

Examining the Role of Negative Pre- and Post-Goal Emotions on Susceptibility to  
Misinformation for Central and Peripheral Details

BY

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## Abstract

The current study examined how the narrowing of cognitive scope due to negative pre-goal emotions and the broadening of cognitive scope due to negative post-goal emotions influences susceptibility to misinformation. The pre-goal emotion studied was threat, and the post-goal emotion studied was sadness. Participants included 91 young adults ( $M = 19.01$  years,  $SD = 2.09$  years) who viewed threatening, sad, and neutral images, then were exposed to misinformation on a memory test. Participants veridical memory and acceptance of misinformation was assessed through a second memory test. A significant misinformation effect was found across conditions. However, there were no differences between threat and sadness images for peripheral misinformation acceptance. As well, across the threat, sadness, and neutral images there were no differences in veridical memory, implying that no narrowing or broadening of cognitive scope occurred. From this, it was concluded that pre- and post-goal negative emotions may not have the expected narrowing and broadening effect on cognitive scope.

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## Examining the Role of Negative Pre- and Post-Goal Emotions on Susceptibility to Misinformation for Central and Peripheral Details

Eyewitnesses are often relied on in legal settings to identify criminal perpetrators, based on assumptions that their memory for the witnessed event is accurate (Forgas, Laham, & Vargas, 2005). This reliance, however, is problematic as eyewitnesses can fall prey to false memories. False memory can occur in anyone and involves an individual remembering an event that did not actually occur or remembering aspects of an event differently than they occurred. These memories tend to be vivid, making them difficult to distinguish from true memories (Jou & Flores, 2013; Loftus, 2005).

False memories are typically studied through the use of two different paradigms: the Deese-Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995), and the misinformation paradigm. The DRM paradigm examines spontaneous false memories and involves presenting a list of semantically similar words, all of which are semantically related to a non-presented word (Deese, 1959; Roediger & McDermott, 1995). The non-presented word is known as the critical lure and participants tend to create a false memory that the critical lure was presented in the word list (Bland, Howe, & Knott, 2016). On the other hand, the misinformation paradigm produces suggestion induced false memories, and involves presenting participants with additional information after an event (Loftus, 1975; Loftus & Palmer, 1974). Participants reconstruct their memory for the event to incorporate the additional information, in a phenomenon known as the misinformation effect (Otgaar, Houben, & Howe, 2019).

### **The Misinformation Effect**

The misinformation effect is a robust phenomenon that has been demonstrated

using a variety of methodologies, such as for videos, pictures, and even in eyewitnesses for real events. Misinformation can be presented in a variety of ways, such as in narratives, multiple choice, or open ended questions format of test (Otgaar et al., 2019). For example, Van Damme and Smets (2014) presented participants with images of scenes, then used an initial memory test to expose participants to misinformation. It was found that participants exposed to misinformation on the first memory test were significantly more likely to identify that information as being true on a second memory test. In addition to being more likely to endorse false information, those exposed to misinformation also had difficulty remembering veridical information about the images. This result has been taken as evidence that exposure to misinformation can act to inhibit access to memories of true information. These results were replicated in a similar study by Forgas et al. (2005), supporting the finding that exposure to misinformation impairs memory.

Virtually everyone succumbs to the misinformation effect, given enough opportunity. Tomes and Katz (1997) demonstrated this by showing participants video clips depicting a crime, and then presenting them with misinformation through a memory test. On a second memory test, it was revealed that 98% of participants exposed to misinformation on the first memory test accepted misinformation as true at least once.

Multiple factors influence the misinformation effect, including time delays, age, and warnings (Otgaar et al., 2019). Otgaar et al. outlined that the effect becomes more prominent as the amount of time between the presentation of misinformation and the testing of memory is increased. Additionally, Otgaar et al. states that children are more susceptible to misinformation than adults, and that warning people about the possibility

of misinformation reduces, but does not completely eradicate, the effect.

Source misattribution has been proposed as an explanation for the misinformation effect. Source misattribution outlines that people forget from what experience they learned information, so they assume the information was part of the event they witnessed, rather than presented after the witnessed event (Van Damme, Kaplan, Levine, & Loftus, 2017). As time increases, the source of information is more likely to be forgotten, and false memories via the misinformation effect occur as a result.

In summary, the misinformation effect is a robust effect that is difficult to avoid (Tomes & Katz, 1997). It occurs when information provided after an event is incorporated into memory for that event and can be influenced by a variety of factors, such as time delays, age, and warnings (Otgaar et al., 2019; Van Damme & Smets, 2014). Another area of research on the misinformation effect incorporates the role that emotions have on memory.

### **Emotions and Cognitive Scope**

Emotions are internal states, and refer to internal changes of arousal and valence due to stimuli exposure (Otani, Libkuman, Knoll, & Hensley, 2019). Emotions have been implicated in cognitive scope. Cognitive scope refers to the range of cognitive processing, and encapsulates domains related to attention and memory (Harmon-Jones, Gable, & Price, 2013). Emotional aspects of events have been proposed to narrow memory aspects of cognitive scope, a phenomenon known as ‘tunnel memory’ (Levine & Edelstein, 2009). This narrowing results in increased recollection for the emotional core of events at the expense of peripheral aspects (Van Damme & Smets, 2014).

Various aspects of emotion have been examined for their role in cognitive scope.

These have included the influence of arousal, the influence of valence, and the concept of pre- and post-goal emotions.

**Arousal.** Arousal refers to a physiological and psychological state ranging from relaxation to excitement (Kaplan, Van Damme, Levine, & Loftus, 2016). Emotional arousal has been implicated as the primary cause of cognitive scope narrowing (Kaplan et al., 2016).

Christianson and Loftus (1991) demonstrated the effects of arousal on cognitive scope by comparing memory for emotionally arousing, unusual, and neutral images. The images were complex and all depicted the same event, but differed in respect to a critical central detail and a critical peripheral detail. The differences for the central detail made the distinction between emotionally arousing, unusual, and neutral images. Participants viewed all images, then viewed the images again with the central and peripheral detail missing and were instructed to recall in detail what was missing from the image.

Christianson and Loftus found that for emotionally arousing images, memory for central details was enhanced, whereas memory for peripheral details was enhanced for neutral images. Additionally, the difference in recollection for central details between emotionally arousing and unusual images showed that it was arousal and not simply peculiar stimuli that caused a narrowing of cognitive scope. More research however, has examined the role that emotional valence has on cognitive scope, while holding arousal levels constant.

**Valence.** Emotional valence refers to how pleasurable a stimulus is, ranging from very pleasurable (positive valence), to not pleasurable (negative valence) (Lang, Bradley & Cuthbert, 2008). There has been debate on the role that emotional valence has on

cognitive scope, especially when the misinformation effect is incorporated.

Forgas et al. (2005) induced positive and negative mood states in participants a week after they viewed an aggressive encounter in class between a lecturer and an individual who randomly entered the class. In order to induce mood, participants viewed a video depicting either a segment from a comedy show (positive mood), someone dying from cancer (negative mood), or an architecture documentary (neutral mood). Following mood induction, participants were exposed to misinformation of the witnessed encounter in class via a memory test, then completed a second memory test after a 45 minute delay.

Participants in a positive mood when misinformation was presented were more susceptible to false memories (Forgas et al., 2005). In contrast, participants in a negative mood were less likely to incorporate the misinformation into their memories. When these results were compared to a neutral mood condition, the effect became clearer.

Participants in a positive mood recalled a greater proportion of misinformation than the neutral mood condition, and participants in the negative mood condition recalled less misinformation than the neutral mood condition (Forgas et al., 2005). However, those in the positive, negative, and neutral groups did not differ with respect to the amount of true information recalled. Additionally, Forgas et al. found similar results when using positively and negatively valenced images as the to-be-remembered items, and even when participants were instructed to suppress their mood. From this, it was determined that positive valence narrows cognitive scope, as participants in positive mood conditions were more susceptible to misinformation.

On the other hand, Porter, Bellhouse, McDougall, ten Brinke, and Wilson (2010) found an opposing effect. Participants' memory was tested for five positive, and five

negative images through the use of two verbal questionnaires. Each of the images contained people and had a visible background. The arousal rating for positive and negative images did not differ, while valence did. The questionnaires contained misinformation for central and peripheral details of the images, and were administered at two different time periods. The first was to present the misinformation, and the second was to test the memory of that misinformation.

The results indicated that negative emotional stimuli increased the misinformation effect for both central and peripheral details compared to positive emotional stimuli (Porter et al., 2010). When looking specifically at peripheral details, Porter et al. found that participants falsely recalled an entire object being present in the background of the negative images twice as often as for the positive images. This implies that there was a narrowing of cognitive scope for negative stimuli as opposed to positive stimuli. Interestingly, while participants were more susceptible to misinformation for peripheral aspects for the negative images, on average participants recalled more peripheral aspects and fewer central aspects of the negative images as opposed to the neutral or positive images. However, this increase in recall could have been due to the incorporation of more misinformation in peripheral than central areas of images (Porter et al., 2010).

Additionally, Porter et al. (2010) had similar results to Forgas et al. (2005) in respect to memory for true information. Valence had an effect on recall for misinformation, but had no influence on memory for true information.

In a related study, Van Damme and Seynaeve (2013) describe opposing results. These authors showed participants a video of a robbery, then used music to induce emotions classified as serene, happy, sad, angry and neutral. Participants were then

exposed to a misleading narrative about the video previously seen, after which their memory was tested for the video. Their results revealed that there was no effect of emotional valence on susceptibility to misinformation. However, Van Damme and Seynaeve found that confidence in memory was impacted by emotional valence, and participants showed greater confidence in judgements when a sad emotion was induced, as opposed to angry, serene, happy, and neutral emotions.

Based on the literature described to this point, it is unclear what effect emotional valence has on cognitive scope, and the implications for false memory production as a result. Forgas et al. (2005) found that positive valence increased susceptibility to misinformation, whereas Porter et al. (2010) found that negative valence increased susceptibility to misinformation. Additionally, Van Damme and Seynaeve (2013) found that valence had no influence on susceptibility to misinformation, adding another layer to the debate. Recently, ideas have come to light that it is the motivations that underlie emotions that influence cognitive scope, as opposed to the arousing or valenced nature of the stimuli.

**Pre- and Post-Goal Emotions.** Appraisal theories have identified that emotions function with respect to an individual's goals, and cognitive scope is a by-product of these goals. The status of achieving, failing to achieve, or being in the process of attaining a goal results in the experience of emotion (Kaplan et al., 2016). For example, an individual may experience happiness after achieving their goal, or sadness if they failed to achieve their goal. The current status of individual's goals requires them to adjust their cognitive processes in order to increase the possibility of goal attainment (Kaplan et al., 2016).

Pre-goal emotions are emotions experienced during the process of goal attainment. They can be positive (e.g., hope, desire), reflecting that the goal is within reach, or negative (e.g. threat, fear, anger), reflecting that the goal is out of reach and failure may occur (Kaplan et al., 2016). Pre-goal emotions reflect that attention needs to focus on aspects of events related to the attainment of the current goal, which narrows cognitive scope (Van Damme et al., 2017).

On the other hand, post-goal emotions occur after an attempt to achieve a goal has been made. They can also be positive (e.g., happiness, serenity) or negative (e.g., sadness, anger), depending on whether a goal was successfully achieved or failed to be achieved (Kaplan et al., 2016). For post-goal emotions, attentional resources do not need to be allocated to focusing on the current goal at hand (as the outcome has been determined), so cognitive scope is broadened to evaluate the outcomes of the past goal, and to develop new goals (Gable & Harmon-Jones, 2010; Van Damme et al., 2017).

The influence of pre- and post-goal emotions on cognitive scope has been demonstrated in numerous studies, including one by Gable and Harmon-Jones (2010). These authors used a monetary incentive delay program to induce positive pre- and post-goal emotions. Participants were exposed to cues of possibly receiving money (pre-goal), or were informed that they had earned money (post-goal). After emotion induction, participants were presented with words in central or peripheral areas of the screen. Participants recalled more centrally presented words when a pre-goal emotion was induced, and recalled more peripherally presented words when a post-goal emotion was induced, supporting the notion that pre-goal emotions narrow, and post-goal emotions broaden cognitive scope (Gable & Harmon-Jones, 2010).

Threadgill and Gable (2019) came to similar conclusions when negative pre- and post-goal emotions were examined. Five experiments were conducted in which anger and threat were used for pre-goal emotions, and sadness was used for a post-goal emotion. The method employed was similar to that of Gable and Harmon-Jones (2010), in which emotional stimuli were presented in the form of images, and a word was presented either centrally or peripherally after the presentation of every image. When compared to neutral images, Threadgill and Gable (2019) found that images that evoked anger and threat narrowed attention. In these cases, memory for peripherally presented words was inhibited, but memory for centrally presented words was bolstered compared to neutral images. On the other hand, sad images resulted in a broadening of attention compared to neutral images, in which memory for peripherally presented words was greater for sad images. In the final experiment, threatening and sad images were compared to directly compare pre- and post-goal emotions. Consistent with expectations, Threadgill and Gable (2019) found that threatening images resulted in worse memory for peripherally presented words, whereas sad images resulted in increased memory for peripherally presented words. However, image type did not influence memory for centrally presented words, indicating that post-goal emotions result in increased attention for all areas, not just peripheral areas.

Pre- and post-goal emotions may also have an influence on susceptibility to misinformation. Van Damme et al. (2017) found that participants experiencing a pre-goal emotion were more susceptible to misinformation for aspects irrelevant to the goal at hand. To examine this, participants viewed a slideshow about a story of a couple, and were told to attempt to relate to the couples feelings of either hope, happiness, fear, or

devastation as the female in the story attempted the goal of saving the relationship. Participants were then exposed to misinformation about the story that were either relevant or irrelevant to the female's goal. Van Damme et al. found a significant misinformation effect, and that participants experiencing pre-goal emotions (hope, fear) falsely remembered more details irrelevant to the female's goal than participants experiencing post-goal emotions (happiness, devastation). This shows that in addition to narrowing cognitive scope, pre-goal emotions increase susceptibility to misinformation for aspects not relevant to the current goal.

In line with Threadgill and Gable (2019), Van Damme et al. (2017) did not find differences between pre- and post-goal emotions for memory of goal relevant details, further indicating that post-goal emotions result in increased attention for all aspects of events. However, Van Damme et al. did find that participants experiencing hope or fear were more confident in the rejection of misinformation about goal-relevant aspects, indicating a possibility that pre-goal emotions increase memory for goal-relevant aspects compared to post-goal emotions.

Previous research and theorizing suggest that pre- and post-goal emotions operate to narrow or broaden cognitive scope, respectively, regardless of emotional valence (Gable & Harmon-Jones, 2010; Threadgill & Gable, 2019). The differing effects of positive and negative valence in earlier studies may have been due to the goals associated with the emotions. That is, studies that found that positive emotions narrowed, and negative emotions broadened cognitive scope may have used a pre-goal positive emotion and a post-goal negative emotion, and vice versa for studies that found the opposite effect of valence.

## **Overview of the Current Study**

The aim of the current study was to examine how the narrowing of cognitive scope due to negative pre-goal emotions and the broadening of cognitive scope due to negative post-goal emotions influence memory for central and peripheral details of a scene. Further, the aim was to determine how the narrowing and broadening of attention due to pre- and post-goal emotions influences susceptibility to misinformation for the central and peripheral details of a scene. The pre-goal emotion under study was threat, and the post-goal emotion under study was sadness. To examine this, images of emotional scenes were used. The images were classified into three categories: threat, sadness, and neutral, with two images in each category. After viewing the images, participants were administered two memory tests at different time intervals with questions on central and peripheral details from the images previously seen. The first memory test included misinformation about the images, and the second memory test examined the production of false memories based on the exposure to the misinformation.

Based on the findings of Van Damme et al. (2017), three hypotheses were assessed. First, participants presented with misinformation would incorporate falsely presented details into their memory for the image. Second, participants in the post-goal emotion (sadness) condition would recall more true peripheral details than participants in the pre-goal emotion (threat) condition. Third, participants in the pre-goal emotion (threat) condition would falsely recall more suggested peripheral details than the post-goal emotion (sadness) condition.

If participants answered more questions correctly about peripheral details for sad images than for threatening images, it can be determined that post-goal emotions, like

sadness broaden cognitive scope, and pre-goal emotions, like threat, narrow cognitive scope. Additionally, if participants incorporated more false peripheral details into memory for threatening images, it can be further determined that pre-goal emotions narrow cognitive scope, and result in an inhibition of memory for aspects irrelevant to the emotional aspect of the scene.

## **Method**

### **Participants**

A total of 91 participants were recruited through the Mount Allison online research system SONA, and the social media site Facebook. Nineteen participated in the pilot study and 72 participated in the main study. Participants had an average age of 19.01 years ( $SD = 2.09$ ). Twenty participants identified as male, 70 identified as female, and one participant indicated that they identified as a gender not listed. All participants had normal or corrected to normal vision and self-reported the ability to see fully in colour. Participants were given partial course credit or were entered into a draw to win a 50 dollar gift card in return for their participation.

### **Materials**

**Pilot Study.** Twelve complex, coloured images were taken from the International Affective Picture System (IAPS; Lang et al., 2008). Four images were of threatening scenes, four images were of sad scenes, and four images were of scenes with average valence and average arousal (neutral). Five of the images (two threatening, two sad, one neutral) had been used previously by Threadgill and Gable (2019), and one threatening image had been used previously by Porter et al. (2010). The rest of the images were found in IAPS. Threatening, sad, and neutral images had similar IAPS ratings of arousal,

and threatening and sad images had similar IAPS ratings of valence. IAPS ratings were on a scale of one to nine, where a score of one meant that the image had low arousal or low pleasure, and a score of nine meant the image had high arousal or high pleasure. Threatening images had an average arousal rating of 5.86, and an average valence rating of 2.34. Sad images had an average arousal rating of 4.76, and an average valence rating of 2.66. Images classified as neutral had an average arousal of 4.18, and an average valence of 5.65. Images were presented using PowerPoint.

In order to ensure that the images elicited the target emotion, participants rated the degree of sadness and threat of each image using a nine point Likert scale immediately following the presentation of the image. As described in Threadgill and Gable (2019), a score of one indicated that the image did not elicit the emotion, and a scale of nine indicated that the image elicited a strong feeling of the emotion.

A distinction was made between central and peripheral details of the images, based on where the core emotional aspect of the scene was (Christianson, 1992). Six individuals independently outlined where they believed the emotional core of the scene was. The average central area was considered to be central details for the scene, and everything outside this area was considered to be peripheral details.

Two memory tests for central and peripheral details were made based on the central, peripheral distinction. The first memory test was comprised of four questions per image. There were two versions of the first memory test. For one version the four questions per image all contained false/suggested information. For the other version the four questions per image all presented true information. All questions were in the form of true/false questions, and differed in respect to central or peripheral details. Two questions

per image were for central details, and two questions per image were for peripheral details.

The second memory test was comprised of eight true/false questions per image, for a total of 96 questions. Four questions were the misinformation questions from the first memory test, and the remaining four questions were novel questions about true information in the images. Questions also differed in respect to central and peripheral details. Four questions per image were for central details, and four questions per image were for peripheral details and were broken down equally between misinformation and true information questions.

The two images in each emotion condition that most consistently resulted in a misinformation effect were used in the main study.

**Main Study.** Six complex, coloured images were taken from IAPS. Two images were of a threatening scene, two images were of a sad scene, and two were of scenes with average valence and average arousal (neutral). These images were chosen from a larger sample, as pilot testing indicated that they evoked the misinformation effect consistently. One threatening scene depicted a car robbery, and the other depicted a scene of a farmer burying a body in a field. One sad scene depicted a boy walking through a lake of garbage, and the other showed two small boys covered in ash and soot in front of a smoking building. Finally, one neutral scene was of factory workers, and the other was of people playing poker.

Images of threat and sadness had similar IAPS ratings of arousal and valence. Threatening images had an average arousal rating of 5.78, and an average valence rating of 2.51. Sad images had an average arousal rating of 4.85, and an average valence rating

of 3.16. Images classified as neutral had an average arousal of 3.59, and an average valence of 5.11. Images were presented using PowerPoint. Image order was pseudo-counterbalanced. Images within each condition were presented together, but the order of conditions was counterbalanced.

A demographic questionnaire asked participants questions about their age, gender, and whether they were colour blind. Participants who were colour blind were removed from the sample as some of the questions on the memory tests involved identifying the colour of objects.

Memory tests for central and peripheral details were created based on the central, peripheral distinction previously mentioned. The first memory test was created to present participants with misinformation. It had a total of 48 true/false questions, comprising of eight questions per image. Two of the questions presented false information for central details of the image, two presented true information for central details, two presented false information for peripheral details, and two presented true information for peripheral details. Question order was pseudo-counterbalanced in a similar way to how image order was counterbalanced. Pre-cautions were made so that questions about images were presented in a different order than images were presented.

The final memory test evaluated the extent to which participants accepted the misinformation that was presented during the first memory test into their memory for images. The final memory test was comprised of 16 true/false questions per image, for a total of 96 questions. Eight questions per image were taken from the first memory test and used for the final memory test (four were based on false information and four were based on true information). The remaining eight questions were novel, of which four

questions assessed veridical memory, while the rest functioned as filler items. Due to the limited amount of central details in images, questions not previously mentioned were not equally subdivided into two questions for central details and two questions for peripheral details. However, there was at least one question about central details in each category. Again, question order was pseudo-counterbalanced in a similar way to how image order was counterbalanced, and the same pre-cautions were made.

### **Procedure**

**Pilot Study.** Participants were tested in groups of up to 10 people. They provided informed consent, then were presented with the demographic questionnaire.

Participants were presented with all 12 images, with instructions to pay attention to images as there would be a memory test. Images were presented for 30 seconds each. Participants first saw the four threatening images, then the four neutral images, then the four sad images. After the presentation of each image, participants rated the image on its degree of threat and sadness. Participants then completed sudoku puzzles for 10 minutes as a distracter task, after which they were presented the first memory test. Half of the participants were presented with the false information memory test, and the other half of participants were presented with the true information memory test. Participants then completed sudoku puzzles again for 10 minutes, and then completed the final memory test. Finally, participants were debriefed.

**Main Study.** Participants were tested in groups of up to 10 people. They provided informed consent, then were presented with the demographic questionnaire. Participants were then presented with the images of emotional scenes.

Participants were instructed to pay attention to the images as there would be a

memory test. Images were presented for 30 seconds each, with a three second delay between the presentation of every image. As previously mentioned, image order was pseudo-counterbalanced. Following the presentation of all six images, participants completed sudoku puzzles for 15 minutes as a distracter task. Participants then completed the first memory test to expose them to misinformation. All participants were presented with the same memory test; that is, they were all exposed to misinformation. Participants then completed sudoku puzzles for another 15 minutes, after which they were presented with the final memory test. Finally, participants were debriefed.

### **Results**

The results reported pertain to the main study. One participant failed to complete the final memory test, so their data was excluded from all analyses. Additionally, one participant's results for measures of central and peripheral veridical memory was excluded due to a failure to respond to two questions. Due to a consistent lack of misinformation acceptance across participants in pilot testing and in the main study, one misinformation question for peripheral details in the threat condition was excluded from all analyses. As proportional scores were computed to analyze misinformation acceptance of peripheral details, results for the threat condition were still comparable to other conditions with the exclusion of one question.

Participants accepted an average of 12.69 pieces of misinformation ( $SD = 2.99$ ) out of a total of 23 pieces of misinformation, supporting the first hypothesis that participants would incorporate falsely presented details into their memories for images.

Proportional scores for peripheral details of misinformation and veridical memory for the threat, sadness and neutral conditions were then computed by taking the average

of answers within each condition for the two types of questions. The means and standard deviations for veridical memory are presented in Table 1. Proportions of correctly recalled details for veridical memory items show that participants in all three image conditions were fairly accurate in their recall of images.

A repeated measures analysis of variance (ANOVA) was conducted to analyze differences in veridical memory for peripheral details. No significant differences were found between the threat, sadness, and neutral conditions in terms of veridical memory,  $F(2, 138) = 2.23, p = .111, \eta^2 = .031$ . Thus, the second hypothesis that participants in the post-goal emotion condition (sadness) would recall more true peripheral details than the pre-goal condition (threat) was not supported.

To further analyze cognitive scope, veridical memory for central details was analyzed. Proportional scores were computed for the threat, sadness, and neutral conditions. A repeated measures ANOVA was conducted and revealed no significant differences for veridical memory of central details across the three image conditions,  $F(2, 138) = 0.23, p = .795, \eta^2 = .003$ .

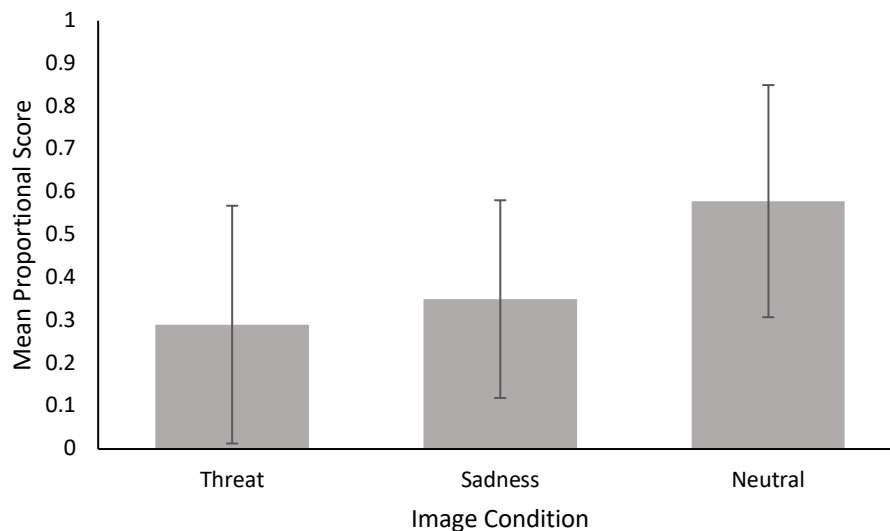
Table 1

*Mean Proportional Scores for Veridical Memory by Image Condition*

	Peripheral Details	Central Details	Total Correctly Recalled
Threat	$M = 0.67$ $SD = 0.15$	$M = 0.65$ $SD = 0.19$	$M = 0.66$ $SD = 0.11$
Sadness	$M = 0.72$ $SD = 0.19$	$M = 0.68$ $SD = 0.24$	$M = 0.71$ $SD = 0.15$
Neutral	$M = 0.67$ $SD = 0.26$	$M = 0.66$ $SD = 0.24$	$M = 0.67$ $SD = 0.18$

*Note.* Higher scores indicate better memory accuracy.

A repeated measures ANOVA was conducted to analyze differences in the amount of peripheral misinformation accepted across the threat, sadness, and neutral conditions, and revealed significant differences,  $F(2, 138) = 29.33, p < .001, \eta^2 = .298$ . Post-hoc Bonferroni analyses indicated no significant differences between threat and sadness images, while participants accepted significantly more misinformation for peripheral details for neutral images than for threat or sadness images, as shown in Figure 1. Thus, the third hypothesis that participants in the pre-goal emotion condition (threat) would falsely recall more peripheral details than the post-goal emotion condition (sadness) was not supported.



*Figure 1.* Mean proportional scores for misinformation acceptance of peripheral details for threatening, sad, and neutral images. Higher scores indicate more misinformation acceptance. Error bars represent standard deviations.

## Discussion

The purpose of the study was to examine the influence of pre- and post-goal negative emotions on the narrowing and broadening of cognitive scope, and how that in

turn influences susceptibility to misinformation. To do this, emotional images were used pertaining to the emotions of threat (pre-goal emotion), sadness (post-goal emotion), and neutral images, and participants answered questions related to central and peripheral aspects of these images. The hypothesis that participants would accept falsely presented information as true to the image was supported, providing evidence for the misinformation effect. However, contrary to expectations, when misinformation acceptance for peripheral aspects of images was examined, no significant differences were found between threat and sadness images. As well, there were no significant differences across the three image conditions in terms of veridical memory for peripheral details, so the final two hypotheses were not supported. To further examine the narrowing and broadening of cognitive scope, veridical memory for central details was examined. No significant differences across image conditions were found, so the lack of differences in veridical memory for both central and peripheral details suggests that no narrowing or broadening of cognitive scope for pre- and post-goal emotions occurred.

The emergence of a misinformation effect is in line with past studies (Forgas et al., 2005; Porter et al., 2010; Tomes & Katz, 1997; Van Damme et al., 2017; Van Damme & Smets, 2014). For example, Porter et al. (2010) found similar rates of overall misinformation acceptance as the current study (60.1% and 55.2% respectively). There are various theoretical explanations for this phenomenon, with the most prominent being source misattribution. As previously mentioned, source misattribution involves an inability to determine the source of familiar information, so participants in misinformation studies tend to attribute the source of misinformation to the original witnessed event instead of an event after the fact (Van Damme et al., 2017). The same

can be said for the current study. It is likely that in the interval between the first memory test and the second memory test, participants forgot whether information was familiar to them due to seeing it in the original presentation of the images, or from seeing it on the first memory test.

Since no narrowing or broadening of cognitive scope occurred, it is not surprising that no differences were found in misinformation acceptance between threatening and sad images. The finding that no narrowing or broadening of cognitive scope occurred for pre- and post-goal emotions has not been reported in previous literature. When compared to a neutral condition, Threadgill and Gable (2019) found that threat caused a narrowing of cognitive scope, and sadness caused a broadening of cognitive scope. Additionally, when looking solely at negative valence, Van Damme and Smets (2014) found higher rates of veridical memory accuracy for central details than the current study, as well as lower rates of veridical memory accuracy for peripheral details than the current study. It is possible that the intended emotions of threat and sadness were not induced as expected in the current study. However, pilot testing determined that the images elicited the desired emotion, and some images were taken directly from Threadgill and Gable (2019) who found the desired effect of pre- and post-goal emotions on cognitive scope. So, the possibility that threat and sadness were not induced as expected is unlikely.

An interesting finding was that there were significant differences between neutral images and emotional images in terms of misinformation acceptance for peripheral details, which supports previous research. The current study reported the same rate of peripheral misinformation acceptance for neutral images as Van Damme and Smets ( $M = 0.58$ ; 2014). However, Van Damme and Smets (2014) found higher rates of peripheral

misinformation acceptance for negative emotional images than the current study. As well, Van Damme et al. (2017) found higher rates of misinformation acceptance for peripheral details for both pre- and post-goal negative emotions than the current study.

A possible explanation for the results of the current study is that misinformation questions for neutral images were more plausible than misinformation questions for emotional images. The source monitoring hypothesis outlines that participants are more likely to make source attribution errors when misinformation is more believable in that scenario (Johnson, Hashtroudi, & Lindsay, 1993). Additionally, previous research has noted an increase in focus for emotional scenes compared to neutral scenes. This increased focus could have interacted with misinformation plausibility to produce higher misinformation acceptance for neutral images. For example, Calvo and Lang (2004) found that when comparing eye gaze detection for emotional and neutral images, participants' gaze was more likely to focus on emotional images for a longer duration the first time the images were presented. As well, it was determined that participants' focus during the first and last 500ms was heightened for threatening images compared to images simply depicting injuries, or neutral images. Thus, it is possible in the current study that emotional images increased participants focus on all aspects of scenes, so for neutral images participants were then more susceptible to plausible misinformation.

Another possible explanation is that negative pre- and post-goal emotions may not have had the expected influence on cognitive scope. In line with the current study, Forgas et al. (2005) found that negative and neutral emotional states had similar rates of veridical memory, and that neutral states were more susceptible to misinformation for peripheral details than negative states. Thus, the findings of the current study offer support to the

fact that it may be valence, as opposed to the motivations underlying emotions, that influence susceptibility to misinformation.

A number of limitations were present in the current study. Although attempts were made to control for colour blindness, it is possible that some participants may not have been aware that they were colour blind. A report by the New Zealand Health Technology Assessment (1998) identified that approximately 40% of individuals with deficiencies in colour vision are unaware of these deficiencies. Thus, a confound is that some participants may have been unaware that they could not distinguish between certain colours, so were not removed from the analysis when they should have been. As some questions analyzed pertained to the colour of objects, the results of the current study could have been affected. Future researchers should test that all participants can see fully in colour as an inclusion criterion.

Another possible limitation relates to the interpretation of images. There may have been individual differences in how participants interpreted what was seen in images that could have influenced how they answered questions. For example, one question on the second memory test for a sad image asked if one of the boys was visibly crying. Participants could have had individual differences in what they determine crying to be, so may have had varying answers on whether the boy was crying, even though the correct answer was no, he was not visibly crying.

Future research should aim to expand on the pre- and post-goal emotions examined. In the current study only one pre-goal and one post-goal emotion was examined. Including more pre- and post-goal emotions, both positive and negative, in future research may provide more insight on whether pre-goal emotions narrow cognitive

scope, and whether post-goal emotions broaden cognitive scope. As well, looking at positive emotions, as opposed to only focusing on negative emotions may provide future researchers insight into whether motivations underlying emotions or valence influences cognitive scope.

As well, avoiding warning participants that their memory will be tested for images is another avenue that future research may explore. As participants in the current study were informed that their memory for images was going to be tested, participants may have consciously focused on all aspects of scenes. Instead, future research may claim that the encoding or the emotionality of images is being analyzed rather than memory for images. This way, the memory test will be a surprise.

The influence of emotions on cognitive scope has implications for the field of forensic psychology. Eyewitnesses may experience a myriad of emotions when they witness an event, especially in regards to negative emotions. The results of the current study offer support for the fact that eyewitnesses experiencing negative emotions may not be especially susceptible to misinformation based on whether these emotions are pre- or post-goal. However, while the current study found no differences between pre- and post-goal emotions in terms of the narrowing and broadening of cognitive scope, many previous studies have (e.g., Gable & Harmon-Jones, 2010; Threadgill & Gable, 2019). Thus, future research should further examine the influence of pre- and post-goal emotions on susceptibility to misinformation.

The results of the current study add to the growing body of literature surrounding pre- and post-goal emotions and susceptibility to misinformation. While a significant misinformation effect was found, pre- and post-goal emotions were not found to have an

influence on susceptibility to misinformation. Instead, the study offers support to the fact that it may be valence, as opposed to the motivations underlying emotions that influence the misinformation effect.

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## Appendix A

### Pilot Study Images IAPS Numbers

#### Threat:

9430 – Farmer burying a body in a field

9400 – Bleeding, injured soldier on the ground while two other soldiers offer assistance

6821 – Four men with weapons robbing a car

9433 – Man bleeding in the street

#### Sadness:

9220 – Couple looking at a gravestone

9341 – Boy walking through a lake covered in garbage

9332 – Woman crying in the street

9530 – Two boys covered in ash with a smoking building in the background

#### Neutral:

2393 – Two workers in front of a large machine

2342 – Two girls feeding pigeons

7506 – People playing poker

7515 – Man crowd surfing

## Appendix B

### Main Study Images IAPS Numbers

Threat:

9430 – Farmer burying a body in a field

6821 – Four men with weapons robbing a car

Sadness:

9341 – Boy walking through a lake covered in garbage

9530 – Two boys covered in ash with a smoking building in the background

Neutral:

2393 – Two workers in front of a large machine

7506 – People playing poker