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The Effects of Conceptually Driven Versus Data-Driven Encoding on Traumatic Memory Amplification

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Abstract

Our research examines whether the way in which a person encodes a traumatic experience affects their post traumatic stress disorder (PTSD) symptoms and ability to remember the trauma over time. In our first study, we were interested in establishing whether people have any existing beliefs about how encoding processes influence the development of PTSD. In line with Ehlers and Clark's (2000) theory, we hypothesized that people would be more likely to indicate that exclusively paying attention to sensory details during a traumatic event contributes to the formation of traumatic memories and PTSD. To test this hypothesis, we designed a simple survey asking about people's beliefs concerning the relationship between encoding and PTSD as well as their confidence in those beliefs. In our second study, we examined whether people's encoding strategy when they experience a traumatic event affects their later emotions and their ability to remember that trauma over time. Participants were randomly assigned to one of three encoding conditions—control, conceptually driven (process the meanings of the images) or data-driven (processing the images by focusing on the sensory details)—while they viewed a set of traumatic photographs from the International Affective Picture System (IAPS; Lang, Greenwald, Bradley, & Hamm, 1993). In Phase 1, participants took a series of baseline mood measures, were randomly assigned to an encoding condition, and were shown a series of traumatic photographs. Participants also monitored the number of intrusions they experienced and took an immediate Old/New memory test. A week later, participants completed Phase 2 involving a second, surprise, Old/New memory test. We also assessed participants PTSD symptoms again to see if their symptomology increased over the week. We hypothesized that participants in our data-driven encoding condition would misremember more trauma over time and experience an increase in PTSD symptoms (indicating the memory amplification effect). Although our Study 1

hypothesis was supported, Study 2 hypotheses were not. Nonetheless, our results provide insights into the importance of encoding strategies following exposure to trauma, changes in PTSD symptoms, and the potential for subsequent memory amplification following traumatic experiences.

The Effects of Conceptually Driven Versus Data-Driven

Encoding in Traumatic Memory Amplification

Post traumatic stress disorder (PTSD) is a significant mental health disorder that can develop after a highly stressful or life-threatening event, such as a natural disaster, car accident, sexual assault, or combat (National Center for PTSD, 2016). According to Breslau, Reboussin, Anthony and Storr (2005), approximately 8% of people who experience a traumatic event go on to develop PTSD following exposure. According to the DSM-5, in order for someone to meet criteria for a PTSD diagnosis, they must experience exposure to a stressor (either directly or indirectly; Criterion A), they must demonstrate intrusive symptoms such as flashbacks to the trauma (Criterion B), demonstrate avoidance symptoms including avoiding trauma-related thoughts/feelings (Criterion C), experience negative alterations in cognitions and moods (e.g., negative affect; Criterion D), and must show alterations in arousal and reactivity (e.g., hyper vigilance; Criterion D; American Psychiatric Association, 2013). Overall, in order to meet criteria for PTSD, one must also experience symptoms for more than one month (Criterion F) and the symptoms must cause significant functional impairment that is not due to the use of medication, illness and/or substance use (Criterion G, Criterion H; American Psychiatric Association, 2013). For the purposes of this thesis, we looked specifically at those who have been directly exposed to a trauma analogue and whether or not they demonstrated diagnostic criteria including intrusive symptoms and changes in affect. While PTSD and the classification of its symptoms is important, we still do not know enough about the mechanisms that contribute to PTSD's development and continuation. Thus, the present research examines beliefs about, and the relationship between, how we encode memories for traumatic experiences and subsequent PTSD symptoms.

The Formation of Traumatic Memories and PTSD

The critical symptoms of PTSD, those that contribute to the continuation of the disorder, include intrusions, avoidance, and hyper-reactivity (e.g., startled responses to loud noises). Intrusions are the sudden remembering or thinking about the traumatic experience (National Center for PTSD, 2016). Intrusions are a particularly crippling component of PTSD because, by definition, they occur without warning, are distressing, and can re-traumatize an individual following their initial traumatic experience (van der Kolk, van der Hart, & Burbridge, 1995). Avoidance, according to Monson and Shnaider (2014) is purposely avoiding thinking about the traumatic experience because of the stress it causes. Such avoidance of traumatic memories may lead to the development of poorly contextualized ideas about the trauma. Over time, that means that one develops an unclear memory about the details of their traumatic experience (i.e., such as exactly where they crashed their car, etc.,) and therefore may get confused about the details of that experience. This inability to contextualize one's memory for their traumatic experience may cause the distortion of their traumatic memories. In fact, Rubin, Bernsten, and Bohni (2008) argue that PTSD is a *memory* disorder. Therefore, the present studies address the relationship between trauma, encoding, and memory distortion by determining whether or not we have existing beliefs about the way someone encodes a traumatic experience, as well as how that encoding effects their ability to remember that trauma and their degree of PTSD symptomology over time.

The Cognitive Model

In line with this idea, Ehlers and Clark (2000) proposed the Cognitive Model of PTSD. It stipulates that how one processes or encodes a traumatic experience may affect their memory and PTSD symptoms. They proposed that PTSD occurs and persists, when people encode, or store, a

traumatic experience in a way that, when reminded of that trauma, makes them feel like they are in a state of ongoing threat (Ehlers & Clark, 2000). This threat comes about in one of two ways. The first occurs when a person creates excessive, negative appraisals, or generates a lot of negative thoughts about their experience; the second occurs when an individual poorly contextualizes, or develops a poor understanding of their experience (Ehlers & Clark, 2000). In other words, the Cognitive Model for PTSD suggests that the way we encode a traumatic experience directly relates to how severe that person's PTSD symptomology becomes. In particular, the Cognitive Model posits that when people process specific details of an experience, or use data-driven encoding processes, they are more likely to poorly contextualize their traumatic experiences and thus are more likely to experience persistent PTSD symptoms.

To elaborate, the two main types of encoding strategies are conceptually driven and data-driven encoding. In conceptually driven encoding, an individual conceptualizes or makes meaning of what they encounter holistically (Oulton, Takarangi, & Strange, 2016). For example, if involved in a car accident, a person who processes this traumatic experience in a conceptually driven manner, would think about the fact that they are in a car accident, and what it might mean, rather than focus on any sensory details. By contrast, in data-driven encoding, the person would focus on, and thus remember specific, sensory details of the traumatic event, such as the sound of broken glass or the smell of blood (Oulton et al., 2016). The research on which encoding strategy has more detrimental effects on PTSD however, has produced inconsistent results.

For example, Krans, Pearson, Maier, and Moulds (2016) tested Ehlers and Clark's (2000) Cognitive Model by manipulating the contextual information given to participants when exposed to traumatic images. Contrary to Ehlers and Clark's model, Krans and colleagues (2016) hypothesized that the conceptual processing that takes place during a traumatic experience would

actually increase PTSD symptoms, contrary to Ehlers and Clark's proposal. Thus, in Part 1 of their study, "healthy" participants, defined as those without PTSD, viewed pictures depicting traumatic scenes. Participants were randomly assigned to one of three conditions; the moderate outcome, severe outcome, and control group. Meaning that, those in the moderate outcome group were given a sentence with contextual information indicating that the situation shown was moderately traumatic (i.e., "There were many survivors"; Krans et al., 2016). Whereas, those in the severe condition were given contextual information indicating that the situation shown was severely traumatic (i.e., "There were few survivors"; Krans et al., 2016). All experimental participants received written narratives, which provided contextual information designed to assist in understanding and establishing meaning (i.e., the details about what was happening in the scene shown) about the negative scenes they were shown. By contrast, control participants saw photos with no context narrative given. In Part 2, participants took a memory test for what they were shown. All participants were also asked to self-report intrusion experiences in diaries. A week later, participants returned to complete an adapted version of the Impact of Events Scales (IES), a self-report measure that assesses a person's distress surrounding a specific event on a Likert scale (i.e., "I had trouble concentrating", 0=not at all, 4= Extremely; Horowitz, Wilner, & Alvarez, 1979). Krans and colleagues (2008) ultimately found that the severe traumatic scene group experienced significantly more intrusions in comparison to the moderate or no context conditions.

By contrast, Barba, Mantovan, Traykov, Rieu, Laurent, Ermani, and Devouche (2002) sought to determine if an interfering task designed to disrupt participant's encoding of traumatic scenes—and thus lead to data-driven processing—would elicit more intrusions and worse free recall performance for the stimuli. In their first experiment, Barba and colleagues found that

interference had no significant effect on participants' ability to retrieve correct information during free recall or the number of intrusions experienced. In their second experiment however, they added an interference task at both encoding and retrieval. Now, there was a significant negative effect on participant's memory and a significant increase in participant's number of intrusions. Thus, Barba and colleagues (2002) demonstrated that data-driven processing could increase PTSD symptoms.

Additionally, Segovia, Strange, and Takarangi (2016) examined whether different encoding instructions affect participants' memory errors and PTSD symptoms. To allow for an objective measurement of memory disorganization using controlled methods, Segovia and colleagues (2016) had participants watch a traumatic film with missing scenes, and randomly assigned participants to one of three conditions. Participants in the conceptually driven encoding condition were told to focus on the meaning of the event. Participants in the data-driven encoding condition where told to focus on sensory details. Meanwhile, control group participants were not given instructions during the film. Participants recorded their intrusions for one week. Then, after a week delay participants returned to the lab to report their analogue PTSD symptoms, had their memory tested for the film, and rated their confidence rated based on what they reported remembering from the film. Segovia and colleagues' (2016) results showed that the instructions did not matter. However, people who self-reported feeling more disorganization in their memory also reported more memory distortion and avoidance symptoms of PTSD. Meaning that, their objective measures did not support Ehlers and Clark's (2000) theory. Instead, they found that participant's self-reported sense of memory was unorganized or lacked meaning, leading to increased symptoms of PTSD.

To summarize, all of the above studies have tested Ehlers and Clark's (2000) Cognitive

Model but have all presented inconsistent results on which encoding strategy actually worsens PTSD symptoms. With, at best, mixed empirical evidence to support that encoding contributes to increased PTSD symptoms, it is imperative that we continue to explore not only the effects of encoding on these symptoms, but how encoding may also effect the distortion of our traumatic memories in line with Rubin and colleagues (2008) more recent proposal.

Memory Distortion and PTSD

Rubin and colleagues (2008) coined the relationship between memories for traumatic events and PTSD symptoms the "memory model of PTSD." They proposed that the current memory one has for a traumatic event, not the event itself, drives symptomology. Most importantly, this model emphasizes that trauma memories are not consistent over time. Instead, trauma memories can be distorted by various factors like expectations, social support, and current emotions related to the memory for the event (Rubin et al., 2008). Indeed, memories are *constructive* by their nature. That makes them malleable, as well as subject to change and error. Certainly, people can come to remember additional details of events as well as totally false, detailed, memories for events that never actually occurred (Bartlett, 1932; Foster, Huthwaite, Yesberg, Garry, & Loftus, 2012; Loftus, 1979; Loftus & Bernstein, 2005; Wade, Garry, Read, & Lindsay, 2002). This fact of memory also extends to traumatic events (Crombag, Wagenaar, & Van Koppen, 1996; Granhag, Stromwall, & Billings, 2003; Ost, Vrij, Costall, & Bull, 2002; Pezdek, 2003).

In brief, trauma theorists had maintained that trauma memory was special; that a different kind of memory system was responsible. For example, Freud argued that traumatic memories are unconsciously buried by repression of the event, but could be recovered often decades later, with little memory error (Freud & Breuer, 1893–1895). Other researchers, such as Van der Kolk

(1994) argued that the "body kept the score." That is, that trauma was stored in sensory-motor and emotional fragments (e.g., images of the trauma with no accompanying memory; Van der Kolk, 1994). However, since the 1990s, research has demonstrated that traumatic memories are not processed by a different memory system as originally proposed.

Take for example, flashbulb memories. A flashbulb memory—say your memory of 9/11—was thought of as a "photographic print" and the memory was assumed special in its ability to be fixed and permanent over time (Brown & Kulik, 1977; Peterson & Bell, 1996). Flashbulb memories got their name from the idea that when a highly emotional event takes place (i.e., community events like natural disasters, terror attacks, etc.,), a *special* type of memory is formed, as if the event was recorded, and preserved for all time (Brown & Kulik, 1977). In their original study, Brown and Kulik (1977) examined peoples' memories of John F. Kennedy's assassination nearly fourteen years after they experienced this highly publicized and emotional event. All participants were able to recall context-related information—where they were at the time, who they were with, what they were doing, etc., —when President Kennedy was killed. Many studies have replicated this basic finding regarding context-related recall: people claim vivid memories of 9/11, spaceship explosions, deaths of celebrities and world leaders, and natural disasters (e.g., Bahrick, Parker, Fivush, & Levitt, 1998; Neisser & Harsch, 1992; Peterson & Bell, 1996).

But Brown and Kulik's (1977) study missed a crucial fact. Although people, specifically their participants, may have been able to report a large number of details about their highly emotional memories, those details are not necessarily accurate. In fact, Neisser and Harsch (1992) found that flashbulb memories were remembered inconsistently overtime, not as a perfect recording of the event. Likewise, other studies have shown that memories for emotional events

tend to be poorly remembered over time - not preserved in a *special* way (Clifford & Hollin, 1981; Loftus & Burns, 1982). Instead of suggesting that emotions encourage the recording-like preservation of memories for those who have experience trauma, these studies have shown that emotions appear to have the opposite effect, often impairing the memory rather than perfecting it (Clifford & Hollin, 1981; Loftus & Burns, 1982).

To be clear, intense emotions have been shown to affect the strength of traumatic memories (Levine & Edelstein, 2009). That is, central details are those that are conceptually associated with key details of an event (e.g., the fact that a car accident occurred). These details are typically better remembered for emotional events (Reisberg & Heuer, 2004). By contrast, peripheral information, details not directly related to the key facts of an experience (e.g., the color of the shirt you were wearing during a car accident), are less likely to be remembered for emotional events (Reisberger & Heuer, 2004). Termed the memory narrowing effect, this effect has been replicated in several studies using different modes of presenting information such as films, narratives, and even simple words (Clifford & Hollin, 1981; Levine & Burgess, 1997; MacKay & Ahmetzanov, 2005; Reisberg & Heuer, 2004; Safer, Christianson, Autry, & Osterlund, 1998). Importantly, this memory narrowing effect helps to explain why people *think* their trauma memories are special and unchanging because they believe that emotional, central details that they may remember to vividly are correct, even when they are not.

Memory Amplification

Contrary to such notions that memories are special and preserved, the memory amplification effect describes how trauma memories can amplify (become more distorted) as PTSD symptoms fail to improve, or get worse, overtime. Southwick, Morgan, Nicolaou, and Charney (1997) were the first to demonstrate this memory amplification effect. They assessed

Gulf War Veteran's exposure to war-related stressors (i.e., seeing comrades killed, being or seeing others wounded by combat, etc.) one month after returning from deployment, and again two years later. Participants completed the Desert Storm Questionnaire and the Mississippi Scale for Combat-Related Posttraumatic Stress Disorder at one month and 2 years post-deployment. The Desert Storm Questionnaire was used to target the veterans' particular Persian Gulf experiences via 19 self-report items where participant's indicated if they had or had not experienced the items (i.e., extreme threat to one's personal safety, living close enemy lines). Similarly, the Mississippi Scale for Combat-related PTSD used 35 self-report items to assess the veterans PTSD symptom severity and the effect those symptoms had on the veterans' lives. Southwick and colleagues (1997) compared the participants' one-month and 2 year responses to both questionnaires. Results revealed that 88% of veterans who originally said they had not been exposed to war-related stressors later changed their response to yes at their two year follow up. In other words, these veterans actually endorsed being exposed to more war-related stressors over time. Most importantly however, these findings also demonstrated a correlation between memory distortion and more PTSD symptoms exhibited overtime- demonstrating the memory amplification effect.

Similar findings have been shown with peacekeepers (Bolton, Gray, & Litz, 2006; Bramsen, Dirkzwager, van Esch, & van der Ploeg, 2001; Roemer, Litz, Orsillo, Ehlich, & Friedman, 1998), prisoners of war (Dekel, Solomon, & Ein-Dor, 2016) and various veteran populations (Alosco, Aslan, Du, Ko, Grande, Proctor, Concato, & Vasterling, 2016; Wilson, Hoge, McGurk, Thomas, & Castro, 2010; Krinsley, Gallagher, Weathers, Kutter, & Kaloupek, 2003; Wessely, Unwin, Hotopf, Hull, Ismail, Nicolaou, & David, 2003). Memory amplification has also been demonstrated in shared natural disasters. For example, Heir, Piatigorsky, and

Weisaeth (2009) surveyed 532 individuals who endured the South-East Asia Tsunami of 2004. Participants were asked about how much danger they believed they were in at two points-six months and a year after the tsunami occurred (Heir et al., 2009). They found a positive correlation between perceived life threats over time with a lack of improvement of PTSD symptoms (Heir et al., 2009). Meaning that, their memories regarding the level of threat became distorted over time, in the same way that their PTSD symptoms failed to improve; again, demonstrating the memory amplification effect.

However, most of the research on this topic has focused on field studies with participants pre-disposed to trauma (i.e., veterans who developed PTSD after exposure to combat during war), which has prevented the use of control measures (i.e., the context by which the traumatic experience occurred, the way the person developed meaning for the experience, etc.) and has yielded limited sample sizes (Anastasides, Beck, Pang, Servatius, Gilbertson, Orr, & Myers, 2015; Dickie, Brunet, Akerib, & Armony, 2011; Scott, Woods, Wrocklage, Schweinsburg, Southwick, & Krystal, 2016). Moreover, there was a distinct lack of control of any of the key variables (i.e., the timing of the traumatic event, the length of time since the event). While these studies have inherently lacked internal validity, in terms of external validity, we know that participants experienced real time trauma, which has allowed for actual cases of memory amplification to be explored.

To avoid some of the internal deficits of these studies however, Strange and Takarangi (2012) attempted to determine whether or not intrusions contribute to the memory amplification effect in a controlled laboratory setting. To do this, participants were shown a short film depicting a fatal car accident. The film was broken up into short clips, some were traumatic (i.e., watching the cars hit each other, the blood on the victims, emergency crews attempting to rescue

the passengers) some were not (i.e., clips of what the drivers were doing prior to the accident, the passengers talking to one another). Participants then returned twenty-four hours later and completed a memory test comprised of Old clips (clips they actually saw), control (New), and missing (footage that was purposely removed from the film they saw) clips. Participants were asked to identify whether or not the clips shown were Old (i.e., from the film) or New (i.e., clips they had never seen). Strange and Takarangi (2012) found that participants successfully recognized the control and Old clips. Critically, participants claimed that they saw twenty-six percent of the missing clips that they were never actually shown and many of these clips also happened to be the most traumatic (i.e., review of the deceased bodies at the accident scene). The rate at which participants also reported re-experiencing these traumatic clips (that is, experienced intrusions of the film) was correlated with the number of memory errors they made. Thus, Strange and Takarangi (2012) suggested that a failure in source-monitoring might explain their effect.

The source-monitoring framework suggests that people do not properly store details of experiences in their memories with labels that specify where those experiences come from. As a result, they tend to rely on heuristics or memory shortcuts, such as how familiar the experience felt, (how much perceptual detail they have for that memory, etc.,) to determine whether or not the details of their memories are imagined, or if they actually occurred. Because people use these shortcuts, they can frequently mistake information they think they remember because these distorted memories feel familiar and come to mind with a lot of detail. Critically, intrusions typically meet these same criteria. Therefore, Strange and Takarangi (2012) suggested people might confuse their intrusive thoughts for something they actually experienced (Johnson, Hashtroudi, & Lindsay, 1993; Oulton, Takarangi, & Strange, 2016).

To test this proposal, Strange and Takarangi (2014) again had all participants watch the traumatic film, this time they warned participants that some scenes had been removed, expecting this instruction would increase systematic source monitoring. Additionally, Strange and Takarangi put labels on some of the missing clips, describing what was missing, expecting that these labels would increase heuristic source monitoring. Their prediction was correct: false recognition rates were higher when participants saw labels and lower when they just got a warning. Thus, source monitoring ability can be manipulated and appears to be one mechanism explaining traumatic memory distortion. However, Strange and Takarangi did not measure memory amplification, per se. They only had one memory test. This is problematic because memory amplification speaks to the distortion of memory over time. With only one memory test, Strange and Takarangi (2014) could only measure immediate memory distortion, not the memory amplification effect.

To address these limitations, Oulton and colleagues (2016) designed a laboratory experiment that more carefully matched the field studies. First, they randomly assigned participants to one of two conditions: the single test and the multiple test condition. Participants in the single test condition served as the control group and only took one memory test a week later. However, the multiple test group received a memory test twenty minutes following encoding and once again a week later to assess the memory amplification affect. All participants completed several PTSD symptom measures including the Traumatic History Screen (THS), the State-Trait Anxiety Inventory (STAI-T), the Beck Depression Inventory (BDI-II), the Positive Affect Negative Affect Schedule (PANAS), the Experience of Intrusion Scale (EIS), and the PTSD Checklist (PLC-5). Next, participants viewed a set of buffer photos, followed by a set of target photographs from a computer screen. These buffer photos were used to control for primacy and recency

effects that may have subsequently influenced the memory-testing results. Participants then completed the PANAS measure for a second time. Participants in the single-test condition were provided paper diaries to record their intrusions for a week and sent away. Whereas, participants in the multiple test condition completed crossword puzzles for an additional 20 minutes, then completed an immediate recognition test, and the PTSD Checklist (PCL-5). Multiple-test participants too, were then given paper diaries to record their intrusions for a week. Following the week delay all participants were emailed a survey that included the PANAS, delayed recognition test, an EIS, and PCL test. Results of Study 1 indicated that analogue symptoms of PTSD were positively associated with remembering more negative images over time- again, demonstrating the memory amplification effect.

Following these results, Oulton and colleagues (2016) conducted a second study to focus on the association between those whose memory amplified over time and their subsequent PTSD symptoms. The study followed the same approach as their Study 1, except all participants completed two tests and they did not complete the THS, BDI-II, STAI-T, or the intrusion dairy. Results of this Study 2, found that participants whose memory of the photos amplified over time also demonstrated more re-experiencing PTSD symptoms. Thus, Oulton and her colleagues (2016) also demonstrated evidence for the memory amplification effect. We follow Oulton and colleagues' (2016) methodology here to test our own research questions.

The Present Studies

We had several goals in conducting this research. First, we were interested in establishing whether people have any existing beliefs about how one processes a traumatic event might contribute to their development of PTSD symptoms. If so, then it would lend some support to Ehlers and Clark's (2000) theory. Indeed, these beliefs may establish that there is a general

expectation people hold about how PTSD develops. Therefore, in Study 1, we surveyed people regarding their beliefs about how encoding strategies influence the development of PTSD. In Study 2, we conducted an experimental study, manipulating the type of encoding people could use during a traumatic event. Our goal for Study 2, was to determine if in fact, data-driven as opposed to conceptual processing, leads to an increase in memory distortion and PTSD symptoms.

Study 1

In our first study, we were interested in establishing whether people have any existing beliefs about how encoding processes influence the development of PTSD. Thus we designed a simple survey comprised of a short paragraph defining the symptoms of PTSD followed by a brief newspaper article detailing a woman, Alex's, traumatic car accident. We then asked participants a single question designed to probe their beliefs concerning the relationship between encoding and PTSD. We also asked them to rate how confident they were in their answer.

Hypothesis

H1.Based on Ehlers and Clark's (2000) Cognitive Model, we hypothesized that people would be more likely to indicate that paying attention to sensory details during a traumatic event contributes to the formation of traumatic memories and PTSD.

Method

Research Design

The study was a simple survey. There was no manipulated factor.

Participants

We recruited a total of 314 participants from the undergraduate research pool at John Jay

College of Criminal Justice. Participants were given extra credit for completing the survey. Of the 314, 261 participants fully completed the study. Participants in this study were not asked to identify their age, gender, or ethnicity.

Materials and Procedure

This survey was designed and administered using Qualtrics. Participants gave their consent to participate before beginning the survey and were informed that they could withdraw their consent to participate at any time. Participants were told that the study was about "facts and evidence from an investigation of a crime," to avoid providing any biasing information. The John Jay Institutional Review Board (IRB) approved this study. See Appendix A for Study 1's informed consent and instructions.

Introduction to PTSD. First, participants were asked to read a short paragraph that defined and listed some symptoms of PTSD (see Appendix B). Once participants finished reading this informational paragraph, they were asked to click the arrow to continue. Specifically, participants read the following:

> "Posttraumatic stress disorder is a mental health condition that typically follows exposure to some kind of trauma (i.e., a car accident). Symptoms of PTSD include, but are not limited to:
>
> - Unwanted thoughts or feelings about the traumatic event (Intrusions)
> - Nightmares
> - Persistent worry and fear (Anxiety)
> - Heightened sensitivity to what is going on around you with the fear that something might go wrong (Hyper-vigilance)

- Purposefully trying not to think about or remember the trauma (Avoidant thinking)
- Zoning out, creating a disconnect between your awareness and what is happening in real time (Dissociation)"

Newspaper Article. Participants were then instructed to read an article that they were told was printed in a local newspaper. It was titled, "Women Suffers Several Injuries Following Car Crash On Way to a Night Out with Friends." This newspaper article (see Appendix C) was written by the author and does not reflect an actual event. This newspaper article explained how the main character, Alex, was texting and driving on her way to dinner with friends when she hit another car, causing her to suffer painful injuries including a sprained neck, broken arm, and heavy bleeding which required several stitches. The newspaper article provided the sensory details of this accident, as well as a statement from Alex, which detailed her thinking before and after the accident. After reading the newspaper article, participants were asked to click on an arrow to continue with the survey.

Encoding Style Question. Immediately following the newspaper article, participants were told (see also Appendix D):

"Alex developed PTSD as a result of this accident. Which of the following explanations do you think is most likely WHY she developed PTSD:

1. Alex focused on the sensory details of the accident (i.e., the sound of the other car's horn honking during the crash, the taste of the blood in her mouth, the pain of the glass cutting into her skin, etc.,).

2. Alex focused on how the accident happened and why it happened to her (i.e., she was rushing, she went through the windshield because she did not have her seatbelt on,

she dropped her phone and took her eyes off the road and that's why she did not see someone hit her, etc.,).

3. It does not matter what Alex focused on during the accident."

Confidence Rating and Explanation. Participants were then asked to rate their confidence in their selection using a Likert Scale (0 = Not at all Confident, 100 = Completely Confident). Participants were given an additional open-ended space to type explanations for their confidence ratings (see Appendix E).

Debriefing. After completing all prior components of the survey, participants were thanked for their participation and debriefed. Participants were informed of the true purpose of the survey, which was to examine whether or not people believe that how someone encodes a traumatic event, effects their PTSD symptomology (See Appendix F).

Results and Discussion

Recall that we hypothesized participants would be more likely to indicate that paying attention to sensory details during a traumatic event contributes to the formation of traumatic memories and PTSD. Our hypothesis was supported. Participants were more likely to endorse option 1 of the encoding question, "Alex focused on the sensory details of the accident (i.e., the sound of the other car's horn honking during the crash, the taste of the blood in her mouth, the pain of the glass cutting into her skin, etc.,)." Indeed, a chi square analysis revealed that participants were significantly more likely to believe that focusing on sensory factors led to PTSD: X^2 (N =261) = 26.94, $p < .01$. See Table 1 below for the means and standard deviations for each option as well as the corresponding confidence rating.

Table 1
Mean Confidence Ratings and Standard Deviations Based on Selection Chosen

Selection Chosen (1-3)	Count of Participants	Mean Confidence Rating	Standard Deviation
1- Alex focused on the sensory details of the accident…	130	68.48	1.71
2- Alex focused on how the accident happened and why it happened to her…	74	67.69	2.26
3- It does not matter…	57	58.09	2.58

We also anticipated that participant's who selected option 1 would be significantly more confident than those who selected option 2 and 3. A one-way ANOVA revealed that there was a significant difference in the confidence ratings of participants who selected the three different options, F (2, 260) = 6.06, $p < .01$. However, follow up t-tests reveal that it was option 3 participants, "It does not matter…" who were significantly *less* confident in their selection (Option 1 & 3: t (185) = 32.48, $p < .01$; Option 2 & 3: t (129) = 22.65, $p < .01$). This may mean then, that people actually believe that encoding styles matter, but did not know which option was "right." And thus, when they chose option 3 they were less confident.

In summary, it appears that people's beliefs regarding the development of PTSD may align with that of Ehlers and Clark's (2000) proposal. As previously discussed, the Cognitive Model is a psychological framework, suggesting that PTSD persists when people encode, or store, a traumatic experience into their memory in a way that, when reminded of that trauma, makes them feel like they are in a state of ongoing threat (Ehlers & Clark, 2000). Here, participants endorsed the idea that by focusing on the sensory details Alex was exposed to during her car accident, she was more likely to develop PTSD. More specifically, participants more often endorsed that her data-driven encoding strategy caused the character, Alex, to poorly contextualize her traumatic experiences, causing her persistent PTSD symptoms. In Study 2, we

tested whether those beliefs match the empirical evidence as these lay beliefs may also affect people's expectancies for responses to trauma.

Study 2

Our second study, Study 2, examined whether people's encoding strategy when they experience a traumatic event, affects their later emotions and their ability to remember that trauma over time. We hypothesized that participants in our data-driven encoding condition would misremember more trauma over time, indicating "New photos in Phase 2 as "Old." In addition, despite the mixed evidence we discussed in the Introduction, in line with Ehlers and Clark (2000) proposal and our Study 1 results, we hypothesized that participants in our data-driven encoding condition would experience more analogue PTSD symptoms over time. Notably, if both occurred, we would have evidence that the memory amplification effect is more likely after data-driven processing.

Hypotheses

H1. We first hypothesized that data-driven participants would be less likely to remember the photos in immediate testing because if they are just focusing on the sensory details, they are likely not encoding the images as well as they would without an instruction or with a conceptual instruction.

H2. In addition, we hypothesized that those in the data-driven encoding condition would misremember more trauma over time.

H3. Lastly, we hypothesized that data-driven participants would demonstrate more PTSD symptoms.

Methods

Note that this thesis was part of a much larger project. Thus, a number of measures were collected that were beyond the scope of this thesis. I describe below all of the measures, and note what was not analyzed in this thesis.

Research Design

The study conformed to a 3 (Encoding Manipulation: conceptually driven, data-driven, and control) x 2 (Test 1, Test 2), mixed design. Participants were randomly assigned to one of three encoding conditions—control, conceptual, or data-driven. Those in the data-driven encoding condition ($N = 63$) were given specific instructions to pay attention to the sensory details of each photograph they were shown at encoding, such as the sound of breaking glass. Those in the conceptually driven encoding condition ($N = 63$) were also given instructions to make meaning of each photograph they were shown at encoding. For example, if the image depicted a deadly car accident, participants were instructed to acknowledge that they were looking at a fatal car accident. Those in the control condition ($N = 64$) were not given any encoding instructions.

Participants

We recruited a total of 389 participants. Of the 389, 143 participants dropped out of the study, meaning that they did not complete Phase 2. We also removed participants who, due to a survey-flow error received additional questions at encoding ($N = 52$), or reported experiencing technical difficulties ($N = 4$). Out of the 190 participants who completed the study, 120 identified as female and 70 participants identified as male. Our participants ranged in age from 17-65 years old with a mean age of 21 years (SD = 5.44). We did not collect data on ethnicity.

Materials

Trauma Stimulus. Following Oulton and colleagues' (2016) design, the trauma stimulus was 80 standardized International Affect Picture System (IAPS) photographs, which depict traumatic, negative scenes such as severe burns, death, and car accidents (Lang et al., 1993). The photographs were counterbalanced into four sets of 20 photos. An additional 10 negative photos were shown at the beginning and at the end of the encoding phase. These photos were used for all participants, never tested more than once and acted as recency and primacy buffers for the traumatic photos (see Appendix G).

Photo Ratings. To assess mood following encoding, participants were asked to rate how distressing, disgusting, and unpleasant they found each photo (1 = not at all, 7 = extremely). To assess our participant's focus and level of attention during testing, we also asked our participants to rate how closely they paid attention to each photo (1 = not at all, 7 = extremely closely). Doing so told use several things about how participants reacted to our encoding phase. First, this attention rating showed us whether or not participants in one encoding condition paid more attention than another, as perhaps this could have influenced our results. Secondly, assessing participant's attention to our trauma analogue tells us something about participants' engagement in the overall encoding process.

Trauma History Screen (THS). Participants completed the Trauma History Screen (THS) to measure their past traumatic experiences and to establish their baseline moods. Carlson, Smith, Palmieri, Dalenberg, Ruzek, Kimerling, Burling, & Spain (2011) developed the THS to examine the frequency of traumatic events and these events' association with a person's exposure to high magnitude stressor events (HMS) as well as their persisting post-traumatic distress symptoms (PPD). For example, participants were asked, "Have you ever been in a car accident," to which they could have responded "yes or no." The THS is a self-report measure

with high construct validity, as supported by correlations found between the PTSD Checklist (PCL-C) scores (which measures PTSD symptoms) and HMS scores found in both veteran (0.41) and college participants (0.22; Carlson et al., 2011). I do not analyze these data here.

Beck Depression Inventory (BDI-II). Participants completed the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) to measure their baseline depression symptoms. To complete the BDI-II, participants rated each of the 21 items on a Likert scale (e.g., 0 = I do not feel like a failure, 3 = I feel I am a complete failure as a person). The BDI-II correlates well with the depression subscale of the Symptom Checklist-90-Revised (SCL-90-R) (r = 0.89; Steer, Ball, Ranieri, & Beck, 1997). BDI–II also has high internal consistency, particularly amongst college students, which is noteworthy given that most of our sample comprised of students (α = 0.93; Beck et al., 1996). I do not analyze these data here.

State-Trait Anxiety Inventory-Trait Scale (STAI-T). In addition, participants completed the trait subscale from the State-Trait Anxiety Inventory-Trait Scale (STAI-T) (Spielberger, Gorsuch, & Lushene, 1970). The STAI-T is another self-report measure where participants rated 20 items (e.g., "I lack self-confidence") on a Likert scale (1 = almost never, 4 = almost always; see Appendix H). The STAI-T yields high test-retest reliability (r = 0.88) and has high internal consistency (α = 0.89) and (Barnes, Harp, & Jung, 2002). We used the STAI-T to establish participant's baseline feelings of anxiety. I do not analyze these data here.

Positive Affect Negative Affect Schedule (PANAS). Participants completed both the Positive Affect Negative Affect Schedule subscales (positive and negative) **(**PANAS) prior to and following encoding to measure their pre and post positive (PA) and negative affects (NA; Watson, Clark, & Tellegen, 1988). Both the positive and negative subscales are measured on a Likert scale with items like "Distressed" and "Attentive" (i.e., 1 = very slightly or not at all, to

5= extremely). The PA subscale is negatively correlated with the BDI ($r = -0.34$) and the NA subscale is highly correlated with the Hopkins Symptom Checklist (HSCL) ($r = 0.74$). The test-retest reliability for PANAS is also high (0.81 (NA) and 0.79 (PA) and yields excellent convergent and divergent correlations (Watson et al., 1988).

Intrusion Monitoring and Vigilance Task. Following baseline mood measures and the encoding phase, participants simultaneously completed an intrusion monitoring and vigilance task. To monitor intrusions after the encoding phase, participants pressed a key when they experienced an intrusive memory. We defined intrusions for the participants as the sudden remembering or re-experiencing of negative feelings about the traumatic photographs (Oulton et al., 2016). For each intrusion participant's experienced, they wrote down a description of that intrusion's content. These descriptions included details, such as whether the intrusion was a thought and/or an image, the level of distress the intrusion caused the participant (1 = not at all, 5 = extremely), the vividness of the intrusion (1 = not at all vivid, 5 = extremely vivid), and how hard the participant tried to forget about the intrusion as it occurred (1 = not at all, 5 = completely). The intrusion task was used to provide a more controlled means of recording intrusions as opposed to having participants complete individual diary entries. During this intrusion monitoring process, participants also worked on a tedious vigilance task, which involved identifying vertical lines amongst horizontal lines on the computer. To assess participant's engagement in the intrusion task, we also asked them to rate how well they conformed to the monitoring phase instructions (1 = not at all well, 7 = extremely well). We chose this specific computer task as it has been shown to reliably prompt task-unrelated thoughts, allowing for intrusions to occur (Oulton et al., 2016; Giambra, 1989). I do not analyze these data here.

Experience of Intrusions Scale (EIS). We also used the Experiences of Intrusions Scale (EIS; Salters-Pedneault, Vine, Mills, Park & Litz, 2009). The EIS uses five self-reports items to assess the quality of participant's intrusions. Participants rated the occurrence, unwantedness and randomness of their subsequent intrusions. Participants also rated the level of distress and interference they experienced because of their intrusions (1 = not at all/almost never, 5 = extremely/very frequently). The EIS correlates well with other intrusion measures such as the re-experiencing subscale of the PCL-C (PTSD Checklist for Civilians; Weathers et al., 1993; r = 0.22) and yields both good test-retest reliability (r = 0.83) and internal consistency (Cronbach's α's > 0.83). I do not analyze these data here.

Recognition Memory Test. Following Oulton and colleagues (2016), our immediate and delayed memory tests included one set of previously encoded photos ("Old" photos) and two sets of photos that had not been shown, considered "New" photos. Of the New photos, one set of pictures was the target, traumatic photos. For the Phase 1 immediate memory test, participants identified "Old" (pictures they had seen before) or "New" (pictures they had not seen) and indicated how confident they are in their "Old" and "New" ratings (1 = not at all confident, 10 = extremely confident). A week later in Phase 2, participants completed the delayed recognition memory test, which contained different photos compared to the immediate test but followed the same methodological design (see Appendix I).

PTSD Checklist (PCL). Lastly, participants completed the PTSD Checklist (PCL; Weathers, et al., 1993). The PCL is a 17 item self-report measure we used to assess participants' trauma symptoms in both phases. For example, following Phase 1 encoding, participants were asked "feeling jumpy or easily startled," to which they would respond, 1 = not at all up to 5 = extremely. Test-retest reliability for the PCL is high (r = 0.96; Weathers et al., 1993). The PCL

correlates well with other PTSD measures (like the Impact of Event Scale- a PTSD symptom measure commonly used following traumatic experiences; re-experiencing: $r = 0.76$, hyper arousal: $r = 0.64$, avoidance: $r = 0.71$; Horowitz, Wilner, & Alvarez, 1979; Ruggiero, Del Ben, Scotti, & Rabalais, 2003; Vreven, Gudanowski, King, & King, 1995). The PCL also has high internal consistency (re-experiencing: $\alpha = 0.94$, hyper-arousal: $\alpha = 0.92$, avoidance: $\alpha = 0.91$; Keen, Kutter, Niles & Krinsley, 2008).

Procedure

Our procedure followed that of Oulton and colleagues (2016), the only difference was the instructions participants were given about what to do with each photo during the encoding phase.

Phase 1 All participants began by reading and signing our consent form (see Appendix J). Prior to receiving encoding training and instructions on how to use their assigned encoding strategy, all participants completed measures to establish their baseline moods. These measures included the Beck Depression Inventory (BDI-II), the Positive Affect Negative Affect Schedule (PANAS), the Trauma History Screen (THS), and the State-Trait Anxiety Inventory-Trait scale (STAI-T) as described above. Next, participants were randomly assigned to one of three encoding conditions—control, conceptual, or data-driven. Those in the data-driven encoding condition were given specific instructions to pay attention to the sensory details of each photograph they were shown, such as the sound of breaking glass. Those in the conceptually driven encoding condition were also given instructions to make meaning of the traumatic photographs. For example, if the image depicted a deadly car accident, participants should have acknowledged that they were looking at a fatal car accident. Finally, those in the control condition were not given any encoding instructions. After completing their training examples, participants moved onto the encoding phase. Here, participants viewed a series of traumatic

(IAPS) photos as well as the buffer photographs at the beginning and end of the photo set. Participants saw each photograph for 2.5 seconds and a blank screen appeared after each photograph for 1.5 seconds. Following the encoding phase, participants completed the PANAS measure for a second time, and were instructed to press "x" on a keyboard when they experienced an intrusion (intrusion monitoring task), or unwanted thought/feeling about the traumatic photos). Finally, participants completed an immediate memory test for the photographs they were shown. This test asked participants to identify if the pictures they were shown were "New" as in they have not seen them before or if the picture is "Old" as in they have seen this picture before in a random order. Participants also indicated how confident they were in their "Old" and "New" ratings (1 = not at all confident, 10 = extremely confident). They also completed the PCL.

Phase 2 A week later, participants were emailed Phase 2 of the study. In Phase 2, participants were given an additional, different, memory test. This second memory test worked the same way as the immediate memory test. Participants indicated whether the traumatic photos they were shown were "Old", as in they have seen the photograph before, or "New" as in they have not seen the photograph before. This step determined whether participants misremembered the traumatic photographs over the course of the week. In Phase 2, participants also completed the EIS to measure their intrusion experiences, the PCL, and the PANAS measure again to see if their PTSD symptomology had increased over the week. To conclude, all participants were debriefed and thanked for their participation (see Appendix K).

Results

We began our data analyses by examining whether participants were affected by the photos: the PANAS ratings before and after the encoding phase as well as examining how much

attention they paid to the photos, how disgusting, unpleasant, and distressing they found them. We then examined participants' memory test performance at Time 1. Finally, we examined participants' sensitivity and response bias to the photos, our measure of memory amplification, and their analogue symptoms according to the PCL.

Responses to the Photos

To determine whether the photographs affected participants emotionally, we compared their PANAS subscale scores before and after viewing the IAPS photos. We conducted two 2 (time 1 versus time 2 PANAS ratings) x 3 (condition: conceptually driven encoding, data-driven encoding, and control) repeated measures ANOVAs one on the positive affect subscale and one on the negative affect subscale. There were no significant differences between the conditions on either subscale, all $p > .34$.

In terms of attention during encoding of the photos, all conditions were comparable for attention to the memory test $F(2, 187) = 1.21$, $p = .30$ (see Table 2). In addition, the proportion of participants who indicated that they looked away during photo encoding and testing was comparable across all conditions, $p = .50$ for encoding and $p = .82$ for testing. The proportion of participants who left the study during the encoding phase was also comparable across all conditions, $p = .51$.

Finally, as Tables 2 and 3 reveal, there was no effect on condition in participants rating of the photos as disgusting, distressing, and unpleasant. This is significant because we know that our analogue worked in its ability to elicit emotional responses for trauma.

Table 2
Time 1 Mean Photo Ratings (SE in parentheses)

Condition	Time 1	Time 1	Time 1	Time 1
	Unpleasant Rating	Distress Rating	Disgust Rating	Attention Rating
Control	5.51	5.42	5.73	5.62
	(.34)	(.35)	(.33)	(.21)
Conceptually Driven	5.51	5.68	5.78	6.02
	(.27)	(.28)	(.26)	(.17)
Data-Driven	5.68	5.48	5.20	5.56
	(.35)	(.36)	(.34)	(.22)
F	0.23	.19	1.00	1.88
P	< .79	< .82	< .37	< .16

Table 3
Time 2 Mean Photo Ratings (SE in parentheses)

Condition	Time 2	Time 2	Time 2	Time 2	Time 2
	How often did you think about the photos?	Distress Rating	How often did the images pop into your head out of the blue?	How many times did you have unwanted thoughts about the photos?	How much did the thoughts or feelings about the photos interfere?
Control	1.70	1.93	1.56	2.00	1.52
	(.17)	(.18)	(.15)	(.23)	(.15)
Conceptually Driven	1.68	2.12	1.61	2.29	1.51
	(.14)	(.14)	(.12)	(.19)	(.12)
Data-Driven	1.88	1.92	1.80	2.16	1.4
	(.18)	(.18)	(.16)	(.24)	(.16)
F	0.42	.54	.72	.48	.19
P	< .66	< .58	< .49	< .62	< .82

Immediate Memory Accuracy

Recall that our first hypothesis was that data-driven participants would be less likely to remember the photos in immediate testing. Therefore, we first analyzed participants' memory accuracy immediately after encoding. To do this, we followed Oulton and colleagues (2016)

methods by calculating the mean proportion of "Old" responses to both Old and New photos. A 3 (condition: conceptually driven, data-driven, and control) x 3 (photo type: old, new, neutral), mixed model ANOVA confirmed that there was a significant effect of condition on responses to neutral photos only, $F(2, 187) = 6.53$, $p = .002$. Post-hoc Games Howell analyses showed that those in the data-driven condition responded "Old" during memory testing significantly more often to neutral photos (e.g., a basket) as compared to the conceptual condition ($p = .003$). See Table 4 for the memory accuracy means and standard deviations. Therefore, while there is some evidence that data-driven encoding affected accuracy, it did not affect our primary measure of interest: Old responses to New photos.

Table 4
*Mean proportion of 'OLD' responses (with 95% confidence intervals) for old, new and neutral photos in each condition***.**

Photo Type	Condition Data-Driven	Conceptual	Control	Statistic
Neutral	.10 [.05, .15]	.01 [.01, .02]	.05 [.02, .08]	$F(2, 187) = 6.53$, $p = .002$
Old	.79 [.74, .84]	.84 [.81, .87]	.84 [.80, .87]	$F(2, 187) = 1.07$, $p = .35$
New	.29 [.22, .36]	.22 [.17, .28]	.27 [.21, .33]	$F(2, 187) = 1.63$, $p = .20$

Memory Amplification

Next we turned to our main interest: whether participant's memory of the trauma stimuli amplified between Phase 1 and Phase 2 and whether that differed by condition. Specifically, we wanted to know whether participants would respond "Old" to more negative photos that were actually New photos, during the Phase 2 delayed memory test as compared to the Phase 1 immediate memory test. To distinguish between participants' ability to accurately remember previously seen traumatic photos (i.e., their sensitivity to these photos) from their response bias

(i.e., whether they have seen a photo), we used a signal detection approach (Stainslaw & Todorov, 1999). The data appear in Table 5.

Indeed, one-way ANOVAs for both sensitivity $F(2, 187) = 1.48$, $p = .23$) and response bias ($F(2, 187) = .25$, $p = .78$), revealed that our encoding condition manipulation did not have a significant effect. In other words, encoding condition did not produce differences in participant's likelihood of endorsing more traumatic images (response bias) at Phase 2 testing. Likewise, these findings show that participant's sensitivity, or their ability to distinguish if they had actually seen the photograph before, was not effected by encoding condition. Overall, these findings suggest that perhaps people's processing style at encoding is not the primary mechanism behind traumatic memory distortion.

Table 5
Participant's Response Bias and Sensitivity Means and Standard Deviations

	Condition	Mean	Std. Error
Response Bias	Data-driven	1.70	.15
	Conceptual	2.04	.12
	Control	1.90	.15
	Total	1.88	.08
Sensitivity	Data-driven	-0.14	.07
	Conceptual	-.10	.06
	Control	-.16	.06
	Total	-.13	.04

Analogue PTSD Symptoms

To see whether or not participant's symptoms changed over time, we compared their Phase 1 and Phase 2 PCL scores. We ran a 2 (PCL scores in Phase 1 and Phase 2) x 3 (conceptually driven, data-driven, and control) ANOVA. Results indicate that there was no difference between PCL scores amongst the three conditions $p < .44$). Moreover, there was no

significant association with change in sensitivity or memory errors over time, $p > .05$. Therefore, contrary to our expectations, we did not observe a memory amplification effect here.

General Discussion

The overall goal of our research was to assess if how one encodes a traumatic experience, affects the memory amplification effect. To do this we first determined if people do, in fact, have an expectation that focusing on sensory details during a traumatic event is critical to the development of PTSD, because perhaps these change their expectations for trauma outcomes. Our Study 1 hypothesis was supported in that participants endorsed the idea that focusing on sensory details increases the likelihood that a person will develop PTSD. Thus, in Study 2, we manipulated encoding instructions to see if different encoding styles contribute to the memory amplification effect.

To do so, in Study 2 we manipulated participants' encoding strategy for our trauma analogue. Our results however, did not confirm a relationship between encoding style and the memory amplification effect, as we originally anticipated. Our response bias and sensitivity analyses reveal that encoding style had no effect. Likewise, our results did not confirm our Study 2 hypothesis that data-driven participants would be less likely to remember all photos in immediate testing. Instead, we found that data-driven participants were less likely to remember target photographs and more likely to endorse remembering neutral photographs than those in the conceptual and control conditions. Finally, we found no difference in participant's PTSD symptoms across conditions. This finding is inconsistent with previous studies, which have suggested that encoding strategies play a critical role in PTSD symptom changes (e.g., Giosan, Malta, Jayasinghe, Spielman, & Difede, 2009; Roemer et al., 1998).

One explanation for why we did not find the memory amplification effect by

manipulating encoding could be that the memory consolidation phase, the time between when one experiences an event and creates a memory for that event, contributes more to the memory amplification effect than encoding. Put simply, we may be looking at the wrong phase of memory. The memory consolidation phase may play a larger role in traumatic memory amplification compared to encoding, as it has been shown to be a critical point at which traumatic memories are most vulnerable and malleable (McGaugh, 1996; McGaugh, 2000). A recent study conducted by Iyadurai, Blackwell, Meiser-Stedman, Watson, Bonsall, Geddes, Nobre, and Holmes (2017) found that cognitive tasks with high visuospatial demands (they used the game Tetris), selectively disrupted sensory aspects in memory and limited the occurrence of intrusions, reducing memory distortions of trauma (Iyadurai et al., 2018). In fact, this task (playing Tetris) reduced intrusive memories for trauma by 62%- a significant reduction in PTSD symptoms that could not be drawn from manipulating encoding conditions as we did in the present study (Iyadurai et al., 2018). By disrupting the memory consolidation phase, Iyadurai and colleagues (2018) were able to prevent not only a significant amount of memory distortion, but also reduced critical PTSD symptoms that have been shown to continue to amplify traumatic memories over time (Iyadurai et al., 2018). Thus, future studies should investigate the effect of manipulations to the memory consolidation stage in traumatic memory amplification.

Additionally, it may be the case that negative responses to our trauma analogue, specifically intrusions, caused our participants to generate false memories about the trauma after their initial encoding exposure. In other words, it may be the case that some people are more prone to ruminate, or continuously think about their traumatic experiences--which leads to an increase in intrusions and encourages the memory amplification effect, not the way by which the experience is originally encoded (Watkins & Moulds, 2005). This idea makes sense considering

that Oulton and colleagues' study (2016), demonstrated the memory amplification effect without manipulating encoding. This is critical because their findings point to the possibility of a mechanism contributing to memory amplification *after* exposure, not during the encoding phase as originally hypothesized. Oulton and colleagues (2016) also demonstrated that the relationship between memory amplification and intrusions was clear; the more re-experiencing symptoms participants reported, the more likely they were to experience the memory amplification effect despite finding a non-significant relationship between Experience of Intrusions Scale (EIS) scores and participant's memory amplification (Oulton et al., 2016). Altogether, perhaps intrusions are contributing to the memory amplification more than anticipated because they are altering the original memory of the traumatic experience. Future research should further explore this relationship to see if people's tendency to ruminate about their traumatic experiences plays a larger role in predicting memory amplification over time. Future studies should also continue to explore why some are more prone to ruminate than others; perhaps the way one ruminates or the extent to which (i.e., the frequency) one experiences intrusions, can reveal more about who is more susceptible to memory amplification than encoding has in the present studies.

Alternatively, it is possible that participant's PTSD symptoms resulted in systematic information-processing biases--biases that contributed to participants overestimating the amount of traumatic images they were actually shown, not the way they encoded that information to begin with (Oulton et al., 2016). The use of information-processing biases has also been shown in cases studying those with anxiety and depression (co-occurring symptoms of PTSD; Mathews, 1990). Future studies should thus, explore the role these biases may play following the encoding of traumatic images. Perhaps even, the way by which one encodes a traumatic event, contributes to their use of this bias, and that is why we see the memory amplification effect occurring over

time, not soon after encoding.

Lastly, memory amplification may be the result of heuristic use, such as the availability heuristic, a bias where people rely on information they think they know but actually refer to that material because it can easily be retrieved from their memory (Tversky & Kahneman, 1973). If people rely on the availability heuristic to remember their traumatic experiences, it may be the case these individuals experience more PTSD symptoms overtime because they easily recalled the negative, traumatic memories they are frequently reminded of via re-experiencing symptoms like intrusions (Oulton et al., 2016). Future studies should examine correlations between the availability heuristic and rumination, because this relationship may explain memory distortion and changes in PTSD symptoms that occur overtime. Overall, our findings do not demonstrate that encoding contributes to the memory amplification effect nor do they show support for Ehlers and Clark's Cognitive Model (2000). However, our findings do have some limitations to be addressed in future research and provide several implications for the exploration of the memory amplification effect.

Limitations

First, it is important to acknowledge the inherent limitations in assessing trauma in a laboratory design. Because we could not expose participants to an actual, *real-time* traumatic experience like a deadly car accident, and could only show participants *photos* of traumatic experiences, our paradigm is clearly artificial. We also acknowledge that viewing graphic images does not exactly replicate emotions or physical responses associated with experiencing real trauma (i.e., intense fear, fight, flight, or freeze responses). Nonetheless, our participants experienced some degree of negative emotion. Our participants, regardless of encoding condition, responded negatively to and experienced negative emotional reactions following

exposure to our trauma analogue. It is important to acknowledge that we did not analyze whether or not our participants would have met criteria for a PTSD diagnosis. We also only assessed certain criteria including changes in affect, which inherently limits our generalizability, as our data does not address all PTSD diagnostic requirements.

Additionally, our sample may not be representative of the entire population. We had to exclude some participants due to failure to pass our instructional manipulation checks, for not completing the study, and for experiencing technical difficulties that could have confounded their responses (i.e., inability to view the traumatic photos). Our sample is also mainly comprised of female college students who could be biased by their age and gender. Research indicates that there are indeed sex differences in physiological reactions to emotional stimuli, like trauma, between males and females (Lang et al., 1993). We did not analyze whether or not our female participants' memory accuracy of the traumatic photos was different than that of our male participants. Thus, we cannot rule out gender differences for memory amplification based on the present study.

In regards to our paradigm, many of our measures relied on self-reporting. This is not uncommon for this line of research as many of the measures for PTSD (i.e., PCL-5, EIS, THS) are made up of self-report questionnaires. However, because self-reports rely on participant's own volition when responding, it is possible that their responses were untruthful or inaccurate (i.e., shame in reporting feelings experienced, or the number of intrusions experienced). We aimed to control for any individual differences via the random assignment of our participants to each of the three encoding conditions, but we did not assess for an array of possibilities. Lastly, because our study was administered online, we do not know if participant's individual environment influenced their responses (i.e., being distracted during the encoding phase).

Implications

Our Study 1 results demonstrate that people do have lay beliefs about the role of encoding on PTSD symptomology. This is important for future studies as this finding suggests that these beliefs may alter the expectations for trauma. However, despite not being able to confirm our Study 2 hypotheses, our findings also yield significant implications. As discussed, this study is one of few to assess trauma in a controlled, empirical setting. Many studies on this subject have focused on those pre-disposed to trauma, yielded limited sample sizes, and lacked control measures (Anastasides et al., 2015; Dickie et al., 2011; Scott et al., 2016; Southwick et al., 1997). By assessing encoding in a controlled lab environment, we addressed many of these limitations and were able to control several factors of exposure to trauma that significantly varied in field studies such as the length of trauma exposure, the type of trauma, and post trauma exposure assessments.

Further, because our findings suggest that encoding may not be the key to understanding the memory amplification effect, we have worked to narrow down possible alternatives. Doing so offers inspiration for several future research projects. First, future research should investigate the role of rumination in memory amplification. We know from research such as that of Oulton and colleagues (2016) that rumination regarding a traumatic experience may increase intrusions and memory distortion. Second, future research should look to assess the frequency of heuristic use such as that of the availability heuristic, in traumatic memory amplification. Perhaps the use of heuristics is creating a bias in tandem with rumination where people are endorsing and more easily retrieving their distorted memories (Tversky & Kahneman, 1973).

Overall, the way by which we encode a traumatic event does not appear to influence the negative emotions, memory distortion, and PTSD symptoms that plague those exposed to

trauma. Thus, it is critical that the field continue to explore traumatic memory amplification. Once we identify the driving force behind this phenomenon, we can potentially develop preventive measures and more appropriate levels of clinical care for those affected. Hopefully one day, we can prevent the memory distortion and increase in PTSD symptoms that make up the memory amplification effect.

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Appendix A

Study 1 Informed Consent and Participant Instructions

THE CITY UNIVERSITY OF NEW YORK

John Jay College Department of Psychology

Title of Research Study: Perspectives on Trauma

Principal Investigator: Kelsey Barnett, John Jay College

Deryn M. Strange, PhD, Associate Professor John Jay College

You are invited to participate in a research study under the direction of Kelsey Barnett, a Ba/Ma student at John Jay College of Criminal Justice, and Dr. Deryn Strange, an Associate Professor at John Jay College of Criminal Justice, USA. Thank you for your interest in participating.

You are being asked to participate in this research study because you are over the age of 18. There will be approximately 300 total participants. In this study, you will see facts and evidence from an investigation of a crime. At the end of the study, you will answer some questions about what you have read. The study should take no more than 45 minutes total and you will be granted course credit upon completion.

Your participation in this online survey involves risks similar to a person's everyday use of a computer and the Internet, and confidentiality will be maintained to the degree permitted by the technology used. Only your responses to each task will be recorded. In accordance with the requirements of some scientific journals and organizations, your coded, anonymous data may be shared with other competent researchers or used in other related studies. Your participation in this research is voluntary and you can stop participating at any time. Although there are no direct benefits to you, your participation will help to expand the scientific literature.

If you have any questions comments, or concerns, you can contact Kelsey Barnett (email: Kelsey.barnett@jjay.cuny.edu) or Dr. Deryn Strange (email: dstrange@jjay.cuny.edu). If you have any questions about your rights as a research participant or if you would like to talk to someone other than the researchers, you can contact CUNY Research Compliance Administrator at 646-664-8918.

CONSENT TO PARTICIPATE

I have read and understood the information about this research project. I understand the purpose of this research, what will happen if I participate, and what will happen to the information I provide. I understand the measures in place to protect my privacy and confidentiality, such that the information I provide will be coded by a number that does not identify me. I understand that I can withdraw my consent at any time prior to the end of my scheduled participation, and I do not have to give a reason.

By clicking the arrow below you are consenting to participate in the study

Instructions:

Thank you for choosing to participate in this survey. We are interested in how newspaper articles about car accidents influence people's understanding of Post traumatic stress disorder (PTSD).

This study will take approximately 20 minutes to complete. You will be asked to read a short paragraph about post traumatic Stress Disorder. You will then be asked to read a newspaper article about a recent, severe car accident. Lastly, you will answer follow up questions regarding the article. Once you complete the entire survey, you will receive credit.

If at anytime, you do not wish to continue participating, you may exit the survey. You will not be penalized for failure to complete this study. If you have any questions please contact the researcher, Kelsey Barnett, at Kelsey.barnett@jjay.cuny.edu.

When you are ready to begin, please click next.

Appendix B

Study 1 PTSD Introduction Paragraph

Please read the following paragraph about Post Traumatic Stress Disorder.

Posttraumatic stress disorder is a mental health condition that typically follows exposure to some kind of trauma (i.e., a car accident). Symptoms of PTSD include, but are not limited, to intrusions (unwanted thoughts or feelings about the traumatic event), nightmares, anxiety, hyper vigilance, avoidant thinking, dissociation, etc,.

Click next to continue.

Appendix C

Study 1 Newspaper Article

Please read this excerpt from a local newspaper article about a severe car accident:

Women Suffers Several Injuries Following Car Crash On Way to a Night Out with Friends

It was 5:00pm on Tuesday, October 5th when Alex was leaving her job and headed to meet up with her friends for dinner. The restaurant was 20 minutes outside of Alex's small suburban town, and she was worried about being late. We spoke with Alex, who told us she rushed into her car, and forgetting to put her seatbelt on, sped off onto the highway. Alex told reporters she usually never uses her cell phone while driving but after each of one her friends called her to see if she was close to the restaurant, she decided to call one of them back to tell them she'd be at least 15

minutes late. Doing 75 mph in a 55mph speeding zone, Alex picked up her phone to

A photo of Alex's car following the accident

dial her friend's number when her phone fell by her feet. Alex scrambled to get her phone when she heard a loud beep and crash, throwing her forward out onto the hood of her car. Alex felt the sharp shooting pain of glass cutting through her skin on her arms, head, and chest as she went through the windshield. She told us that blood covered her entire face and began soaking into her clothes. Alex's friend, who was still on speakerphone, heard the car crash and started screaming to see if Alex was okay. Alex could hear her friend calling her name but she could not answer her. This friend, Stacy, told reporters she was talking with Alex when suddenly she heard a loud crash and Alex's screams. Stacy knew something must have gone wrong and tried to call out for Alex before calling 911. Soon after, Alex told us she began to hear the sound of sirens and was able to whisper the words, "help me." Alex tried to roll off the car but she was immobilized by pain she inflicted from the accident. Every time she tried to wiggle out of the car the tiny shards of glass that lay around her also cut her. Alex attempted to answer the emergency crew's questions but was exhausted by the pain. Sam, a member of the emergency crew who helped Alex off of her car, stated that Alex stayed conscious throughout the entire process and cooperated with them as best as she could. In total, Alex had suffered a sprained neck, broken arm, sprained wrist, a severe concussion, and was given multiple stiches to her head, arms and legs. Alex spent a week in the hospital before she could get back to work. We

caught up with Alex after she was discharged from the hospital. She told our reporters that she hopes others will learn from her accident by wearing their seatbelts, staying off their phones, and most importantly stressed, “don’t rush and drive. Being late is better than being hospitalized or worse, killed.

Appendix D

Study 1 Encoding Question

You will now be asked to answer questions about what you have read so far. Click next to continue.

(Next)

Alex developed PTSD as a result of this accident. Which of the following explanations do you think is most likely WHY she developed PTSD:

1. Alex focused on the sensory details of the accident (i.e., the sound of the other car's horn honking during the crash, the taste of the blood in her mouth, the pain of the glass cutting into her skin, etc.,).
2. Alex focused on how the accident happened and why it happened to her (i.e., she was rushing, she went through the windshield because she did not have her seatbelt on, she dropped her phone and took her eyes off the road and that's why she did not see someone hit her, etc.,).
3. It does not matter what Alex focused on during the accident.

Appendix E

Study 1 Confidence Rating and Explanation

Please rate your confidence in your response on the scale below.

1 2 3 4 5 6 7 8 9

10

Not at all Confident **Completely Confident**

Please Use the Additional Space Below to Explain Your Choice:

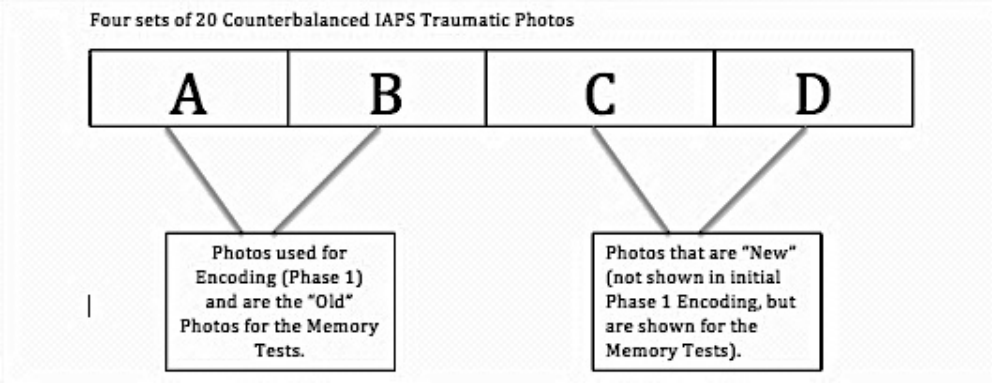
Appendix F

Study 1 Debriefing

Thank you for your participation in this study. The goal of this study is to survey if people have a belief about how encoding, or how memories are processed and stored during traumatic experiences. We are also interested in whether or not people believe how someone encodes a traumatic event, effects their PTSD symptomology. Because this study relies on participant's reporting their beliefs about traumatic memories and PTSD symptoms, it is important that you do not talk about this study or share the goal of the study with any others who may take it. If you have any further questions or concerns about this study, you can contact the following: Kelsey Barnett: Kelsey.barnett@jjay.cuny.edu or Dr. Deryn Strange: dstrange@jjay.cuny.edu. Thank you again for your participation!

Appendix G

Study 2 IAPS Counterbalancing and Photo Set Structure.



Appendix H

STAI-I Question Examples

We are unable to provide the entire manual because it would need to be purchased in order to see the full scale and items.[1]

Directions: A number of statements, which people have used to describe themselves, are given on the following pages. Read each statement and then select the appropriate button to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

Not at all - Somewhat - Moderately so - Very much so

I feel at ease.*

I feel upset.*

Directions: A number of statements, which people have used to describe themselves, are given on the following pages. Read each statement and then select the appropriate button to indicate *how you generally feel*.

Almost never - Sometimes - Often - Almost always

I lack self-confidence.*

I am a steady person.*

Gender Male Female*

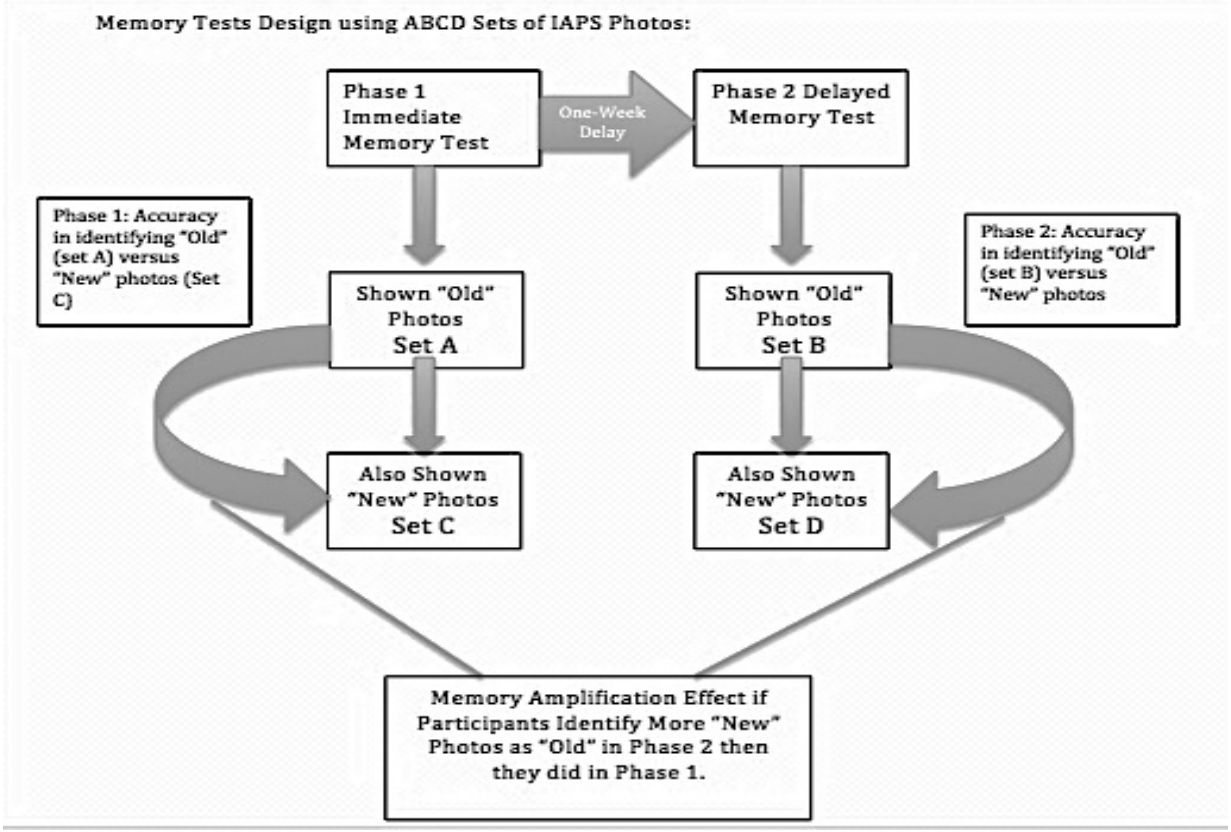
Age: *

Items marked by * are required.

[1] Retrieved From http://www.mindgarden.com/145-state-trait-anxiety-inventory-for-adults#horizontalTab2

Appendix I

Memory Test Design for Phase 1 and Phase 2



Appendix J

Study 2 Session 1 Informed Consent

CITY UNIVERSITY OF NEW YORK John Jay College of Criminal Justice Department of Psychology. CONSENT TO PARTICPATE IN A RESEARCH PROJECT

Project Title: The Strategic Use of Resources During Traumatic Experiences

Principal Investigator: Deryn M. Strange, PhD Associate Professor John Jay College 524 West 59th Street New York, NY 10019 (212) 484-1345

Introduction/Purpose: You are invited to participate in a research study. The study is conducted under the direction of Dr. Deryn Strange, an Assistant Professor at John Jay College of Criminal Justice, USA, and Dr. Melanie Takarangi, a lecturer at the School of Psychology at Flinders. We are interested in the psychological effects of exposure to stress and emotion (in this case, stressful photos), and particularly how the strategic use of resources while exposed to the material effects mood and level of distress.

Procedures: Approximately 2000 individuals are expected to participate in this study. If you agree to participate in this study, you will participate in two online sessions. In both sessions you will be shown a series of photographs, and asked some questions regarding the content of the photos and what you thought about the photos. You will also be asked to do a task assessing your thinking and attention. The first session will take approximately 45-60 minutes. The second session will take place a week later. It will take approximately 15 - 30 minutes. Please be aware that you can ask to stop the experiment at any time without penalty—please contact the researcher. You are also free to withdraw from the study, at any point before the end of the session, or to decline to answer particular questions.

Possible Discomforts and Risks: It is important to note that in this study, you will be asked to view a large number of emotional images, some of which may be very graphic and very negative (e.g. burns, sexual and physical violence, torture, maltreatment, and death) in nature. Some people may find these images distressing. Please do not proceed if you do not want to view such images. A small minority of people also experience distressing memories and reactions in the week after viewing the photos although these reactions generally subside quite quickly. Please DO NOT participate in this study if you think that you may be adversely affected by viewing the photos, or if for example you have been a victim of sexual or physical violence, serious injury

(burns, car accident, etc).

Benefits: There are no direct benefits from participating in this study. However, participating in the study may increase general knowledge of the impact of trauma.

Voluntary Participation: Your participation in this study is voluntary, and you may decide not to participate without prejudice, penalty, or loss of benefits to which you are otherwise entitled. If you decide to leave the study, please contact the principal investigator, Deryn Strange, to inform them of your decision. You may refuse to answer any specific questions or refuse to engage in any task at any time during the study.

Financial Considerations: Participation in this study will involve no cost you. For your participation in this study you will receive four research credits after you complete Session 2.

Confidentiality: The data obtained from you will be collected via digital and written document. The collected data will be accessible to the Principle Investigator – Dr. Deryn Strange, Dr. Melanie Takarangi, and her research assistants. The researcher will protect your confidentiality by labeling your data with a participant number, which will not be tied with your name. You will never be identified in our research project or in any other presentation or publication. Your videotapes data will be coded following the experiment and erased. The collected data will be stored in paper and digital format in a locked and secured laboratory. In accordance with the requirements of some scientific journals and organizations, your coded data may be shared with other competent researchers. Your coded data may be used in other, related studies.

Contact Questions/Persons: If you have any questions about the research now or in the future, you should contact the Principal Investigator, Deryn Strange (email: dstrange@jjay.cuny.edu). If

you have any questions concerning your rights as a participant in this study, you may contact the John Jay Human Research Protection Program Office at jj-irb@jjay.cuny.edu, or (212) 237-8961. In the event of any problems resulting from participation in the study, please contact one of the following agencies: The National Center for Victims of Crime, link victims with a variety of important services, including crisis intervention, information, counseling, and support groups. Phone:1-800-FYI-CALL or 1-800-211-7996 Web:http://www.ncvc.org/ National Sexual Assault Hotline for services such as counseling, therapy, support groups, and advocacy. Phone:1-800-656-4673 Web:http://www.rainn.org Safe Helpline for sexual assault support for military personnel. Phone:1-877-995-5247 Web:http://www.safehelpline.org/ Safe Horizon for victims of violence Phone:1-800-621-4673 Web:http://www.safehorizon.org National Center for PTSD Phone:1-800-273-8255 Web:http://www.ptsd.va.gov

- **Statement of Consent:** "I have read the above description of this research and I understand it. I have been informed of the risks and benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions that I may have will also be answered by the principal investigator of the research study. I voluntary agree to participate in this study. By clicking the "yes" box I agree to participate in the study. I agree to participate. ( ).

Session 2 Informed Consent

Welcome back!

- I agree to participate (1)

ID Please enter your participant ID below. Note: Your participant ID for this study is the letter "A" followed by your ID number, which could be found on CunyFirst in the Student Center. During this experiment, we ask that you comply with the following experiment requirements: 1) Please maximize the size of your web browser so that it covers your entire screen. 2) Please complete the experiment in a single session, and do not leave the experiment to engage in other tasks. So don't check your mail, look at Facebook, send or read a text message, get up for a drink, etc. 3) Please do not use your web browser's back or refresh buttons at any point during the experiment. 4) Because this experiment requires your close attention, we ask that you complete the experiment in an environment that is free of noise and distraction. Please do not speak to anyone, or have anyone near you. Because of the nature of the images that will be shown, we ask that you be alone in a quiet room. Thank you for your help with these matters. Continue to the next page when you're ready to begin.

Please wait while the experiment is prepared...

Appendix K

Study 2 Debriefing

Debriefing Information: Dear participant, Thank you for your participation in this study. This debriefing is given as an opportunity for you to learn more about this research project, how your participation plays a part in this research, and why this research may be important to society. Please do not discuss this study with anyone else who might also participate in the future. Knowledge about the study may influence their responses and, essentially, invalidate the information obtained from them. (For this same reason it is important that you tell the experimenter if you knew details about this study before participating.) This is part of your responsibilities as a research participant. We originally told you we were interested in evaluating the impact of self-relevance on responses to graphic material. We were actually most interested in whether you had intrusive thoughts about the photos you viewed. Specifically, we were interested in whether experiencing intrusive thoughts can adversely affect peoples' memory about the photos. We hope you understand why we did not tell you about the true purpose of our study until now. For example, if you were aware that there would be a memory test, you would have changed your viewing behavior and would not have been fooled, and we would be no closer to understanding traumatic memory. It is likely that the results of this research will be presented at academic conferences and/or published as an article in a journal. Again, your individual responses will be kept confidential during this process. If you are interested in the results of this study or if you have any additional questions or comments, please contact Dr. Melanie Takarangi by email at melanie.takarangi@flinders.edu.au. Please click Next.
