him, overhears his conversation and asks about Palmer.

12:24A.M. Nina confronts Jack about not being included in a meeting with District Director George Mason. Jack does not tell her what the secrecy is about. Teri calls to tell Jack that she found joints in Kimberly's desk. Jack apologizes for not being there to help. Meanwhile, Rick and Kim chat on the roof of the furniture store. He talks about life at San Diego State. In a heart-to-heart talk with Rick, Kimberly lies and says that her father died 3 months ago.

12:28A.M. Prior to his meeting with Mason, Jack changes into a green shirt. Mason does not reveal to Jack what his source is for the information on the Palmer case. Jack asks Mason to call for higher authority to reveal the source. Mason agrees but actually calls a number for the date/time. Jack is suspicious. Jack gets a white binder to hide a tranq gun and shoots Mason with the tranquilizer gun to knock him out. Jack orders Nina to look up the assets of convicted cocaine dealer Phillipe Darcet because he has always suspected that Mason skimmed \$100,000 from the bust. Jack hopes to use that information to blackmail the District Director.

12:36A.M. Teri receives a call from Alan York, the father of Kimberly's friend Janet. He too is looking for his daughter.

12:40A.M. Jack requests that Nina get Tony to access the Darcet files. Tony is suspect that Nina is doing this because she is still sleeping with Jack. She doesn't give a straight answer, but convinces the reluctant Tony to get her the information. Jack asks Jamey to trace the passwords for the email accounts on his home phone line. He informs Teri that Kimberly's password is LIFESUCKS.

12:43A.M. On the plane, Mandy continues to grill Martin flirtatiously. While looking at some of his photos, he mentions that he recently photographed Munich. There is growing attraction between them.

12:45A.M. Senator Palmer gets a phone call from Maureen Kingsley at the network. He gets angry at her allegation, and avoids telling his wife Sherry what was discussed.

Appendix A (Continued)

Misleading Narrative

12:49A.M. Nina grows worried about Jack's erratic behavior, and she voices her concern that he is breaking the law by tapping into private files. He says that he will not compromise himself. Meanwhile, Teri and Alan York decide to try to find the girls at the furniture store in Hollywood found in Kimberly's email account. Seeing her mother has left 7 messages on her cell phone, Kimberly asks the guys to drive her home.

12:52A.M. Martin and Mandy make love in the airplane bathroom. She asks if they can get together in Los Angeles, but he replies that he will be "pretty busy." At CTU, Tony sends to Jack the accessed wire transfers on the Darcet account, and Jack wakes Mason. He once again asks the District Director who his source is, but this time shows the incriminating Darcet transfers. Mason relents when Jack shows that he can access the account in Aruba. In the air, Mandy goes to the back of the plane and knocks a flight attendant unconscious with a chloroform rag. She takes out Martin's stolen identification and she puts on a protective jumpsuit. She removes a bomb from the plane's fire extinguisher. She attaches the bomb to the trash door and sets the timer. Mandy ejects herself from the cabin within seconds of the plane's explosion, parachuting to safety.

12:57A.M. Teri speaks to Jack while driving with Alan York in his black sedan. When he loses contact with his wife, Jack sets out to find her. Tony stops him with news that a DC-10 airplane has blown up over the Gila Desert. Preliminary reports indicate that it was bombed. While Dan drives the van with the girls inside, Kim tells to turn on 39th st. He ignores Kimberly's directions to her house. For the first time she is afraid, and she realizes that she may not be in control of the situation.

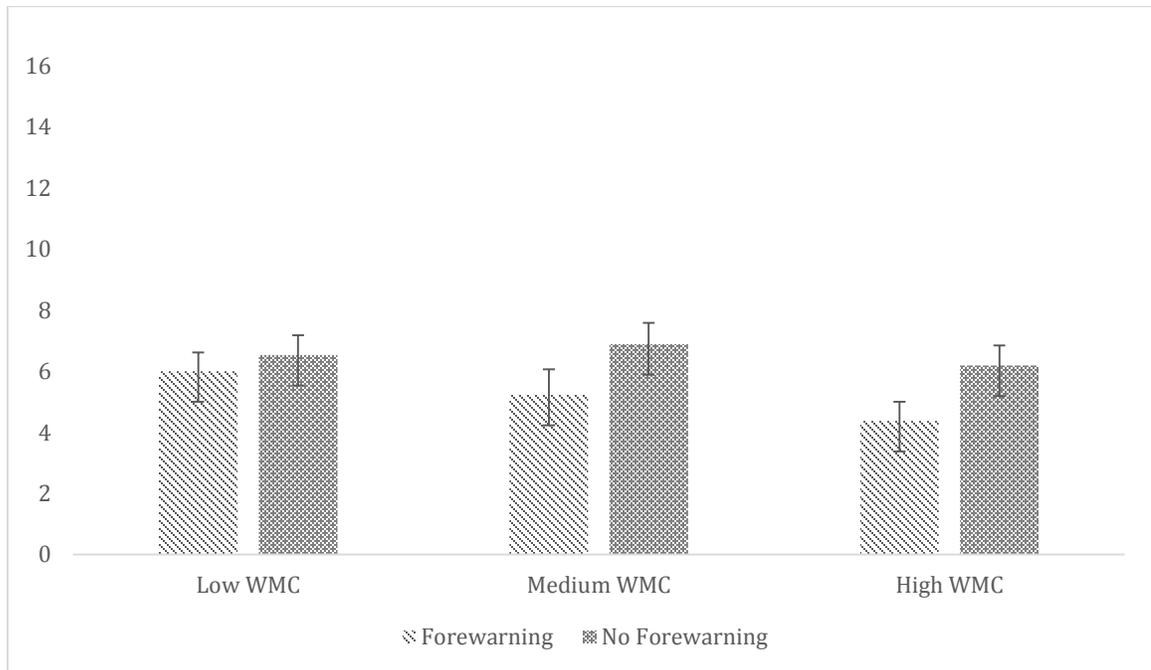
Appendix B

Memory Questions

Question	Correct Answer	Misled Answer
1. What is David Palmer's shirt color?	Blue	Grey
2. What is Sheri Palmer working on at the beginning of the episode?	Thank You Notes	Campaign Staff Appointments
3. At the beginning of the episode, what color is Jack Bauer's shirt?	Blue	Black
4. What are Jack and Kim doing at the beginning of the episode?	Chess	Dominos
5. When you first see her, what is Teri Bauer's shirt color?	Green	Yellow
6. What item does Jack take out of the refrigerator?	Jello Cup	Soda
7. How long does Jack expect to be gone when he is called from home?	1 hour	2 hours
8. Jack speaks to Kim's ex-boyfriend on the phone. What is his name?	Vincent	Xander
9. What type of vehicle does Jack drive?	SUV	Van
10. What color is Nina's shirt?	Black	Brown
11. What is the color of Dan & Rick's van?	Purple	Black
12. What item is on the dashboard of Janet's car?	Hawaiian Lei	Fuzzy Dice
13. What time is Martin's meeting with Palmer?	7am	8am
14. How long does Kim say it has been since her father died?	6 months	3 months
15. Midway through the episode, Jack changes his shirt. What is the new shirt color?	Grey	Green
16. Jack talks to Mason about a drug dealer. What type of drug was being trafficked?	Heroin	Cocaine
17. How much money was missing from the aforementioned drug deal?	\$200,000	\$100,000
18. What part of the city does Teri tell Jack that Kim has gone?	Valley	Hollywood
19. How many messages does Kim have on her cell phone?	5	7
20. What does the terrorist use on the flight attendant?	Hypodermic Syringe	Chloroform Rag
21. What type of plane does Tony report has exploded?	747	DC-10
22. Tony reports the plane exploded over a desert. Which desert?	Mojave Desert	Gila Desert
23. What street does Kim say to turn on to get to her house?	10th	39th
24. What color is the car Teri is in at the end of the episode?	Silver	Black

Appendix C.1

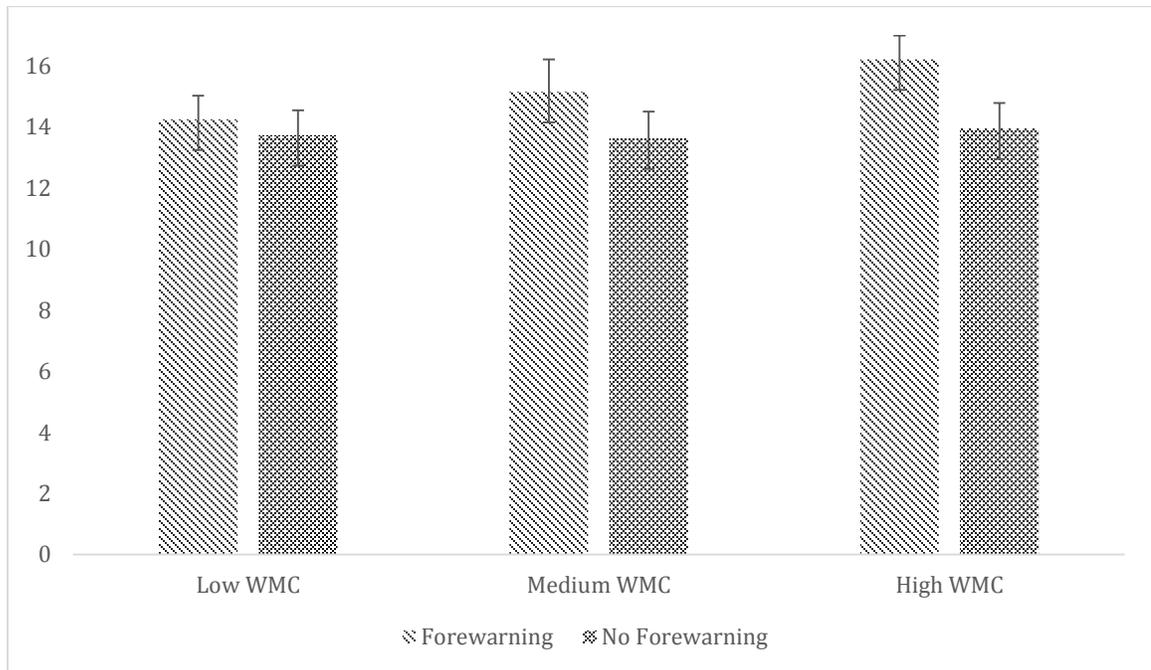
Mean Scores of Misled Answers



Note: Bars represent standard error (SE).

Appendix C.2

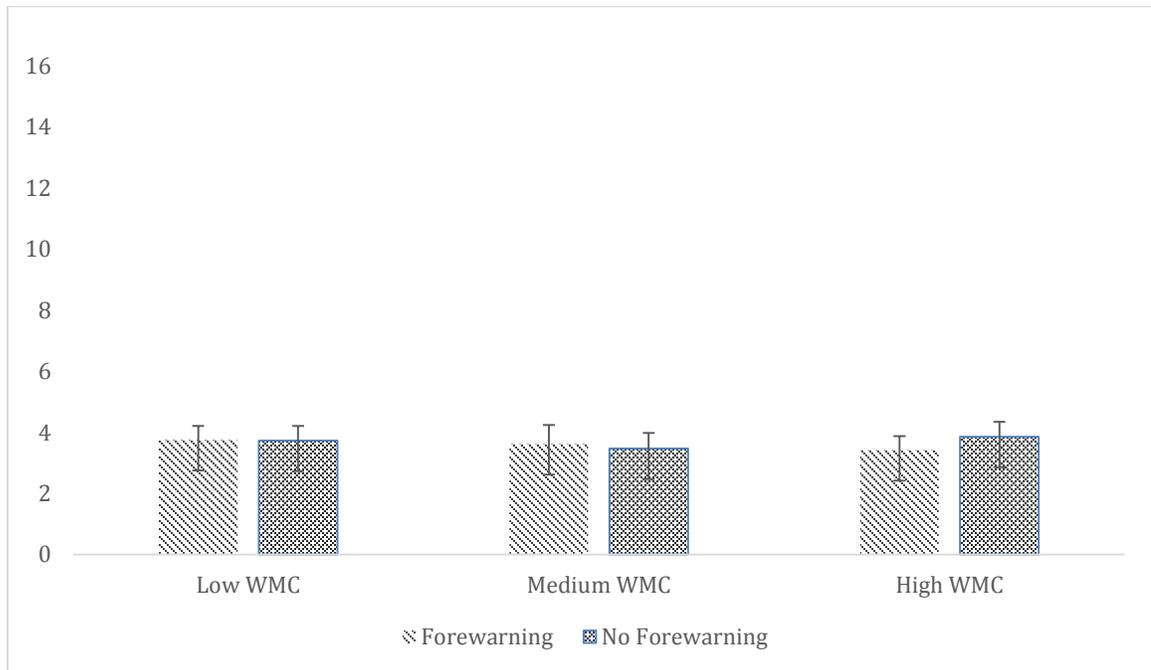
Mean Scores of Correct Answers



Note: Bars represent standard error (SE).

Appendix C.3

Mean Scores of Incorrect/Other Answers



Note: Bars represent standard error (SE).