Negative Emotion and Eyewitness Memory

by

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An oral defense of this thesis took place on December 1, 2022, in front of the following examining committee:

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The above committee determined that the thesis is acceptable in form and content and that a satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate during an oral examination. A signed copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

ABSTRACT

Witnessing or being the victim of a crime is often emotionally distressing, and this emotional distress reaction can influence the storage and retrieval of event-related memory. Eyewitness memory, therefore, cannot be adequately understood without an account of the memorial effects of negative emotion. On this point, however, there remains a considerable degree of inconsistency in both the methods and findings of existing research. In this dissertation I sought to clarify the nature of this effect. Across two experiments, participants (N = 204, N = 132) viewed either a Negative or Neutral version of a video of a staged social interaction. Either immediately or after a one-week delay, participants reported their memory for the video. I assessed participants' recall (Study 1 and 2) and lineup identification (Study 1) performance. In both studies, those who viewed the Negative version of the video demonstrated superior recall performance for central event details than did those who viewed the Neutral version, though this did not appear to extend to lineup identification performance (Study 1). The Negative video group also reported more subjective and vague information than did the Neutral group. The current results, together with that of a growing number of studies, provide grounds for doubting the prevailing view among eyewitness researchers – that emotional distress causes generalized impairment of eyewitness memory. The current findings speak in favor of a pattern of *selective memory enhancement*. I end with a discussion of several practical and theoretical issues that were brought to the fore in the present work.

Keywords: eyewitness memory; negative emotion; stress; recall; lineup identification

AUTHOR'S DECLARATION

I hereby declare that this thesis consists of original work of which I have authored. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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_____ Mark D. Snow

STATEMENT OF CONTRIBUTIONS

I performed the majority of experimental work, data analysis, and writing.

The work described in Chapter 2 has been published as:

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Of course, I alone am responsible for the final form of this dissertation, including its inevitable shortcomings.

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LIST OF ABBREVIATIONS AND SYMBOLS

ACP	Arousal congruent performance
CI	Cognitive Interview
MAST	Maastricht Acute Stress Test
MCR	mental context reinstatement
TBR	to-be-remembered
TA	target-absent
TP	target-present

Chapter 1. Introduction

1.1 Introducing the Problem

Witnessing or being the victim of a crime is often emotionally distressing (Bornstein & Robicheaux, 2009; Shepherd et al., 1999), and such emotional reactions can influence the storage and retrieval of event-related memory (McGaugh, 2003; McNally, 2003). Understanding how eyewitnesses remember and report criminal events, therefore, requires understanding the memorial consequences of their affective responses – what eyewitness researchers have variably referred to as negative emotion, stress, and arousal (Bornstein & Robicheaux, 2009; Christianson, 1992; Głomb, 2021)[1]. But there is a problem: Most laboratory studies of eyewitness memory do not include an affective component (Price et al., 2022). Instead, researchers generally examine participants' memory for innocuous stimuli, usually in the form of a short video. Among the eyewitness studies that have directly examined the role of negative emotion or "stress", results have run the gamut: some report memory enhancement effects, some report memory impairment, and some report no effects in either direction (for recent reviews, see Marr et al., 2021a, 2023). This situation has prompted calls for more, and more methodologically sound research (e.g., Sauerland et al., 2016; Marr et al., 2021a, 2023), and has thus provided the impetus for the current dissertation.

I begin with an overview of the relevant literature on the effects of negative emotion and stress on eyewitness memory. Drawing on recent discussions within the

[1] "The literature on the effects of stress and negative emotion on memory appear to be interlinked and are often cited together" (Lane & Houston, 2021, p. 100). "Negative emotion" seems appropriate for the present purposes. However, when referring to past research I have tried to retain the researcher's original terminology.

eyewitness literature, I will argue for the necessity of using target stimuli that double as the emotion-source and the to-be-remembered (TBR) material as well as for the necessity of assessing memory after a post-encoding delay. I will then introduce the present set of experiments.

1.2 Emotional Memory

Let us first consider the extent of disagreement among leading researchers regarding the effects of emotion/stress on human memory. Take the following summary from McNally (2003): "laboratory experiments, flashbulb memory studies, and field research all point to the same conclusion: emotional stress enhances memory for the central features of the stressful experience. *Stress does not impair memory; it strengthens it*." (p. 62, emphasis added). McGaugh (2003) arrived at the same conclusion: "clinical observations as well as observational and experimental studies have provided *considerable evidence that emotionally arousing experiences tend to be well remembered*" (p. 136, emphasis added).

Yet, at around the same time – and in no less uncertain terms – several eyewitness researchers endorsed the opposite conclusion: "we have adduced considerable support for the hypothesis that high levels of stress negatively impact both accuracy of eyewitness identification as well as accuracy of recall of crime-related details*… the current meta-analytic conclusion regarding the negative effect of stress on eyewitness identification accuracy is unlikely to be overturned any time soon*…" (Deffenbacher et al., [2004], p. 699-700, emphasis added). Or, as expressed by Read and Connolly (2007), "the idea that memories for emotional events will be highly accurate and resistant to forgetting is *seriously misleading*" (p. 145, emphasis added). More recently, Pezdek and Reisberg

(2022) characterized the view that stress improves memory as a "common myth" (p. 145). These varying assessments of the available evidence are clearly incompatible, provided they are attempting to describe the same phenomenon. To begin to make sense of this discrepancy, I will provide a brief overview of the relevant literature.

In its early stages, the eyewitness literature seemed to indicate that negative emotion harms eyewitness memory. In one study, participants viewed either a violent or nonviolent video and then had their memory assessed for the video (Clifford & Scott, 1978). Participants were worse at recalling details of the violent video compared to the nonviolent video. Clifford and Hollin (1981) similarly assessed participants' memory for a violent vs. nonviolent video and found that recall memory (but not person-identification) for the target person was worse in the violent version. In another study comparing memory for violent vs. nonviolent video stimuli, Loftus and Burns (1982) showed participants either a violent video (described by the authors as "mentally shocking") or nonviolent video and then had their memory assessed. Participants' memory was worse for the violent video (at least for information preceding the violent incident) as compared to the nonviolent video. These studies purportedly show that negative emotion – or at least violent content – can have a detrimental effect on eyewitness memory (though they do not show that this effect is *uniformly* detrimental, Christianson, 1992).

These initial findings appear to dovetail with that of several more recent studies of eyewitness memory (e.g., Davis et al., 2019; Pezdek et al., 2020). For example, in a seminal study of eyewitness memory by Morgan and colleagues (2004), many participants demonstrated a memory impairment effect for facial stimuli encoded under

conditions of high stress. In this study, 509 military personnel participated in training procedures consisting of classroom and mock prisoner of war camp (POWC) components. Twelve hours after their placement in the POWC, participants were exposed to both low- and high-stress interrogations (of note, participants were subjected to sleep and food deprivation prior to interrogation). Twenty-four hours after their release from the POWC, their memory was assessed. For the live lineup and photo arrays, 42-50% of participants demonstrated better recognition memory for the low-stress interrogator (compared to high-stress), 42-45% showed no difference across low- versus high-stress, and 8-13% showed superior performance for the high-stress condition. For comparable findings within a naturalistic paradigm, see Valentine and Mesout (2009; but also see Ridgway, 2020 for contrasting findings).

Other researchers in this area have reported null effects. In several recent experiments using validated stress-induction procedures (e.g., the Maastricht Acute Stress Test [MAST]; Smeets et al., 2012), researchers have failed to find either impairing or enhancing effects of stress on eyewitness memory. In one study, 123 participants witnessed a staged theft, which was preceded by either a stress or no-stress (control) condition, and then returned to the lab one week later to complete a lineup identification task (Sauerland et al., 2016). Stress had no effect on target-present or target-absent lineup identification performance nor did stress affect recall performance (recall data from this experiment was reported separately by Krix et al., 2016). Marr and colleagues (2021b) similarly failed to find effects of stress at encoding or retrieval on facial or word recognition (tested 24-26 hours later). In another study, Price and colleagues (2022) examined undergraduate participants' memory for a staged theft. Participants experienced

either low, moderate, or high stress immediately before and after the target video and completed a lineup identification task within the same study session. Lineup identification performance was unaffected by the manipulation of stress during encoding.

Despite indications of both impairment and null effects, evidence of emotional memory *enhancement* has also accumulated. In a study by Christianson (1984), participants viewed a series of slides depicting a story in which a boy and his mother look for a taxi (neutral version) or where the boy gets hit by a car and severely injured (traumatic version). Two weeks later, participants better recalled the central thematic elements of the "traumatic" slides (vs. the neutral slides). Across three experiments, Christianson and Loftus (1987) showed participants slide sequences in which a boy either rides to school in a taxi (neutral version) or gets hit by a car (traumatic version) and then assessed their memory for the event. Participants were better able to recall the central information from the "traumatic" slides than the neutral slides. This pattern held across retention intervals of 20 minutes, two weeks, and six months. In subsequent research, Heuer and Reisberg (1990) presented participants with slide sequences depicting either a neutral or emotional version of a story about a mother and a child visiting the boy's father at work: the man was either a mechanic repairing a car (neutral) or a surgeon operating on a patient (emotional). Two weeks later, the researchers assessed participants' memory and found enhanced memory for both the central and peripheral components of the emotional version (compared to neutral).

Cahill and McGaugh (1995) provided a replication of Heuer and Reisberg's (1990) research using the same stimuli (i.e., emotional vs. neutral slide sequences). Participants showed enhanced memory for the emotional slides compared to the neutral

slides. In an attempt to minimize extraneous differences between the emotional and neutral stimuli, Cahill and McGaugh (1995) conducted a follow up study in which they presented all participants with the *same* slides but with different narrations regarding a mother and a young boy visiting the boy's father at work. In the "arousal" version, the boy was seriously injured in a car accident, whereas the neutral version described the visuals as a "practice disaster drill". Again, participants in the emotional condition recalled more of the story than did those in the neutral condition.

1.2.1 Selective Enhancement

One of the most highly cited phenomena within the emotional memory literature is a pattern of asymmetrical, or selective, enhancement of emotional memory. That is, rather than generalized impairment or enhancement, emotion has been shown to *selectively* enhance memory for the central details of an event, sometimes at the expense of peripheral details (see Christianson, 1992; Kensinger, 2009; Reisberg & Heuer, 2004, 2007; Talmi, 2013). As previously articulated by McNally (2003), "emotional stress enhances memory for the *central features* of the stressful experience" (emphasis added). Researchers have described this pattern as "memory narrowing" (e.g., Levine & Edelstein, 2009), "tunnel memory" (Safer et al., 1998), and an emotional memory trade-off effect (e.g., Kensinger, 2009; Kim et al., 2013). This pattern appears to be real and reliable, though it has not been replicated unfailingly.

In one early study, Christianson and Nilsson (1984) presented participants with a series of slides containing photos of faces with four verbal descriptors associated with the person in the photo (ostensibly peripheral information). For the "trauma" group, faces in the middle of the series were grossly disfigured whereas the control group viewed only

neutral faces. Consistent with the selective enhancement hypothesis, participants were less able to recall the words accompanying the disturbing photos than the words accompanying the neutral photos (see also Kramer et al., 1991). Christianson and Nilsson (1984) argued that participants had allocated their attention to the "traumatic" stimuli, leaving fewer attentional resources available to encode the peripheral descriptors. In another study, Christianson and Loftus (1991) examined participants' memory for emotional vs. neutral slide sequences (i.e., a woman injured on a bicycle vs. a woman riding a bicycle). Participants showed enhanced memory for the central aspects of the emotional content and impaired memory for the peripheral aspects (see also Christianson et al., 1991).

In a 1992 study, Burke and colleagues examined a question that, up to that point, had been largely unaddressed: what *are* central and peripheral details? Among other definitions (see Levine & Edelstein, 2009), some researchers had defined central details as those that were *spatially* central (e.g., Christianson & Loftus, 1991), whereas others had defined them in more *conceptual* terms (e.g., based on their relevance to the plot*;* Heuer & Reisberg, 1990). Burke and colleagues (1992) found that emotion enhanced memory for details associated with the center of the event – *whether defined conceptually, spatially, or temporally* – and impaired memory for peripheral details (see also Libkuman et al., 2004; Safer et al., 1998).

1.2.2 Meta-Analyses

In an attempt to shore up the "muddle of findings" in the then-extant literature (p. 690), Deffenbacher and colleagues (2004) conducted the first and only meta-analytic review of the eyewitness literature regarding the effects of "high stress" on eyewitness

memory. They examined two sets of studies. The first sample consisted of 27 tests of stress on eyewitness face identification accuracy from 1727 participants across 16 papers published between 1974 and 1997. The second sample consisted of 36 tests of stress on eyewitness recall accuracy from 1946 participants across 18 published papers. Their results indicated that stress has a modest negative effect on the accuracy of both eyewitness identification (for target-present lineups but not target-absent; mean effect sizes $h = –.52$ and $h = +.01$, respectively) and recall memory (for interrogative recall more so than free recall; mean effect size $d = –.34$ and $d = –.20$, respectively). In the nearly two decades since its publication, eyewitness researchers have cited this study as the authoritative statement on the effects of stress on eyewitness memory.

Several aspects of Deffenbacher and colleagues' (2004) analyses are worth noting. First, they excluded many of the studies reviewed above (e.g., Burke et al., 1992; Christianson, 1984; Christianson et al., 1991; Heuer & Reisberg, 1990), claiming that they were not relevant to their analyses because those studies "likely generated an orienting response… rather than the defensive response (activation mode of attention control) typically produced by a successful manipulation of stress or anxiety" (p. 690). This means that the authors excluded many of the enhancement effects that had been documented in the literature up to that point, leading ultimately to a much different assessment of the literature than was presented in an earlier review by Christianson (1992). Deffenbacher and colleagues (2004) also did not examine the potential moderating effects of detail type (i.e., central vs. peripheral) or retention interval (more on this later, see Chapter 1.3).

The conclusions of Deffenbacher et al. (2004) appear to conflict with that of a more recent meta-analysis by Shields et al. (2017), which examined a disparate body of basic memory research. Interestingly, each of these meta-analyses captured *entirely* different sets of studies. Shields and colleagues (2017) included 113 studies, published between 2001 and 2015, on the effects of stress on three different phases of human memory – encoding, postencoding, and retrieval. Most relevant for the present purposes is their analysis of the effects of stress on encoding (examined in 33 studies). They found that the overall effect of stress on encoding was not statistically significant, but this differed as a function of several moderators (i.e., stress-encoding delay and the relevance of the encoding material). The results showed that stress enhances memory when stress onset coincides with the encoding task (rather than preceding it) and when the to-be-remembered information is relevant to the stressor. Translated to the eyewitness context, where (a) stress onset would ostensibly occur during the crime and (b) the to-be-remembered information is integral to the stressor (i.e., the criminal event), Shields and colleagues' (2017) findings suggest that stress will enhance eyewitness memory.

The mixture of findings in this area has raised concerns among several eyewitness researchers who have begun to examine this body of research more critically (Sauerland et al., 2016; Marr et al., 2021a). One point of concern is the divergence between the methods and conclusions of eyewitness memory researchers and that of memory researchers in other areas. Several methodological factors may account for the divergent conclusions within and between memory literatures (see Marr et al., 2021a). Drawing upon ongoing discussions in the eyewitness literature, I will argue for the necessity of two key methodological features of experimental studies of negative emotion and

eyewitness memory: (1) the insertion of a delay between encoding and retrieval and (2) assessing memory performance for material that is also the source of the emotional response.

1.3 Delay

The delay between the time of encoding (i.e., the time of the crime or other target event) and the time of memory retrieval is a crucial consideration in eyewitness memory studies. Unlike other areas of memory research, eyewitness memory studies often do not include substantial delays between encoding and retrieval (Sauerland et al., 2016). Other memory researchers (e.g., neurobiologists) often insert delays (i.e., > 24 hours) between encoding and retrieval and generally find memory enhancement effects (see LaBar & Cabeza, 2006). However, as Sauerland and colleagues (2016) pointed out, fewer than half of the eyewitness studies included in Deffenbacher and colleagues' (2004) meta-analysis included a delay of at least 24h between encoding and retrieval. Participants in eyewitness lab experiments typically enter the memory retrieval stage just *minutes* after the target event (e.g., after a brief "filler task"). This is a curious design feature given that encoding-retrieval delays in actual criminal investigations are often on the order of days, weeks, or months (Christianson, 1992; Flowe et al., 2018). But does delay affect eyewitness memory outcomes? Research suggests that it does, *particularly when comparing emotional and non-emotional memory.*

The crux of why delay matters is that emotional and non-emotional memories decay at different rates (e.g., Burke et al., 1992; Cellini et al., 2019; Christianson, 1992; Park, 2005). We appear to forget emotional memories more slowly than neutral ones, meaning that the effects of emotion on memory are *time dependent* (Yonelinas &

Ritchey, 2015). Thus, an immediate memory assessment – as is common in eyewitness experiments – may fail to detect an emotional memory advantage if said advantage is only reliably apparent after a delay. Some researchers have argued further that without a delay, the effects of emotion/stress on encoding and retrieval may be confounded (Marr et al., 2021a; Sauerland et al., 2016). At the very least, eyewitness researchers must include a delayed retrieval condition if they wish to conduct an appropriate test of negative emotion on eyewitness memory because (a) delays are common in real investigations and (b) compared to non-emotional memory, emotional memory may be more resistant to forgetting over time (that is, emotional memory effects may be time-dependent).

1.4 Relevance of Experimental Stimuli

Another enduring point of methodological divergence is the experimental manipulation of participants' affective state. Eyewitness experiments seek to describe the eyewitness context as it occurs in the real world. And in the eyewitness context, the *crime* generally serves as both the source of emotional distress and as the to-be-remembered (TBR) event. Yet, this is not always the case in eyewitness experiments, where the source of emotion or stress is often unrelated to the memory assessment content. This occurs when researchers assess participants' memory for target events (e.g., videos, live events) that occur independently of the source of their affective response (e.g., social stress, threat of electric shock). This type of setup, however, is roughly analogous to examining witnesses' memory for information *unrelated to the crime*. Clearly, this is not the question of interest.

In his seminal review of the literature in this area, Christianson (1992) observed that while "emotional stress" may harm memory under certain conditions, it often appears to improve memory, particularly when the source of emotion is causally related to the to-be-remembered (TBR) stimuli. Others have described this phenomenon as the causal belonging hypothesis (Bower, 1987) and arousal congruent performance (ACP; Hanoch & Vitouch, 2004). In a direct empirical examination of the source of arousal, Libkuman and colleagues (1999) differentiated between physiological and emotional arousal by comparing the effects of physical exercise (physiological arousal) versus slides depicting a surgical operation (emotional arousal). While emotional arousal was found to enhance memory across experiments, few effects were observed for physiological arousal. The authors concluded that arousal, per se, is insufficient to affect memory and instead arousal must be relevant to the TBR event in order to exert an effect. These results are consistent with Christianson's (1992) argument that emotional arousal is memory-enhancing when it is an "inherent property of the TBR event" (p. 293). Or, as summarized by Hanoch and Vitouch (2004), "there should be a connection between the emotional arousal state induced and the performance evaluated" (p. 431).

Meta-analytic evidence (from outside the eyewitness literature) provides additional support for the view that the connection between the source of stress and the TBR stimuli can affect memory outcomes (Shields et al., 2017). Shields and colleagues (2017) found that stress enhances memory when the TBR material is *relevant* to the stressor (and when there is limited delay between the onset of stress and the onset of encoding). Together, the available evidence suggests that a pattern of memory enhancement is, all else being equal, more likely when the stressor is relevant to what is

encoded (and when the onset of the stressor coincides with the onset of encoding). Therefore, eyewitness studies of negative emotion should ensure that the source of distress is associated with the TBR material as this reflects real-world conditions and failing to do so may produce misleading results.

1.5 The Current Dissertation

The purpose of the current dissertation was to examine the effects of negative emotion on eyewitness memory. In Study 1, I assessed the effects of negative emotion on recall and recognition (lineup identification) across variable delays (either immediate or 1-week delay). In Study 2, I examined the effects of negative emotion on recall across different delays (i.e., immediate vs. 1-week delay) and different retrieval instructions (i.e., free recall vs. memory-enhancement instructions). Few studies have examined the effects of negative emotion on eyewitness memory while satisfying both criteria of appropriate study design outlined above (i.e., by inserting a delay between encoding and retrieval and ensuring congruence between the source of negative emotion and what is to-be-remembered). By doing so within the present research, I hoped to advance our understanding of the reality of emotional eyewitness memory.

Chapter 2. Study 1: Evidence for selective emotional memory enhancement in a mock witness paradigm

2.1 Introduction

Being a witness or victim of a crime is often emotionally distressing (Bornstein & Robicheaux, 2009; Shepherd et al., 1999). Understanding how criminal events are remembered and reported, therefore, requires careful consideration of the memorial consequences of witnesses' affective responses – what eyewitness researchers have

variably referred to as emotion, stress, and arousal (among other terms; Bornstein & Robicheaux, 2009; Christianson, 1992; Głomb, 2021; Marr et al., 2021b)[2]. Existing research in this area, however, has come under increased scrutiny due to limitations in methodology as well as divergent conclusions within and between relevant bodies of research (Głomb, 2021; Marr et al., 2021b; Sauerland et al., 2016).

That emotionally distressing events tend to be well-remembered has received extensive empirical support on multiple fronts (see McGaugh, 2003; McNally, 2003). Laboratory experiments involving emotional audiovisual stimuli (e.g., Bornstein et al., 1998; Burke et al., 1992; Houston et al., 2013) and other stress-induction procedures (e.g., Bierbrauer et al., 2021; Wiemers et al., 2013; see Shields et al., 2017 for a meta-analysis), together with several studies involving actual witnesses/victims (e.g., Dodier et al., 2021; Yuille & Cutshall, 1986) and trauma survivors (e.g., McKinnon et al., 2015) provide convergent evidence that people tend to retain strong memories for the central components of emotionally salient events (sometimes at the expense of peripheral components; see also Christianson, 1992; Kensinger, 2009; Reisberg & Heuer, 2004, 2007).

Yet other findings appear to tell a different story. There is evidence – adduced primarily within the eyewitness literature – that stress during encoding is associated with memory impairment (e.g., Morgan et al., 2004; Valentine & Mesout, 2009). Meta-analytic evidence reported by Deffenbacher et al. (2004) indicated that stress (during

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[2] We concur with Lane and Houston's (2021) observation that "the literature on the effects of stress and negative emotion on memory appear to be interlinked and are often cited together" (p. 100). "Negative emotion" seems appropriate for the present purposes. However, when referring to past research we attempt to retain the researchers' original terminology.

encoding) impairs eyewitness recall and recognition memory. While several more recent eyewitness studies appear to support this conclusion (e.g., Davis et al., 2019; Pezdek et al., 2021), others report little or no effects in either direction (e.g., Marr et al., 2021a; Price et al., 2022; Sauerland et al., 2016). As summarized in a recent review by Marr and colleagues (2021b), "previous experiments have reported impairing effects, enhancing effects, and null effects of encoding stress on recognition and recall performance" (p. 1093).

Given the mixture of findings within and between existing lines of research (i.e., basic memory research and eyewitness memory research) as well as explicit calls for increased methodological rigor (e.g., Sauerland et al., 2016), there remains a need for closer consideration of research methodology in this area. Two such methodological considerations are (1) the delay between encoding (i.e., the time of the event) and retrieval (i.e., the time of the interview and/or lineup identification procedure), and (2) the retrieval procedure (i.e., type of memory test, instructions). While eyewitness studies often consist of single-session experiments (with trivial delays between encoding and retrieval; Marr et al., 2021; Sauerland et al., 2016) assessing either recall or recognition performance, here we chose to include a delay and consider multiple modes of retrieval.

2.1.1 Delay

The delay between encoding and retrieval is a critical consideration in eyewitness memory studies for at least two reasons. First, emotional memories appear to decay more slowly than non-emotional memories (e.g., Cellini et al., 2019; Christianson, 1992; Park, 2005; see also Burke et al., 1992 for partial support). One of the leading perspectives among emotional memory researchers outside of the eyewitness field – the modulated-

consolidation model – concerns the underlying neurobiological processes that modulate memory consolidation in the interim period between encoding and retrieval (e.g., Cahill & McGaugh, 1998; McGaugh, 2018). Other researchers have similarly emphasized the passage of time between encoding and retrieval in explaining emotional memory processes (see Yonelinas & Ritchey, 2015). By contrast, many eyewitness researchers have focused less on post-encoding processes and have attempted to account for emotional memory effects by pointing to differences in attentional processes during encoding, drawing heavily upon the work of Easterbrook (1959) and Yerkes-Dodson (1908; see Christianson, 1992). Contrary to encoding-based explanations, however, attentional differences during encoding cannot account for differences in emotional and non-emotional memory that emerge only after a post-encoding delay (Yonelinas & Ritchey, 2015).

Second, real-world contexts often involve longer encoding-retrieval delays than are used in laboratory experiments (Flowe et al., 2018). In many criminal investigations, witnesses are asked to provide their accounts and/or make person-identifications after considerable delays – possibly days, weeks, or months after an event (Christianson, 1992). Based on a comparison of the characteristics of eyewitness laboratory studies and archival felony cases, Flowe et al. (2018) found that the median delay between a criminal event and making a lineup identification in real cases is 11 days whereas laboratory participants typically make identifications after much shorter delays (~20 minutes). They argued that there is a need for eyewitness researchers to vary the retention interval (among other factors) in laboratory studies to better establish the generalizability of the phenomenon of interest. Other eyewitness researchers have argued in favour of inserting

a delay because the absence of a delay conflates the effects of emotion/stress on encoding and retrieval (e.g., Marr et al., 2021a; Sauerland et al., 2016). The argument for including a delay is particularly salient when considered alongside previous findings of time-dependent emotional memory enhancement (Yonelinas & Ritchey, 2015) as well as recent calls for more modern emotional memory research in which memory is assessed after variable delays (Ack Baraly et al., 2017).

2.1.2 Retrieval Procedure

In practice and in the scientific literature, the assessment of eyewitness memory generally takes one of two forms: (i) an interview (recall) and/or (ii) lineup identification (recognition). Is it reasonable to assume that the effects of negative emotion on one form of eyewitness memory will generalize to the other? Perhaps not. We can observe an initial indication of discontinuity in recall and recognition effects in the meta-analytic results reported by Deffenbacher et al. (2004). Although they reported evidence of stress-based memory impairment overall, the decrement in (target-present) lineup identification performance ($h = –.52$) was considerably larger than that observed for narrative recall ($d = –.20$). Providing further evidence of discontinuity between recognition and recall performance in the context of emotional eyewitness memory, Houston and colleagues (2013) found that emotional participants were *better* than neutral participants at describing the perpetrator but *worse* at identifying them from a lineup. Ack Baraly and colleagues (2017) argued that emotional memory recall may be superior to recognition due to greater usage of controlled processing; recall may involve more effortful self-initiated processing than recognition (Craik & McDowd, 1987). Yet, as Ack Baraly et al.

(2017) noted, few studies have examined this hypothesis directly within an emotional memory context.

On the issue of witness recall, there is considerable variability in the instructions that have been used in research and forensic practice. One procedure that has received extensive empirical support is known as the Cognitive Interview (CI; Fisher & Geiselman, 1992). The CI consists of various memory-enhancement techniques that have been shown to increase information yield without jeopardizing overall accuracy (for a meta-analysis, see Memon et al., 2010). To explore the potential differences in emotional memory effects across different recall procedures, we chose to manipulate the recall instructions that participants received. Specifically, we assessed both basic free recall instructions as well as instructions that included two memory-enhancement techniques from the CI: *report everything* and *mental reinstatement of context* (see Appendix A for full instructions).

2.2 The Current Research

In the current experiment, we sought to investigate the effects of negative emotion during encoding on subsequent eyewitness memory performance (i.e., lineup identification and recall). In light of recent discussions (e.g., Marr et al., 2021a; Sauerland et al., 2016) regarding the potential importance of delay – both in theory (given the differential rates of decay for emotional vs. non-emotional memories; Yonelinas & Ritchey, [2015]) and in practice (given the differential delays in laboratory studies vs. criminal investigations; Flowe et al., [2018]) – we sought to take a closer look at the role of delay by documenting participants' memory either immediately or after a 1-week

delay. Further, given the potential discontinuity between recognition and recall effects in this context (e.g., Houston et al., 2013), we chose to consider both modes of retrieval.

Hypothesis 1. In line with emotional memory enhancement effects documented elsewhere (e.g., Kensinger, 2009), we expected participants in the Negative video condition to demonstrate superior recall compared to those in the Neutral condition, particularly in regard to central event details.

Hypothesis 2. Given the time-dependent nature of emotional memory (Yonelinas & Ritchey, 2015), the emotional enhancement effect (see Hypothesis 1) should be larger after a 1-week delay as compared to immediate recall.

Hypothesis 3. As hypothesized by Ack Baraly et al. (2017), we expected to find minimal differences in lineup identification (recognition) performance among Negative video viewers compared to Neutral viewers.

2.3 Method

2.3.1 Design

We used a 2 (Emotion Video: Negative vs Neutral) × 2 (Delay: Immediate vs. 1-Week) × 2 (Retrieval Procedure: CI-based Recall/Free Recall) × 2 (Lineup: TP Lineup vs. TA Lineup) between-participants design. Participants were randomly assigned to experimental condition. The retrieval procedure consisted of both a recall (either CI-based or Free Recall) and a lineup task (either a target-present or target-absent lineup). Participants completed the recall and lineup tasks in a randomized order. We used variable retrieval conditions to explore potential effects of recall instructions by comparing memory-enhancement instructions (based on the Cognitive Interview; Fisher & Geiselman, 1992) vs. basic free recall instructions (see Appendix A). Following

convention in the eyewitness identification literature, we chose to examine both TP and TA lineups (e.g., Houston et al., 2013; Sauerland et al., 2016).

2.3.2 Participants

Participants were undergraduate students, recruited remotely from two university campuses located in different Canadian provinces. In total, 427 responses were recorded initially in Qualtrics. We included in our final sample those who successfully completed both parts of the study a single time within the appropriate timeframe (i.e., the duration of part one must have exceeded the length of the video stimuli, part two must have been completed within 24 hours of part one for the immediate condition and not more than 8 days later for the 1-week delay condition). The final sample consisted of 204 undergraduate students (100 males, 101 females, 3 other). The mean age of the sample was 20.51 years (*SD* = 3.02). Participants reported the ethnic/cultural origins of their ancestors (and could select all that applied): 84 (41.2%) reported Asian origins, 64 reported European origins (31.4%), 49 reported North American origins (24.0%), 17 reported African origins (8.3%), 14 reported Caribbean origins (6.9%), 3 reported Latin, Central and South American origins (1.5%), and 3 reported Other North American origins (1.5%). Participants also reported their year of study: 54 were in their first year of study (26.5%), 57 were in their second year (27.9%), 66 were in their third year (32.4%), and 27 were in their fourth year or above (13.2%).

2.3.3 Video Stimuli

I created Negative and Neutral video stimuli for the purposes of the present research. Each video is 2 min and 26 sec long, filmed from a first-person perspective, depicting a social interaction among three students (one female and two males, portrayed

by local actors) in a university study space. Both negative and neutral versions consisted of three discrete segments such that the first and last segments were identical in both conditions, whereas the middle segment differed between conditions. While both versions followed the same basic sequence, the middle segment in the negative version depicted an altercation (including accusations of infidelity, explicit threats of violence) whereas the neutral version depicted a mundane interaction (including greetings and small talk). Importantly, the use of video stimuli ensured that the to-be-remembered (TBR) material (i.e., the video content) was also the source of participants' emotional response. This matches the situation in the real world where the criminal event is that which an eyewitness must attempt to remember *and* the source of distress (for discussion on this point, see Christianson, 1992; Marr et al., 2021a; Snow & Eastwood, 2022).

2.3.4 Lineup Construction

In the current experiment we used six-person simultaneous target-present (TP) and target-absent (TA) photo lineups presented entirely within the online survey. The first author selected a set of potential fillers (16 photos) from the Chicago Face Database (Ma et al., 2015) based on their general physical resemblance to the suspect. Similar to the lineup construction procedure described by Houston and colleagues (2013), for all potential filler photos we gathered similarity-to-suspect ratings (from 0 = *Not at all similar* to 10 = *Very similar*) and distinctiveness ratings (from 0 = *Not at all distinctive* to 10 = *Very distinctive*) from an independent group of participants (n = 10). The six photos with the highest similarity ratings were used as fillers. Of the selected filler photos, similarity ratings were between M = 3.44, SD = 2.30, and M = 4.60, SD = 2.41, and distinctiveness ratings were between M = 3.40, SD = 1.78, and M = 5.70, SD = 1.42. We

edited the lineup photos to standardize the appearance of all visible clothing (i.e., all clothing was coloured solid black) and lineup photos appeared in a randomized order.

2.3.5 Survey

Survey materials are available on the Open Science Framework (https://osf.io/ngckb/). The experimental stimuli in the present research consisted of a two-part online survey, hosted at Qualtrics.com. The first page of the survey (part one) consisted of an informed consent form outlining the details of the study. Next, participants received instructions to ensure their computer audio was turned on and to wear headphones if possible. They also received the following instructions:

You're about to watch a video of a social interaction. This video may contain scenes of violence or startling events and may contain coarse language. If you wish to stop the video and withdraw from participation, you may do so at any time by closing your internet browser. The video was filmed from a first-person perspective, and so please try to imagine yourself in the situation as if you were behind the camera. Please pay close attention to the video.

Next, participants watched either the Negative or Neutral video and were instructed to view the video a single time, in full screen, and without pausing or replaying. Following the video stimuli, participants received the following questions regarding their emotional experience: "*To what extent did you feel anxious during the video?"* (1 = *Not at all* to 7 = *Extremely*); "*To what extent did you feel tense during the video?"* (1 = *Not at all* to 7 = *Extremely*); "*How would you describe your feelings during the video?*" (1 = *Very Negative* to 7 = *Very Positive*). Then participants received the following questions assessing their perceptions of the video: "*How easy was it to imagine*

yourself in the situation shown in the video?" (1 = *Very difficult* to 7 = *Very easy*); "*How believable was the situation shown in the video?*" (1 = *Not at all* to 7 = *Extremely*). Last, participants provided basic demographic information and received debriefing information concerning part one. Participants indicated whether they wished to complete the second part of the study and were instructed that "*Participation in Part 2 will consist of answering questions about your experiences during Part 1*".

The first page of part two also consisted of an informed consent form. Next, participants were instructed to "please read all instructions carefully and take as much time as you need to complete the following questions". Participants then completed the recall task and lineup identification task, presented in a randomized order. For the recall task, participants received either basic free recall instructions or more detailed instructions based on the Cognitive Interview (Fisher & Geiselman, 1992) and typed their response into the provided textbox (see Appendix A for full instructions). To be clear, this was not intended to serve as an in-depth examination of the full CI; the recall procedure in the current study was text-based and self-administered. Immediately following the recall task, participants received the following questions: "*How confident are you that you recalled <u>all</u> the details from the video in your written response?*" (out of 100%); "*How confident are you that the details you provided in your response were <u>accurate</u>?*" (out of 100%); "*How difficult was it to remember the details of the video?*" (0 = *Not at all* to 100 = *Extremely*).

For the lineup task, participants received either a TP or TA lineup as described above (see Appendix A for full instructions). Immediately following the lineup task, participants received the following questions: "*How confident are you in your lineup*

decision?" (out of 100%); "*How difficult was it to remember the man from the video?"* (out of 100%). Last, participants indicated whether they completed part one and two in the same or in different locations and then received additional debriefing information.

2.3.6 Procedure

We recruited participants from online research participation pools at two Canadian universities [blind for review]. We received approval from the Research Ethics Board at each institution prior to data collection. Upon accessing the study link and providing informed consent, participants worked their way through the online survey outlined above. In the first session, participants viewed either the Negative (n = 108) or Neutral (n = 96) video and provided their subjective ratings. At the end of part one, participants received debriefing information and indicated whether they wished to participate in part two. Those who agreed to complete part two, automatically received the survey link via email either immediately (M_{Delay} = 2.7 minutes) or after one week (M_{Delay} = 7.3 days). Upon accessing the survey link to part two and again providing informed consent, participants worked their way through the memory recall and lineup procedures (in a randomized order) as described above. As mentioned, participants received either CI-Based (n = 94) or Free Recall (n = 106) instructions[3] and completed either a TP (n = 99) or TA (n = 105) lineup. At the end of part two, participants received additional debriefing information. All participants received course credit as compensation.

2.3.7 Data Coding

[3] We were unable to determine the recall instructions received by four participants who provided no recall response.

The first author reviewed participants' responses to the memory recall task and created a coding guide based on the reported details. We categorized details as either Environmental (e.g., objects, surroundings), Person (e.g., hair, clothing), Critical Incident (i.e., action details within the middle video segment), Peripheral Action (i.e., action details within the first and last video segments), or Uncodable (i.e., vague or subjective statements). Details were coded as either present (1) or absent (0). The first author met with a research assistant (RA) to familiarize them with the coding process. The RA was blind to our hypotheses and otherwise uninvolved in the current research. The RA independently coded a small set of responses for training purposes (n = 15). After a brief follow-up session with the first author, the RA coded a substantial portion of the remaining recall responses. For the latter subset of responses (n = 85), we examined inter-rater reliability using Cohen's kappa (Cohen, 1960). Mean kappa values are $\kappa_{correct} = 0.80$, $\kappa_{incorrect} = 0.66$, $\kappa_{uncodable} = 0.63$, ps < .001. Although the values for incorrect and uncodable details were slightly lower than for correct details, all values are indicative of substantial agreement between coders (Landis & Koch, 1977).

2.4 Results

2.4.1 Preliminary Analyses

Comparison of participants' self-reported emotional responses to the Negative and Neutral videos suggested that the manipulation of negative emotion was successful. A series of between-subjects ANOVAs indicated that participants who viewed the Negative video reported feeling significantly more negative (p < .001, d = 1.25, 95% CI [0.95, 1.55]), anxious (p < .001, d = 0.49, 95% CI [0.21, 0.78]), and tense (p = .001, d = 0.46,

95% CI [0.18, 0.74]) during the video compared to those who watched the Neutral version. Descriptive statistics are presented in Table 2.1.

Participants rated how easy it was to imagine themselves in the situation shown in the video (M = 4.34, SD = 1.76) as well as the believability of the situation shown in the video (M = 4.37, SD = 1.69). As shown in Table 2.1, results revealed only small differences in imaginability ratings (p = .09, d = 0.24, 95% CI [0.04, 0.52]) and believability ratings (p = 0.04, d = 0.30, 95% [0.02, 0.57]) between Negative and Neutral video groups. Participants also reported whether they completed both parts of the study in the same or different locations. Most participants (90%) reported completing both parts of the study in the same location. A chi-square test indicated that study location was associated with Delay such that 137 participants in the Immediate condition completed both parts in the same location, whereas 47 did so in the 1-Week delay condition, χ^2 (1, N = 204) = 39.76, p < .001, Cramer's V = .44.

Table 2.1

Mean Emotion and Realism Ratings (with Standard Deviations) and [95% Confidence Intervals] as a Function of Video Condition

	Anxious	Tense	Feelings	Imaginability	Believability
Negative video	4.18 (1.78) [3.84, 4.51]	4.28 (1.75) [3.94, 4.61]	2.61 (1.15) [2.39, 2.83]	4.14 (1.73) [3.81, 4.47]	4.14 (1.69) [3.82, 4.46]
Neutral video	3.32 (1.67) [2.98, 3.66]	3.48 (1.72) [3.13, 3.83]	3.81 (0.69) [3.67, 3.95]	4.56 (1.77) [4.20, 4.92]	4.64 (1.66) [4.30, 4.97]

2.4.2 Recall Performance

To examine differences in recall performance we conducted 2 (Video) × 2 (Recall Instructions) × 2 (Delay) between-subjects ANOVAs for each detail category. For this

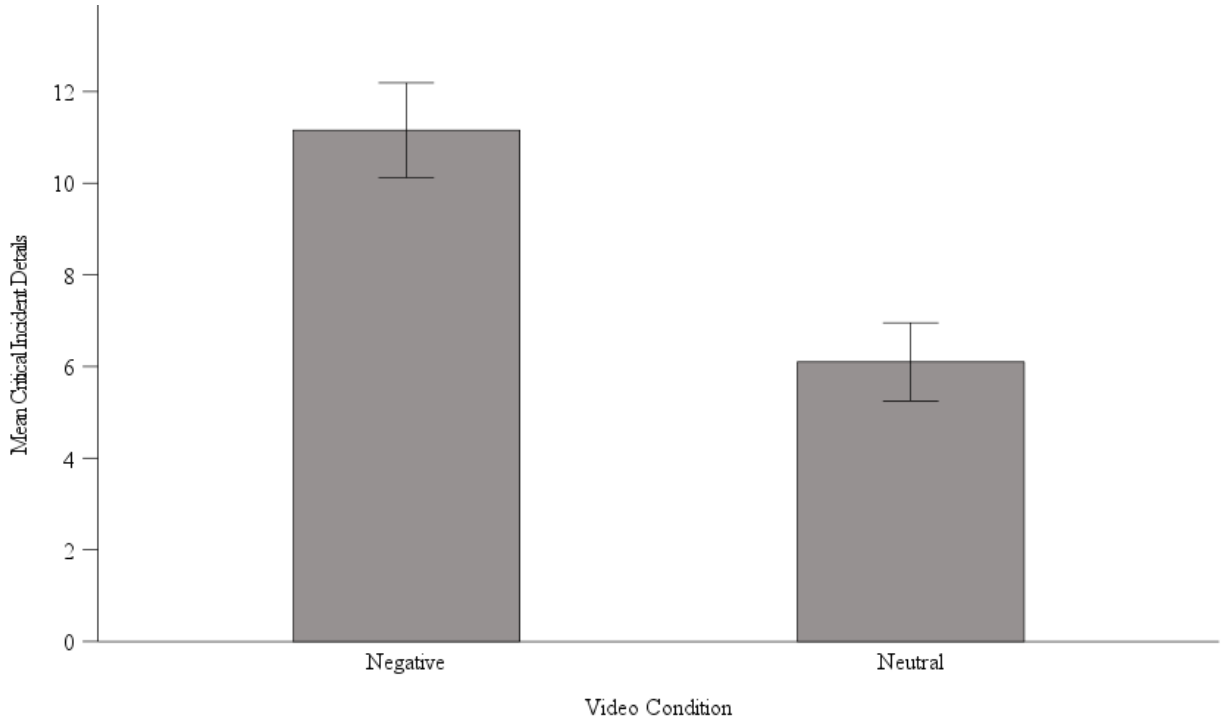
analysis, we excluded participants (n = 15) who did not provide an appropriate response (e.g., non-responses, responses that did not pertain to the present stimuli). These exclusions were determined independently by the first author and an RA who was otherwise uninvolved in the current research. Disagreements were resolved through discussion. The following analysis of recall performance included data from 189 participants ($n_{Free\ Recall}$ = 96; $n_{CI\text{-}Based}$ = 93).

Critical incident details. Participants reported 8.80 Critical Incident details on average (SD = 5.34). We observed a significant effect of Video condition, $F(1, 181) = 39.62$, $p < .001$. As shown in Figure 2.1, participants in the Negative video condition (M = 11.16, SD = 5.25) reported more critical event details than those in the Neutral condition (M = 6.10, SD = 4.03, d = 1.07, 95% CI [0.77, 1.38]). We also found a significant effect of Delay, $F(1, 181) = 25.12$, $p < .001$. Participants in the immediate condition reported more critical incident details (M = 9.96, SD = 5.44) than those in the 1-week delay condition (M = 5.93, SD = 3.82, d = 0.80, 95% CI [0.47, 1.13]). These were both large effects. All other main effects and interactions were non-significant (ps > .05).

Peripheral action details. Participants reported 10.77 Peripheral Action details on average (SD = 6.60). We observed a significant effect of Delay, $F(1, 181) = 33.10$, $p < .001$. Participants in the immediate condition reported more peripheral action details (M = 12.40, SD = 6.73) than those in the 1-week delay condition (M = 6.69, SD = 3.98, d = 0.94, 95% CI [0.61, 1.27]). This was a large effect. All other main effects and interactions were non-significant (ps > .05).

Figure 2.1

Mean Differences in Number of Critical Incident Details Reported as a Function of Video Condition



Note. Error bars are 95% Confidence Intervals.

Environmental details. Participants reported 5.46 Environmental details on average (*SD* = 4.74). We observed a significant effect of Delay, $F(1, 181) = 13.88$, $p < .001$. Participants in the immediate condition reported more environmental details ($M = 6.26$, $SD = 5.03$) than those in the 1-week delay condition ($M = 3.46$, $SD = 3.18$, $d = 0.61$, 95% CI [0.29, 0.93]). This was a medium effect. All other main effects and interactions were non-significant (*p*s > .05).

Person details. Participants reported 3.44 Person details on average (*SD* = 1.49). Whether considered together (i.e., total Person Details) or separately (i.e., Female, Male 1, Male 2), all main effects and interactions were non-significant (*p*s > .05)[4].

Incorrect details. Participants reported 1.82 Incorrect details on average (*SD* = 1.90). We observed a significant effect of Delay, $F(1, 181) = 4.33$, $p = .039$. Participants in the Immediate condition (*M* = 1.64, *SD* = 1.80) reported fewer Incorrect details than did those in the 1-week delay condition (*M* = 2.28, *SD* = 2.07, *d* = 0.34, 95% CI [0.02, 0.66]). This was a small effect. All other main effects and interactions were non-significant (*p*s > .05).

Uncodable details. Participants reported 2.50 Uncodable details on average (*SD* = 1.94). We observed a significant effect of Video, $F(1, 181) = 13.23$, $p < .001$. Participants who watched the Negative video reported more Uncodable details (*M* = 3.05, *SD* = 1.92) than did those who watched the Neutral video (*M* = 1.88, *SD* = 1.77, *d* = 0.63, 95% CI [0.34, 0.93]). There was also a significant effect of Recall Instructions, $F(1, 181) = 9.13$, $p = .003$. Participants in the CI-based condition (*M* = 3.00, *SD* = 2.06) reported more Uncodable details than did those in the Free Recall condition (*M* = 2.02, *SD* = 1.69, *d* = 0.52, 95% CI [0.23, 0.81]). These were both medium effects.

2.4.3 Recall Confidence

Confidence in Completeness. Participants reported their level of confidence that they recalled all the details from the video (from 0% to 100%). A 2 (Video) × 2 (Recall

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[4] Because the video was filmed from a first-person perspective and participants were instructed to imagine themselves in the situation, some participants referenced their (or the cameraperson's) presence in the scenario. However, we chose to omit this detail as it did not affect the analysis.

Instructions) × 2 (Delay) between-subjects ANOVA revealed that those who viewed the Negative video were more confident that they recalled all the details from the video (M = 65.49, SD = 25.03) than were those who viewed the Neutral video (M = 49.13, SD = 25.92), $F(1, 181) = 22.93$, $p < .001$, $d = 0.64$, 95% CI [0.35, 0.94]. There was also a main effect of Delay such that participants in the Immediate condition reported greater confidence that they recalled all of the video details (M = 61.08, SD = 26.55) than did those in the 1-Week delay condition (M = 49.83, SD = 25.46), $F(1, 181) = 6.38$, $p = .012$, $d = 0.43$, 95% CI [0.11, 0.75]. However, these effects were qualified by a Video × Delay interaction, $F(1, 181) = 4.25$, $p = .041$, partial $\eta^2 = .023$. Neutral participants were significantly less confident in the completeness of their recall after a 1-week delay (M = 35.93, SD = 19.53) as compared to immediate (M = 55.28, SD = 26.37, $p = .001$, d = 0.79, 95% CI [0.33, 1.25]), but this did not hold for Negative participants ($p = 0.87$, d = 0.04, 95% CI [–0.41, 0.48]). Exploratory correlation analyses also revealed that participants' confidence in the completeness of their recall was positively correlated with the number of Critical Incident details reported ($r = .18$, $p = .011$, 95% CI [.04, .32]), but was not correlated any other detail category (ps > .05).

Confidence in Accuracy. Participants reported their level of confidence that the details they recalled were accurate (from 0% to 100%). A 2 (Video) × 2 (Recall Instructions) × 2 (Delay) between-subjects ANOVA revealed a main effect of Video such that those who viewed the Negative video were more confident that the details they provided were accurate (M = 79.56, SD = 19.38) than were those who viewed the Neutral video (M = 69.55, SD = 21.75), $F(1, 181) = 12.13$, $p < .001$, $d = 0.49$, 95% CI [0.20, 0.78]. There was also a main effect of Delay such that those in the Immediate condition

reported greater confidence that the details they provided were accurate (M = 78.96, SD = 18.36) than did those in the 1-Week delay condition (M = 64.76, SD = 23.98), $F(1, 181)$ = 18.18, $p < .001$, d = 0.71, 95% CI [0.38, 1.03]. The main effect of Video was qualified by a Video × Recall Instructions interaction, $F(1, 181) = 6.59$, $p = .011$, partial $\eta^2 = .035$. Within the CI-Based recall condition, Negative participants were more confident in their accuracy (M = 81.15, SD = 17.10) than were Neutral participants (M = 62.46, SD = 23.42, $p < .001$, d = 0.94, 95% CI [0.50, 1.37]), but this effect did not hold within the Free Recall condition (p = 0.53, d = 0.13, 95% CI [–0.27, 0.53]). Exploratory correlation analyses also revealed that participants' confidence in the accuracy of their recall was positively correlated with the number of Critical Incident details (r = .37, $p < .001$, 95% CI [.24, .49]) and Peripheral Action details reported (r = .26, $p < .001$, 95% CI [.12, .39]).

Difficulty of recall. Participants reported how difficult it was to remember the details of the video (from 0% to 100%). A 2 (Video) × 2 (Recall Instructions) × 2 (Delay) between-subjects ANOVA revealed a main effect of Delay such that those in the 1-week delay condition reported greater difficulty (M = 56.44, SD = 27.92) than those in the Immediate condition (M = 43.15, SD = 25.76), $F(1, 181) = 9.11$, $p = .003$, d = 0.50, 95% CI [0.18, 0.82]. There was also a main effect of Video such that those who viewed the Neutral video reported greater difficulty (M = 53.76, SD = 26.58) than those who viewed the Negative video (M = 41.01, SD = 26.06), $F(1, 181) = 9.45$, $p = .002$, d = 0.49, 95% CI [0.19, 0.77]. These were both small-medium effects. Exploratory correlation analyses revealed that participants' self-reported difficulty was negatively correlated with the number of Critical Incident details (r = –.24, $p < .001$, 95% CI [–0.37, –0.10]) and Uncodable details reported (r = –.15, p = .035, 95% CI [–0.29, –0.01]).

2.4.4 Lineup Identification Performance

We analyzed TP and TA lineup performance separately. We coded TP lineup identification decisions as Hits (correctly selecting the target person), False Positives (incorrectly selecting a filler), or Misses (incorrectly selecting "not here"). We coded TA lineup identification decisions as False Positives (incorrectly selecting a filler) or Correct Rejections (correctly selecting "not here"). For this analysis, we excluded data from participants (n = 23) who provided incompatible identification responses (i.e., those who selected a lineup photo but also selected "not here"). Thirteen participants were excluded from the TP condition; 10 participants were excluded from the TA condition.

Overall, 41.6% of participants (37/89) correctly identified the perpetrator in the TP lineup (33.7% False Positives, 24.7% Misses) and 62.0% (57/92) correctly selected "not here" in the TA lineup (38.0% False Positives). A 2 (Video: Negative vs. Neutral) × 3 (Hit vs. False Positive vs. Miss) chi-square test did not reveal a significant association between Video condition and TP identification response, χ^2 (2, N = 89) = 0.51, p = .78, Cramer's V = .08. A 2 (Video: Negative vs. Neutral) × 2 (False Positive vs. Correct Rejection) chi-square test did not reveal a significant association between Video condition and TA identification response, χ^2 (1, N = 92) = 0.34, p = .56, Cramer's V = .06.

A 2 (Delay: Immediate vs. 1-Week) × 3 (Hit vs. False Positive vs. Miss) chi-square test revealed a significant association between Delay and TP identification response, χ^2 (2, N = 89) = 11.62, p = .003, Cramer's V = .36. The TP Hit rate was 53.2% in the Immediate condition (vs. 14.8% in the 1-week delay condition), the TP False Positive rate was 25.8% in the Immediate condition (vs. 51.9% in the 1-week delay condition), and the TP Miss rate was 21.0% in the Immediate condition (vs. 33.3% in the

1-week delay condition). A 2 (Delay: Immediate vs. 1-Week) × 2 (False Positive vs. Correct Rejection) chi-square test did not reveal a significant association between Delay and TA identification response, χ^2 (1, N = 92) = 0.04, p = .84, Cramer's V = .02. The TA False Positive rate was 37.3% in the Immediate condition (vs. 39.4% in the 1-week delay condition) and the TA Correct Rejection rate was 62.7% in the Immediate condition (vs. 60.6% in the 1-week delay condition).

2.4.5 Lineup Confidence

Participants reported their confidence in their lineup decision (from 0% to 100%). A 2 (Video) × 2 (Delay) between-subjects ANOVA revealed a significant effect of Delay on TP lineup decision confidence, F(1, 82) = 6.91, p = .010. Participants reported greater confidence in the Immediate condition (M = 57.82, SD = 30.06) than in the 1-Week delay condition (M = 41.65, SD = 22.30, d = 0.58, 95% CI [0.11, 1.05]). Participants also reported how difficult it was to remember the man from the video (from 0% to 100%). A 2 (Video) × 2 (Delay) between-subjects ANOVA revealed a significant effect of Delay on ratings of TP lineup difficulty, F(1, 83) = 4.15, p = .045, d = 0.34, 95% CI [–0.12, 0.79]. However, this effect was qualified by a Delay × Video interaction, F(1, 83) = 7.68, p = .007, partial η^2 = .085. Within the 1-week Delay condition, Neutral participants reported greater difficulty (M = 87.09, SD = 11.99) than did Negative participants (M = 55.00, SD = 26.64, p < .001, d = 1.46, 95% CI [0.58, 2.32]); however, this difference did not hold in the Immediate condition (p = 0.34, d = 0.26, 95% CI [–0.27, 0.79]). Exploratory correlation analyses indicated that TP lineup decision accuracy correlated positively with decision confidence (r = .44, p < .001, 95% CI [.25, .60]) and negatively with perceived difficulty (r = –.47, p < .001, 95% CI [–.62, –.29]).

A 2 (Video) × 2 (Delay) between-subjects ANOVA revealed a significant effect of Delay on TA lineup decision confidence, $F(1, 87) = 11.04$, $p = .001$. Participants reported greater confidence in the Immediate condition ($M = 50.81$, $SD = 26.87$) than in the 1-Week delay condition ($M = 31.38$, $SD = 26.77$, $d = 0.72$, 95% CI [0.28, 1.17]). A 2 (Video) × 2 (Delay) between-subjects ANOVA revealed a significant effect of Delay on ratings of TA lineup difficulty, $F(1, 87) = 9.72$, $p = .002$. Participants reported greater difficulty in the 1-Week delay condition ($M = 81.91$, $SD = 23.75$) than in the Immediate condition ($M = 63.95$, $SD = 26.82$, $d = 0.70$. 95% CI [0.26, 1.14]). Exploratory correlation analyses indicated that TA lineup decision accuracy was not correlated with decision confidence ($r = –.01$, $p = .94$, 95% CI [–.21, .20]) nor with perceived difficulty ($r = –.08$, $p = .47$, 95% CI [–.28, .13]).

2.5 Discussion

Consistent with Hypothesis 1 as well as previous research (e.g., Dodier et al., 2021; Kensinger, 2009), we observed a pattern of selective emotional enhancement of recall memory. Recall was not enhanced uniformly, but rather only for Critical Incident details (i.e., action details from the middle video segment which differed between Negative vs. Neutral conditions). This was a large effect ($d = 1.07$), and one that fits with past findings indicating that emotion enhances memory for the central elements of the target stimuli, as opposed to – and sometimes at the expense of – peripheral details (Kensinger, 2009; Reisberg & Heuer, 2004, 2007). Interestingly, despite enhanced recall of the central action details among the Negative video group, recall of the target person's physical appearance was not enhanced. Perhaps, within the context of a negative emotional event, the central actions – including that of the target person – are more

memorable than the target person's physical appearance. However, this is contrary to Houston and colleagues' (2013) observation that emotional (vs. neutral) witnesses showed enhanced (i.e., more complete) recall for the perpetrator's physical appearance but recalled less about what the central character did. In the current study, the fact that few Person details were reported *in general*, may suggest that the characters' physical appearance was not particularly memorable for participants across the board. Concerning the relative memorability of a central character's actions vs. their physical appearance within the context of a negative emotional event, further investigation is warranted.

The Negative video group also reported more Uncodable details (i.e., subjective or vague information that could not be coded as correct or incorrect) than did those who viewed the Neutral video. This included statements such as inferences regarding the potential relationship between the perpetrator and female (e.g., "…the blonde woman's boyfriend comes into the room…"; "…the woman's boyfriend entered…"). Although this information was categorized as "uncodable" in the context of the current experiment, such statements may be of practical importance in the context of a real investigation.

Based on previous literature indicating time-dependent effects of emotion on memory (Yonelinas & Ritchey, 2015), we expected to find more pronounced emotional memory enhancement after a 1-week (vs. immediate) delay (see Hypothesis 2). Although we found strong evidence of diminished memory performance after a 1-week delay (i.e., medium-to-large effects), Emotion and Delay did not interact as predicted. It may be that our manipulations were too weak to observe the interaction. For example, perhaps our delay was not substantial enough to detect differential effects on Negative vs. Neutral recall. Alternatively, it may be that the predicted interaction is simply not as robust as

expected or that the present study was not sufficiently powered to detect the interaction. Another possibility is that Delay was confounded with other factors such as testing location (as indicated in our preliminary results), that may have made it harder to identify the predicted interaction. Further research is needed to identify the conditions under which the hypothesized interaction can or cannot be reliably observed.

Consistent with Hypothesis 3, although negative emotion was associated with enhanced recall memory, we did not find evidence of enhanced recognition (lineup performance). This finding is consistent with the predictions of Ack Baraly (2017) and roughly in line with the recall-recognition discontinuity observed by Houston and colleagues (2013) in which emotional participants were better than neutral participants at describing the perpetrator but worse at identifying them from a lineup. Our data provide at least a preliminary indication that the null effects of negative emotion on lineup identification performance may be attributable to *what* was being retrieved (i.e., the target person) rather than *how* it was being retrieved (i.e., recall vs. recognition). Neither recall nor recognition of the target person differed between Negative and Neutral participants, suggesting that negative emotion simply did not convey a benefit to this particular aspect of the event (i.e., the target person's appearance). Although we found few differences in participants' recall performance between CI-based and Free Recall conditions, the current results highlight the need for caution when attempting to generalize the effects of emotion across disparate eyewitness memory tasks, in particular, recall vs. lineup identification.

The null hypothesis – that there is no difference in identification performance between Negative and Neutral participants – cannot be rejected on the basis of the present findings. This particular null finding is consonant with a growing number of studies

reporting no effects of stress on identification performance (Marr et al., 2021b; Price et al., 2022; Sauerland et al., 2016). These studies, together with the current results, lend support to the conclusion that the effects of negative emotion/stress on lineup identification performance may be less robust than previously believed. However, given strong claims to the contrary (Deffenbacher et al., 2004), more research is warranted.

Exploratory measures of participants' confidence and difficulty ratings provided additional indices of emotional memory enhancement in the current study. Participants who watched the Negative video (vs. the Neutral video) reported greater confidence and less difficulty remembering event-related details. Increased negative emotion thus appears to have increased the ease with which details were retrieved from memory, consistent with the broader emotional memory literature (Phelps & Sharot, 2008). Exploratory analyses also indicated that participants' confidence ratings were moderately correlated with at least some aspects of their memory performance (i.e., recollection of central details, TP-lineup accuracy), suggesting that participants had some degree of insight into the quality of their memory. However, this relationship may be weaker among Negative participants than Neutral participants, as indicated by the correlations between confidence (in completeness) and the number of Critical Incident details among Neutral (r = .28, p = .009) vs. Negative participants (r = –.11, p = .27), and the correlations between identification confidence and TP-lineup accuracy among Neutral (r = .58, p < .001) vs. Negative participants (r = .36, p = .008).

2.5.1 Limitations

This study has several limitations. First, our manipulation of negative emotion, while statistically reliable, almost certainly pales in comparison to the levels of emotional

distress experienced by actual witnesses/victims. Nevertheless, this is a ubiquitous limitation for laboratory research in this area, and it is worth noting that our results converge with that of recent work with actual witnesses/victims (Dodier et al., 2021). Second, despite our best efforts to ensure maximal similarity across Negative and Neutral videos, the two versions may have differed in aspects other than their emotionality (e.g., distinctiveness, coherence, realism). However, this "confound" is likely inherent in any real-world emotional event. As Cahill and McGaugh (1995) argued, it is unlikely that *any* study can definitively rule out these "other" factors and, moreover, the effects of emotion on memory may be attributable (at least in part) to emotion's effects on these seemingly extraneous factors. Third, because video content differed between conditions, coders were unable to be truly blind to experimental condition. Fourth, although we believe our approach to measuring negative emotion was effective in assessing the concepts of interest, the current scale ratings have not been validated and therefore should be interpreted with caution.

2.6 Conclusion

Although only a single study, the current results speak to the selectivity with which negative emotion may affect eyewitness memory processes – both with respect to the nonuniformity of enhanced recall as well as the differential effects on recall vs. facial recognition. The current findings suggest that caution is warranted when discussing the effects of negative emotion on eyewitness memory, as eyewitness memory does not appear to be an undifferentiated unidimensional process. The pattern of memory enhancement observed in the present study was rather selective and uneven. The prevailing view (at least among eyewitness researchers) has been that emotional distress

generally *impairs* memory. The current results, and that of several other recent experiments in the eyewitness literature (e.g., Marr et al., 2021b; Price et al., 2022; Sauerland et al., 2016), speak against this conclusion. Given researchers' growing awareness of such discrepancies and an increasing emphasis on appropriate methodology (see Marr et al., 2021a), we are optimistic that this line of research will continue to refine our understanding of how well (or poorly) witnesses remember events in the real world.

In Study 2, I conducted a replication and extension of Study 1. Study 2 retained much of the procedure from Study 1 but with several key differences. First, I chose to focus solely on recall performance. Given the minimal effects of recall instructions in Study 1, rather than the text-based instructions used in Study 1, participants in Study 2 received pre-recorded audio instructions. This was intended to provide a more fulsome, engaging procedure that allowed for the inclusion of the eye closure component of the mental context reinstatement instructions. Second, participants in Study 1 consisted of undergraduate students, whereas participants in Study 2 included a community member sample.

Chapter 3. Study 2: Examining the Effects of Negative Emotion and Interviewing Procedure on Eyewitness Recall

3.1 Introduction

In criminal investigations, witnesses are routinely called upon to report their memory for criminal events and to identify persons of interest. Given the distressing nature of many criminal events (e.g., Shepherd et al., 1998) and the role of emotional arousal in memory formation and retrieval (e.g., see McGaugh, 2003), the question of emotional memory is of particular interest and importance within eyewitness contexts.

Although researchers have studied this phenomenon for decades (Christianson, 1992; Reisberg & Heuer, 2004, 2007), an interdisciplinary consensus is yet to be established (see Marr et al., 2021a; Sauerland et al., 2016). The divergent effects of emotional arousal – ranging from memory enhancement to memory impairment – appear to stem from differences in methodology such as the encoding-retrieval delay and the experimental manipulation of arousal (e.g., Christianson, 1992; Sauerland et al., 2016). In the current study, we aim to advance knowledge in this area by examining the effects of acute emotional arousal and investigative interviewing procedures under conditions intended to reflect key components of real-world investigations – namely, an encoding-retrieval delay and a to-be-remembered (TBR) event that is also the source of emotional arousal.

3.1.1 Emotional Arousal and Eyewitness Memory

Deffenbacher and colleagues (2004) reported the first and only meta-analytic review of the eyewitness literature regarding the effects of stress on eyewitness memory. These authors examined two sets of published studies. The first consisted of 27 tests of stress on eyewitness face identification accuracy from 1727 participants across 16 papers published between 1974 and 1997. The second set consisted of 36 tests of stress on eyewitness recall accuracy from 1946 participants across 18 published papers. Their results indicated that stress has a modest negative effect on the accuracy of both eyewitness identification (for target-present lineups but not target-absent; mean effect sizes h = -.52 and h = +.01, respectively) and recall memory (for interrogative recall more so than free recall; mean effect sizes d = -.34 and d = -.20, respectively). These findings dovetail with the results of several subsequently published studies (e.g., Davis et al., 2019; Morgan et al., 2004; Pezdek et al., 2020; Valentine & Mesout, 2009) and

collectively support the conclusion that emotional stress impairs eyewitness memory. This conclusion is widely cited in the forensic literature and has served as a benchmark for evaluating the state of knowledge in the field (e.g., Dodier et al., 2019).

Despite the widespread acceptance of a memory impairment effect among eyewitness researchers, some have suggested that the reality may not be quite so simple (e.g., Christianson, 1992; Sauerland et al., 2016). For instance, the conclusion that heightened stress impairs memory would appear to be inconsistent with findings from trauma survivors who experienced profound stress and retain strong memories of their traumatic experiences (e.g., McKinnon et al., 2015; for reviews, see Kihlstrom, 2006; McNally, 2003) as well as other field studies within the eyewitness literature in which memory accuracy is generally quite high (Christianson & Hübinette, 1993; Odinot et al., 2009; Yuille & Cutshall, 1986). Moreover, there is considerable empirical evidence of emotional memory enhancement (e.g., Cahill & McGaugh, 1995; see McGaugh, 2003). Many such studies show that emotional arousal enhances memory for the central details of an event, often (but not always) at the expense of peripheral details (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Wiemers et al., 2013; see Reisberg & Heuer, 2004, 2007). This phenomenon is known variously as tunnel memory (e.g., Berntsen, 2002; Safer et al., 1998), memory narrowing (e.g., Levine & Edelstein, 2009), and the central/peripheral trade-off (e.g., Kensinger, 2009; Kim et al., 2013). In sum, although many early studies of emotional arousal and eyewitness memory tended to take a holistic view of the data, the memorial effects of emotion may be more nuanced (Lane & Houston, 2019; 2021). Emotional arousal may have *selective* effects on eyewitness

memory, requiring an analytical distinction between central and peripheral details (e.g., Houston et al., 2013).

3.1.2 Methodological Considerations

Several researchers have suggested, upon closer scrutiny of the relevant literature, that (a) there is considerable variation in the extent to which researchers' methodological choices reflect real world conditions and (b) that such methodological choices may influence the direction of observed effects (see Christianson, 1992; Sauerland et al., 2016; Marr et al., 2021a). Here, we highlight two such considerations: (1) the delay between encoding and retrieval, and (2) the source of emotional arousal and its (in)congruence with the target event.

Regarding the encoding-retrieval delay, Sauerland and colleagues (2016) observed that the memory impairment effects reported by Deffenbacher and colleagues (2004) may have been due in part to the absence of sufficient delays between encoding and retrieval in most of the included studies. Specifically, these authors noted that most of the meta-analyzed studies used minimal delays (i.e., < 24h between encoding and retrieval) whereas studies from the neurobiological literature regarding stress and memory – which generally show memory enhancement effects – use more substantial delays (i.e., > 24h). This is consistent with the observation that emotional memory enhancement may take time to emerge because we forget emotional memories more slowly than non-emotional memories (Yonelinas & Ritchey, 2015; see also Christianson, 1992; Park, 2005; but see Burke et al., 1992 for mixed support).

The time-dependent nature of emotional memory is particularly relevant within applied memory contexts such as real-world criminal investigations because

investigations take time. Police generally interview witnesses and/or administer lineups in the days, weeks, and months following an event (Christianson, 1992; Flowe et al., 2018). Together, the time-dependency of emotional memory and the ecological validity of delayed retrieval suggest that the effects of emotional arousal observed within single-session eyewitness studies may not reflect the emotional memory processes of real-world forensic contexts. Still, few modern studies have considered emotional memory effects at multiple time intervals (Ack Baraly et al., 2017), and so we aim to do so here by manipulating the passage of time (immediate vs 1-week) between the target event (video) and memory retrieval (virtual interview procedure).

Another aspect of methodological variation in the extant literature concerns the experimental manipulation of emotional arousal itself. This is a fundamental issue with empirical consequences, and so our approach in the current study warrants further comment. In his review of the literature, Christianson (1992) observed that emotionally stressful events seem to confer a memory advantage when the source of arousal is causally related to the to-be-remembered (TBR) stimuli (see also Hanoch & Vitouch, 2004; Libkuman et al., 1999). More recent findings from outside the eyewitness literature also highlight the importance of the relation between the source of stress and TBR stimuli (e.g., Wiemers et al., 2013; see Shields et al., 2017). Meta-analytic findings reported by Shields and colleagues (2017) indicate that stress enhances memory when the TBR material is relevant to the stressor (and when there is limited delay between the onset of stress and the onset of encoding).

Eyewitness studies that present participants with TBR stimuli (e.g., video, staged event) and induce emotional stress by some other means (e.g., pharmacological,

social/evaluative, threat of electric shock) may achieve relatively high levels of stress but do so in a way that maintains a causal separation between arousal source and TBR information. But the fact remains that, for eyewitnesses, the source of arousal and the event for which memories are sought are not merely temporally coincidental, they are one and the same (i.e., the criminal event). Therefore, in the current research, we will use video stimuli as both the TBR event as well as the source of participants' affective response. To summarize, we propose that in order to preserve ecological validity, experimental studies of emotional arousal and eyewitness memory should, at the very least, examine memory performance for stimuli that are causally related to (rather than independent of) the source of arousal and memory should be assessed after a delay (rather than only being assessed immediately after the target event).

3.1.3 Emotional Memory and Witness Interviewing

The quality of eyewitness accounts rests to a large extent on the tactics used by investigators at the time of memory retrieval (Fisher et al., 2011). The Cognitive Interview (CI; Fisher & Geiselman, 1992) is perhaps the most widely studied and empirically supported approach to gathering information in eyewitness contexts (e.g., Satin & Fisher, 2019; see Köhnken et al., 1999; Memon et al., 2010). There is, however, limited research examining the effectiveness of interviewing techniques for witnesses of emotional versus non-emotional events. To our knowledge, there are only two published experiments that have examined the CI or CI-based procedures for neutral versus emotionally arousing stimuli (Ginet & Verkampt, 2007; Krix et al., 2016).

Krix et al. (2016) examined the effectiveness of the Self-Administered Interview (SAI) – a CI-based pencil-and-paper procedure (see Gabbert et al., 2009) – across

stressful vs. non-stressful conditions. Participants underwent either a stress (i.e., mental math with hands immersed in cold water; see Smeets et al., 2012) or no-stress (i.e., hands immersed in lukewarm water) procedure and then witnessed a staged theft. Participants immediately reported their memory for the event via a written free recall or SAI. The SAI improved memory performance whereas stress neither improved nor impaired memory. Given the dissociation between the stressor and the TBR event as well as the absence of a substantial delay between encoding and retrieval, the lack of an effect for the stress manipulation is somewhat unsurprising.

In their study of emotional memory and investigative interviewing, Ginet and Verkampt (2007) presented 70 undergraduate students with video footage of a traffic accident. Half of the participants received instructions that they would receive electric shocks during the film (high arousal condition) and half received no such instruction (low arousal). One week later, they interviewed participants about the video using a modified CI procedure (MCI; consisting of rapport-building, transfer of control, followed by *mental context reinstatement* and *report everything* instructions) or a structured interview (SI; consisting of rapport-building, transfer of control, followed by free recall instructions without the CI instructions). The authors found that, irrespective of arousal, the MCI elicited more correct central and peripheral details than the SI and that high arousal was associated with greater accuracy for peripheral details than was low arousal. In a recent study of 56 witnesses'/victims' memories for real traffic accidents that had occurred up to 25 months prior, Dodier et al. (2021) found that participants provided more event-related details when interviewed using a CI (vs. a control interview) and the high-stress group reported more central details than did the low-stress group. One aspect of the CI effect –

increased recall of injury details – was stronger for the high-stress group than the low-stress group.

Ginet and Verkampt (2007) also investigated the potential interaction between interviewing procedure and emotional arousal. These authors hypothesized that, for central details, the memory enhancement of high arousal would be more pronounced in the MCI condition relative to the SI. Given the relative saliency of the high arousal condition, by mentally reinstating this context, the MCI should produce particularly strong memory relative to the less salient (i.e., low arousal) condition. This prediction is consistent with a phenomenon sometimes referred to as the mood-dependent memory effect (Christianson, 1992; Eich, 1995). That is, memory is often improved when one's internal context (i.e., mood) during encoding is reinstated during retrieval. Ginet and Verkampt (2007), however, did not find support for this effect. This null finding is somewhat difficult to interpret given the dissociation between the arousal source (threat of electric shock) and TBR stimuli (video) in this study. Therefore, we aim to test this prediction when the source of emotional arousal and the TBR stimuli are causally connected.

3.2 The Current Research

Mixed findings in the extant literature appear to stem from underlying methodological discrepancies across studies, including fundamental differences in the extent of encoding-retrieval delay and the manipulation of arousal (Christianson, 1992; Sauerland et al., 2016; Marr et al., 2021). In the current study, our primary goal was to elucidate the role of emotional arousal in eyewitness memory by examining the phenomenon under the aforementioned conditions of ecological validity (i.e., by varying

the delay between encoding and retrieval and maintaining congruity between the emotion source and TBR event). More specifically, we aimed to measure the effects of acute emotional arousal during encoding on recall memory either immediately or after a one-week delay. Our methodological choices regarding delay and TBR event were meant to reflect two underlying realities of eyewitness contexts, thus minimizing the gap between experimental and real-world processes in several respects.

Our secondary aim was to explore the effects of interviewing procedure on recall memory for stimuli of varying emotionality. Specifically, we compared the effectiveness of a CI-based retrieval procedure vs. a free recall. As both conditions are self-directed and completed asynchronously, we did not seek to explicate here the broader role of social dynamics (nor, for that matter, did we wish to examine all possible components of the CI). Instead, we provided a selective examination of the role of mnemonic instructions (i.e., report everything and mental context reinstatement) that may have a more pronounced benefit when the TBR stimuli are emotionally salient.

3.2.1 A Note on Terminology

When discussing previous research, we have attempted to retain the terminology used by those researchers. As may be apparent in the forgoing discussion, however, eyewitness researchers in this area have used a mixture of terms (e.g., emotion, stress, arousal), often interchangeably (Bornstein & Robicheaux, 2009; Głomb, 2021; Lane & Houston, 2021). As observed by Lane and Houston (2021), "the literature on the effects of stress and negative emotion on memory appear to be interlinked and are often cited together" (p. 100). Any attempt to advance knowledge in this area, then, faces the problem of first identifying with sufficient clarity the variable(s) of interest. In the present

research, as in most emotional memory research outside the eyewitness literature (Kensinger & Schachter, 2016; LaBar & Cabeza, 2006), we adopt a two-dimensional perspective according to which emotional experiences arise from two underlying neurophysiological systems: valence and arousal (e.g., Barrett & Russell, 1999; Posner et al., 2005). Thus, within the context of the current experiment we use shorthand labels such as "negative emotion" and "emotional arousal" to denote what is fundamentally a combination of negative valence and heightened arousal. Some researchers, however, favour other conceptualizations (e.g., Deffenbacher et al., 2004; Levine & Edelstein, 2009; Levine & Pizarro, 2004), and establishing a consensus on this matter is beyond the scope of the present article. At a minimum, we wish to remind readers of the absence of an agreed-upon vocabulary in this area and to make explicit our own conceptualization.

3. 3 Hypotheses

Based on the literature reviewed above, we generated several hypotheses:

Hypothesis 1. In line with previous CI research (Memon et al., 2010), we predicted that participants in the CI-based condition would report more correct details compared to participants in the FR condition.

Hypothesis 2. As per the emotional memory advantage for central event details (e.g., Kensinger, 2009), we predicted that participants in the Negative video condition would show superior recall for central details compared to those in the Neutral condition. We did not make a specific prediction regarding peripheral details given that our experimental stimuli involve both visual and thematic components, and these components may differentially affect the extent of memory narrowing (Laney et al., 2004). Due to disagreements in the literature as to what constitutes central vs. peripheral details, our

current analytical approach allowed us to examine two alternative definitions of central and peripheral details (similar to that of Houston et al., 2013; for an overview of other proposed definitions, see Levine & Edelstein, 2009):

Perceptual definition. Some researchers have defined central details in perceptual terms, such as those associated with the central characters (e.g., Christianson & Loftus, 1991). Under a narrow interpretation of central characters, we compared memory recall for Perpetrator details between Negative and Neutral conditions. However, because all three people in the video are arguably "central", we also compared all Person details (perpetrator and victim details collapsed) between Negative and Neutral conditions.

Conceptual definition. Some researchers have defined central details in conceptual terms, such as those that are central to the plot of an event (e.g., Heuer & Reisberg, 1990). Similar to the comparisons performed by Houston et al. (2013), we compared participants' memory recall for Critical Incident details between negative and neutral conditions.

Hypothesis 3. Consistent with the Arousal × Interview interaction hypothesized (but not observed) by Ginet and Verkampt (2007; see also Dodier et al., 2021), we predicted that for central details, the memory enhancement effect of the CI-based instructions would be significantly larger in the Negative video condition than in the Neutral condition.

Hypothesis 4. Given the time-dependent nature of emotional memory (Yonelinas & Ritchey, 2015), we predicted that emotional memory enhancement would be more pronounced after a 1-week delay as compared to immediate retrieval.

3.3 Method

3.3.1 Participants

Our participant recruitment process deviated from our registered plan (see our Stage 1 Registered Report, https://doi.org/10.1002/acp.3907). Although we planned to collect an undergraduate student sample, we chose instead to recruit a general community sample (including adults from Canada and the United States who were fluent in English) using an online participant recruitment service (Prolific; https://www.prolific.co/). This allowed us to reach our target sample size. From our initial sample (n = 182), we excluded participants who either failed to complete the study (n = 30) or failed the attention check (n = 2). We also excluded participants (n = 17) who provided an inappropriate recall response (i.e., blank responses, reporting a complete inability to provide an account, reporting on something other than the target stimuli). Inappropriate responses were identified independently by both the first author and a research assistant who was otherwise uninvolved with the study. We excluded one additional participant for having completed the second part of the study in the 1-Week Delay condition after an excessive delay (i.e., 10 days after part one). Originally, we had stated that we would exclude participants from the 1-Week Delay condition if they completed part two after more than eight days. However, to minimize data loss, we chose to retain those who completed part two up to 9 days after part one.

Our final sample consisted of 132 participants (55 males, 74 females, 3 other). The mean age of the sample was 34.54 years (*SD* = 11.94, *Range* = 18–76). Participants reported the ethnic/cultural origins of their ancestors (and could select all that applied): 72 reported European origins (55%), 33 reported North American origins (25%), 26

(20%) reported Asian origins, 8 reported African origins (6%), 8 reported Latin, Central and South American origins (6%), and 4 reported Caribbean origins (3%).

3.3.2 Design

We used a 2 (Emotion Video: Negative vs. Neutral) × 2 (Interview Procedure: CI-based interview vs. free recall) × 2 (Delay: Immediate vs. 1-week) between-participants design. Participants were randomly assigned to experimental conditions.

3.3.3 Video Stimuli

We created Negative and Neutral video stimuli for the purposes of the first author's doctoral research. We also used the current video stimuli in an independent and ongoing study (N = 204). Initial results from which support the effectiveness of the manipulation, such that participants who viewed the Negative video reported feeling more negative (d = 1.25), anxious (d = 0.50), and tense (d = 0.46) during the video than did participants in the Neutral condition (Snow, 2021). Researchers commonly use videos to manipulate emotional arousal in emotional memory research (e.g., Houston et al., 2013; Bornstein et al., 1998). Each video is 2 min and 26 sec in length and depict a social interaction among three young adults in a university study space. Both videos consist of three discrete segments such that the first and last segments are identical across conditions, whereas the middle segment differed between conditions (this three-part video structure in which only the middle/critical segment varies across conditions is comparable to that used in previous work, Bornstein et al., 1998; Hulse et al., 2007).

To ensure the stimuli were maximally immersive, we filmed the videos from a first-person perspective using a GoPro video camera. The setting depicted in the video is a student study space on a university campus. Local actors played the three characters in

the video (two males and one female). The initial segment (1 min 26 sec) consists of the first-person camera (i.e., the "participant") moving into the study space, panning through the room, and eventually taking a seat near the corner of the room. A man enters the room and sits with a woman who is already sitting at a desk in the room and the two engage in conversation. Next, both negative and neutral variants of the middle segment begin as a second man enters and ends once he exits the room. The negative version of the middle segment consists of the second man entering the room and accusing the woman of cheating on him. The man swears, strikes several objects in the room (recycling bin and chair), grabs the other man, and utters threats (e.g., threatens to stab the man). The neutral version of the middle segment consists of the second man entering the room, greeting the two people in the room, and shaking hands and making small talk with the other man. Both negative and neutral versions of the middle segment are the same length (44 sec) and share the same basic structure. Both versions depict the same setting and perspective, include the same characters, contain elements of physical contact between the two male characters (shoving vs. handshake), depict the female character's use of her cellphone (ostensibly speaking with campus security in both versions), provide direct acknowledgement of the camera by the same male character, and contain similar amounts of dialogue overall (169 words in Negative vs. 136 words in Neutral). The final segment (16 sec) consists of the first man leaving the room while the woman is on her phone, and the video ends as the camera moves toward the exit.

3.3.4 Emotion Assessment

Participants provided ratings of their emotional responses to the experimental stimuli on the following three items: (1) *To what extent did you feel anxious during the*

video? (1 = Not at all to 7 = Extremely) (2) *To what extent did you feel tense during the video?* (1 = Not at all to 7 = Extremely) (3) *How would you describe your feelings during the video?* (1 = Very negative to 7 = Very positive). Eyewitness researchers have measured emotional arousal in a variety of ways (see Bornstein & Robicheaux, 2009), and the current assessment is similar to measures used previously (e.g., Bornstein et al. 1998; Congleton & Berntsen, 2020; Smeets et al., 2004).

3.3.5 Realism Assessment

We used two questions to assess the realism of the experimental stimuli: (1) *How easy was it to imagine yourself in the situation shown in the video?* (1 = Very difficult to 7 = Very easy) (2) *How believable was the situation shown in the video?* (1 = Not at all to 7 = Extremely).

3.3.6 Interview Procedure

We used a CI-based interview and a free recall, similar (but not identical) to that used by Ginet and Verkampt (2007). Each interview procedure was self-administered, consisting of a set of audio instructions and a written (typed) recall completed within the Qualtrics survey. The use of pre-recorded audio instructions ensured consistency in the provision of interview instructions across conditions. The CI-based procedure consisted of *report everything* (i.e., report everything they can remember from the video) and *mental reinstatement of context* (i.e., instructions encouraging the mental reinstatement of the encoding context, including eye closure) mnemonics followed by a free recall prompt. The free recall procedure consisted only of the free recall prompt with no mnemonics (see Appendix B for complete interview scripts). As mentioned, the current procedure is *not* a test of the full CI – we are omitting several components that are either unnecessary

or infeasible to include for the present purposes (e.g., witness-compatible questioning). To minimize data loss due to technical issues, we decided to record participants' recall via text entry using a textbox rather than using their device's microphone as was originally intended in our Stage 1 Report.

3.3.7 Post-Interview Questions

For exploratory purposes, we created a short post-interview survey to assess participants' perceptions of the interview and the remembering process (see Appendix B).

3.3.8 Procedure

Prior to data collection, we received approval from the Research Ethics Board at Ontario Tech University. The present study consisted of two online phases completed asynchronously via Qualtrics.com: (1) a video phase and (2) an interview phase. Upon accessing the initial survey link, participants landed on an informed consent page. At this point, the stated purpose of the study was to examine psychological responses to social stimuli. Within this consent form, we instructed participants that the study involves watching a video of a social interaction and that the video may or may not contain violence or startling events (for comparable warnings, see e.g., Bornstein et al., 1998). Note, however, that we did not instruct participants that we were interested in their memory for the video. After completing the consent form, participants completed a brief audio test and received instructions to wear headphones if possible and to ensure that they completed the study in a private, distraction-free location. Next, participants received the following instructions:

You're about to watch a video of a social interaction. This video may contain scenes of violence or startling events and may contain coarse language. If you wish to stop the

video and withdraw from participation, you may do so at any time by closing your internet browser. The video was filmed from a first-person perspective, and so please to try to imagine yourself in the situation as if you were behind the camera. Please pay close attention to the video.

Participants viewed either the Negative or Neutral Video. Immediately following the video, participants provided the abovementioned emotion and perceived realism ratings as well as basic demographic information. At the end of part one, participants received a debriefing form that provided additional study information and reminded participants of their eligibility to complete part two (which reportedly consisted of "answering questions about their experiences" in the current phase of the study).

Either immediately or one week later, those who completed part one gained access to the second part of the study. Upon beginning part two, participants received a new consent form, informing them that they would be asked to complete an interview procedure regarding the video they watched in part one. After completing the consent form, participants completed either a CI-based or comparison (i.e., free recall) procedure. After providing their account, participants completed several post-interview questions (see Appendix B). Last, participants received a debriefing form thanking them for their participation and providing additional information about the study, researcher and mental health contact information, etc.

3.3.9 Coding

We developed a coding guide using an iterative review process such that the final set of all possible details for each video consisted of those details mentioned at least once within the sample. We organized all event details within a template using the following

detail categories (modified from Houston et al., 2013): Person (including separable categories for each character in the video)[5], Critical Incident (i.e., all action details in the middle video section), Peripheral Action (i.e., all action details in the first and last video sections), Environmental (i.e., objects, setting), and Uncodable (i.e., vague or subjective statements). The coding template for Negative and Neutral video conditions consist of the same details except for those that varied between conditions (i.e., Critical Incident details). The first author coded all interview transcripts and an independent research assistant (RA) independently coded 69 interview transcripts to ensure reliability. The RA received a brief training session to ensure familiarity with the coding process and coding guide. Mean Cohen's kappa values ($\kappa_{correct} = 0.80$, $\kappa_{incorrect} = 0.61$, $\kappa_{uncodable} = 0.57$) indicated moderate-to-substantial inter-rater agreement (Landis & Koch, 1977).

3.4 Results

3.4.1 Data Availability

Data and study materials are available on the Open Science Framework (https://osf.io/jc4k5/).

3.4.2 Preliminary Analyses

To verify the validity of the manipulation in the current sample we conducted independent samples t-tests to measure differences in emotion ratings between Negative and Neutral conditions. We similarly examined ratings of perceived realism and conducted exploratory analyses of between-group differences on these measures. All effect sizes are reported as absolute values.

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[5] Because the video was recorded from a first-person perspective, some participants referenced their (or the cameraperson's) presence in the scenario. We chose to omit this detail from the Person detail category as it did not affect the analyses.

Participants who viewed the Negative version of the video reported feeling significantly more negative ($p < .001$, $d = 1.51$, 95% CI [1.12, 1.89]), anxious ($p < .001$, $d = 0.74$, 95% CI [0.38, 1.09]), and tense ($p < .001$, $d = 0.98$, 95% CI [0.61, 1.34]) during the video than did those who watched the Neutral version (see Table 3.1 for descriptive statistics). These were medium-to-large effects, indicating that the manipulation was successful.

Table 3.1

Mean Emotion Ratings (with Standard Deviations) and [95% Confidence Intervals] as a Function of Video Condition

	Anxious	Tense	Feelings
Negative video	4.41 (1.53) [4.03, 4.78]	4.67 (1.46) [4.31, 5.03]	2.35 (1.06) [2.09, 2.61]
Neutral video	3.21 (1.72) [2.79, 3.64]	3.09 (1.75) [2.66, 3.52]	3.83 (0.90) [3.61, 4.06]

Participants rated how easy it was to imagine themselves in the situation shown in the video ($M = 4.91$, $SD = 1.56$) as well as the believability of the situation shown in the video ($M = 5.12$, $SD = 1.43$). Ratings of how easy it was to imagine themselves in the situation did not differ between Negative and Neutral conditions ($p = .27$, $d = 0.19$, 95% CI [–0.15, 0.54]). Ratings of believability were lower for those who viewed the Negative video ($M = 4.74$, $SD = 1.46$) as compared to the Neutral video ($M = 5.50$, $SD = 1.30$, $p = .002$, $d = 0.55$, 95% CI [0.20, 0.89]). This was a medium effect.

3.4.3 Main Analyses

We conducted a 2 (Emotion Video) × 2 (Interview Procedure) × 2 (Delay) × 4 (Detail Type) mixed-measures ANOVA to examine differences between experimental

conditions in the number of details participants reported. Emotion Video, Interview Procedure, and Delay were between-participants variables, whereas Detail Type was a within-subjects variable. We also conducted separate between-subjects ANOVAs to examine potential differences across experimental conditions regarding the provision of Uncodable and Incorrect details.

There was a significant Video × Detail Type interaction, $F(3, 372) = 24.77$, $p < .001$, partial $\eta^2 = .17$. Participants who viewed the Negative video reported significantly fewer Peripheral Action details ($d = 0.43$, 95% CI [0.09, 0.78]) and significantly more Critical Incident details ($d = 0.89$, 95% CI [0.53, 1.24]) than did those who viewed the Neutral video. These were small-to-medium effects.

There was a significant Interview Procedure × Detail Type interaction, $F(3, 372) = 5.47$, $p = .001$, partial $\eta^2 = .04$. Participants who received CI-Based instructions reported significantly more Peripheral Action ($d = 0.61$, 95% CI [0.26, 0.96]), Person ($d = 0.39$, 95% CI [0.04, 0.73]), Critical Incident ($d = 0.42$, 95% CI [0.08, 0.77]), and Environmental details ($d = 0.67$, 95% CI [0.32, 1.02]) than did those who received only basic Free Recall instructions. These were small-to-medium effects.

There was a significant Delay × Detail Type interaction, $F(3, 372) = 19.37$, $p < .001$, partial $\eta^2 = .14$. Participants who reported their memory after a 1-Week Delay reported significantly fewer Peripheral Action ($d = 1.12$, 95% CI [0.74, 1.50]), Person ($d = 0.42$, 95% CI [0.05, 0.78]), Critical Incident ($d = 0.98$, 95% CI [0.60, 1.35]), and Environmental details ($d = 0.80$, 95% CI [0.42, 1.16]) than did those in the Immediate recall condition. These effects ranged from small to large.

There was a significant Delay × Video × Interview Procedure × Detail Type interaction, $F(3, 372) = 3.40$, $p = .018$, partial $\eta^2 = .03$. When provided with Free Recall instructions, Neutral participants ($M = 11.42$, $SD = 7.75$) reported more Peripheral Action details than Negative participants ($M = 6.70$, $SD = 3.79$), $F(1, 62) = 8.81$, $p = .004$, partial $\eta^2 = .12$; however, when provided with CI-Based recall instructions, Negative and Neutral groups did not differ in the number of Peripheral Action details they reported, $F(1, 62) = 0.77$, $p = .39$, partial $\eta^2 = .01$. Furthermore, within the Peripheral Action detail category, there was also a significant Delay × Video interaction among the Free Recall group, $F(1, 62) = 6.61$, $p = .013$, partial $\eta^2 = .10$, but not the CI-Based group, $F(1, 62) = 1.18$, $p = .28$, partial $\eta^2 = .02$. Thus, the superior recall of Peripheral Action details among the Neutral (vs. Negative) video group appears to be driven by differences within the Immediate, Free Recall conditions.

We found a significant effect of Video on number of Uncodable details reported, $F(1, 124) = 41.56$, $p < .001$. Participants who viewed the Negative video ($M = 3.98$, $SD = 2.30$) reported significantly more Uncodable details than did those who viewed the Neutral video ($M = 1.61$, $SD = 1.30$), $d = 1.28$, 95% CI [0.90, 1.65]. This was a large effect.

We found significant effects of Recall Procedure, $F(1, 124) = 4.69$, $p = .03$, and Delay, $F(1, 124) = 4.47$, $p = .04$, on the number of Incorrect details reported. Participants who received CI-Based instructions ($M = 2.18$, $SD = 2.30$) reported significantly more Incorrect details than did those who received FR instructions ($M = 1.55$, $SD = 1.54$), $d = 0.33$, 95% CI [–0.02, 0.67]. Participants who reported their memory after a 1-Week delay ($M = 2.35$, $SD = 2.35$) reported significantly more Incorrect details than did those who

reported Immediately (*M* = 1.60, *SD* = 1.70), *d* = 0.38, 95% CI [0.02, 0.74]. These were both small effects.

3.4.4 Exploratory Analyses

Participants provided their level of confidence (from 0% to 100%) that they remembered all the details from the video (*M* = 55.92, *SD* = 28.38), their level of confidence (from 0% to 100%) that they remembered the video accurately (*M* = 74.98, *SD* = 21.76), and they also rated how difficult it was (from 0% to 100%) to remember the details of the video (*M* = 42.89, *SD* = 25.89). A series of between-subjects ANOVAs revealed that confidence (in completeness) ratings were higher in the Immediate recall condition (M = 63.20, SD = 28.00) as compared to the 1-Week Delay condition (M = 42.46, SD = 24.06), *F*(1, 123) = 18.52, *p* < .001, *d* = 0.78, 95% [0.41, 1.15]. Participants in the Immediate recall condition (M = 81.79, SD = 17.45) were also more confident in the accuracy of their recall than were those in the 1-Week Delay condition (M = 62.39, SD = 23.45), *F*(1, 123) = 28.90, *p* < .001, *d* = 0.98, 95% CI [0.60, 1.36]. Participants in the Immediate recall condition (M = 35.07, SD = 25.17) reported less difficulty recalling the details of the video than did those in the 1-Week Delay condition (M = 57.35, SD = 20.63), *F*(1, 123) = 27.61, *p* < 001, *d* = 0.94, 95% [0.56, 1.32]. These were large effects.

Exploratory correlation analyses revealed a significant positive correlation between confidence (completeness) and the number of Critical Incident details, *r* = .20, *p* = .02, 95% CI [.03, .36], significant positive correlations between confidence (accuracy) and the number of Peripheral Action details (*r* = .18, *p* = .04, 95% CI [.01, .34]) and Critical Incident details (*r* = .22, *p* = .01, 95% CI [.05, .38], and significant negative correlations between difficulty ratings and the number of Peripheral Action details (*r* = –

.23, p = .009, 95% CI [–.38, –.06]) and the number of Critical Incident details (r = –.21, p = .019, 95% CI [–.36, –.04].

3.5 Discussion

3.5.1 Hypothesis 1

Our first hypothesis concerned the putative advantage of CI-based recall instructions over a more basic set of free recall instructions. Our results revealed that participants who received the CI-based instructions (i.e., *report everything + MCR*) reported more details on average (including Peripheral Action, Person, Critical Incident, and Environmental details) than did those who received the FR instructions. These were medium-to-large effects. However, participants who received CI-based instructions also reported more incorrect details than did those who received the comparison instructions, though this was a small effect (d = 0.33). Although we did not conduct a test of the full CI, the medium-to-large increase in correct details alongside the smaller increase in incorrect details observed here is consistent with findings reported within the broader CI literature (Memon et al., 2010).

While the effectiveness of the CI is already well-established (see Fisher & Geiselman, 2018; Fisher et al., 2014), several aspects of the current findings are worth noting. First, our findings suggest that even a substantially abridged version of the CI is sufficient to reliably benefit recall performance, and this appears to hold irrespective of the emotionality of the event (as evidenced by the lack of an Interview Procedure × Video interaction; see also Ginet & Verkampt, 2007). Second, the present findings support the effectiveness of CI-based instructions within the context of a virtual, self-administered memory elicitation procedure. The instructions in the present study were

delivered via audio and we recorded participants' written (typed) accounts. These results lend support to recent efforts to translate effective interviewing principles to technology-mediated contexts (e.g., Gabbert et al., 2022).

3.5.2 Hypothesis 2

Our results provide support for our hypothesis that participants who viewed the Negative video would show superior recall for central details as compared to those who viewed the Neutral video. The Negative video group reported more Central Incident details than did the Neutral group but did not report more Person details (regardless of whether Person details were considered as a combination of all person descriptors or perpetrator details only). Thus, negative emotion appeared to convey a benefit to details that were *conceptually* central (i.e., central to the plot), rather than those that were *perceptually* central (i.e., physical descriptors of central persons). Participants who viewed the Neutral video also reported significantly more Peripheral action details than did those who viewed the Negative video, though this was a small effect and qualified by an interaction. Ultimately, this effect appeared to hold only for those in the Free Recall, Immediate condition. The current pattern of results thus comports with the memory narrowing hypothesis, though there appears to be an asymmetry in the emotional memory trade-off such that the gain in central details is more robust than the loss in peripheral details.

As regards the selective emotional memory enhancement effect, several additional aspects of our results are worth noting. First, participants who watched the Negative video reported more Uncodable details (i.e., vague or subjective information) than did those who watched the Neutral video (d = 1.28). To be clear, uncodable does not mean

unimportant. At least some such subjective or vague statements (e.g., regarding the emotions, intentions, and relationships of potential persons of interest) may be of practical utility within the context of an actual criminal investigation. However, given that such details are (by definition) not captured by conventional coding, unless they are recorded separately, researchers run the risk of overlooking a potentially meaningful outcome.

Second, and somewhat contrary to existing findings in the emotional memory literature (e.g., Phelps & Sharot, 2008), we found only small and nonsignificant differences in average confidence and difficulty ratings between Negative and Neutral conditions. However, participants' confidence ratings were correlated, at least to some extent, with some aspects of memory performance (e.g., confidence ratings were positively correlated with the number of Critical Incident details reported). Confidence ratings were also considerably lower among those who reported their memory after a one week delay as compared to those who reported immediately. Given the persistent disagreement among eyewitness researchers regarding the diagnostic value of eyewitness confidence (e.g., Berkowitz et al., 2022; Wixted et al., 2022), more in-depth analyses are warranted before attempting to reach a definitive conclusion about the confidence–accuracy relationship in emotional eyewitness contexts.

3.5.3 Hypothesis 3

Contrary to our third hypothesis, we did not find that emotional memory enhancement was particularly pronounced when participants received CI-based instructions. A similar failure to observe this interaction was reported by Ginet and Verkampt (2007). Although there is evidence that memory is enhanced when one's mood

at retrieval matches the emotional content of what is being remembered (e.g., Lewis & Critchley, 2003), the MCR procedure may simply be an insufficient means of reinstating the emotional context. In future work, researchers may wish to examine a modified set of instructions that specifically target the emotional experience of the witness at the time of the event. At present, however, there is no evidence that an eyewitness who experiences moderate negative emotion during a criminal event will stand to benefit from CI-based memory enhancement instructions beyond that which can be achieved with witnesses in non-emotional circumstances.

3.5.4 Hypothesis 4

The present results do not provide support for our fourth hypothesis that emotional memory enhancement would be more pronounced after a 1-week delay as compared to immediate recall. Although we found that memory performance was worse overall after a 1-week delay (vs. immediate recall), we did not observe the predicted interaction. On the one hand, these results may alleviate concerns about the empirical consequences of inserting little-to-no delay between encoding and retrieval (as is common in eyewitness memory studies). However, it would be premature to conclude that the delay is empirically irrelevant with regard to the overall pattern of findings on emotional memory, particularly given prior findings regarding time-dependency (Yonelinas & Ritchey, 2015). One possibility is that the time dependency of emotional memory is observable only after a longer delay or under higher levels of emotional distress. In retrospect, it may be that our study was underpowered to detect this interaction. Given the practical and theoretical reasons to retain a delay condition (as

other eyewitness researchers have argued; Marr et al., 2021a), more research is needed to establish the boundaries of this effect in eyewitness settings.

The current study is not without its limitations. In particular, the current experimental stimuli are limited in at least two respects. First, although there were medium-to-large differences in the average levels of anxiety, tension, and negative feelings reported by participants who watched the Negative (vs. Neutral) video, ratings of negative emotion were far from the maximum possible ratings and the emotional experience undoubtedly failed to capture the quality and intensity of the emotional experience associated with actually witnessing or being the victim of a crime. However, this is true of almost all experimental research in this area, and it is worth noting that the current pattern of memory performance dovetails with that of recent research with actual witnesses/victims (Dodier et al., 2021). Second, because the video content differed somewhat between Negative and Neutral groups, we cannot rule out other extraneous factors (apart from the level of emotion elicited) that may have differed between videos (e.g., event distinctiveness). As noted previously, the current results also cannot speak to the potentially distinct contributions of arousal vs. valence. However, it is not obvious that such extraneous factors can be eliminated in any single study (McGaugh et al., 1995) and, moreover, such factors likely persist in actual eyewitness contexts (i.e., crime may be emotionally distressing but also distinctive, surprising, threatening, etc.). It is also worth noting that because of obvious differences in Negative and Neutral videos, coders could not be truly blind to condition.

3.6 Conclusion

The present study was motivated by persistent discrepancies in the literature regarding the effects of negative emotion on eyewitness memory (Christianson, 1992; Marr et al. 2021). The prevailing view among many eyewitness researchers is that "stress" during encoding harms eyewitness memory (Deffenbacher et al., 2004). Our findings, together with that of several recent studies (Krix et al., 2016; Marr et al., 2021b; Price et al., 2022; Sauerland et al., 2016), challenge the view that stress or negative emotion exerts a categorically negative effect on eyewitness memory. The reality appears to be more complex (as some researchers have long argued, e.g., Christianson, 1992). According to the present data, negative emotion neither enhances nor impairs memory *uniformly*. Instead, the present findings are consistent with a pattern of focal, or selective, memory enhancement (e.g., Burke et al., 1992; Christianson, 1992; Kensinger, 2009; Talmi, 2013) and do not support the idea that emotion effects are time-dependent (cf. Yonelinas & Ritchey, 2015). There remains a need to pursue these questions in future research, given the existence of conflicting findings and the practical importance of establishing a clearer understanding of emotional memory in forensic contexts.

Chapter 4. General Discussion

The purpose of this dissertation was to contribute to the clarification of the role of negative emotion in eyewitness memory. Taken together, the current results are consistent with the view that emotional distress during encoding leads to a focal enhancement of memory (e.g., Christianson, 1992; Talmi, 2013). Across two studies, I found that negative emotion was associated with enhanced witness recall memory for central event details as well as details that could not be coded as either correct or incorrect (i.e., subjective or vague statements). Next, I consider four issues that are

central to the present work: (1) The Issue of Selectivity, (2) the Issue of Experimental Stimuli, (3) the Issue of Delay, and (4) the Issue of Terminology.

4.1 The Issue of Selectivity

At the broadest level, eyewitness research is concerned with what witnesses can recall (e.g., within an investigative interview) and their ability to recognize persons of interest (e.g., within a photo lineup). There are different ways to assess eyewitness memory, and the evidence suggests that the effects of negative emotion do not affect all aspects of eyewitness memory equally. Several studies have shown a pattern of discontinuous or even *opposing* effects of negative emotion depending on the mode of retrieval (i.e., lineup identification vs. recall) and type of details recalled (e.g., central vs. peripheral). On the first point, regarding the mode of retrieval, results from Study 1 suggest that caution is warranted when attempting to generalize the effects of negative emotion on recall vs recognition performance. Specifically, I found evidence of selectively enhanced recall but no evidence of enhancement (or impairment) of lineup identification performance.

This finding is consistent with the suggestion that emotion enhances recall to a greater extent than it does recognition (Ack Baraly et al., 2017). However, the current findings are not independently sufficient to determine whether this finding is attributable to differences in the *mode* of retrieval, per se, as opposed to differences in the *content* of retrieval. Although, the present data provide some preliminary evidence in favour of the latter explanation. That neither recall nor recognition of the central actors was enhanced (or impaired) among those who watched the negative video in Study 1 suggests that

negative emotion simply did not benefit this particular aspect of the video; the target person's physical appearance was not participially memorable for participants.

One may reasonably argue that in the present work the deck was stacked against the possibility that the recall-recognition discontinuity could be attributed to inherent differences in the mode of retrieval. The present work did not provide a comparison of recall and recognition, *per se*. Within the eyewitness context, there is a confound between retrieval mode and retrieval content. Recognition, in the eyewitness context, involves identifying a target person from a lineup, whereas recall involves reporting *any* event-related details. Taken together, the current findings provide some preliminary grounds for doubt regarding the generalizability of the effect of negative emotion across disparate eyewitness memory tasks. Exactly why this may be, remains an open question for future research.

The specificity of the effects of emotion on eyewitness memory are also evident in the differences in recall between Negative and Neutral participants. Across both experiments, the recall advantage for those who watched the Negative video as compared to the Neutral video was limited to Critical Incident and Uncodable details. Enhancement of Critical Incident details is in line with previous findings of enhanced recall for central event details (e.g., Reisberg & Heuer, 2007). To my knowledge, however, the benefit to Uncodable details is a novel finding within the eyewitness literature. This may be due to the obvious fact that "Uncodable" details are generally not coded[6]. This effect appears to

[6] The "Uncodable" label notwithstanding, these details were coded within the present research. These details are difficult or impossible to categorize objectively within a dichotomous (e.g., correct vs. incorrect) coding procedure. Researchers often explicitly exclude such details from their coding (e.g., Hope et al., 2019; Kontogianni et al., 2020).

be driven, at least to some extent, by the increased reporting of subjective or vague information about the motivational and emotional experiences of those involved in the event (e.g., “the angry guy”; “the upset guy”; “the woman was yelling in fear”; “the young woman was in distress”). In future studies, researchers must be cognizant of the possibility that realistic emotional events may have inherent qualities that increase witnesses’ informational output, but which are not readily captured by traditional coding procedures.

In sum, if researchers treat eyewitness memory as a holistic construct, they may fail to detect more nuanced, focal patterns such as was observed in the current experiments (Lane & Houston, 2019). The question, “how does negative emotion affect eyewitness memory?” is admittedly ill-specified. The available data suggest that researchers would do well to ensure their approach to this question is responsive to the possibility that their results will vary depending upon how they choose to assess “eyewitness memory” (e.g., recall vs. recognition; central vs. peripheral details; consideration of subjective and/or vague details).

4.2 The Issue of Experimental Stimuli

One of the limitations of the existing literature highlighted recently (e.g., Marr et al., 2021a; Sauerland et al., 2016) is the importance of eliciting robust levels of distress that approximate that of real-world eyewitness situations. I agree. It is encouraging to see that, in several recent experiments, researchers have opted to use validated stress-induction procedures (e.g., Marr et al., 2021; Price et al., 2022; Sauerland et al., 2016) in contrast to the unstandardized procedures used in most other eyewitness experiments. While these validated procedures are not without their critics (Pezdek & Reisberg, 2022),

compared to the bulk of the existing eyewitness literature, these recent experiments represent some of the most methodologically robust procedures to date.

Why, then, in the current research did I not use a similar procedure? In each of these recent studies, the stress-induction procedures – though effective in eliciting measurable signs of psychological and physiological distress – failed to maintain a connection between the stressor and the stimuli for which participants' memory was assessed. In Sauerland et al. (2016), participants attempted to identify a target person who was involved in a staged theft that participants had witnessed shortly *after* a 15-minute stress-induction procedure. In Price et al. (2022), participants completed a stress procedure (math exercise and speech) immediately before and after a target video. Marr et al. (2021b) achieved temporal overlap between the presentation of TBR stimuli and the stress-induction procedures (MAST), but even here it must be said the TBR material was not itself the source of the participants' distress.

By contrast, in the two experiments reported here, I chose to use video stimuli to manipulate the level of negative emotion. Thus, the current procedure involved a trade-off. On the one hand, the use of video stimuli ensured an integral connection between the source of distress and the TBR material. This is an important methodological feature, as this arrangement corresponds with the typical eyewitness experience (Marr et al., 2021). On the other hand, the current video likely elicited a considerably lower level of distress than could potentially be achieved using a validated stress-induction procedure or a more naturalistic paradigm.

Marr et al. (2021a) recently expressed reservations about the kind of approach used in the present study, stating that "although these eyewitness stressors better reflect

reality, they may not sufficiently induce acute stress, making it difficult to draw conclusions regarding the effects of acute stress on memory performance" (p. 1094). I do not dispute the noted difficulty. I would argue further that it is difficult to draw conclusions regarding the effects of acute stress on memory performance from *any single study*. Conclusions should be drawn from the full body of available evidence, with due consideration to the methodological weaknesses of each study. Researchers should work to develop, in future work, novel paradigms that get the best of both worlds – eliciting high levels of stress while retaining an integral connection between the stressor and the TBR stimuli.

4.3 The Issue of Delay

If (a) emotional memory enhancement is time-dependent (e.g., Cellini et al., 2019; see Yonelinas & Ritchey, 2015) and (b) witnesses are often asked to provide an account or make an identification after a delay (Flowe et al., 2018), then it is important for eyewitness researchers to consider the effects of negative emotion on delayed retrieval (e.g., Sauerland et al., 2016). It is more convenient, however, to run an eyewitness experiment within a single session, and to assess participants' memory very shortly thereafter (e.g., after 10-20 minutes). This is indeed the normal experimental procedure (Flowe et al., 2018). Despite arguments expressed here and elsewhere in favour of inserting a substantial post-encoding delay, across both experiments, delay did not interact with emotion as predicted. Given previous findings of a time-dependent effect of emotion (e.g., Christianson, 1992; Yonelinas & Ritchey, 2015), the failure to observe this interaction in the present studies remains something of a puzzle.

The present data indicate that the memory advantage for Negative (vs. Neutral) central event details held for both Immediate and 1-Week Delay conditions. However, the decrease in the number of details recalled at 1-week (vs. immediate) was similar for Negative and Neutral groups. That is, the rate of forgetting appeared to be roughly similar for both Negative and Neutral participants. This pattern is contrary to my prediction that, due to relative differences in the rates of forgetting, the decrease in details after one week would be more pronounced for those who watched the Neutral video as compare to the Negative video. It may well be that the delay and the relatively small sample size in the present study was insufficient to detect the predicted interaction. Further investigation is needed to provide a more comprehensive and well-powered examination of the role of delay in emotional eyewitness memory.

4.4 The Issue of Terminology

As noted previously, researchers in this area have been inconsistent in their terminology, and various terms such as emotion, stress, arousal, and trauma have been used somewhat loosely and interchangeably in the past (see Christianson, 1992). Given the extent of this terminological imprecision, it may be tempting to conclude that the inconsistent results observed across previous studies are due to the fact that some studies were looking at "emotion" while others were looking at something else, like "stress" or "arousal" or "emotional stress". This argument would hold only if researchers' use of terminology corresponded reliably with their research design and methodology. This, however, is not the case. Because eyewitness researchers have used these terms *inconsistently* and *interchangeably*, the terms simply fail to track any reliable distinctions in the way the studies are conducted, or the nature of the phenomena being investigated.

Simply put, studies sometimes differ in their terminology without differing in their methodology.

Consider, for example, Deffenbacher and colleagues' (2004) meta-analysis of the effects of "high stress" on eyewitness memory. Though this study is widely cited as evidence of the effects of "stress" on eyewitness memory, the individual studies that were included were neither consistent in their use of terminology nor in their methodology. While some studies used the term "stress" (e.g., Goodman et al., 1991), others purportedly examined "arousal" (e.g., Bothwell et al., 1987; Brigham et al., 1983; Hosch & Bothwell, 1990), "anxiety" (Mueller et al., 1987; Nowicki et al., 1979), "mental shock" (Loftus & Burns, 1982), and "negative emotional events" (Bornstein et al., 1998). The research methods underlying these studies consisted of various staged events and use of video stimuli. Some of these procedures (e.g., threat of electric shock, use of video stimuli) overlap with that of several studies (reported elsewhere) that purportedly examine the effects of "emotion" on eyewitness memory (e.g., Ginet & Verkampt, 2007; Houston et al., 2013).

Clearly, this situation suggests that readers should not take researchers' terminology at face value. Because the terminology has not varied systematically, inconsistent terminology is not a sound explanation for the discrepant findings within the literature. One unfortunate consequence of inconsistent terminology is that once researchers select a label, they may become unintentionally siloed from other relevant areas of research that use different terminology. I speculate that this is due to the fallacious, but understandable, assumption that a difference in terminology signals a reliable and substantive difference in methodology. I believe the persistent fragmentation

of the relevant memory literature (such as the divergence between eyewitness memory research and basic memory research; Marr et al., 2021a) has been, and continues to be, sustained in part by this mistaken assumption.

Establishing a consensus about which single term would be most appropriate for researchers to adopt is a project that goes far beyond the present thesis. At present, I would submit that using different terms to refer to the same phenomenon is not inherently problematic. The onus is on researchers to understand how relevant terms have been used in the literature for the past several decades, rather than to simply assume that those who used slightly different terminology must have been conducting an entirely different kind of study or examining some unrelated phenomenon.

To be clear, I do not mean to suggest that emotion and stress are fundamentally undifferentiable. Rather, my argument is concerned only with the variable use of these terms in the comparatively narrow domain of eyewitness memory research. The research literatures on emotion and stress extend far beyond the relatively narrow question of how these variables affect human memory. Furthermore, other areas of memory research place greater emphasis on discrete emotions (e.g., fear, anger, sadness). However, most studies of "emotional memory" do not study the effects of such discrete emotions. Thus, neither the current findings nor the bulk of the available emotional memory literature are able to speak to the potentially distinct effects of different emotions.

4.5 Conclusion

Much has been written about the effects of stress and emotion on human memory storage and retrieval (e.g., McNally, 2003; McGaugh, 2003). What I have tried to accomplish in the present thesis is to join a growing coterie of eyewitness researchers

who have voiced concerns about the inconsistencies and limitations that plague this line of research (e.g., Sauerland et al., 2016; Marr et al; 2021a). This recent work represents something of a resurgence of critical discussion (e.g., regarding potential methodological limitations), as Christianson (1992) expressed many of these same concerns thirty years earlier. This thesis was intended to serve as a response to calls for a renewed (i.e., methodologically sound) line of research on the issue of stress/emotion and eyewitness memory (Sauerland et al., 2016; Marr et al., 2021a, 2023).

The current research is not, nor was it intended to be, the "final word" on this matter. It would be scientifically irresponsible to reach definitive conclusions on the basis of two experiments, particularly when contradictory conclusions abound (e.g., Deffenbacher et al., 2004). Nevertheless, the results reported here are suggestive, and not particularly surprising, when considered alongside the extensive body of memory literature on selective emotional memory enhancement (e.g., Kensinger et al., 2009; Talmi, 2013). The present findings should also be considered alongside a recent line of eyewitness research (e.g., Sauerland et al., 2016; Krix et al., 2016; Marr et al., 2021b; Price et al., 2022) that has failed to support the consensus view, held by eyewitness researchers, that stress impairs eyewitness memory. Considered in its entirety, I submit that the available evidence provides significant grounds for doubt about the prevailing *impairment* view within the eyewitness field. In conclusion, I share the forward-looking vision of Sauerland et al. (2016), such that "it seems probable that [a new line of research] will challenge the assumption that there is a simple relationship between stress and eyewitness memory (Deffenbacher et al., 2004) and replace this with research that comes closer to what happens in the real world" (p. 592).

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Appendices

Appendix A.

A1. Study 1 Retrieval Instructions

Recall Instructions (Free Recall Instructions)

Please write everything you can remember about the video you watched in the previous session. When you are ready, please tell me everything you can remember about the video in as much detail as possible.

Recall Instructions (CI-Based Instructions)

Thanks for taking the time to provide your account of the video you watched in the previous part of the study!

Please take your time. Do not edit anything out of your account even if it seems unimportant. However, please do not make anything up – it is okay if you don't know something. The goal is for you to report everything you can remember about the video.

Please tell us about the video you watched in the previous part of this study. It is very important that you write everything you can remember, every little detail even if you think it is not important. Anything at all that you remember please make sure to mention it.

In order to help with the remembering process, please take your time and carefully read the following instructions.

To begin, I would like you to try to think back to when you saw the video. Try to picture yourself in the room where you watched the video. Try to think about your mood at the time when you were watching the video... think about your reaction to the video… think about how it made you feel.

Now I would like you to focus on the video itself… think about what you saw… think about what you heard… think about the people in the video.

When you have a clear picture of the event in your mind, please write everything you can remember about the video in as much detail as possible.

TP and TA Lineup Instructions

You will be asked to view a lineup consisting of several photographs. One of the men from the video you watched in the previous part of the study may or may not be present in the lineup. If you see the man from the video, please select his photograph. If you do not see the man from the video, please select "not here".

PLEASE NOTE: There was more than one man in the video. We are asking specifically about the second man who entered the room.

Appendix B.

B1. Study 2 Materials

Post-Video Questions:

To what extent did you feel anxious during the video?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

To what extent did you feel tense during the video?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

How would you describe your feelings during the video?

1	2	3	4	5	6	7
Very negative			Neutral			Very positive

How easy was it to imagine yourself in the situation shown in the video?

1	2	3	4	5	6	7
Very difficult			Neither easy nor difficult			Very easy

How believable was the situation shown in the video?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

Demographics:

The following refer to your demographic characteristics. You do not have to answer any questions that you are not comfortable answering.

How old are you? (years)

Gender: Male/Female/Other

What were the ethnic or cultural origins of your ancestors? (An ancestor is usually more distant than a grandparent). Select all that apply:

North American Aboriginal origins	Other North American origins	European origins	Caribbean origins
Latin, Central and South American origins	African origins	Asian origins	Oceania origins

Interview Procedure Scripts:

[Free Recall Condition]

Hello, my name is Lincoln, and I will be assisting you during your self-interview today. In a minute, you will see an empty textbox in the page below this video where you can type out your recall of the event. Please do not move off of this page until you are finished recalling everything you can remember so that all your information is captured.

So, whenever you are ready, please go ahead and report in as much detail as possible, everything that you remember from the video that you watched by typing into the provided box.

[Cognitive Interview-Based Condition]

Hello, my name is Lincoln, and I will be assisting you during your self-interview today. In a minute, you will see an empty textbox in the page below this video where you can type out your recall of the event. Please do not move off of this page until you are finished recalling everything you can remember so that all your information is captured.

In a moment I am going to ask you to tell me what you remember about what happened in the video that you watched. Please keep in mind that all the information that you can remember may be important, so do not leave out any detail no matter how small and report anything at all that you can remember.

Now before you begin, I am going to ask you to try a memory-enhancing technique that can often help people to remember more about what they have experienced. This technique involves you having you close your eyes and putting yourself mentally back to when you witnessed the video so you can really focus on the details of what you saw. Research has shown that this technique is really helpful in blocking out distractions and allowing people to put themselves mentally back into the event so they can remember more details. So, what I will do now is just walk you through some instructions to help you create this mental image before you provide your recall.

So first what I would like you to do, if you are comfortable with it, is to close your eyes. And just keep your eyes closed all the way through the process until you need to recall the details of the video. Next, I am going to provide a list of instructions that will help you re-create the context of the video in your mind. Please do not report anything yet, just concentrate on the instructions and try to mentally visualize the event. I will let you know

when to begin typing. So while keeping your eyes closed, I would like you to think back to when you first started watching the video…[5 second pause]…think about your surrounding environment where you watched the video….[5 second pause]…now think about the location where the event took place…[5 second pause]…think about the people involved…[5 second pause]…think about what you could hear… [5 second pause]…

Now when you have a really clear picture in your mind of the event, please go ahead and report, in as much detail as possible, everything that you remember from the video that you watched by typing into the provided box.

Post-Interview Questions:

Please answer the following questions based on the interview you just completed.

How confident are you that you recalled all the details from the video during the interview? (0 – 100%)

How confident are you that the details you provided during the interview were accurate? (0 – 100%)

How difficult was it to remember the details of the video? (0 – 100)

To ensure the quality of our data, please let us know if you paid attention to the recall instructions (you will still receive credit for participating).

A) Yes, I paid attention to the interview instructions, please use my data
B) No, I did not pay attention to the interview instructions, please disregard my data