

THE INFLUENCE OF SCHEMAS ON MEMORY: EFFECTS ON THE CRIMINAL
JUSTICE SYSTEM

by

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HONORS THESIS

Submitted to Texas State University
in partial fulfillment
of the requirements for
graduation in the Honors College
May 2020

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DEDICATION

To my father. You were right; where I'm going, I don't need roads.

ACKNOWLEDGEMENTS

Thank you to my mentors who have guided me along this journey. I appreciate the dedication, patience, and compassion you have shown me as I navigate the path to research.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	v
ABSTRACT	vii
CHAPTER	
I. INFLEUNCE OF SCHMEAS ON MEMORY: EFFECTS OF THE CRIMINAL JUSTICE SYSTEM.....	1
Schemas	1
Misinformation	4
Rationale for Current Study	6
II. METHODS.....	7
Participants.....	7
Procedure	7
Analysis Plan	10
III. PREDICTED RESULTS	11
IV. DISCUSSION.....	12
Schemas and eyewitness credibility.....	12
Schema retention and neural correlates	14
Conclusion	15
REFERENCES	17

ABSTRACT

When people go to a restaurant, they have expectations of how their experience will go from the moment they walk in the restaurant to the moment they walk out. This sequence of expected events is called a *schema*. A schema is defined as a mental framework involved in organizing specific experiences into particular themes (Baron & Branscombe, 2016; Goldstein, 2019). Schemas are very useful for organizing information that we encounter frequently. However, there is debate that schemas can also impair our memory and possibly lead us to remembering something that did not happen. So, what does this mean for our Criminal Justice system, an institution that relies on the memory of eyewitnesses to administer a fair trial? The following paper will discuss and explain the importance of understanding how schemas influence eyewitness memory for information and misinformation. A proposed study will extend a study done by Tuckey and Brewer (2003) by adding a misinformation component. After participants have watched a staged crime video, they will read narratives that include misinformation (schema-consistent, schema-inconsistent, or none) regarding the crime video. Participants will be interviewed using free-recall and cued-recall questions regarding the original video. Finally, the participants will be called back after one week to undergo another interview. The accuracy of participant recall will provide important information the impact of schemas in eyewitness testimony.

I. THE INFLUENCE OF SCHEMAS ON MEMORY: EFFECTS ON THE CRIMINAL JUSTICE SYSTEM

Understanding the relation between psychology and the law is extremely important especially with regard to eyewitness testimony. Eyewitness testimony has a huge impact on the outcome of a court ruling. Research has been done that concludes the perception of the reliability and credibility of an eyewitness has a significant impact on jury verdicts (Shermer, Rose, & Hoffman, 2011). The impact of eyewitness testimony can also be seen in a study done by Lindsay, Wells, and Rumpel (1981). The researchers ran a study to determine if jurors can recognize errors in eyewitness testimonies. Participants watched a staged crime and then were assigned as either a juror or an eyewitness. Those who were assigned as eyewitnesses were told to make either an incorrect or a correct identification of the perpetrator. The most interesting result from this study is that participants assigned as jurors believed the incorrect identification over 75% of the time, even though they also witnessed the crime. We can conclude from this study how persuasive an eyewitness testimony is, even when it comes to incorrectly believing wrong information. It is important to have more research like the proposed study to explore how eyewitness memory can be impacted.

Schemas

A schema is defined as a mental framework involved in organizing specific experiences into particular themes (Baron & Branscombe, 2016; Goldstein, 2019). For example, when we go to a restaurant, we typically know how the sequence of events will play out from the moment we walk in and are greeted to the moment we pay the bill and walk out. Schemas are useful to our memory systems and allow us to easily process

information when we are cognitively busy. However, sometimes events happen that are inconsistent with our past experiences. For example, if the hostess is not there to seat us and there is no sign saying to seat ourselves. Will this event, which is inconsistent with our schema, be more or less likely to be remembered accurately? We can theorize that schemas also influence eyewitness's memory, but in this case, it is uncertain whether the influence of a schema is beneficial.

Schema-consistent information are features of an event that we expect to occur based on prior experiences. For example, when we walk into a restaurant, we expect the hostess to seat us. Schema-inconsistent information are features we do not expect to happen and therefore clash with our schema for that event (e.g., no one being at the hostess stand to seat us). There is debate about whether items consistent or inconsistent with our existing schemas are remembered more accurately and why. Is schema-consistent information better remembered because we expect it, or is schema-inconsistent information remembered better because we do not expect it and therefore becomes more distinctive? Sentis and Burnstein (1979) studied the mental representation of schema-consistent and schema-inconsistent-information. Participants studied short scenarios that described either schema-consistent or schema-inconsistent representations about the relationship between people in the scenario (e.g., Mary and Sarah are part of the same cooking class). Afterwards, participants answered questions that required the retrieval of either one, two, or all three of the relationships. Researchers found that retrieval for all three schema-consistent relations of the scenario were remembered quicker and more accurately than any two or one of the schema-inconsistent relations. Results concluded that any information that is inconsistent with our schema is less likely to be remembered.

However, other researchers found that items inconsistent with our schemas are better remembered (Pezdek, Whetstone, Reynolds, Askari, & Dougherty, 1989). In this study, participants walked into a familiar setting (e.g., a professor's office) that had items that were consistent (e.g., a globe) and inconsistent (e.g., a hammer) with that setting. Next, participants took both a recall and a recognition test on the presented items. Items inconsistent with existing schemas for that setting were better recalled and recognized than items consistent with that setting. It is interesting to note that in the Sentis and Burnstein (1979) study, participants were tested on actions in recorded scenarios, whereas in the Pezdek et al. (1989) study, participants were tested on objects in real-world settings. This difference in the use of actions versus objects might potentially explain why the studies, although studying the same concept, come to different conclusions.

Yamada and Itsukushima (2013) hypothesized that this could be correlated to schemas provoking false recognitions of schema-consistent actions but not of schema-consistent objects. Participants watched scenes of a man cooking in a kitchen who performed schema-consistent actions with schema-consistent objects. Participants then completed a recognition test for the actions and objects. Possible answers for the recognition test included schema-consistent and schema-inconsistent object and action distraction answers. They confirmed three different conclusions. First, schema-consistent distractors were more often falsely recognized than schema-inconsistent distractors. Second, schema-consistent object distractors were more often falsely recognized than schema-consistent action distractors. Lastly, schema-consistent action targets were correctly recognized more than schema-consistent object targets. Yamada and

Itsukushima theorized that action information might be better recalled and recognized than object information because action information can be better elaborated on than object information. This is further supported by earlier work examining memory for a kidnapping scene by Migueles and Garcia-Bajos (1999). These researchers suggested that the reason object information is not better recalled than action information is because object information is not directly related to the real-world scene. The researchers suggested that objects of a real-world setting could be better remembered if repeatedly recalled, similar to a real case investigation.

Misinformation

The misinformation effect is the presenting of information after a person witnesses an event which can affect how the person describes the event later (Goldstein, 2019). Research into the misinformation effect has shown that misinformation is just as confidently remembered as fact (Loftus, Donders, & Hoffman, 1989). Loftus and colleagues note that this could be happening because participants may have no strong memory about the item in question and therefore create a false memory from the misinformation. The participant then has no reason to doubt this misinformation and consequently believes the misinformation as fact. Misinformation can even be incorporated into eyewitness memories by discussion with co-eyewitnesses (Paterson, Kemp, & McIntyre, 2012).

Loftus and Palmer (1974) examined if switching a single word in a leading question could affect how participants remember an event. In this study, participants viewed a series of slides that depicted a car accident. Afterwards, participants answered questions about the predicted speed of the vehicle at the time of the accident (e.g., “How fast was

the car going when it crashed”). Researchers changed the verb (e.g., bumped, smashed, collided, hit, slammed, etc.) and found that each word produced different predicted speeds. The results from this study confirmed that the misinformation effect can result from a single word.

A more recent study examined the effects of exposure to differing amounts of misinformation on memory accuracy (Pena, Kelmfuss, Loftus & Mindthoff, 2017). In this study, participants watched a mock crime video and then read a narrative containing 20%, 50% or 80% of misinformation about the video. Finally, participants completed a memory test and rated the credibility of the narrative and their own memory. Researchers speculated that receiving high amounts of misinformation negatively impacted participants’ performance by increasing their susceptibility to misinformation. As exposure to misinformation increased, memory accuracy decreased, but skepticism of the credibility of the narratives also increased. It is interesting to note that as skepticism for the narratives increased, participants became more aware of the source of their memory. The awareness of the source of information is known as source monitoring. This created a negative correlation between source credibility and source monitoring. Researchers assume that the skepticism, arising from the narratives with high percentages of misinformation, is associated with source monitoring accuracy. This correlation could be the reason why a negative relationship was found between source credibility and source monitoring.

In the criminal justice system, misinformation can influence a criminal lineup decision. Greenspan and Loftus (2020) conducted a study to examine the impact of feedback on confidence levels after a criminal lineup. In the study, participants watched a

crime video and then were asked to identify the perpetrator and rate their confidence. A week later, the participants were given either typical feedback (i.e., about the identification accuracy), confirming misinformation feedback, or disconfirming misinformation feedback. Finally, the participants reported a retrospective confidence judgement. Results showed that misinformation feedback created a significant increase in confidence levels (Greenspan & Loftus, 2020). This study is very important because witnesses are often seen as credible if they are confident (Lindsay et al., 1981).

Rationale for Current Study

Tuckey and Brewer (2003) investigated the influence schemas have on the types of information remembered across repeated retrievals. Researchers assessed participants' schema for a bank robbery and conducted multiple interviews with varying retention periods in which participants recalled schema-consistent, -inconsistent, or -irrelevant information. In two experiments, researchers compared the number of correct schema-consistent, -inconsistent, and -irrelevant facts reported at several time points including immediately, after three days, three weeks, and three months. Researchers also measured for memory intrusions (e.g., items that were incorrectly recalled). Both experiments revealed similar findings in that schema-consistent and schema-inconsistent information did not decay after repeated retrieval attempts. Memory intrusions also did not increase or decrease over time. This study concludes that schemas provide an overall benefit to memory by preserving the accuracy of specific types of information. However, an open question is whether misinformation interrupts the preservation of a schema? The proposed study would provide evidence of how schemas influence eyewitness memory for information and misinformation.

The current study will be an extension of the Tuckey and Brewer (2003) study to examine how schemas can influence the impact of misinformation. Similar to the Tuckey and Brewer study, participants will view a video of a crime and their memory will be examined for elements that are schema consistent and inconsistent. The novel aspect of the proposed study will be the manipulation of misinformation presented in narratives participants will read after the video but before the interview. The narratives in the proposed study will consist of misinformation related to schema-consistent and schema-inconsistent elements that were categorized by Tuckey and Brewer (2003). We will examine whether misinformation interferes with eyewitness testimony differently depending on whether the information relates to an existing schema or not.

II. METHODS

Participants

Seventy-five participants (ages 18-30) will be needed for the proposed study. Having 75 participants total will allow for 25 participants in each of the three narrative conditions. Participants will be recruited from undergraduate psychology classes using the Psychology Research Participation System (SONA). Using the SONA system will allow for students who are interested in participating in the proposed study to sign up for the study. On the SONA page for the proposed study will be a brief explanation of the study and eligibility requirements. In order to participate in the proposed study, participants must meet the age requirements and have normal or corrected-to-normal vision and hearing.

Procedure

After informed consent, participants will be instructed to watch a video about a

staged bank robbery. The video (used previously by Tuckey & Brewer, 2003) depicts two men entering a bank while carrying bags. One man stands by the door while the other goes up to the counter and tells the teller to hurry up. The teller collects the money, gives it to the robber, and the robber takes it and says, "Let's go," to his partner. Finally, the two robbers leave the bank and escape in a getaway car.

Immediately after watching the video, participants will be assigned randomly to one of three conditions. Each participant will read a narrative about the same staged bank robbery video, but the narrative will vary in the types of schema misinformation it emphasizes based on the experimental condition. One narrative will present misinformation regarding schema-consistent information, another will present misinformation about schema-inconsistent information, and the third will have no misinformation. Each participant will be instructed to read their given narrative.

The narratives in the proposed study will be a summary of the crime video. The summary will talk about eight main points that happened in the video. In the misinformation narratives, four of the eight points will be altered to be misinformation. In the narrative that will contain no misinformation, none of the eight points will be altered.

The schemas consistent and inconsistent information will be based on findings from Tuckey and Brewer (2003). In the Tuckey and Brewer study, researchers identified the elements that make up a schema for a bank robbery by having various participants fill out questionnaires. In the questionnaires, participants outlined what they believed would be features most common to a bank robbery. Participants were also prompted with headings to illicit more schema-specific elements for a bank robbery. The statements were then broken down to convey a single item of information. The elements were

categorized according to meaning or function, and then finalized. In order for an element to be considered a schema, it had to be mentioned by at least 25% of participants. Correct schema-consistent elements consisted of two robbers, both male, who carried bags, entered and exited the bank, and escaped in a getaway vehicle. Correct schema-inconsistent elements were that the robbers did not carry guns and only one robber spoke (Tuckey & Brewer, 2003).

Each participant will be interviewed twice after completing both tasks. The initial interview will take place following the video, narrative, and a 10-minute delay, and the second interview will be one week after the initial session. Both interviews will consist of free-recall and cued-recall questions. The free-recall format, which asks the participant, “Please recall everything you remember about the video,” will be immediately followed by a closed cued-recall interview. During the closed cued-recall interview, participants will be asked more specific questions relating to the misinformation, introducing narratives. After one week, the participants will be asked the same free-recall and cued-recall questions (*Fig.1*).

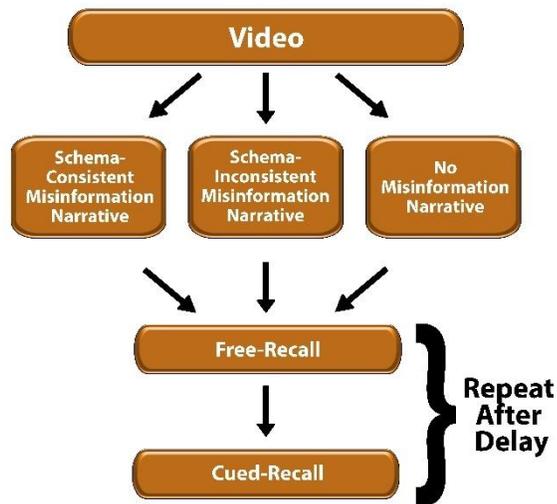


Figure 1. Visual representation of the procedure for the proposed experiment.

The recall accuracy of the video will be used to examine whether the information relates to an existing schema or not. We will also examine errors related to the provided information. After participants have watched the crime video and have read their designated narrative, they will be interviewed using free-recall and cued-recall techniques. The free-recall interview will be a singular question asking the participant to remember everything they can about the video. The cued recall will consist of multiple questions relating to specific items featured in the narratives.

Analysis Plan

We will compare the number of elements remembered between the free-recall and the cued-recall interviews across the three narrative conditions. Then, we will compare the first set of interviews to the second to analyze if memory decayed over time and is

that differed for the three narrative conditions. We are examining participants' recall accuracy for the original video and trying to see if the narratives helped or hurt their memory.

Using a two-way repeated measures ANOVA statistical test, we will be able to test the effects of the three narrative conditions and two time points for the free-recall and cued-recall interviews. The proposed study will use a within-subjects design. Any significant effect in the ANOVA will be followed up with relevant post-hoc tests.

III. PREDICTED RESULTS

Given the description of the misinformation effect and schemas, there are four possible scenarios that could result from the proposed study. First, there is a possibility that the misinformation effect has no impact on any of the conditions and all three conditions have equal accuracy of recalling the video. A second possibility is that any type of misinformation leads to worse performance on recall accuracy. In this case, the control condition scores would be higher on recall accuracy than either of the two misinformation conditions. A third possibility is that schema-consistent misinformation is more detrimental than the schema-inconsistent misinformation. In this instance, the schema-inconsistent misinformation condition would have a higher recall accuracy than the schema-consistent misinformation condition. The final possibility would be that schema-inconsistent misinformation is more detrimental than schema-consistent misinformation to memory performance. This would mean that the schema-consistent misinformation condition would have a higher recall accuracy than the schema-inconsistent misinformation condition.

IV. DISCUSSION

The proposed study will investigate the impact schemas have on the misinformation effect in eyewitnesses. The findings of this study would have important implications for future research and for the criminal justice system. If one type of misinformation leads to worse memory recall than another, that provides critical information about how misinformation may influence and potentially distort eyewitness memory. If memory performance is better in the schema-inconsistent misinformation narrative condition, then more distinctive original events may make us less susceptible to misinformation. This means that schema-inconsistent information would make us less likely to fall victim to the misinformation effect. The opposite might be true if the schema-consistent narrative condition shows better memory performance; expected information is easier to recall and thus less susceptible to misinformation because it does not match our schema.

The proposed study could also add to the debate about memory accuracy between schema-consistent and schema-inconsistent information by introducing the factor of misinformation and examining the relationship between these two effects. The proposed study could go even further as to include more proportions of schema-consistent and inconsistent stimuli, meaning add more schema-related elements (Tuckey & Brewer, 2003) and examining whether this impacts memory or confidence as in prior studies (Pena et al., 2017).

Schemas and eyewitness credibility

Eyewitness testimonies are extremely important during the deliberation of a verdict. As mentioned previously, even when participants have witnessed a crime, they still may believe wrong information 75% of the time (Lindsay et al., 1981). However, the question

still remains of why the juror participants believed the wrong identification even though they saw what really happened? It is reasonable to assume that the participants in this study had a schema of what a jury is supposed to do and what an eyewitness is supposed to do. Those assigned as jurors gave up their roles as an eyewitnesses and deferred authority to the participants assigned as eyewitnesses. These findings suggest that even naming someone as an eyewitness puts them in a position with enough credibility to influence the ruling of a trial (Lindsay et al., 1981; Shermer et al., 2011).

A future direction for research in this area would be to examine the relation between expected schemas and eyewitness credibility. Jones, Palmer, and Bandy (2015) examined if the consistency of one witness will harm or help the perceived consistency, accuracy, and credibility of a second witness. Participants read two trial transcripts of witnesses for the prosecution that were either consistent or inconsistent with the prosecution's argument. The order in which the participants read the transcripts varied in combinations of consistency and inconsistency (e.g., consistent/consistent, inconsistent/inconsistent, consistent/inconsistent, or inconsistent/consistent). Then participants rated the credibility and accuracy of the second witness. Results demonstrated that the first witness greatly influenced the perceptions of the second witness and culpability of the defendant (Jones et al., 2015).

Neal, Christiansen, Bornstein, and Robicheaux (2012) studied jury decision making as it relates to factors that are known to influence eyewitness memory accuracy (i.e., age, weapon focus effect, and slow identification). A correlation was found between juror beliefs about eyewitness age and reliability of the eyewitness. This means that the age of the eyewitness correlated with how reliable the juror believed the witness to be (e.g., the

younger the witness, the less reliable they were perceived as) (Neal et al., 2012). We can assume that perhaps there is a schema that younger people, such as children, remember less accurately than adults and that is why they are perceived as a less reliable witness. This study also shows how schemas can affect a jury's view of an eyewitness and furthermore, the outcome of a trial. It would be interesting to further investigate this claim and examine if there are schemas that effect jury decision making.

Schemas and neural correlates

Another future direction would be to examine the link between brain regions and the influence of schemas on eyewitness testimony. Studies suggest that activation in the ventromedial prefrontal cortex (vmPFC) may be correlated with the retention of schematic memory (Gilboa & Marlatte, 2017; Spalding, Jones, Duff, Tranel, & Warren, 2015). Spalding and colleagues conducted a study to examine if participants with damage to their vmPFC would show less schematic memory than control participants. Participants were given a recognition test that examined memory for previously encountered schema-consistent and schema-inconsistent stimuli. For example, participants would be shown a picture of a cactus with context words that were consistent (e.g., desert) or inconsistent (e.g., ice rink). Afterwards, participants were asked to identify a given picture or word as old or new and rate their confidence. Results showed that healthy control participants were more likely to identify an item as being old when they viewed it in schema-consistent context than participants with a damaged vmPFC. These findings conclude that there is an interplay between the vmPFC and integration of schemas.

There is also speculation on the relationship between schemas and different memory

processes (Lane, Roussel, Villa, & Mortia, 2007; Mullet, Umanath, & Marsh, 2014; Pezdek et al., 1989; Sweegers, Coleman, van Poppel, & Talamini, 2015). Höljtj, Lubahn, and Mecklinger (2019) used event-related potentials (ERPs) to investigate temporal dynamics of the memory processes. Researchers hypothesized that the encoding of exemplar words would activate the encoding of schema-consistent information. Participants were shown exemplar words that were either semantically consistent or inconsistent with the preceding category while ERPs were being recorded. After a 24-hour delay, participants were given a recognition test for the exemplars and the category cues and their ERPs were recorded again. As expected, schema-consistent exemplars were remembered better than schema-inconsistent exemplars. Subsequent memory effects were related to activity in the frontal lobe electrodes for both schema-consistent and -inconsistent exemplars, however, late frontal lobe activity was recorded when participants remembered schema-inconsistent exemplars.

To add to the neuroimaging findings from the previous studies, it would be interesting to examine neural correlates and schema retention as it relates to eyewitness testimony using functional magnetic resonance imaging (fMRI). fMRI can be used to examine task-related brain activity by tracking blood flow in the brain. An extension of the proposed study would be to use an fMRI to examine differences in activity in the frontal and medial temporal lobe regions while participants watch the video, read the narratives, and during the memory tests.

Conclusion

The study proposed in this these would be an important extension of the Tuckey and Brewer (2003) study and will include misinformation narratives to determine the impact

of schemas in memory for both information and misinformation. The overall goal of the proposed study is to understand the influence of schemas on eyewitness testimony and the impact this could have on the criminal justice system.

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