

Examining the Impact of Guided Memory Retrieval on Intrusive Memories:

An Online Trauma Film Paradigm Study

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Abstract

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Intrusive memories are a cardinal symptom of chronic post-traumatic mental health problems (e.g., Brewin et al., 2010). Post-event memory processing may be a key facilitator of remission of intrusive memories (Marks et al., 2018). Contextual processing has been proposed to decrease unwanted distressing memories (e.g., Besnard & Sahay, 2016). In this study ($N = 87$), participants viewed a distressing film, following which memory retrieval of context, gist, or film-independent information was experimentally manipulated via text-message. Both context and gist retrieval facilitated decreased intrusion distress ($d = 0.17, p = .03$; $d = 0.17, p = .005$) and vividness ($d = 0.16, p = .046$; $d = 0.17, p = .005$) over a three day follow-up relative to the control condition. This study highlights the potential adaptive role of post-event retrieval processing following trauma and is the first to investigate the role of context in memory retrieval, rather than encoding. Implications for early intervention development are discussed.

Examining the Impact of Guided Memory Retrieval on Intrusive Memories: An Online Trauma Analogue Study

After a traumatic event, many individuals will have intrusive memories, also known as intrusions, which are involuntary, distressing, and vivid memories of an event that can come out of the blue or be prompted by internal or external stimuli associated with the event in some way (Marks et al., 2018). For most individuals, intrusions will taper off over time, while in a subset of individuals, intrusive memories persist and can become a cardinal feature of memory-related psychopathology such as posttraumatic stress disorder (PTSD) and depression (e.g., Brewin et al., 2010). Understanding the factors that cause intrusions to persist for some is key to better predicting related chronic mental health problems and potentially intervening early on trajectories of psychopathology.

The way an individual encodes and engages with a memory of a potentially traumatic event is thought to be a key component in the persistence of intrusive memories (e.g., Brewin, 2014). Particularly, the role of post-trauma memory retrieval, either voluntary or involuntary via re-experiencing symptoms, is thought to enhance the retrieval strength of specific traces of the trauma memory while weakening other memory traces (Marks et al., 2018). Thus, in a retrieval-based feedback loop model of memory intrusions, if an individual repeatedly engages in non-adaptive memory retrieval after a traumatic event (e.g., details highlighting one's feelings of powerlessness), it may potentially become more difficult to access and process more adaptive aspects of their memory (e.g., details highlighting one's own heroic survival efforts). This model highlights the critical role of retrieval-induced remembering and forgetting, the cognitive phenomenon by which certain aspects of a memory trace are strengthened through their retrieval, while other aspects of the memory are weakened as a consequence (Murayama et al., 2014;

Anderson et al., 1994). This work has been replicated across a variety of real-world stimuli, including images depicting highly negative events (e.g. train crash; Kuhbandner et al., 2009) and participants' own autobiographical memories (Somos et al., 2022; Matsumoto et al., 2021). In general, this dynamic of remembering and forgetting is thought to function as an adaptive method of reducing retrieval competition among related memory traces and helps us to easily recall the most relevant aspects of our memory. Within the context of post-trauma memory retrieval, repeated accessing of non-adaptive aspects of the memory may actually make more adaptive components of the memory increasingly more difficult to remember, though what constitutes non-adaptive and adaptive traces is not evident (e.g., Brewin, 2014; Ehlers & Clark, 2000; Krans et al., 2013; Park & Blake, 2020; Reyna et al., 2016).

Contextual memory processing and retrieval has been proposed as one potential protective factor against intrusive memories for its capacity to limit the generalizability of fear (Brewin, 2014; Krans et al., 2013; Meyer et al., 2017). Context broadly includes the temporal, spatial, social, environmental, and other factors surrounding a traumatic event. For example, context can mean the torrential downpour and stray tire in the road that differentiate a past car crash from a car ride on a typical day. Contextual information is thought to be essential in placing distressing memories in a specific time and place in the past and thus minimizing threat associated with a feared stimulus in other contexts. Specifically, the integration of context into memory is thought to play an essential role in limiting the generalizability of fear learning by increasing pattern separation and acting as a sort of "gate" around the mental representation of a feared stimulus, and thus preventing the activation of related fear schemas in safe environments (e.g., Besnard & Sahay, 2016; Bouton, 2002; Maren et al., 2013). This process is thought to depend on coordinated activity in the medial prefrontal cortex and the hippocampus, which

together allow for the retrieval of contextual information, thus disambiguating potentially threatening cues (Jin & Maren, 2015). Specifically, the DG-CA3 circuit in the hippocampus is thought to be responsible for differentiating highly similar cues in the environment, which helps to limit fear generalization to non-dangerous cues (Besnard & Sahay, 2016; Dunsmoor & Paz, 2015).

A few analogue studies have been conducted on the impact of event-related contextual information and intrusive memories, but results have been varied, with some studies surprisingly suggesting this form of processing *increases* intrusive memories (Krans et al., 2013; Pearson et al., 2012; Pearson, 2012), while one other study has suggested that this type of processing is associated with decreases in intrusions (Meyer et al., 2017). Increased intrusions are counter to the proposed adaptive effects of contextual information, namely increasing memory specificity and minimizing the generalizability of traumatic events. This experimental work on contextual processing been scrutinized by some for the way it has operationalized the construct—in one case, the context manipulation simply labeled the trauma analogues as “war,” “crime,” or provided no label (no-context condition; Brewin & Burgess, 2014; Pearson et al., 2012). It is likely that the meaning of context is much richer, including more specific, personally-relevant details occurring before, during, and after a traumatic event, which may have the potential to anchor an event to a specific moment in the past. Research with a more carefully designed contextual processing construct is essential to clarifying the role of context in human memory for traumatic events.

In contrast to contextual retrieval, some individuals may more readily retrieve the gist of an event, which includes central details and thematic features of an event, such as whether or not there were multiple perpetrators, the presence of weapons at the time of the event, and resulting

injuries, among other aspects of the memory (Poppenk et al., 2013). Indeed, this kind of overgeneral memory processing, particularly for autobiographical memory, is associated with PTSD (Moore & Zoellner, 2009; Ono et al., 2016). Fuzzy trace theory (FTT) posits that the brain stores two separate streams of memory for an event: verbatim and gist traces (Reyna et al., 2016). While verbatim memory stores precise details of an event (e.g., the exact words spoken by a perpetrator), gist memory stores the general idea or theme of an event (e.g., whether or not a motor vehicle accident survivor was speeding at the time of the crash). Gist memory is thought to be more susceptible to one's own interpretation (e.g., one individual driving 5 mph over the speed limit may consider oneself to be speeding, while another might not; Reyna, 2021). This more generalized gist-based processing is also thought to make individuals more susceptible to misinformation that is consistent with their beliefs and gist-based memory (Reyna et al., 2016). This gist-based processing, rising from the cognitive psychology literature, has had limited application to the study of trauma.

Taken together, these aspects of the memory literature converge on the question of whether the retrieval of more adaptive aspects of a verbatim memory trace, specifically contextual information, defined as temporal, spatial, social and other details that increase the specificity of an event, can subsequently decrease the frequency and intensity of intrusive memories. Given the limited empirical literature and mixed findings on contextual processing, alongside the proposed theoretical benefits of context in the trauma literature, the present study examined whether brief prompts to retrieve the context of a trauma analogue (12 min distressing film) in the hours following exposure to the film would lead to fewer self-report intrusions and lower intrusion distress and vividness over a 3 day follow-up via daily diary. An active control group was similarly prompted to retrieve film gist details, to control for non-context-specific

effects of film memory retrieval. A second control group, which was prompted to retrieve details related to the study that were not associated with the film was included to observe the effects of study-related reminders that did not specifically elicit elements of the distressing film.

Accordingly, on the basis of the proposed benefits of context on limiting the generalizability of trauma memory (e.g., Besnard & Sahay, 2016; Bouton, 2002), it was hypothesized that repeatedly cueing the retrieval of context-related information after viewing a distressing film would lead to fewer and less distressing and vivid intrusive memories than cueing with gist-related reminders or reminders unrelated to the film. Conversely, based on potential overgeneralizing effects, gist related cues were hypothesized to lead to more intrusive memories than context-related reminders or reminders.

Method

Participants

Eighty-seven undergraduate students participated in this study at a large, metropolitan university. Potential participants were recruited online via a psychology department research pool, where students in undergraduate psychology courses received extra credit points in exchange for participation in research studies. Participants were provided with a short description of the study, which was described as a study focused on understanding reactions to a distressing film, including five days of study participation in total. Participants were told that the film they would be asked to view depicts the sexual and physical assault of a teenage boy in a school bathroom, and that the television show it was excerpted from was rated TV-MA. Eligible participants were between 18 and 65 years of age, self-reported as fluent in English, and had access to a computer and internet to complete study components. Individuals reporting current suicidal ideation on the Patient Health Questionnaire-9 (indicated by any frequency greater than

“Not at all” on item 9: “Over the last 2 weeks, how often have you been bothered by... Thoughts that you would be better off dead or of hurting yourself in some way”; Kroenke et al., 2001), or a history of experiencing or witnessing sexual or physical assault, indicated via self-report on the Life Events Checklist for DSM-5 (Weathers et al., 2013), were also excluded.

Of the 188 individuals who were potentially eligible to participate, 87 participants returned to the study portal, provided informed consent, and completed Day 1 of the study. 95% ($n = 83$) of participants responded to over 50% (4 or more) of the guided memory retrieval prompts on Day 1. Those who did not complete more than three of the guided memory retrieval prompts ($n = 4$) were removed from study analyses, due to limited dose of the study manipulation. Accordingly, $n = 83$ (context condition: $n = 31$; gist condition: $n = 26$; control: $n = 26$) participants were included. See Table 1 for sample demographics and other characteristics.

Materials

Trauma Analogue Film Clip

The trauma film clip that was used in this study was a short (12 min), fictional video depicting a physical and sexual assault of a teenage boy and the storyline leading up to and following the assault, which allowed for the development of characters, establishment of motivation behind the climax of the film, and the near-term impact of the event on the victim. The storyline involves a teenage boy returning to school following a suspension after vandalizing the school’s football field. When the teen returns to school, he experiences conflict with former friends and experiences bullying from the football team. Three football players physically and sexually assault the teen in the school bathroom, from which the teen suffers physical injuries. Following the assault, the teen withdraws further from friends and hides the event from his family. At the end of the clip, the teenager discloses the event to a friend and receives social

support. The film is excerpted from a television show rated TV-MA. This clip was selected to provide ample contextual material surrounding the trauma depiction in order to maximize ecological validity. Other common trauma analogue stimuli, such as distressing photographs (Krans et al., 2016) or a montage of motor vehicle accident clips with short audio descriptions (Pearson, 2012) were not used for this study due to limited contextual features. After viewing the film, participants were asked if they had seen the episode of television before (Yes/No/Not sure) and if they watched the entire clip without looking away (Yes/No). Participants were instructed that their responses to these questions would not impact compensation.

Memory Cueing Stimuli

Thirty memory retrieval prompts (10 per condition), in the form of short-answer questions, were generated by the research team. Participants were randomly assigned 6 of the 10 potential prompts within their assigned condition to receive during the memory cueing procedure. Within 5 hours of completion of film viewing, participants were sent a text message with a link to the first memory retrieval prompt. Participants opened the link and were asked one of the memory retrieval prompts. Participants were instructed to type their answer to the prompt, in one sentence or less, in a blank free response box and then advance to the next page. On the next page the correct response to the question was provided in order to ensure accurate retrieval of the contextual, gist, or film-independent detail. In total, on Day 1 of the study, participants were each sent 6 prompts, one hour apart.

Contextual Retrieval Condition. Prompts for the context condition were extracted from the film scenes prior to and following the scene depicting the assault (e.g., “What location did [the main character’s] friend notice he has been avoiding since the assault?”, “How did [the main character] hide his head wound in the scene following the assault?”). These prompts were

developed to emphasize the specific context of the depicted assault and limit the generalizability of this event to other examples of physical assault, sexual assault, or bullying.

Gist Retrieval Condition. Prompts for the gist condition were extracted from the film scene depicting the assault (e.g., “Where did the assault occur?”, “Why was [the main character] struggling to breath”). These prompts were designed to promote retrieval of central themes of the overall film and highlight the ways in which the assault might fit an individual’s schema for an assault in the context of severe bullying.

Film-independent Retrieval Condition. Prompts for the film-independent cueing control condition focused on components of the study that participants learned about or were exposed to, but were independent of the film content (e.g., “How are you being compensated for participating in this study?”, “How did you learn you were eligible to participate?”). These prompts were designed to control for the experience of being reminded of the research study, without specifically guiding retrieval of any content from the film clip, so prompts were focused on study procedures that occurred before or after the film viewing.

Measures

Intrusion Measures

Intrusion Daily Diary. The daily diary was a short (2 min) self-report survey that served as the primary measure of intrusion frequency, distress, and vividness. Text message reminders to complete the daily diary were distributed at 9 PM on Days 1 – 4. The survey included instructions to focus on experiences within the past 24 hrs (or, on Day 1, since viewing the film clip). Intrusions were defined for participants as “... unwanted thoughts or images that come into your mind out of the blue or may be triggered by something around you.” The survey assessed the overall number of intrusive memories experienced via a drop-down menu ranging from 0 –

20+, as well as the level of distress and vividness associated with intrusive memories on a 7-point Likert scale ranging from 0 “*not at all*” to 6 “*extremely*.” For individuals who indicated they experienced no intrusions at a given assessment point, intrusion distress and vividness were coded as zero.

Impact of Event Scale – Revised (IES-R). The IES-R (Weiss et al., 2007) is a 22-item self-report measure of subjective distress, typically associated with a traumatic event. The scale was completed with respect to the film clip viewed in the study. The intrusion subscale of the measure was used to evaluate the impact of the film clip on intrusion experiences as a secondary measure of the effect of condition, consistent with past literature (James et al., 2016). Items were rated on a 5-point scale from 0 “*not at all*” to 4 “*extremely*,” with total scores ranging from 0 – 88. In past research internal consistency for the intrusion subscale is generally good ($\alpha = .88 - .90$; Beck et al., 2008; Sveen et al., 2010).

Screening and Individual Difference Measures

Life Events Checklist for DSM-5 (LEC-5). The LEC-5 (Weathers et al., 2013) is a 17-item self-report questionnaire designed to assess lifetime DSM-5 trauma exposure across 16 types of potential trauma exposure (e.g., natural disaster, sexual assault), as well as an additional, open-ended item “any other very stressful event or experience.” The nature of the exposure is captured via a series of checkboxes where individuals may select more than one option (“happened to me,” “witnessed it,” “learned about it,” “part of my job,” “not sure,” and/or “doesn’t apply”). This measure was included to determine eligibility; individuals who reported “happened to me” or “witnessed it” in regards to a physical or sexual assault were excluded from participating. Past work has demonstrated that test-retest reliability of items is fair to good ($\kappa =$

.23 - .66; mean $\kappa = .47$); reliability for items used to determine study eligibility (sexual assault, physical assault) is good ($\kappa = .53 - .66$).

Patient Health Questionnaire (PHQ-9). The PHQ-9 (Kroenke et al., 2001) is a 9-item self-report measure of past 2-week depressive symptoms. The PHQ-9 was used as a screening instrument to exclude for suicidal ideation, to capture individual differences in vulnerability to intrusions as a potential covariate, and to characterize the sample. Items were rated on a 4-point Likert scale ranging from 0 “*Not at all*” to 3 “*Nearly every day*,” with total scores ranging from 0 – 27 with higher scores indicating greater depressive symptoms. In past research, internal consistency is good ($\alpha = .87$) and the measure converges well with another measure of depression ($r(1010) = .80, p < .001$; Beard et al., 2016).

Post Film Questionnaire (PFQ). The PFQ (Rottenburg et al., 2007) is a self-report measure of participants’ emotional reactions to a film clip consisting of 18 items rated on a 9-point Likert scale. This measure was included to assess emotional reactions to the film clip in order to assess individual differences, as well as to ensure that the film was sufficiently evocative on average. This questionnaire measures the intensity of participants’ reactions to 18 discrete emotions (e.g., amusement, disgust, sadness), as well as any additional emotions that the participant identifies, on a scale from 0 “*not at all/none*” to 8 “*extremely/ a great deal*.” Salient individual items that emerged as most pertinent to the film clip were used to capture individual differences in film-related emotional experiences as potential covariates.

Interpersonal Reactivity Index (IRI). The IRI (Davis, 1983) is a 28-item self-report questionnaire that measures empathy as a feature of four dimensions (perspective taking, fantasy, empathic concern, and personal distress). This measure was included to assess individual differences in empathy to be included as a potential covariate. Items were rated on a 5-point

Likert scale from 1 “*Does not describe me well*” to 5 “*Describes me very well.*” Higher total scores indicate greater levels of empathy. In past research the IRI converges well with other measures of empathy (Davis, 1983).

Generalized Anxiety Disorder Scale (GAD-7). The GAD-7 (Spitzer et al., 2006) is 7-item self-report measure of past 2-week anxiety symptoms. This measure was used to characterize the sample and to be considered as a potential covariate. Items were rated on a 3 point scale ranging from 0 “*not at all*” – 2 “*nearly every day,*” with total scores ranging from 0 to 21. Previous work has demonstrated that internal consistency of the measure is good ($\alpha = .87$) and converges well with other measures of worry and anxiety (Löwe et al., 2008).

Posttraumatic Diagnostic Scale for DSM-5 (PDS-5). The PDS-5 (Foa et al., 2016) is a 24-item self-report measure of past month PTSD symptoms based on the DSM-5. This measure was included to characterize the sample and capture individual differences in PTSD symptoms as a potential covariate. Following screening for exposure to traumatic events, a primary most distressing event was selected by the participant. For this target event, 20 items assessing re-experiencing, avoidance, negative mood/cognitions, and hyperarousal were rated on a 5-point Likert scale from 0 “*not at all*” to 4 “*6 or more times a week/severe.*” The total score of the measure provides a severity rating of current PTSD symptoms. Participants who report no past trauma exposure are coded as a zero. Past work has demonstrated that internal consistency ($\alpha = .95$) and test re-test reliability ($r = .90$) of the PDS-5 are excellent, and the measure converges well with other self-report and interview assessments of PTSD (Foa et al., 2016).

Alcohol Use Disorder Identification Test (AUDIT). The AUDIT (Babor et al., 1992) is a 10-item self-report measure of alcohol use disorder symptoms, including amount and frequency of drinking, dependence, and alcohol-related problems (social, occupational, and

health-related). The AUDIT was used to characterize the sample and assess individual differences in alcohol use disorder symptoms to be considered as a potential covariate. Items were rated on a 5-point Likert scale ranging from 0 “*Never/ No/ 1 or 2*” to “*4 or more times per week/ 10 or more/ Daily or almost Daily*” with a total score range of 0 – 40. Past work has demonstrated that the measure converges well with other interview and self-report assessments of alcohol use disorder symptoms (de Meneses-Gaya et al., 2009).

Procedure

The study was posted on the psychology research pool where participants read a short description of the study. The project was described as a research study focused on mental health and memory, which included watching a distressing video depicting a sexual assault and reporting on experiences over a four day follow-up period. Interested individuals completed a brief (< 5 min) eligibility questionnaire (LEC-5, PHQ-9). Eligible participants were provided a code to access the informed consent form.

The initial study session (Day 1) was completed virtually and asynchronously by eligible participants on personal computers and took 30 – 40 min. To ensure there was enough follow-up time for the same-day memory retrieval manipulation, individuals were not allowed to begin Day 1 past 2:30 PM. After consenting to participate, participants completed baseline measures assessing demographic information, dispositional empathy (IRI), depressive symptoms (PHQ-9), PTSD symptoms (PDS-5), generalized anxiety symptoms (GAD-7), and alcohol use disorder symptoms (AUDIT). Next, participants were instructed that they would view the distressing film described in the consent form. Participants were instructed to pay close attention, not to look away from the film, and that there would be a memory assessment on the film later. Finally, participants were asked to confirm that their computer audio was on via a check-box.

Participants viewed the brief trauma film clip (approx. 12 min). Afterward, participants were asked whether they watched the whole film without looking away and whether they had seen the film before. Participants were instructed that their responses to these questions would not affect their compensation and were encouraged to answer honestly. Finally, participants self-reported their emotional reactions to the film (PFQ).

Participants were then randomized to one of the three conditions: context, gist, or film-independent control. Participants received the first memory retrieval prompts via text message within 5 hours of viewing the film clip. To access the prompts, participants followed a link that they received via text message to a webpage with the relevant prompt and a short answer box for their response. Participants submitted their responses, following which they were provided with the correct response on the next page. In total, participants received 6 memory retrieval prompts, each 1 hour apart. Beginning the evening of Day 1, participants completed daily diary reports on the frequency and characteristics of intrusive memories for four consecutive days (Days 1, 2, 3, 4). Participants were reminded to complete diary entries once daily via text message at 9 PM.

After completing four days of daily diary reporting, participants then completed a 20-min virtual, asynchronous measure of film-related intrusions (IES-R) on Day 5. Participants were provided with a debriefing document that included mental health resources should they experience residual distress. Following completion of all study components, participants were compensated with 2 extra credit points for eligible undergraduate psychology courses.

Data Analysis

Main outcome analyses were conducted using multilevel modeling (MLM; Raudenbush & Bryk, 2002) in SPSS (v. 27), with day of diary nested within participant and restricted maximum likelihood (REML) for handling missing data. For longitudinal models, the best fitting

model was a random intercept and fixed slope model with a variance component covariance type. Due to individual differences in intrusions, demographics, psychopathology, and emotional responding to the film were examined as potential covariates. Number of intrusive memories experienced on Day 1, empathy (IRI), and post-film disgust (PFQ) were strongly related to intrusions and were used as covariates for all main analyses. Due to high multicollinearity among negative affect items, disgust was selected.

Results

Manipulation Check

Film exposure

The vast majority of individuals reported that they watched the entire film clip without looking away (81.6%). A subset of participants reported having seen this scene before on television (26.4%). There were no significant differences across conditions in number of participants who looked away during the film, $\chi^2(2, N = 83) = 3.38, p = .185$, or had seen the television scene previously $\chi^2(2, N = 83) = 1.69, p = .429$.

Emotional reactions to film. After viewing the film, participants reported post-film anxiety (PFQ; $M = 4.28, SD = 2.53$), disgust (PFQ; $M = 6.01, SD = 2.29$), fear (PFQ; $M = 4.59, SD = 2.37$), and anger (PFQ; $M = 5.48, SD = 2.25$). Additionally, most individuals (64.4%) reported at least one intrusive memory at the end of Day 1 ($M = 2.31, SD = 2.68$) suggesting that the stimuli were sufficiently evocative. There were no significant differences across conditions on post-film emotional reactions (PFQ; $F[2, 79] = 0.05 - 1.94, ns$), or number of Day 1 intrusions ($F[2, 78] = 1.22, p = .30$).

Context, Gist, and Control Condition Effects on Intrusive Memories from Day 2 to 4

Intrusion Frequency

In examining the trajectory of intrusions over diary days, intrusion frequency decreased with Time, $F(2, 148.79) = 36.43, p < .001$. While there was no main effect of Condition, there was a significant Condition x Time interaction $F(4, 148.79) = 2.48, p = .047$. Specifically, as can be seen in Figure 1, there was a slightly attenuated effect of Time among participants in the gist condition, $F(3, 36.13) = 10.94, p < .001, d = 1.56$, relative to the context, $F(3, 39.29) = 21.62, p < .001, d = 1.54$, and control conditions, $F(3, 33.43) = 17.74, p < .001, d = 1.00$.

Intrusion Distress

Ratings of intrusion distress decreased over Time, $F(2, 148.86) = 20.21, p < .001$. There was also a main effect by Condition $F(2, 73.68) = 3.96, p = .02$, such that individuals in the control condition experienced significantly higher intrusion distress across follow-up than either the context ($F(1, 148) = 4.62, p = .03, d = 0.17$) or gist ($F(1, 142) = 8.13, p = .005, d = 0.17$) conditions. See Figure 1b. The interaction of Condition x Time approached significance, $F(4, 148.87) = 2.44, p = .05$.

Intrusion Vividness

Ratings of intrusion vividness likewise decreased over Time, $F(2, 148.84) = 17.07, p < .001$. There was also a main effect of Condition, $F(2, 73.79) = 3.98, p < .02$. As can be seen in Figure 1c, the control condition reported higher intrusion vividness than either those in the context ($F(1, 48.897) = 4.21, p = .046, d = 0.16$) or gist conditions ($F(1, 46.90) = 8.846, p = .005, d = 0.17$) conditions. There was no significant Time x Condition interaction for intrusion vividness ratings.

Context, Gist, and Control Condition Effects on Impact of Event Scale

Finally, when examining the post-film reactions using the IES intrusion subscale, there was a main effect of condition, $F(3, 73) = 7.24, p < .001$. Individuals in the context ($M = 4.18$,

$SE = 0.542$ 95% $CI = 3.10 - 5.26$, $d = 0.24$) and gist ($M = 3.38$, $SE = 0.511$, 95% $CI = 2.36 - 4.40$, $d = 0.41$) conditions scored lower on the intrusion subscale of the IES than the control condition ($M = 5.23$, $SE = 0.606$, 95% $CI = 4.02 - 6.44$).

Discussion

This study builds on the emerging literature examining the role of post-event processing in the development and persistence of intrusive memories. This work investigates the hypothesized role of contextual processing in decreasing intrusive memories (Brewin et al., 2014; Ehlers & Clark, 2000). Consistent with prior studies highlighting the association between contextual processing and decreased intrusions (Meyer et al., 2017), prompting individuals to remember contextual information after the distressing film led to less distressing and vivid intrusions than those in the control condition. These results point to the potentially adaptive role of post-event contextual processing on limiting intrusion symptoms in the acute period following trauma exposure. Critically, this study did not manipulate any stimuli at encoding, highlighting the dynamic role of retrieval on memory, particularly soon after an event has occurred. Interestingly, the individuals in the gist condition similarly reported decreased intrusion frequency, distress, and vividness as compared to the control condition and did not significantly differ from the context condition with respect to distress and vividness. It may be that the memory retrieval manipulation in the context and gist retrieval conditions operated as a prompt to approach the distressing memory, as opposed to engaging in avoidance, which is thought to be a key mechanism targeted in efficacious trauma-focused therapy (e.g., Cooper et al., 2017).

Consistent with the proposed adaptive role of contextual processing (Besnard & Sahay, 2016; Bouton, 2002; Brewin, 2014), individuals who were prompted to retrieve contextual features of the trauma film (e.g., events preceding assault, behaviors displayed by survivor

following the assault) in the hours following viewing reported decreased distress and vividness associated with intrusive memories experienced. This is consistent with past work observing that individual differences in contextual memory processing were associated with intrusive memories in a trauma film paradigm study, such that those with better visual contextual memory performance experienced fewer intrusive memories over follow-up (Meyer et al., 2017). Yet, this is in contrast with others in the field who have reported that the presence of contextual information at encoding *increased* intrusions (Krans et al., 2016; Krans et al., 2013; Pearson et al., 2012; Pearson, 2012). This discrepancy may potentially be attributable to the use of a more contextually rich 12 min trauma analogue film that included salient pre- and post-assault content rather than other typical trauma analogue stimuli such as distressing photographs (Krans et al., 2016; Krans et al., 2013; Pearson et al., 2012) or a sequence of clips showing the aftermath of various motor vehicle accidents (Pearson, 2012). This discrepancy may also be due to the fact that the present study was the first to experimentally manipulate context *retrieval* rather than context encoding; past work manipulated the presence of contextual information when presenting the trauma analogue, as opposed to in the hours following the stimuli viewing (Krans et al., 2016; Krans et al., 2013; Pearson et al., 2012; Pearson, 2012). The observed effects of context retrieval on distress and vividness suggest that post-event retrieval of context may be a promising area of investigation for the prevention of chronic intrusive memories given that distress and vividness predict the perpetuation of intrusions over time in trauma exposed populations (Nader et al., 2000). Additional research investigating the role of contextual processing in a clinical sample with greater variance in intrusion frequency is necessary to evaluate the effect of contextual retrieval on intrusive memory trajectories.

Individuals prompted to recall the film gist (details from the assault scene of the 12 min. film clip) also reported less distressing and vivid intrusive memories than those in the control condition. The similar impact of context and gist retrieval on intrusion distress and vividness may point to a shared process, such as the facilitation of approaching distressing memories, rather than avoidance. Individuals who demonstrate decreased avoidance following trauma exposure are less likely to develop PTSD (Shin et al., 2015). Imaginal exposure interventions that encourage approaching trauma memories during the acute post-trauma period, which likely promote both context and gist-based memory retrieval, have demonstrated decreased posttraumatic stress symptoms (Rothbaum et al., 2012). The similar results observed for both the context and gist conditions may also be explained in part by insufficient separation of prompts across these two conditions. In this study, context prompts were developed based on details that led up to and followed the main assault scene in the film, while gist prompts were details drawn from the assault scene itself in order to elicit retrieval of the overall theme of the clip. The decision to prompt the retrieval of concrete details (as opposed to open-ended reflections or interpretations of the film) in both conditions facilitated a clear, discrete, and time-efficient memory retrieval manipulation, however, it may have limited the capacity to model gist, which is thought to be more generalized, meaning-focused processing (Reyna et al., 2016). Additionally, gist and context are both dynamic over time and rely heavily on an individual's own interpretation of the event. For example, some may have viewed the film as a depiction of a sexual assault, others a physical assault, and still others bullying. Depending on an individual's own interpretation, eliciting retrieval of some aspects of the film clip may have been more or less aligned with an individual's own experience of the film's gist. Additional research with alternative operationalizations of gist, particularly those aligned with an individual's own event

interpretations and allowing for more generalized retrieval that doesn't rely on verbatim details, will help to clarify the role of gist-related retrieval.

There are several limitations to this study. While this work advances this area of research by including more contextually rich stimuli (12 min film clip vs. still images or video montages of disasters), future studies that manipulate context and gist based on individuals' own interpretations of the film might better capture these concepts. For example, future work might ask individuals to identify their own context and gist retrieval prompts following film viewing to be used to guide subsequent retrieval. Additionally, measuring reactions to more evocative stimuli (e.g., more distressing trauma analogue, real-world potentially traumatic event) would help to clarify the impact of post-event memory retrieval on the frequency of intrusive memories; the overall low frequency of intrusions reported in this study and the rapid decline of intrusions by day 3 of the study limited our capacity to observe trajectories of change over time. Indeed, trauma film paradigm studies are inherently limited in their application to clinical samples given the considerably lower level of stress at encoding and potential lack of personal relevance or actual threat associated with a trauma film viewing relative to a traumatic event. Conducting experimental work is a necessary but not sufficient step to better understanding the role of memory retrieval in trauma survivors. Finally, the non-representative racial demographics, higher than average academic performance, and exclusion of individuals with exposure to physical or sexual assault and suicidal ideation in the sample represent factors that constrain the potential generalizability of these results.

The current study adds to the emerging empirical literature evaluating the prospective impact of post-event contextual processing, with implications for survivors of trauma. Repeated retrieval of the broader context and also the gist of the trauma film facilitated decreased intrusion

distress and vividness. Specifically, this is the first experimental study to manipulate contextual- or gist-level processing at retrieval, rather than at encoding, consistent with the retrieval-based feedback loop model of intrusions (Marks et al., 2018). Indeed, the brief and easily scalable memory retrieval protocol used in this study facilitated early and modest effects on intrusion distress and vividness in the context and gist conditions relative to the control condition.

Research in samples with higher overall intrusion frequency will help to evaluate the role of retrieval on intrusions, particularly given that decreases in intrusion distress and vividness levels, as observed in this study, tend to predict subsequent decreases in intrusion frequency (Marks et al., 2018; Nader et al., 2000). Understanding the relationship among contextual, gist-focused, and other types of encoding and retrieval processing that are hypothesized to impact intrusive memory characteristics, such as data-driven processing (Ehlers et al., 2004; Roediger, 1990) and semantic processing (Park & Blake, 2020) will help this area of post-event memory processing move forward given the considerable overlap of several of these concepts. Qualitative research that works with trauma survivors to understand the characteristics of adaptive memory processing will help develop novel hypotheses to refine the current understanding of how to interact with one's trauma memory in the peri- and post-traumatic periods. Critically, brief memory prompts such as those used in this study are associated with much lower intensity and are more highly-scalable than imaginal exposure protocols for the prevention of chronic PTSD. Accordingly, further investigation in this understudied area may hold promise for better understanding post-event memory processing and potentially developing early interventions to prevent the development of PTSD and other trauma-related disorders.

Table 1*Demographics and Baseline Psychopathology*

	M (<i>SD</i>) or Percentage	Range
Age	19.06 (2.04)	18 - 35
Gender (% woman)	59.8	
Race/Ethnicity		
Asian or Asian American	70.1	
Black or African American	1.1	
Latinx, Latino, Latina, or Hispanic	3.4	
Middle Eastern or North African	4.6	
White or Caucasian	16.1	
GPA	3.59 (.45)	.7 – 4.0
PTSD Criterion A exposure (PDS-5)	42.0%	
PTSD severity (PDS-5)	2.80 (6.71)	0 - 31
Alcohol use disorder severity (AUDIT; <i>n</i> = 84)	1.82 (2.66)	0 - 11
Depression severity (PHQ-9)	4.40 (3.98)	0 - 18
Generalized anxiety severity (GAD-7)	4.51 (4.66)	0 - 18

Note. GPA = Grade Point Average; PDS - 5 = Posttraumatic Diagnostic Scale for DSM-5; AUDIT = Alcohol Use Disorder Identification Test; PHQ-9 = Patient Health Questionnaire, depression module; GAD-7 = Generalized Anxiety Disorder scale.

Figure 1a

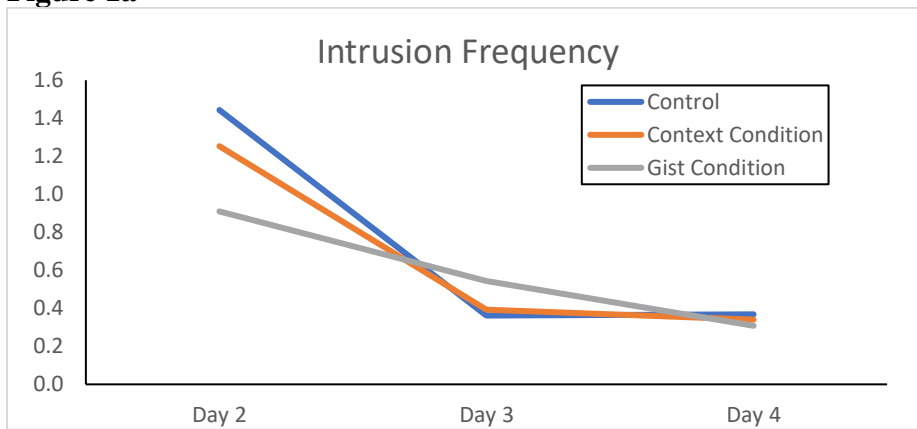


Figure 1b

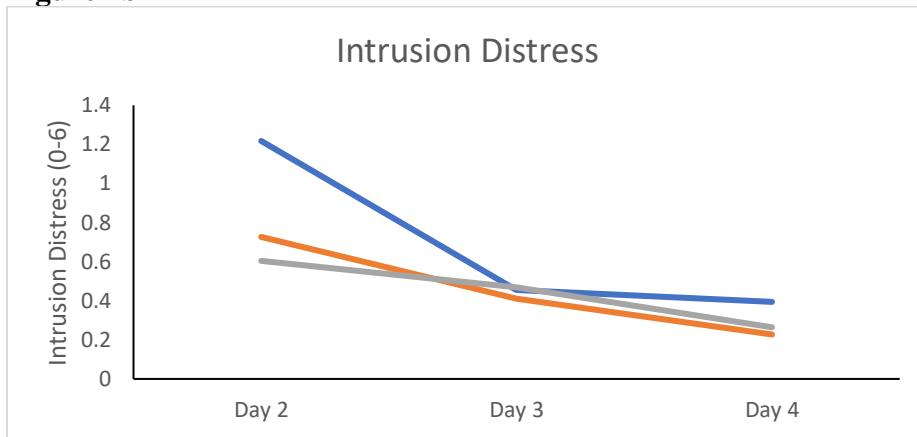
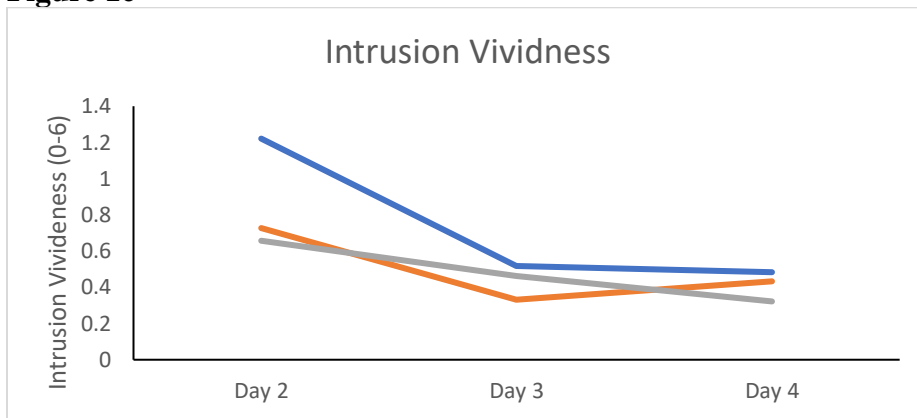


Figure 1c



Note. Figures 1a-1c show estimated scores from MLM for daily diary self-report of intrusion frequency and characteristics across the three day follow-up period. As can be seen in 1b and 1c, intrusion distress and vividness decreased across follow-up, particularly among those guided to retrieve contextual and gist-related details of the trauma film.

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