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VIVIDNESS OF VISUAL IMAGERY AND FALSE MEMORY CREATION

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By

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By

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Abstract

Research has established that encouraging people to visually imagine events through guided imagery can induce false memories (Muschella & Schonborn, 2021; Paddock et al., 1998) through imagination inflation (Loftus et al., 1996). Much of the previous research has focused solely on situations where people are formally asked to visualize events. This study experimentally investigated the role of prompting visualization on false memory creation while testing for vividness of a person's visual imagery as a possible moderator. The first hypothesis was that those who were given the visualization prompt would have more false memories than those with no prompt. The second hypothesis was that there would be a positive correlation between vividness of visual imagery and false memory creation; the more vivid a person's visual imagery, the more susceptible they would be to false memories. The third and final hypothesis was that the vividness of a person's visual imagery would moderate the effect of the visualization prompt; when prompted to visualize, those with especially vivid visual imagery would be more prone to false memory than those with less vivid visual imagery. In session 1, participants watched a video of a local arts festival and were asked questions over the video. The experimental group was asked to visualize the events from the videos that were being asked about. This 'interview' included subtle pieces of misinformation about the events in the video (e.g., referring to a red golf cart that was actually blue). In session 2, after a three-day delay, they were given a recognition task in which they selected the events they remembered from the video from a provided list, which included some correct and some incorrect details. They also completed the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973). Results indicated no significant difference in the use of a visualization prompt. Vividness of visual imagery did not significantly moderate the formation of false memories. There was no significant

relationship between vividness of visual imagery and false memory formation. The major limitations of the current study are limited sample size and the resulting low statistical power. The results of the current study may be beneficial in the context of police interviewing using visualization to induce context-reinstatement. This area of research may benefit from further investigation to more conclusively close the door on the relationship between false memory creation and vividness of visual imagery, especially if we consider a person's natural tendency to visualize. In other words, the prompt may not matter because people are naturally inclined to automatically visualize when recalling a memory.

Keywords: visual imagery, false memory, vividness, eyewitness testimony, cognitive interview

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Vividness of Visual Imagery and False Memory Creation

Eyewitness memory and testimony are crucial factors in the criminal justice system. Facial recognition (i.e., lineups, identification techniques) and eyewitness memory recollections are heavily relied upon within the system. There is a history of cases that have resulted in the death penalty as punishment based solely on eyewitness identification, some of which were later overturned on the basis of disconfirming DNA evidence (The Innocence Project, 2023). These false identifications illustrate the imperfection of memory. The possibility of faulty memory promotes research to pinpoint which factors impact the accuracy of eyewitness testimony.

Memory Construction

Memory consists of three stages: encoding, retrieval, and consolidation (Melton, 1963). According to McDermott & Roedinger (2014), encoding happens after the initial perception and learning of sensory input and refers to the information being sent into long term memory for storage. Not all information you are exposed to ends up being encoded into memory. In order to encode information, you first have to be attending to it. Attention is crucial in filtering out irrelevant information and focusing cognitive resources on the most important aspects of the sensory input. Attention allows you to select and prioritize what gets encoded into memory therefore, without attention, much of the sensory input goes unnoticed and does not end up being encoded.

Once encoded, memory must be retrieved to bring it to our conscious thought. Stored information can be accessed through retrieval cues, which can be external (i.e., an image, scent, or noise), or internal stimuli (i.e., a thought or sensation; Schacter, 2001) that triggers memories to be recalled. These cues can be related to the context in which the memory was encoded, or the content of the memory itself. Engrams (also known as memory traces) are conceptualized as the

complex neural pathway that makes up a stored memory (Josselyn & Tonegawa, 2020). When learning or experiencing something new, the brain encodes this information by strengthening or forming new synaptic connections between neurons. During retrieval, the memory trace is reactivated, and the brain reconstructs the experience based on the activated neural pathways. Retrieval refers to the process of pulling information, which has already been encoded, from long-term memory back into working memory (Roediger & Butler, 2011). There are a few types of memory retrieval—recall, recognition and reconstruction. During recall, information is retrieved without specific cues or prompts. Recognition involves identifying information when it is presented to you and reconstruction takes place when memories are recreated from bits of information, like filling in gaps. The more the information is recalled and then consolidated again, the easier it is to retrieve the memory (Roediger, & Butler, 2011), as the repeated firings of the same neural circuit make it easier to activate or fire in the future (Attneave et al., 1950).

Memory consolidation refers to the neural changes that occur through which newly acquired information is stabilized and stored in long term memory (Elsey et al., 2018; McDermott & Roedinger, 2014). During the initial encoding process, the new information will be stored in a short-term form and may be easily forgotten if not consolidated. Consolidation takes place over time and involves the engrams (memory traces) linked to memories where temporary memories become stronger, and longer lasting. There are two types of consolidation: synaptic and systems consolidation. Synaptic consolidation is a short-term process that occurs rapidly, usually within the first few hours after an event, and involves the neural changes where synapses between neurons involved in encoding a memory become stronger (Paller, 2009). In comparison, systems consolidation is a long-term process that happens over a course of days, weeks, or years after experiencing the event and involves the gradual transfer of memories from

temporary storage to more permanent storage through repeated reactivation of the memory trace (Squire et al., 2024).

There are two types of memory that are important when understanding memory: gist and verbatim. Gist memories encompass the "big picture" focusing on the overall themes or meaning of an experience or event, while verbatim memories are focused more on specific details of an event such as exact words, images, or sensory elements present (Brainerd & Reyna, 2004). As explained by the Fuzzy Trace Theory (Brainerd & Reyna, 1995), both gist and verbatim memory are utilized when experiencing an event. Overall, we tend to rely more on gist memory as we age (Brainerd & Reyna, 2015; Mih, 2009), but the timing of retrieval also plays a role in the extent to which we rely on each type of memory. Importantly, gist memory is closely related to semantic memory which refers to our general understanding of the world (i.e., facts, concepts, ideas, and meanings).

Any time information is retrieved, it must then be reconsolidated in long term memory. Reconsolidation is the process where previously consolidated memories become re-active in short term memory after being retrieved and are updated before being stored in long term memory again (Elsey et al., 2018). During this process, encoding, retrieval and consolidation all work together which means memories can be reactivated, re-encoded, and even modified by new information or experiences. Any time you recall a memory or think about it, it is retrieved from long term memory and becomes active in working memory. Once active in your work memory, the information or memory becomes susceptible to alteration, because incoming sensory information (e.g., someone telling you a false detail) is also processed in your working memory. When memory reconstruction takes place, semantic specification occurs as part of the process.

Semantic specification can be explained as attaching meaning to memory details and figuring out how they fit into a larger narrative (Hart, 2007).

Memory Errors

Errors in memory can occur throughout any stage of memory construction and can range from a temporary difficulty recalling one detail of a larger memory to having a memory of a completely fabricated event. Most memories experience loss over time, or natural decay (Hardt et al., 2013). Information can also be temporarily 'unavailable' due to interference during the retrieval process. This includes retroactive interference, a new piece of information getting in the way of remembering older information, and proactive interference, an older memory disrupting recall of a newer memory (McGeoch, 1932; Underwood, 1957). Whereas these refer to a difficulty retrieving a memory, the term false memory typically indicates an addition or change to a memory from its original form. These false details can come from many sources including post-event misinformation, leading questions, suggestions from authority, source misattribution, or semantic distortion.

Research involving newly created false memories has largely included the misinformation paradigm (Loftus, 1992). The misleading post-event misinformation effect is when someone is introduced to contradictory information after witnessing an event, which interferes with their original memory of what happened (Oeberst & Blank, 2012; Pena et al., 2017). Blatantly different information is usually identified as incorrect or incongruent with one's memory, but more subtle misinformation is less likely to be identified (Butler & Loftus, 2017). The contradictory/false information is then reconsolidated, tainting future recollections of that memory. Similarly, semantic distortion can be largely attributed to post-event false memories. Semantic distortion refers to the alteration or misrepresentation of a memory during recall or the

reconstruction of the memory (Atkins, & Reuter-Lorenz, 2008). Instead of involving changes to specific details or facts, semantic distortion involves changes to the underlying meaning or interpretation of the original memory, which can be influenced by emotions, biases, or newly acquired information.

Any time you recall a memory or think about it, it is retrieved from long term memory and becomes active in working memory. Once active in your work memory, the information or memory becomes susceptible to alteration, because incoming sensory information (e.g., someone telling you a false detail) is also processed in your working memory (WM). When activating a memory into WM, the two active items (the memory, and new information) can get confused and then reconsolidated as a single altered memory. An experiment conducted by Lindsay and colleagues (2004), activated participants' memory of their elementary school years by showing their 3rd or 4th grade class photograph. The participants read several narratives, one of which included an event that never occurred: another student putting slime in the teacher's desk. That false event was embedded within accurate details (e.g., their teacher's name). While reading the narratives, the participant's actual memories were activated, being brought into WM. While this memory is active, false information (the false event) was also introduced into WM. Due to the misinformation and the real memory both being active at the same time, the false details of the slime are then incorporated into the original memory when sent back to long term storage and reconsolidated. This phenomenon has been replicated in cognitive lab studies (Hupbach et al., 2007) and in animal studies (Nader et al., 2000).

This misinformation can come from many sources including interviews, fellow eyewitnesses, authority figures, and feedback from eyewitness identifications. For example, a study by Takaoka and colleagues (2001) established that incorrect information provided after the

event over repeated interviews can lead to children falsely remembering actions, people, and physical appearances from a staged event. A study by Shaw and Porter (2015) investigated interviewing tactics and false confessions discovered 70% of participants reported a false memory of committing a crime. In this study, undergraduate college students were interviewed once a week for three weeks. These interviews were scripted and included suggestive memory retrieval techniques. Half of the participants were told in the interview that they had committed a crime that had resulted in police contact. The researchers provided an event that actually occurred before introducing the false event, in order to gain credibility with the participants. This action also increased the possibility of participants retrieving the real event into working memory, adding the information about the false event, then reconsolidating the memory with both events combined. During the interviews, if the participants experienced trouble recalling the false event, they were encouraged to keep trying and instructed to use guided imagery in order to recall the memory. Of the 30 participants assigned to this condition, 21 (70%) eventually recalled the false memories of being involved in the criminal event (i.e., offered a false confession). Even subtle agreement from police after an eyewitness identification can result in eyewitnesses later recalling an increased confidence at the time of their identification (Wells & Bradfield, 1998).

Visual Imagery

Visual imagery is a type of mental imagery, which refers to creating something in your mind when it is not in front of you physically. There are several types of mental imagery, one for each of the senses: auditory, olfactory, visual, gustatory, and tactile. Visual imagery is one of the most used types of imagery. It is used every day, often when we do not even realize it or without a conscious choice. It is used when conjuring future scenarios, recalling past experiences (i.e., retrace steps), and when creating a fictitious world in the mind (i.e., daydreaming, reading).

There are two subtypes of visual imagery: object and spatial. Object imagery refers to the ability to visualize specific details, objects, and features of those objects, while spatial is the ability to mentally form an image of objects' locations, and spatial relations. People's ability to create these mental pictures can vary greatly in how vivid or detailed those mental images are. Vividness has been described as a combination of clarity and liveliness. Clarity is the brightness of an image's colors and the sharpness of the details in the image (Marks, 1999), while liveliness is how much it resembles real life, or the ability to relive something.

In the late 19th century Sir Francis Galton, a prominent researcher in psychological history, noticed some people lacked the ability to visually imagine at all. This was later termed aphantasia by Zeman et al. (2015). Aphantasia refers to extreme deficits in the ability to create visual mental images. On the other end of the spectrum is hyperphantasia, the ability to visualize extremely vividly. Those with hyperphantasia experience such vivid and lifelike imagery it is considered to be as clear as seeing in "real life" (Zeman et al., 2020). Around 2-4% of the general population is believed to have aphantasia (Dance et al, 2022; Zeman et al, 2015), however there is an estimated prevalence of 0.7% for 'extreme aphantasia' and 2.5% for 'extreme hyperphantasia' (Milton et al., 2021). While these are two extremes, visual imagery ability exists on a spectrum.

Keogh and Pearson (2018) researched aphantasic individuals using both the Vividness of Visual Imagery Questionnaire (VVIQ), and the Object and Spatial Imagery Questionnaire (OSIQ). The aphantasic participants reported extremely low scores on the object portion of the OSIQ, but their spatial scores were significantly higher (almost double their object scores). Interestingly, those who are congenitally blind have remarkably similar outcomes, where they lack the ability to visually imagine, yet their spatial imagery ability remains intact (Vecchi,

1998). This separation between object and spatial visual imagery may be supported by neuro-imaging research which has found that static object imagery and spatial imagery activate separate neural pathways (i.e., the "what" and "where" pathways; Goodale & Milner, 1992; Postle & D'Esposito, 2000; Smith et al., 1995).

Visual Imagery and Memory

Research suggests a strong link between visual imagery and memory. More specifically, visual imagery ability has shown to play a role in autobiographical memory recall. People often re-create the event visually in their mind suggesting those with more vivid visual imagery influence the way autobiographical events are recollected. Specifically, previous research has found a positive correlation between visual imagery vividness and accuracy and details in memory recall (Greenberg & Knowlton, 2014; Childs, 2016; Milton et al., 2021; Rubin, 2005). In a study conducted by D'Argembeau and Van der Linden from 2006, participants took the VVIQ and were given a key word ('tree') and asked to generate seven autobiographical memories associated with the key word, then rate their perceptual properties on a series of scales. The researchers found that the level of visual detail and other sensory detail in the memory and the amount of temporal information were significantly predicted by VVIQ scores.

Damage to areas of the brain involved in visual imagery processes can negatively impact autobiographical memory retrieval (Gardini, et al., 2011; Greenberg, et al., 2005; Ogden, 1993). Specifically, those with aphantasia consistently report general deficits to their episodic memory and describe their autobiographical memories with significantly less detail than those with normal imagery ability (Dawes, et al., 2020). Aphantasic individuals have also exhibited problems with object memory as opposed to spatial memory (Bainbridge et al., 2020; Keogh & Pearson, 2018). Considering that people can also compensate for their lack of visual imagery

ability with associations and labels (Jacobs et al., 2017; Knauff & May, 2006; Wicken et al., 2021), aphantasics may be using other cognitive strategies in order to remember visual information. This compensation may be the reason these individuals are able to perform well on visual working memory tasks even without the ability to visually imagine. Importantly, individuals with low visual imagery ability also report extreme difficulty in face recognition, a type of visual memory (Zeman et al., 2020). Facial recognition plays a larger part in memory than one may think. If a person lacks the ability to recognize faces, this may lead to worse memory due to the loss of facial memory cues, and may contribute to false memories (Rubin et al., 1998; Schacter et al., 2011).

Visual Imagery and Memory Errors

While visual imagery appears to play a crucial role in recalling autobiographical memories, research has also found that guided imagery can induce false memories, an effect referred to as imagination inflation (Garry et al., 1996; Paddock et al., 1998). This is a phenomenon where people that imagine an event (that never occurred), trick themselves into (mis)believing they experienced the event simply by imagining it. These errors may be attributed to imagined and experienced events being encoded and retrieved in the same way neurally (Johnson, et al., 1993; Johnson & Raye, 1981; Gonsalves et al., 2004). Confidence is also seemingly affected by visualizing. In Garry et al. (1996), those that were prompted to imagine false events had a significant increase in confidence that the event occurred. This is particularly important as it pertains to police interviewing techniques. Most law enforcement agencies use a form of the cognitive interview (Campos et al., 2010) which includes a visualization prompt when interviewing witnesses or persons of interest. The interviewees are asked to visualize the crime scene and are often instructed to close their eyes to help recreate the scene or event. This is

done with the intention of recreating (mentally) the environment that the interviewee was in to aid in recall. As mentioned previously, the context (i.e., physical environment) from an event can serve as an important retrieval cue to aid in recalling memories, which is referred to as context-reinstatement or context-dependent memory (Fodarella et al., 2021). While the use of context reinstatement is typically beneficial to recall, it may also inadvertently increase false details as well, especially for those with highly vivid visual imagery abilities. Though research on imagination inflation typically incorporates subtle misinformation during the visualization process, people can create false details themselves during this process. Research from Mazzoni and Memon (2003) found that imagination alone, without any additional suggestive procedure, can increase participants' convictions that an event had occurred in their childhood, and produce further elaborations on these false memories of the event. However, this phenomenon has solely been tested with recall of distant childhood memories up until this point.

While the role of visualization and false memory formation is abundant, studies focused specifically on the visual imagery *vividness* and false memories is fairly limited and has mostly focused on source misattribution. A relatively consistent finding among these research studies is that those with highly vivid visual imagery (often referred to as high imagers) are more likely to make source attribution errors than those with less vivid visual imagery (low imagers; Dobson & Markham, 1993; Eberman & McKelvie, 2002; Markham & Hynes, 1993). Basic research using the Deese-Roediger-McDermott (DRM) paradigm, an experimental tool that uses word lists and lures to measure false memory, most often finds such an effect. In the context of the DRM paradigm, multiple studies have found that participants with more vivid imagery abilities recalled more false lure items than those with less vivid imagery (Roberts, 2002; Wilkinson & Hyman, 1998). The DRM is a prime example of how the semantic structure of a list can cause

people to falsely recall or recognize words that were never presented, highlighting the role of semantic distortion in memory. Winograd et al. (1998) found a trend towards a similar relationship between individual differences in imagery vividness and remember judgements to critical lures. When instructed to visualize during a study phrase, Markham and Hynes (1993) also found that high imagers made more errors when recalling the details of complex geometric shapes. Gonsalves et al. (2004) found that those with enhanced vivid imagery more often falsely attributed their visualizations as previously being seen in a photo. This is not an entirely consistent finding, however, as Robin et al. (2022) failed to find a significant difference in false memory rates between high and low imagers.

While the research on the relationship between visual imagery vividness and basic false memories or source misattributions is relatively consistent, research testing high and low imagers with more complex false autobiographical memories is even more limited and with mixed results. In more applied experiments, some research has found a positive correlation between accepting misinformation and visual imagery vividness after watching videos involving crimes (Tomes & Katz, 1997). However, there are also several studies that have failed to find a significant difference in false memories of life events between high and low imagers (Hegerty, 2015; Mazzoni & Memon, 2003). While there was no significant difference in the *number* of false memories between high and low imagers for brief events in the Hegerty (2015) study, those with high imagery ability were more detailed and adamant in their false memories.

Previous literature over false memory may be considered noteworthy as some techniques used in the studies are similar to the strategies within criminal investigative proceedings such as the use of guided imagery to assist in recall and applying pressure to remember events or specific

details (Fisher, 1995; Magnusson et al., 2022; Schreiber Compo et al., 2012). The ability to generate completely falsified memories of committing a crime raises concern in forensic settings.

Present Study

Research has established that purposefully asking people to generate mental images (i.e., guided imagery) *can* induce false memories (Muschalla & Schönborn, 2021; Paddock et al., 1998). However, most of this research is based on adults imagining childhood events, lacking more recent events during other stages in life. The current study focused on potential false memories in a recently experienced event and the role that visual imagery may play in the creation of those false memories. Previous research has identified a possible relationship between visual imagery and accurate memory details, while specific research into imagery vividness has identified a relationship between visual imagery vividness and false details. This may be because visual imagery itself is a positive aid in recalling memory, but vividness may increase false details as well as accurate ones.

When anyone, including a high imager, retrieves a memory, a mental image is re-created and becomes malleable. If people with highly vivid visual imagery are asked to visualize (imagine) false details, those could be implanted into the original memory and reconsolidated as the 'truth.' Because they are so good at mentally visualizing, those false details may seem just as real within the mentally re-created memory as the details they are retrieving from the actual event. The present study investigated the role of prompting visualization, and visual imagery vividness in the creation of false memories. First, I hypothesized that prompting someone to visualize an event would lead to more false details than not explicitly prompting visualization. Second, those with high vivid imagery will have more false memory than those with low vividness. Further, I believed that this effect would be moderated by visual imagery vividness

such that for those who are prompted to visualize, those with highly vivid imagery would generate more false details than those with less vivid imagery.

Method

Participants

Participants consisted of University of Central Oklahoma students, faculty, and staff recruited through a global email blast and local residents recruited through various online platforms such as Facebook and Instagram. A total of 122 participants completed Session 1 of the survey. Of those, 45.90% either failed to return for Session 2 (n = 49) or returned more than four days after completing Session 1 (n = 7). Participants were removed if they reported that they identified the deception in the study (n = 3) or they participated in the study more than once (n = 4). This resulted in a total of N = 59 participants used in data analysis. Race and ethnicity of participants were reported as follows: White (64.41%), Black/African American (6.78%), Asian (6.78%), American Indian or Alaska Native (1.69%), Other (6.78%), more than one (11.86%), and prefer not to say (1.69%). Of the 59 participants, 84.75% identified as female, 11.86% as male, 1.69% as other and 1.69% preferred not to say. The age of participants varied from 18 to 76 years old (M = 30.45, SD = 15.83).

Materials

The researcher documented the 2024 Edmond Arts Festival and developed an 8-minute video showcasing the event. The video included vendors, people walking by, and minor events (such as a crying child, people biking through the crowd, etc.) from a series of static points of view. Additional audio including barking dogs, background noise, and unintelligible background talking were added to the video from freesound.org. The independent variable was the visualization prompt which was manipulated through the instructions given to participants before

answering questions over the video. Participants were asked to respond to a series of 'interview questions' to induce misinformation about events and people in the video. For example, "How many officers escorted the blue golf cart?" All interview questions were a short answer format with a textbox for participants to type their response. While there was a golf cart in the video, and this was escorted by one police officer, the golf cart was actually red, rather than blue. The complete list of interview questions is provided in Appendix A. The participants who were randomly assigned to receive the visualization prompt were explicitly asked to mentally visualize the events from the video as they answered each question.

The vividness of participants' visual imagery was measured using the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), which consists of 16 items, each rated on a 5-point Likert-type scale ranging from 1 "no image at all, you only 'know' you are thinking of the object" to 5 "perfectly clear and as vivid as normal vision". A total score was calculated as the sum of responses, ranging from 16 to 80, with higher values indicating more vivid visual imagery. Instructions for the questionnaire were taken from the updated version (VVIQ-2; Marks, 1995) as the original version does not appear to have had specific instructions. Items included a prompt or scenario, followed by specific aspects of the prompt for which participants rate the vividness of their mental image. For example, "Think of some relative or friend whom you frequently see (but who is not with you at present). Consider carefully the picture that comes before your mind's eye and rate the vividness of… 1) the exact contour of their face, head, shoulders, and body 2) characteristic poses of their head, attitudes of body, etc. 3) the precise carriage, length of step, etc. in walking." Please see the full measure in Appendix B.

False memory was measured by using a recognition task in which the participant is asked to select which events, people, and places they saw in the video. The list of items included a total

of 14 details that the participants could choose to select, seven of which were false details mentioned in the misinformation interview questions. The total number of false details selected by each participant was recorded as a measure of their false memory. See Appendix C for the full list. The survey also included demographic questions for age, race/ethnicity, and sex. There was one manipulation check item at the end of the study which asked participants, “During Part 1, when you were answering questions about people and events in the video, did you use visual imagery (mentally 'seeing' or trying to visualize the people, events, etc.) when answering the questions?” with answers of Yes, No, or Unsure/do not remember. The deception detection question asked participants, “What do you think the purpose of this study was?”. Those that indicated the study was about false memories were removed from data analysis.

Procedure

The study was a Qualtrics survey consisting of two sessions three days apart. Session 1 included the video recording of the Edmond Arts Festival. The participants were first asked if they attended the event and excluded from further participation if they reported that they attended the event or if they were not sure if they attended. This was done because some of the misinformation provided in the interview may have actually occurred at the event, so participants who experienced the entirety of the event (beyond what was shown in the video) may be recalling true details that we intended to be false. Before watching the video, participants were asked to “imagine that you are the one attending this event with the video being your point of view at the arts festival”. The participants received instructions to turn the audio up for the video or to use headphones. They were also asked to complete the study on a tablet or computer as the video would not display at the same size/quality on a cell phone. After watching the video, participants completed a brief filler task (fake personality survey) which took on average

approximately 5 minutes. The participants then answered the interview questions in which misinformation was embedded. At the conclusion of Session 1, participants entered their email addresses, so that a link to the second part of the study could be automatically emailed to them three days after completing Session 1. Session 2 included the measure of false memory in which participants were asked to select which events, items, and/ or people they recall seeing in the video. This list included 14 items, half of which did occur in the video and half which were introduced as false memories during Session 1. After this, participants completed the VVIQ, answered the demographic questions, answered the manipulation check and deception detection question, and were debriefed. The debriefing included the explanation of the deception that occurred during the misinformation interview of Session 1.

Results

The purpose of the current work was to assess the moderating role of imagery vividness in the formation of false memories between those who are prompted to visualize and those who are not during a misinformation interview. This included three hypotheses: 1) those who were given the visualization prompt would have more false memories than those with no prompt and 2) those with high vivid imagery will have more false memory than those with low vividness and 3) that this effect would be moderated by visual imagery vividness such that for those who were prompted to visualize, those with highly vivid imagery would generate more false details than those with less vivid imagery. A hierarchical regression was conducted to test the hypotheses. The first step in the model predicted false memory (number of false details identified during the recognition task) based on visualization prompt (not prompted = 0, prompted = 1) and VVIQ score. The second step in the model added the interaction between prompt and VVIQ to the model. The first step tested Hypothesis 1 and Hypothesis 2, but the model was not significant,

$F(2, 56) = 0.23$, $p = .80$. Prompt condition was not a significant predictor of false memories, $\beta = 0.05$, $t(56) = 0.37$, $p = .72$. Nor was VVIQ score a significant predictor of false memories, $\beta = 0.08$, $t(56) = 0.61$, $p = .55$. The second step in the model tested Hypothesis 3, but was also not significant, $F(3, 55) = .53$, $p = .67$. The interaction term was also not a significant predictor of false memories, $\beta = -0.61$, $t(55) = -1.06$, $p = .29$. Descriptive statistics are provided in Table 1.

Table 1

Means and (Standard Deviations) for Vividness of Visual Imagery and False Memories

Prompt Condition	VVIQ	False Memories
Visualization prompt (n = 28)	56.11 *(15.57)*	3.04 *(1.62)*
No prompt (n = 31)	59.81 *(12.78)*	2.90 *(1.85)*
Total (N = 59)	58.05 *(14.17)*	2.97 *(1.73)*

Note. VVIQ scores range from 16-80, with higher scores indicating more vivid visual imagery. False memories are the number of details selected from a recognition task that did not occur in the event video. Possible scores range from 0-7.

Discussion

This study investigated the relationship between prompting someone to visualize and the creation of false memories, while testing for a moderating effect of a person's visual imagery vividness. Hypothesis 1 was not supported; there was no significant difference in false memory creation between those who received a visualization prompt and those who did not receive one. Hypothesis 2 was not supported; there was no significant relationship between the vividness of a person's visual imagery and their tendency to create false memories. Hypothesis 3 was also not supported by the findings; vividness of visual imagery did not moderate the formation of false memories. While this is unfortunate and diminishes the strengths of the conclusions that can be

drawn, the lack of significant effects has also been seen in previous research. For example, Mazzoni and Memon (2003) failed to find a difference in the effects of imagination inflation based on the participants' self-reported vividness of visual imagery. There was also research that showed mixed results in regard to visual imagery. Though many found a relationship in the predicted direction, a handful of studies from Madore and colleagues (2014) found that people who imagine vividly had more reliable memories. These studies looked specifically at episodic specificity and guided visualization mirroring techniques used in the cognitive interview. Hegerty (2015) also found no significant difference in the number of false memories between high imagers and low imagers, although they did find that those with more vivid imagery were more detailed and confident in their false memories. This may suggest that the difference is not in the number of false memories created, but the level of detail and confidence tied to the false memory.

Further, the emotional valence of the memory may be an important factor to consider. In a recent study by Brainerd and Bookbinder (2019), semantic distortions were more likely to occur with emotionally charged details of an experience. The stimuli used in the current experiment lacked any emotional arousal, meaning the neutrality of the video may have contributed to the lack of significance in false memory formation. Most of the research surrounding guided visualization is based on adults recalling childhood events. These events often undergo decay (Hardt et al.,2013) and due to the considerable time gap between event and questioning, these have a higher possibility of alteration. This may partly explain why there was no seen effect for being visually prompted after a recently occurring event (a video event occurring three days prior).

While it is possible that the lack of a significant effect of prompting visualization was due to methodological concerns, to be discussed as limitations below, it is possible that prompting one to visualize simply does not affect false memory creation. If this is the case, the use of guided visualization may not have a deleterious effect on recent memory, and the use of guided imagery in contexts such as the cognitive interview may still be advantageous. This is not unfounded, as the benefit of context-reinstatement, sometimes through guided imagery specifically, has been found to aid recall (Fodarella et al., 2021; Hanczakowski et al., 2014).

This study contained a few limitations. Due to the strict criteria for participants in the study and a high attrition rate, the sample size for the current study was relatively small. A priori power analyses using G-Power indicated we would need a total of 80 participants to achieve 80% power with a moderate effect size. Due to the small sample size, the current work may have failed to find a significant effect due to insufficient statistical power. This research should be replicated using a broader sampling method to increase the sample size and achieve sufficient statistical power. While the attrition rate also negatively impacted the final sample size, it is important to continue including delays in false memory research, as that is more realistic to the real world. The study included a manipulation check to make sure that those in the visualization prompt condition did in fact visualize. Regardless of whether they were explicitly prompted, nearly 85% of all participants reported visually imagining during the interview in Session 1. This is important as the prompt may not make a difference since we cannot prevent people from visualizing. Lastly, there may have been a ceiling effect in this study as the average VVIQ score was relatively high at 58 (out of a possible 80). If a ceiling effect is present, this may limit the ability to detect change and lower the likelihood of finding an effect.

Even with the lack of significant results, there are some important implications of the current study. The lack of a relationship between prompting someone to visualize leads to the believed continuation of the visualization section in the Cognitive Interview. Madore and colleagues (2014) attempted to recreate the guided imagery in the Cognitive Interview and found that those with more vivid imagery had less faulty memory. Without a negative effect of prompt on memory, it seems the type of prompt used within the interview may be advantageous for memory in terms of context reinstatement. Secondly, although not novel information from the current work, it is important for lawyers to be aware of the possible variability in a juror's visual imagery abilities when presenting a case/describing a scene. Photographs are often shown to assist the jury in forming a picture of the event/scene but are not always able to be presented. It is crucial to keep in mind that there is individual variability in someone's ability to picture a scene or story in their mind. This leaves the possibility that without the presence of photographs or diagrams, the jury may not have the ability to mentally visualize depicted scenes, which could lead to the jury not fully understanding what is trying to be conveyed. Further, it is a common belief in lay people that vividness of a memory relates to more accurate and reliable memory. Based on the mixture of previous research, and the lack of significant results in this study, it is important that people within court settings like judges, jury, and law enforcement be made aware that high vividness of a memory does not equal accuracy. The same can be said of less vivid memory such that a memory that is less vivid or has less details, doesn't necessarily mean that it is less accurate.

The role of visual imagery ability and false memories needs to continue to be researched into the details of the false memories. Hegerty (2015) found that there may be a difference in the number of false details attached to a memory as well as the depth of confidence linked to the

memory. If this is the case, there may be a difference in the type of details that are often created with high imagers. In addition to the suggested continuation of visualization and false memory research, I believe it important that the natural tendency of using visual imagery should be further investigated, especially in relation to the creation of memories. Most participants self-reported the utilization of visual imagery in the 'non-prompt' group when going through the 'misinformation interview'. It has little inclusion to the research surrounding visual imagery. Research has shown (Jacobs et al., 2017; Knauff & May, 2006; Wicken et al., 2021) that people rely on different encoding strategies, which may help those who cannot visually imagine at all. The difficulty to separately measure people's reliance on one or the other has led to the lack of research surrounding people's natural tendency and use of imagery, even when compared to other sensory use in memory.

In summary, the present study investigated the relationship between visual imagery vividness and the creation of false memories, based on the inclusion of an explicit instruction to visualize during an interview. Although no significant data was found, this study has determined a necessary direction for future research regarding natural tendency to visualize and introduced important implications in the continued use of the Cognitive Interview and a visualization prompt when remembering an event, commonly used in law enforcement.

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Appendix A

Misinformation Interview

Note: False details are underlined in each question (but would not appear so to the participants). Some statements do not contain false details. The order of the questions were randomized per participant.

1. The woman walking on crutches has made an accusation about a petty theft. Who did you notice walking near her?
2. How many officers escorted the blue golf cart?
3. How did the child react after he fell down?
4. How did the other dogs in the scene react to the service dog?
5. When the two young girls skipped past toward the end of the event, what kind of face paint did they have?
6. Please estimate how many people took free samples from the deep-fried candy booth.
7. There was a grandmother attending with her granddaughter, who lost her phone. Can you describe anyone that you noticed walking past them when they were taking pictures of the pottery display?
8. Police are trying to locate a young girl (approximately aged 6) who was last seen with a teenage girl. Please describe what they were wearing.
9. Someone has accused a dog of being aggressive at the event. Please describe that event as you remember it.
10. Toward the end of the event there was a man talking on the phone. Please describe him and anyone he was with in as much detail as possible.

Appendix B

Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973)

Instructions: Visual imagery refers to the ability to visualize, that is, the ability to form mental pictures, or to "see in the mind's eye." Marked individual differences have been found in the strength and clarity of reported visual imagery and these differences are of considerable psychological interest.

The aim of this test is to determine the vividness of your visual imagery. The items of the test will possibly bring certain images to your mind. You are asked to rate the vividness of each image by reference to the 5-point scale given below. For example, if you are able to form a mental image that is reasonably clear and vivid, select the fourth option, "reasonably clear and vivid" shown below.

	No image at all, you only 'know' that you are thinking of the object	Vague and dim	Moderately clear and vivd	Clear and reasonably vivd	Perfectly clear and as vivid as normal vision
The exact contour of face, head, shoulders and body.	○	○	○	○	○

Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. Try to score each item separately, independent of how you scored other items.

The test consists of 16 items to be imagined with your eyes closed. When we say, "eyes closed," we mean the item is read, you close your eyes, an image is formed with them closed, and then you open your eyes to rate the vividness.

1. Think of some relative or friend whom you frequently see (but who is not with you at present). Consider carefully the picture that comes before your mind's eye and rate the vividness.

   How well can you visualize the following people, objects, or settings?

   - The exact contour of face, head, shoulders and body.
   - Characteristic poses of head, attitudes of body, etc.
   - The precise carriage, length of step, etc., in walking.
   - The different colors worn in some familiar clothes.

2. Visualize a rising sun. Consider carefully the picture that comes before your mind's eye and rate the vividness.

   How well can you visualize the following people, objects, or settings?

   - The sun is rising above the horizon into a hazy sky.
   - The sky clears and surrounds the sun with blueness.
   - Clouds. A storm blows up, with flashes of lightning.
   - A rainbow appears.

3. Think of the front of a shop which you go to. Consider carefully the picture that comes before your mind's eye and rate the vividness.

   How well can you visualize the following people, objects, or settings?

   - The overall appearance of the shop from the opposite side of the road.
   - A window display including colors, shapes and details of individual items for sale.
   - You are near the entrance. The color, shape and details of the door.

- You enter the shop and go to the counter. The counter assistant serves you. Money changes hands.

4. Think of a country scene which involves trees, mountains, and a lake. Consider carefully the picture that comes before your mind's eye and rate the vividness.

   How well can you visualize the following people, objects, or settings?

   - The contours of the landscape.
   - The color and shape of trees.
   - The color and shape of the lake.
   - A strong wind blows on the trees and on the lake causing waves.

Appendix C

Memory Recognition Task

Note: the false details are underlined (but would not appear so to the participants)

Instructions:

1. girl with face paint
2. woman walking on crutches
3. woman walking with her bike
4. police officer
5. girl with boot on her foot
6. service dog
7. blue golf cart
8. sign for ‘kids area’
9. deep-fried candy booth
10. pottery booth
11. roasted nuts booth
12. child falling
13. women taking photographs
14. man talking on a cellphone