Retrieval-Induced Forgetting: A Proposed Mechanism for Intrusive Reexperiencing in Posttraumatic Stress Disorder

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Abstract

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Prominent theories of PTSD implicate the disorder-specific process of memory fragmentation as a key mechanism underlying intrusive reexperiencing. Across methods used to explore fragmentation in PTSD, we see these theories do not hold up well as studies fail to show a compelling association between fragmentation and PTSD. In the current study, an alternative retrieval inhibition explanation of intrusions was explored, using the distressing film paradigm to examine memory performance, fragmentation, and intrusion in an analogue undergraduate sample. Using a modified between-subjects retrieval practice paradigm, 165 participants watched a distressing film and were then randomized into one of three conditions; a retrieval practice condition, a no-retrieval practice condition, and a presentation only condition. As predicted, intrusion for film stimuli differed between groups showing both facilitation effect of practice and the RIF effect, demonstrating that the manipulation successfully shifted unintentional recall of memory for the film stimuli. Intentional free recall also

differed by group. A facilitation effect was seen; practiced material was recalled more frequently than unpracticed material. However the RIF effect was not observed. Rather than events from the film being recalled more frequently by participants who did not engage in retrieval practice of the film stimuli, as compared to recall for unpracticed events from the practice condition events, the opposite was true. Unpracticed events in the practice group were recalled more frequently than the same events in the no-practice group. The pattern indicated that increased contact with the film appeared to facilitate recall of the unpracticed events and that retrieval practice facilitated unpracticed events beyond that of mere increased contact. Findings are related to boundary conditions of RIF. As the current study proposed an alternative mechanism to fragmentation, the study was designed to examine the role of retrieval on fragmentation indices as well as the association of fragmentation and dissociation on subsequent intrusions. Neither construct was associated with intrusions in the current study; a finding that further challenges fragmentation theories as well as the dissociative encoding hypothesis of PTSD. The need for further study of post-trauma processes, such as differential retrieval, is discussed.

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Introduction

Retrieval-Induced forgetting: A Proposed Mechanism for Intrusive Reexperiencing in PTSD

Fragmentation theories of posttraumatic stress disorder (PTSD) suggest that the state or condition of the trauma memory has a key role in the etiology and maintenance of the disorder (Brewin, Dalgleish, & Joseph, 1996; Foa & Rothbaum, 1998; van der kolk & Fisler, 1995). Theories vary in the proposed mechanism underlying fragmentation (e.g., peritraumatic dissociation, alternative memory processes) but typically concur that altered peritraumatic encoding processes result in a disjointed, incomplete, and unorganized memory for the traumatic event and this leads to key symptoms associated with the disorder, most specifically the intrusive reexperiencing symptoms (i.e., flashbacks, nightmares, intrusive reexperiencing, distress upon reminder) and lack of complete memory for trauma events. Fragmentation-based theories are primarily informed by anecdotal clinical reports of trauma memory disruptions and abnormalities reported by clients seeking treatment for trauma-related difficulties. While empirical findings regarding trauma narrative fragmentation are inconclusive (Bittinger, 2005; Zoellner & Bittinger, 2003), the fragmentation hypothesis of PTSD continues as perhaps the most widely held view of trauma-related psychopathology. Support for fragmentation theories appears in a number of studies that examine the state of trauma memories across two broad categories of related research, trauma narrative analysis (e.g., Amir, Stanford, Freshman, & Foa; 1998; Gray & Lombardo, 2001; Halligan Michael, Clark, & Ehlers, 2003) and metamemory

assessment studies (e.g., Halligan et al., 2003; Tromp, Koss, Figueredo, & Tharan, 1995; van der Kolk, Burbridge, & Suzuki, 1997; van der Kolk, & Fisler, 1995). Narrative studies, as the name suggests, examine a verbal or written narrative of the traumatic event using either objective linguistic coding procedures via computer program or more subjective coherence coding schemes evaluating organization and coherence by trained evaluators. Metamemory studies (e.g., Engelhard, van den Hout, Kindt, Arntz, & Schouten, 2003; Koss, Figueredo, Tharan, & Tromp, 1996; Porter & Birt, 2001), in contrast, ask participants to comment on or rate the condition of their trauma memory often by the use of self-report questionnaires or through a single global item.

Consistent with anecdotal reports, in a number of early studies assessing metamemory for trauma, individuals with PTSD often describe their memories as being fragmented, highly sensory in nature, disorganized, and that coherent narratives of the traumatic event only emerge over time (e.g., van der Kolk et al., 1995, 1997, 2001). However, in studies where greater control is included and psychometrically validated measures of metamemory fragmentation are incorporated, while traumatic memories are rated as typically more in sensory in nature than other memories (e.g., smells, vividness; Byrne, Hyman, & Scott, 2001; Koss et al., 1996; Porter & Birt., 2001; Tromp et al., 1995), they do not differ terms of fragmentation (e.g., disorganization) and fragmentation is not typically associated with PTSD (Byrne et al. 2001; Megias, Ryan, Vaquero, & Frese, 2007; Porter & Birt, 2001).

In contrast to studies asking for global metamemory appraisals, narrative studies ask participants to produce a description of their traumatic event, either in written or verbal form. To measure fragmentation, narratives are typically analyzed for features such as structure and coherence. Unfortunately, operationalization of fragmentation and assessment methods vary widely in these studies, including single global ratings of fragmentation by trained raters (e.g., Hellawell et al., 2002), qualitative analyses of narrative content (e.g., Foa, Molnar, & Cashman, 1995), and computer-calculated indices such as reading ease and grade level (e.g., Amir et al., 1998) making it difficult to compare results across investigations. A number of studies have investigated fragmentation by collecting narrative accounts for individuals with trauma-related psychopathology, either PTSD or acute stress disorder (ASD). Some studies found support for the fragmentation hypothesis (e.g., Halligan et al., 2003; Harvey & Bryant, 1999); yet others failed to support a fragmentation account (e.g., Foa et al., 1995; Gray & Lombardo, 2001; van Minnen, Wessel, Dijkstra, & Roelofs, 2002). Overall, many studies have mixed results where some concurrent or prospective association is detected (Foa et al., 1995; Halligan et al., 2003; Jones, Harvey, & Brewin., 2007; Murray, Ehlers, & Mayou., 2002) however in these studies fragmentation does not appear to reduce with recovery or treatment (Halligan et al., 2003; Harvey & Bryant, 1999; Jones et al., 2007; Moulds & Bryant, 2005; van Minnen et al., 2002), indicating that although some associations are detected, the two constructs do not appear to move together. Notwithstanding, most studies to date have notable design issues or limitations that make drawing firm conclusions quite difficult.

The majority of these studies are limited by small sample size, lack of key comparison groups that would help isolate effects to PTSD specifically (e.g., trauma exposed no-PTSD), lack of comparison across types of events (e.g., positive, neutral, negative), and lack of control for confounding variables (e.g., cognitive ability, state anxiety). If fragmentation is a key mechanism underlying intrusions in PTSD, then across studies, fragmentation and PTSD should be consistently associated with one another and varying together; and this evidence is lacking.

Although there is less than compelling support for fragmentation theories, nevertheless, an information processing account of PTSD may be still be germane, as defining features of the PTSD include hypermnesia for the event and event-related material in the form of intrusions, and hypomnesia or reports of inability to remember key parts of the trauma. To investigate alternative explanations of these symptoms, we can look to the general memory literature for processes known to impact retrieval of memory. Perhaps the most central memory constructs related to intrusive recall are those of storage strength, that is, how well learned or inter-associated the item is with other items in memory, and retrieval strength, that is, how accessible, primed or activated the representation is with respect to its associated retrieval cues (Bjork & Bjork, 2006). Both storage and retrieval are strengthened by recall and alternatively weakened by disuse. Perhaps more importantly, while storage in memory is considered an unlimited capacity, retrieval capacity is not. Hence, there is a limit to the number of items that are retrievable at any point in time in response to a retrieval cue. This limited nature of retrieval capacity results in retrieval competition; whereas relative retrieval

strengths of some items are increased, other items related to the same cue become less recallable or are inhibited by the strength of the retrieved items. Said more simply, increasing the ease of retrieval of a memory can occur by repeatedly retrieving the memory and in doing so other pieces of memory associated with the same retrieval cue becomes less available for retrieval. It is this basic process, commonly termed retrieval-induced forgetting (RIF) that may help explain both hypermnesia and hypomnesia seen in PTSD, where the repeated retrieval of information to a cue functions to increase its retrieval strength at the expense of inhibiting the accessibility of other information related to the same cue.

These normative memory processes may have interesting implications when applied to post-trauma phenomena. Traumatic events and the resulting trauma memory, by their nature, are highly salient and will naturally be recalled frequently in the immediate aftermath of trauma. This initial recall, then, will function to strengthen both storage and retrieval strength of the memory. However, as with any memory, it is typically not the entire trauma memory that is retrieved. Likely, there are sections of the trauma memory with particular meaning and salience (e.g., the face of a perpetrator as he threatens and attacks) that are retrieved more frequently and as a result the relative storage and retrieval strength of these portions of memory will be increased. In addition, these fear-inducing pieces of the trauma memory when recalled stimulate distress and hence retrieval is often terminated quickly to avoid distress, again resulting in repeated differential retrieval of truncated portions of the trauma memory. This repeated selective retrieval practice will likely both increase the retrieval and storage

strength of those memories and decrease the strength of those portions of the memory not receiving repeated retrieval. The result of this differential impact on retrieval strength, then, may be hypermnesia or intrusions for hot spots of trauma memory, with the alternative experience hypomnesia or unavailability of other pieces of trauma memory.

The specific term retrieval-induced forgetting (RIF; Anderson, Bjork, & Bjork, 1994) refers to the robust finding that retrieval of items, typically word category associates, from memory appears to inhibit the retrieval of related (semantically or episodically) items. This inhibition has been suggested to represent a mechanism for the adaptive forgetting of unneeded information and a mechanism for the continued updating of information in memory. RIF is typically examined using the retrieval practice paradigm (Anderson et al., 1994). The prototypical retrieval practice paradigm has four phases: 1) an initial *study phase* where lists of word pairs (category words and exemplars) are presented to participants (e.g., Fruit: orange; Flower: tulip; Animal: cat); 2) a *retrieval practice phase*, where some but not all category words (e.g., Fruit, Flower) are presented with a subset of exemplar stems, and participants practice retrieving the association through a word stem completion task (Fruit: ora____; Flower: tul__); 3) a *distracter phase*, and 4) a final *test phase*, where free recall is examined for practiced category-exemplar pairs (RP+; Fruit-orange), unpracticed pairs from the practiced categories (RP-; Flower-rose), and unpracticed pairs from unpracticed categories (N; Animal-lion). As expected, RIF studies typically find the highest recall rates for practiced words from practiced categories (RP+), demonstrating

that practice itself facilitates retrieval. While we would expect practice to enhance recall of practiced events over unpracticed ones, the standard RIF effect is demonstrated when unpracticed words from practiced categories (RP-) are actually recalled *less* frequently than unpracticed words from unpracticed categories (N), indicating that retrieval of information that is related to retrieved information is inhibited beyond the mere effect of lack of practice. Thus retrieval practice of some items inhibits recall of associated unpracticed items.

While the vast majority of studies investigate the RIF phenomenon utilize standard semantically related category-exemplar word lists, a more recent trend broadens the types of stimuli used to test the phenomenon using more complex and personally-relevant stimuli. The RIF effect has been demonstrated using geometric shapes (Ciranni & Shimamura, 1999), facts (Anderson & Bell, 2001; Macrae & MacLoed, 1999), participants' own actions (Koustaal, Schacter, Johnson, & Galuccio, 1999; Sharman, 2011; Stone, Barnier, Sutton, & Hirst, 2010), academic testing material (Macrae & McLeod, 1999), eyewitness memory (MacLeod, 2002; Saunders & McLeod, 2002; Shaw, Bjork, & Handal, 1995), and personality judgments/social cognition (Dunn & Spellman, 2003; Storm, Bjork, & Bjork, 2005). Overall, the RIF effect is found across studies and appears to be quite robust. Perhaps the most compelling modification of this paradigm is the incorporation of participants' autobiographical memories into a retrieval practice. Barnier, Hung, and Conway (2004) elicited both emotional and unemotional (negative, neutral, or positive) autobiographical memories from male and female undergraduates. Manipulating

retrieval practice of these personal memories, results demonstrated the prototypical RIF finding that unpracticed memories from practiced categories were recalled less frequently than unpracticed memories from unpracticed categories. Subsequently, Wessel and Hauer (2006) explored the potential that RIF may be a mechanism underlying the observed overgeneral nature of autobiographical memories as seen in depressive and posttraumatic stress disorders (Moore & Zoellner, 2007). Specifically, Wessel and Hauer (2006) hypothesized that repeated intrusions may lead to overgeneral autobiographical memory, suggesting that intrusive memories themselves are a form of retrieval practice that reduces the accessibility or availability of related autobiographical memories and may result in a more global overgeneral retrieval style. Partially consistent with this hypothesis, using both self-nominated positive and negative autobiographical memories in a non-clinical sample, Wessel and Hauer (2006) replicated the standard RIF effect, though the effect was smaller than is seen in standard word-list paradigms.

While typically studied in non-clinical samples as a normal cognitive process, the RIF paradigm has been extended to examine the interaction of RIF and psychopathology. The RIF effect has been examined in samples with general social phobia (Amir, Coles, Brigidi, & Foa, 2001), clinical depression (Groome & Sterkaj, 2010), dysphoria (Harris, Sharman, Barnier, & Moulds, 2010; Moulds & Kandris, 2006), schizophrenia (Nestor, Piech, Allen, Niznikiewicz, Shenton, & McCarley, 2005) and PTSD (Amir, Badour, & Freese, 2009; Blix & Brennen, 2012; Brown, Kramer, Romano, & Hirst, 2012; Koessler et al., 2010). Examining RIF in clinically

depressed individuals as compared to non-depressed controls, Groome and Sterkaj found a facilitation effect in both groups for typical neutral word list stimuli. However, the RIF effect was seen only in the control participants, suggesting a deficit of inhibition processes for the depressed group. Examining generalized social phobia, Amir and colleagues (Amir et al., 2001) found the standard RIF effect with both individuals with social phobia and non-anxious controls. However, for individuals with social phobia, there was no inhibition of unpracticed negative social words from practiced categories, or no RIF effect, suggesting increased salience for negative social information in individuals with GSP may have interfered with the inhibition of these words. A similar failure of inhibition for negative but not neutral words was demonstrated in a non-clinical sample of dysphoric individuals (Moulds & Kandris, 2006) again, suggesting that the salience of negative words to individuals with dysphoria may have interfered with normal inhibition processes. No failure of inhibition was seen when RIF was examined in individuals with schizophrenia (Nestor et al., 2005), although word stimuli in this study were neutral only and therefore results are consistent with the two previous psychopathology studies that demonstrated the typical RIF effect with neutral words. Though preliminary, these studies suggest that failure of inhibition in clinical samples may reflect a bias toward categorically salient negative words.

Recently, citing theories of inhibitory deficits in individuals with PTSD, researchers have begun to examine the RIF effect using trauma-exposed and PTSD samples. Amir and colleagues (2009) investigated RIF in a mixed sample of

undergraduate students. The standard RIF effect was found for the non-traumatized control group. However, the effect was not seen for the PTSD group or the trauma-exposed, no-PTSD group. Of interest, the PTSD group actually showed a smaller benefit from practice, or facilitation effect, than did the other groups. The lack of the RIF effect here is notable given the stimuli were typical neutral categories of fruits and drinks. Findings suggest that a deficit of inhibition more generally may differentiate the groups rather than a response specific to neutral or trauma-specific material. This potential deficit, however, was not associated with post-trauma psychopathology, but rather, for trauma exposure itself and therefore is less applicable to differentiating processes the underlie psychopathology. Examining the effect of emotionally valenced stimuli, Blix and Brennen (2012) applied the RIF paradigm comparing a group of sexual assault victims and non-victimized controls. Measuring recognition, and not recall, no group differences were detected. Rather, across groups a RIF effect was detected for neutral material but not for positive, negative, or trauma-specific words. Findings indicate that valence of material had an effect on RIF, not trauma exposure, per se. Again, this study did not investigate differences between trauma exposed and PTSD groups, so findings are less applicable to mechanisms underlying PTSD. Brown and colleagues (2011) investigated RIF across groups of combat veterans with PTSD, veterans without PTSD and non-veterans. Across two experiments RIF effects were detected for a neutral story with no group differences. When combat-related stories were used again RIF effects were detected across groups, indicating that trauma exposure or PTSD groups did not demonstrate a deficit for inhibition of neutral or

trauma-related material. In fact, the PTSD group not only demonstrated the RIF effect for the combat related material but the size of the RIF effect was largest for the PTSD group when combat-relevant material was used. This finding appears to contradict that of Amir and colleagues (2009) that suggest a general deficit of inhibitory abilities in individuals with PTSD and instead findings were that the individuals with PTSD in this sample had enhanced ability to inhibit trauma-specific material. Doelssler and colleagues examined RIF using a pictorial RIF paradigm in German university students without PTSD and Ugandan refugee camp residents with and without PTSD. Testing recognition, rather than the typical free recall of stimuli, the RIF effect was detected for the German students but not for the Ugandan refugees with or without PTSD. Interpretation of these results is difficult given the novel nature of the stimuli and the unique characteristics of a sample of refugees currently residing in a refugee camp. Overall these preliminary studies attempting to uncover deficits in inhibitory processes through the RIF paradigm have demonstrated notably mixed findings that, of yet, have not demonstrated that a lack of RIF distinguishes trauma-exposed (or non-traumatized controls) individuals from those with PTSD or that negative valence/trauma relevance plays a role in inhibitory processes.

Preliminary studies that have examined RIF in relation to psychopathology are aimed at the premise that abnormalities in the normal process of retrieval inhibition may underlie psychopathology. While a cogent picture has yet to emerge, the application of retrieval inhibition suggested in the current study differs quite notably in intent from this body of research. Rather than suggesting that abnormalities in RIF

underlie pathology (e.g., intrusions in individuals with PTSD), we suggest normative and typically adaptive retrieval inhibition processes may underlie the generation of intrusions in general, across disorders and in non-clinical samples. That is, that a normative process underlies the generation of unwanted intrusions rather than a lack of normative inhibition. As such, the current study extends the typical retrieval practice paradigm to investigate the possibility that selective or differential retrieval of pieces of a distressing memory may increase retrieval strength of those pieces leading to unwanted intrusions of this memory. Further, that this increase in retrieval strength may lead to an inhibition of aspects of the memory not recalled. And further, that this differential impact on retrieval strength may underlie apparent narrative fragmentation.

To investigate these hypotheses an analogue design testing memory for a distressing film was used to control for event encoding. This design was chosen over a more naturalistic autobiographical memory design (e.g., Wessel and Hauer, 2006), as examining individual autobiographical memory does not allow control for what memory was encoded, for what events "should" be there, and for idiosyncratic differences in experience (e.g., valence, severity, meaning, time since event). Further, given the potential differences in encoding of threat-relevant information due to dissociative processes (e.g., DePrince & Freyd, 2004; Terr, 1994), the sample was divided for analyses using a median split, resulting in groups representing high and low trait dissociation (e.g., Zoellner, Alvarez-Conrad, & Foa, 2002). Thus, examining memory for a controlled stimulus with a measure of control for dissociative encoding

style, this analogue design both allows a more precise measurement of the accuracy of memory as well as the potential influence of a dissociative encoding style.

In a between-subjects design, after viewing a distressing film clip, participants were randomized into one of three conditions: a retrieval practice condition (RP), a no retrieval practice condition (NRP), and a re-presentation condition (P). Modeled after a typical RIF paradigm, the RP condition contained selective retrieval practice of a subset of events (RP+) and no practice for a subset of related events (RP-). Further, the NRP condition provided a control condition where no practice of the film content occurs, allowing for the demonstration of the standard RIF effect, where NRP events are recalled more frequently than RP- events. Given that the RP condition has more contact with film content via practice, and contact alone could account for subsequent intrusions, a novel re-presentation condition (P) was also included. Further, this condition, not typical of RIF studies, allows a specific examination of retrieval mechanism compared to simple presentation or re-encoding. Key dependent variables are percentage of correct recall of film events, objective and subjective measures of narrative fragmentation, and frequency of intrusions for film content. Free recall of the film and narrative fragmentation were assessed both immediately and 72-hours later. Intrusions were assessed through the use of a 72-hour diary.

We predicted, first, if selective retrieval practice increases retrieval strength, RP- events will be recalled less frequently than NRP events, demonstrating the typical RIF effect. Second, if retrieval practice increases retrieval strength of practiced events inhibiting memory for other events, film narratives generated by participants in the

retrieval practice (RP) condition would be more fragmented than film clip event narratives generated by participants in either of the control condition (NRP). Third, if increasing retrieval strength of events through retrieval practice functions to increase the likelihood of intrusions for practiced events, over a 72-hour diary monitoring period, participants in the retrieval practice condition (RP) would experience more intrusive thoughts compared to participants in either of the control conditions (NRP). Furthermore, we predicted the RIF effect will extend to content of intrusions, therefore, in the RP condition, practiced events (RP+) would occur more frequently as intrusions than unpracticed events (RP-); and more importantly, following patterns of RIF these RP- events would occur as intrusions less frequently than the same events in the NRP condition.

Method

Participants

One hundred and sixty five undergraduate participants were recruited through the University of Washington psychology department subject pool. Of the 165 participants 161 were retained for analyses. Given that most key dependent variables were derived from narratives provided by each participant, three participants were excluded from analyses, one from each condition, as their narratives lasted under 2 minutes. An additional case was deleted whose narrative was 50 minutes long, over 5 standard deviations from the mean. The final sample (N = 161) was comprised of females (n = 90) and males (n = 71) between the ages of 18 and 65 and fluent in English. Participants received course credit, with one credit given per hour of participation up to a maximum of six credits over two testing sessions. For analysis participants were further divided into high and low trait dissociation groups, using a median split (Med = 12.14) of scores on the Dissociative Experiences Scale (DES; Bernsten & Putnam, 1986). The sample was reasonably diverse in terms of ethnicity. Age and education variables were reflective of a college sample. Demographic information is presented for all participants and seperately by condition, in Table 1.

Study Design

This study employed a 2 x 3 between-subjects design, with Group (High DES, Low DES) and Condition (retrieval practice (RP), no retrieval practice (NRP), re-presentation (P)). The main dependent variables were the proportion of items correctly recalled from the film, objective and subjective measures of narrative fragmentation,

and frequency and characteristics of intrusions of the film content recorded over a 72-hour period. In addition, potentially confounding variables such as trauma exposure, PTSD, cognitive ability, anxiety/distress, and dissociation were also examined, and when relevant, included in analyses.

Distressing Film Paradigm

A distressing film clip was used as an analogue for a real-world potentially traumatic experience. Such films have been previously used safely and effectively to induce film-related intrusion (e.g., Gross & Levensor, 1995; Holmes, Oakley, Stuart, & Brewin, 2006; Horowitz, & Becker, 1971; Laposa & Alden, 2006; Lazarus, Opton, & Tomita, 1966; Stuart, Holmes, & Brewin, 2006). Following the method employed by Marsh, Tversky, and Hutson (2005), the film clip was chosen to fit three criteria. First, the clip must be disturbing to watch. Pilot testing with members of the research lab, not affiliated with this project, confirmed that the film clip was distressing as it reliably increased SUDS level pre- to post-film. Second, distressing scenes in the film were consistent with the DSM definition of a potentially traumatic event (APA, 2000). Film events included sexual (e.g., fondling and kissing at gun point) and non-sexual (e.g., stabbing, shooting, severe beating, graphically violent hand-to-hand fighting) assault, and the violent murder of four of the characters. And third, although the clip was selected to be distressing, scenes were taken from a major motion picture released with an "R" rating, therefore consistent with films commonly viewed by participants. The stimulus chosen was a 17 minute segment from the film The Devil's Rejects that met all of the above criteria. As the film chosen was not widely seen by participants we did

not pre-select individuals who had not seen the movie. This was also done with the intention of keeping information about the study less available to potential participants. Therefore, after viewing the film participants were asked to indicate if they had seen the film, how many times, and approximately how long ago. Only 9.9% of participants endorsed having seen the film stimuli prior to the study and this variable did not differ between groups (See Table 2), therefore data from these subjects was retained for analyses.

Retrieval Practice Conditions

In preparation for the study, the clip was divided into 24 short (M = 28 seconds, *Range* = 14 – 36) salient events. Events were selected such that memory items from each event would not occur in other events to insure that coding for memory would be precise. These events were manipulated for the following retrieval practice conditions.

Retrieval practice (RP). For participants in the RP condition, half (12) of the identified events in the film were practiced (RP+) and half were not (RP-). As full counterbalancing of event presentation orders was not feasible, these events were counterbalanced across participants such that each event occurred as RP+ and RP- with the same frequency. To facilitate analysis of items by practice condition, four orderings of stimuli events were generated. A pool of events was generated with each event occurring three times. Events were drawn, at random, for the ordering with the only constraint that no event would occur twice in a row. When the same event was pulled consecutively it was put back in the pool and another draw was made.

No retrieval practice (NRP). In the NRP condition, after viewing the entire film clip as did participants in all of the conditions, no short film segments were shown. Instead, a distracter task (i.e., completing a large questionnaire on experiences with varied forms of media, other self-report questionnaires) was inserted to control for the amount of time between film and test as in the other two conditions.

Presentation only (P). In the P condition, using the same counterbalancing and randomization procedures as the RP condition, the same segments from the film were presented, mirroring the RP condition. Rather than having a break for retrieval practice, each segment ran from start to completion with a 5 second additional break between segments to help control for time. Participants in this condition completed additional questionnaires to serve as a distractor task to equate the time between initial film viewing and the memory testing phase.

Free Recall Test

A verbal narrative recounting of the film events served as the free recall test of film memory. Narratives were collected at the end of session one and again at session two three days later. Audiorecorded narratives were transcribed and coded for specific indices including coding for the presence and absence of film events.

The memory coding protocol (i.e., specific items, coding rules) was developed to assess the memory for events seen in the film. In the first phase of development, a focus group of four research assistants in addition to the principle investigator (PI) viewed the film in multiple iterations listing each event in order of occurrence in the film. Viewings occurred in both group and individual sessions. Each subsequent

viewing was used to add items to the preexisting version of the list or adjust items for accuracy and detail. The list was considered final when all five group members indicated that they had viewed the film twice without detecting any additional items or changes needed for accuracy. The final list contained 358 items which were available for coding. Of these 344 actually appeared in at least one of the narratives coded and were used to calculate variables for determining percentage of correct recall for subsequent analyses.

In the second phase of pilot testing, five new participants completed the narrative recall task. These participants viewed the film stimuli a single time. Again, pre-film, post-film and peak SUDS levels were collected. After viewing the segment, pilot participants provided a narrative account of the film segment. These narratives were evaluated for presence of elements recalled based on the list of events generated in the focus group phase. Given the full coding protocol was not yet developed to measure dependent variables that would be used in the final analyses, these participants appeared to recall events in such a way that floor and ceiling effects were considered unlikely.

Ten percent (33) of narratives were selected to be coded by both coders for reliability purposes. Given the nature of the task, reliability was assessed using the number of "hits" when coders both coded an item as being recalled as a percentage of the number of items coded as recalled. This was the most conservative measure of reliability considered as using the number of potential hits would have unreasonably inflated reliability (i.e., percent agreement for items not present was nearing 100%) .

Percentage hits ranged from 80% to 100% with a mean of 93%, indicating good agreement between the two coders.

Narrative Coding

Narratives were audiotaped, transcribed, and coded using both objective and subjective indices.

Objective narrative fragmentation coding. The coding system used to more objectively evaluate narrative fragmentation was based on the system first used by Foa and colleagues (1995) and used in varied modified forms in subsequent studies (e.g., Halligan et al., 2003, Jelinek, Randjbar, Seifert, Kellner, & Moritz, 2009). After transcription of verbal narratives, each narrative was divided into "chunks" or meaningful units by two trained coders. Ten percent of narratives were coded by both coders for reliability. Then chunks were coded into a series of categories (repetitions, organized thoughts, unfinished thoughts, actions, feelings, sensations, details) and the number of speech fillers (e.g., um, uh, ah) were calculated as well.

These categories have primarily been applied to narratives of actual trauma memory. As the current story is using memory for a film, certain determinations needed to be made to adjust the coding protocol. For example, sensations were only coded when participants articulated that they themselves had a sensation (e.g., saw something, heard something) and not when participants indicated that a character in the film had a sensation. As fragmentation is considered to encompass multiple types of speech, categories considered indicative of fragmentation were combined (i.e.,

repetitions, disorganized thoughts, unfinished thoughts) and divided by the total number of chunks for a percent fragmentation score. Speech fillers were also counted and percentages used as an index of fragmentation. Speech fillers were not included in the fragmentation percentage as speech fillers typically generated an "unfinished" chunk. Counting both unfinished chunks and speech fillers was determined to be artificial inflation of the measurement of the construct. Coding instructions are provided in Appendix B.

Ten percent (33) of narratives were selected to be coded by the full coding team for reliability purposes. Given the nature of the task, reliability was assessed using percent "hits" when coders were in agreement. Reliabilities were coded separately for chunking and coding processes. With regard to chunking, percent agreement was calculated for each of the 33 narratives. Percentage hits ranged from 86% to 98% with a mean of 94%, indicating very high agreement between the two coders. For fragmentation coding 33 narratives were selected without regard to narratives selected for other reliabilities (with replacement). Again percentage agreement was calculated. Given there were 3 coders, a hit was only calculated if all 3 coders agreed. In the thirty three narratives selected for reliability, percentage agreement ranged from 79% to 96% with a mean of 91%. Again, these values indicate more than adequate reliability between coders.

Subjective film narrative coding. Similar to methods used in past studies (e.g., Halligan et al., 2003; Murray et al., 2002), after each narrative was transcribed into written form, a trained coder blind to condition read and coded narratives assigning a

single global narrative score using a 0 to 10 anchored scale (0 = *not at all*, 10 = *extremely)*. The coding instructions are provided in Appendix A. To examine interrater reliability, 10% of the narratives (32) were selected for recoding by a second trained coder. ICC for these ratings was .92 indicating exceptional inter-rater reliability.

Metamemory

Metamemory judgments were assessed using both a standardized questionnaire and single global ratings.

Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988). The MCQ was used to assess participants' metamemory for the film stimulus. The MCQ is a 38-item questionnaire that assesses a range of memory characteristics including visual detail, complexity, temporal information, and emotions. Items are endorsed on a 7-point scale from 1 *(e.g., vague, little or none)* to 7 *(e.g., clear/distinct, a lot)*. To assess fragmentation, similar to Byrne et al. (2001), five sensory items, six vividness items, five clarity items, eleven coherence items, and three emotion items were totaled as subscales and were subsequently summed to create a total fragmentation meta-memory score. These subscales have good internal consistency (Byrne et al., 2001), clarity (.89), vividness (.88), coherence (.81), and sensory (.72), suggesting that the individual items within the subscales correlated well with one another. Items and subscales are provided in Appendix C.

Trauma Memory Questionnaire (TMQ; Halligan, Michael, Clark, & Ehlers, 2003). The TMQ was also used to assess participants' metamemory for the film stimulus. The TMQ is a 13-item measure that asks participants to rate aspects of their

memory on a scale from 0 “Not at all” to 4 “Very strongly”. The measure consists of two subscales. Disorganization assesses deficits in intentional recall or the extent to which memory for the target event id disorganized or incomplete. The Intrusion subscale measures the extent to which the respondents’ memory for the target event is accompanied by a sense of reliving of the event. Reliability in the initial study was Disorganization (a = .88) and Intrusions (a = .90). Wording was changed at the suggestion of the author to facilitate using the measure for memory of a distressing film. The words “the event” were changed to “the film clip”.

Global Ratings. A single item assessing overall metamemory fragmentation was included as well for comparisons with studies using this type of measure (e.g., Halligan et al., 2003). The item was “When you recall the film, do you think of it as a continuous series of episodes or as some isolated incoherent fragments?” Participants were asked to respond using a scale from 0 “not at all fragmented” to 10 “very fragmented”. An additional item asked participants “On the scale below, please rate the degree to which your memory of the film clip has a snapshot quality.” Participants responded using a scale from 0 “not at all” to 100 “very much”.

Intrusions

A paper and pencil diary was used to record any intrusive images or thoughts of the film (based on Holmes, Brewin, & Hennessy, 2004; Stuart, Holmes, & Brewin, 2006) during the 72 hours following the film viewing. Intrusions were defined for participants as, “Any spontaneously occurring (not deliberate) images or thoughts of the film (or related to the film) that suddenly pop into mind spontaneously or are

triggered by something that reminds you of it and not times when you deliberately think about the film or mull it over". For each intrusion, the content of each intrusion ("What was the intrusion of?") and whether it was an image, a thought, or a combination of both was be recorded. In addition, both intensity from 0 (*not very intense*), 100 (*extremely intense*) and level of distress from 0 (*not at all distressing)* to 100 (*extremely distressing*) was recorded. Dependent variables for intrusions were total number of intrusions over the 72 hour monitoring period, average daily distress, and average daily intensity.

To insure data for intrusions and to measure compliance with the diary task, retrospective self-report of intrusions were collected using an intrusion questionnaire, based on the work of Hackmann, Ehlers, Speckens, and Clark (2004), where ratings of the frequency of intrusions, distress, vividness and the "happening now" quality were assessed on a scale from 0 (*not at all*) to 100 (*very much*). Ratings of diary compliance were made at session two, following Davies and Clark (1998); "How accurate do you believe your daily intrusion Diary is? This is the paper diary you just turned in to the research assistant, not this form. That is, how well do those ratings reflect your experience of film-related intrusions over the last few days? The response scale was anchored from 0 (*not at all accurate*) to 100 (*very accurate*). Compliance with the diary task was very high. Not only were ratings of compliance high, estimates for number of intrusions on the measure was nearly identical to counts from the diaries themselves.

Self-report Measures

A series self-report measures was administered to measure demographic and other variables to characterize the samples and to capture potential confounding variables and covariates.

Demographics. Demographic information including age, ethnicity, race, and years of education were obtained using a brief questionnaire.

The Posttraumatic Diagnostic Scale (PDS; Foa, Riggs, Dancu, & Rothbaoum, 1993) was administered as both a measure of previous trauma exposure and self-report PTSD symptoms. Unlike the majority of self-report measures of PTSD that assess only the17 symptoms of Criteria B, C, and D, the PDS assesses Criteria A through F specified by the DSM, including, the objective and subjective criteria for Criteria A status, Reexperiencing (Criterion B), Avoidance (Criterion C), Arousal (Criterion D), as well as the duration (Criterion E) and functional impairment (Criterion F) criteria yielding both a DSM-IV PTSD diagnosis and a measure of PTSD severity. In addition, through a checklist of potential trauma categories, the instrument assesses lifetime trauma exposure and then anchors the symptom reporting to the most distressing or problematic event. The PDS demonstrated high internal consistency (.92 total, .78 reexperiencing, .84 avoidance, and .84 arousal). Test-retest reliability ranges from .74 to .85. High diagnostic agreement (82%) with the Structured Clinical Interview for DSM-IV-TR (SCID) was found: sensitivity was .89, and specificity, .75 (Foa, Cashman, Jaycox, & Perry., 1997).

The Beck Depression Inventory – Second Edition (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II was used to measure depressive symptoms experienced over the previous week including the day of the initial session. The BDI-II is a 21-item self report inventory measuring attitudes and symptoms characteristic of depression. The BDI-II demonstrates high internal consistency. Among student samples, internal reliability of the BDI–II has ranged from .89 (Steer & Clark, 1997; Whisman, Perez, & Ramel, 2000) to .93 (Beck et al., 1996), and among psychiatric samples, the internal reliability has ranged from .89 (Steer, Rissmiller, & Beck, 2000) to .92 (Beck et al., 1996). Evidence for criterion-related validity comes from data showing that patients diagnosed with major depressive disorder score significantly higher on the BDI–II than those without the diagnosis (Arnau, Meagher, Norris, & Bramson, 2001). Finally, research has shown convergent and discriminant validity for the instrument, demonstrating that it correlates more strongly with other measures of depression than with measures of anxiety (Beck et al., 1996).

The State and Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) is a 40-item measure included to assess both trait and state anxiety. The trait subscale of this measure has good test-retest reliability (.81). The state subscale has lower test-retest reliability (.40), as expected for a measure assessing state emotions (Speilberger et al., 1970).

Dissociation and absorption. Given encoding of the film may be influenced by dissociation and absorption (e.g., Harvey & Bryant, 1999; Holen, 1991); measures of state and trait dissociation and absorption were also administered.

The Dissociative Experiences Scale (DES; Bernsten & Putnam, 1986) was given to assess trait dissociation or an individual's general tendency to experience depersonalization, derealization, and altered perceptions during everyday events. This self-report scale asks respondents to indicate on a series of 28 100-mm analog scales (0 = not at all; 100 = very much) the frequency with which they experience dissociative phenomena (e.g., finding yourself in a place and having no idea how you got there). The DES has demonstrated good test-retest reliability (ranges from .84 to .96; Carlson & Putnam, 1993). The DES was used to divide the sample into those with high and low dissociation.

The Multidimensional Personality Questionnaire-Absorption Scale (MPQ-A; Tellegen & Atkinson, 1974) was included to assess ability to become immersed in an activity or experience. Items assess constructs such if a person can imagine vividly, easily relives the past, becomes engrossed in his own thoughts, and has episodes of expanded or altered awareness. Cronbach's alpha for the absorption scale = .74 (Miller, Greif, & Smith, 2003).

State Emotion. Given that state anxiety and distress may impact both encoding of the film and subsequent narrative production, brief measures of state distress, positive and negative affect and dissociative experiences were administered before, during, and after both film viewing and narrative collection.

Subjective Units of Distress (SUDS; Wolpe, 1990) ratings were used to assess subjective arousal level. SUDs is measured on a 0 to 100 scale, with 0 being "*no anxiety*" and 100 being the "*most anxious you can imagine*"

The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) was used measure changes in state affect through multiple administrations. For each administration, participants were asked to rate both negative (e.g., sadness, anxiety) and positive affect (e.g., enthusiasm, pleasure) on a scale of 1 (very slightly or not at all) to 5 (very much). The PANAS shows good reliability in both clinical and non-clinical samples (ranging from .84 to .90) and has high convergent validity with lengthier measures of mood (Watson et al., 1988).

CADSS. The Clinician Administered Dissociative States Scale self-report adaptation (CADSS; Bremner et al., 1998) was used to measure changes in state dissociative experiences pre- and post- film, as well as pre- and post-narrative. The CADSS is a 21-item measure that assesses state symptoms of dissociation, such as depersonalization, derealization, and altered perceptual experiences, present during each narrative recounting. The CADSS correlates modestly with total scores on other dissociation measures such as the DES (.48) and the SCID-D (.42).

General Memory/Intellectual Functioning. Given that low cognitive ability is a risk factor for PTSD (e.g., Vasterling, Duke, Brailey, Constans, Allain, & Sutker, 2002) and prior findings of narrative fragmentation can be consider to be due to low cognitive ability (e.g., Gray & Lombardo, 2001) we assessed verbal skill as a potential covariate for fragmentation effects.

The Shipley Institute of Living Scale (SILS; Shipley; Shipley, 1967; Kaufman, 1990) was administered as a measure of general cognitive functioning. The SILS assesses both verbal ability and analytical subscales, totaled together into a score of

cognitive ability. The verbal subscale contains 40 forced-choice items, and the abstraction scale consists of 20 series completion items. The SILS is scored through counts of incorrect items subtracted from the total number of items. Omitted items are weighted less than incorrectly answered items. The SILS is correlated (coefficients between .70 and .80) with varied versions of the Wechsler Adult Intelligence Scale (Kaufman, 1990) and was included as a proxy for cognitive ability to control for the potential impact of general cognitive ability on memory performance (Wessel, Merckelbach, & Dekkers, 2002; Williams, Williams, & Ghadiali, 1998). The SILS can be used as raw subscores or the raw total score; however the most reliable score generated is the estimated WAIS Full Scale IQ (Kaufman, 1990). Therefore the estimated WAIS scores were used for analyses in this study.

Cognitive Style.

The White Bear Suppression Inventory (WBSI, Wegner & Zanakos, 1994) is a 15-item self-report measure designed to assess the tendency to avoid, suppress, or withhold unwanted thoughts was administered to all participants. Respondents indicated the degree of agreement with each item using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The WBSI has been found to be significantly associated with frequency of intrusive thoughts in suppression experiments (Muris, Merckelbach, & Horselenberg, 1996). Due to an error in the initial compilation of measures for this study, the items on the WBSI were measured on a 7-point Likert scale with the same anchors at the endpoints and midpoint as described above.

The Questionnaire Upon Mental Imagery (QMI; Sheehan, 1967; Betts, 1909) was included to measure and potentially control for ability to imagine, more generally. This 35-item measure assesses ability to imagine sensory characteristics such as sight, sound, smell, touch, and taste on a scale from 1 (perfectly clear and as vivid as the actual experience) to 7 (no image present at all, you only "know" that you are thinking of the object), with lower scores indicating superior imagery ability. The shortened form of the QMI used here, shows high correlations with actual imagery ability (Sheehan, 1967).

Procedures

Participants from the UW Department of Psychology Human Subjects Pool had the opportunity to volunteer to participate by selecting the study from a list of available studies place on the department website. Students signed up for a specific day/time slot with no more than eight participant slots allowed per session. In Session 1, after an informed consent procedure, participants completed self-report questionnaires (Demographics, PDS, BDI, STAI-T, DES, WBSI, TCQ). Prior to viewing the film, participants then completed baseline measures of state emotion and dissociation (STAI-S, SUDS, PANAS, CADSS). Participants were then given the following instructions:

> You are about to see a brief film clip. We would like to you to focus your attention on the film and engage with the film as much as possible. Please attend to the events as we will be asking you questions about the film in the later part of the study. Though this study is described as studying emotion and

> memory, this is not a test of memory itself but of how emotion and memory interact. Therefore, you are encouraged to engage with the film clip you're about to see as fully as you can, allowing yourself to experience the film without worrying about recalling it later. There is no wrong way to do this. The key is to put your full attention on experiencing the film as fully as possible.

At the end of the film, participants again completed state emotion and dissociation measures (SUDS, PANAS, CADSS). In addition, they were asked to provide a rating of their highest SUDS level (peak SUDS) experienced while viewing the film.

For the subsequent practice phase of the procedure, participant groups were randomly assigned to either: be shown specific film segments and practice retrieval (RP), be shown specific film segments (P), or be given a distracter task (NRP).

Participants in the RP condition were given the following verbal instructions:

> You will now be shown a series of short clips from the film you just saw. Please attend to the clips in the same way that you watched the film. You'll see the first half of each clip and when the screen goes black, you'll see instructions to close your eyes and picture what occurs next, immediately after what you just saw. Do your best to recall this next image as vividly as you can, including the people, images, and actions in the scene. Keep your eyes closed and after a short period of time, you will hear a tone. When you hear the tone, open your

eyes and you'll see instructions on the screen to write down what you just imagined when your eyes were closed. Start writing and after a short time you'll hear another tone to let you know to finish up writing and get ready to watch the 2nd half of the clip. Please flip to the next page of your packet and you'll see a diagram showing you what to do.

So I'll review the instructions again. First you will see the first half of a short film clip followed by instructions to close your eyes and imagine what occurs next in the scene. At that point imagine just the next few moments of action in the scene as vividly as you can, including the people, images, and actions and keep imagining with your eyes closed until you hear a tone to indicate when to open your eyes. When you hear the tone, open your eyes and write down a short description of what you just imagined. Please turn to the next page in your packets to see the form you'll write on. You'll have a short amount of time to write and then another tone will sound to let you know to finish up writing and look up at the screen to watch the 2nd half of that clip. After you've seen the remainder of the segment, you will then see instructions on the screen asking you to rate how closely what you imagined matches what you then saw in the film clip using the rating scale on the page below where you wrote. For the rating we want you to rate how closely what you imagined when your eyes were closed matched the film, not what you wrote down. Make the rating quickly and after you make your rating you will hear another tone which will

signal that the next clip is about to begin and the process will start again for the next film clip. This part of the study is not a test of your general memory abilities. When your eyes are closed please stay focused on imagining the events that occur next in the film. When you are writing, don't pay attention to spelling or grammar as we will not be evaluating your writing or the completeness of your thoughts. The point of the writing is for you to communicate to us and remind yourself what you imagined when your eyes were closed. You may use bullet points or short 2-3 word phrases to indicate what you imagined. It is more important that you stay focused on imagining and the vividness of the image when your eyes are closed than focusing on the writing portion of the task.

Participants in the P condition were given the following instructions:

You will now be shown a series of clips from the film you just saw. Please attend to the clips in the same way that you watched the film.

Participants in the NRP condition were given instructions for a short paper-and-pencil distracter task with the following instructions:

Please flip to the next section and complete the next set of questionnaires. Again, feel free to ask questions at any time.

Following the practice phase, participants in all three conditions completed the

SILS, which served as a proxy measure of intelligence as well as a standardized 20 min distracter task. In the final test phase, participants completed the MCQ, TMQ and global ratings of metamemory. Next, participants were moved to separate rooms and asked to recall the events of the film by generating a verbal narrative of the film. Before beginning the narrative participants were asked to rate their current SUDS level. All participants were given the following instructions based on those from Foa et al. (1995):

> In a moment, I am going to ask you to recall the film as vividly as possible. I don't want you to tell the story in the past tense. Rather, I would like you to describe the events of the film in the present tense, as if it were happening now, in the order in which they occurred and in as much detail as you can, so that somebody who has not seen the film can imagine exactly what happened. I'll ask you to close your eyes and tell me what happened in as much detail as you remember. This includes details about the surroundings, activities, and people. For example, you might say, a blonde haired woman wearing white underwear is sitting on a double bed in what looks to be a motel room. Do you have any questions before we begin? Okay, please close your eyes and when I say "begin" you may begin.

During recounting, a research assistant remained in each room as an unengaged listener, proving minimal standardized feedback only probing for continuation if the narrative recounting did not last 5 min. After completing the narrative, participants again rated their current SUDS level and gave a rating of the peak SUDS. At the end of

Session 1, the intrusion diary was explained as well as the procedure for returning for Session 2, which was scheduled for approximately 72 hours from the first session. At Session 2, paper diaries, ratings of diary compliance, and additional ratings of self-reported intrusions were collected. Memory characteristics (MCQ, TMQ, global ratings of metamemory) and a second free recall task using narrative collection was conducted in the same manner as was done in Session 1. Finally, participants were thoroughly debriefed regarding the nature of the study and received course credit for participation.

Data Preparation

Power Analyses

Power analyses were conducted prior to study recruitment in order to determine sufficient sample size. In the 2 (Group: High DES, Low DES) by 3 (Condition; RP, NRP, P) analyses, to examine the main effect of Group a minimum of 21 participants per cell would provide 80% power to detect a medium effect (Cohen's d = .5) and 9 participants per cell would detect a large effect (Cohen's d = .8). Analyses of data indicated that the lowest number of participants obtained in any of the 6 cells was 23, indicating that the study was sufficiently powered to detect a medium effect of Group. To examine the main effect of Condition a minimum of 13 participants per cell would provide 80% power to detect a medium effect (Cohen's d = .5) and 30 per cell would detect a large effect (Cohen's d = .8). Finally, to detect a simple effect of condition at a level of either high or low dissociation, 25 participants per cell would provide 80% power to detect a large effect (Cohen's d = .8). As this was the first study examining

our main manipulation, the RIF effect using a distressing film paradigm, it was unclear what effect size to predict. As we were interesting in detecting effects that are reasonably large and robust we powered the study to detect between medium and large effects. Therefore, a goal of 26 participants per cell was set which would result in a total sample of 156 participants. As DES scores and the resulting designation of Group are not manipulated in this study cell sizes were not equal. Of the 161 participants spread across the 6 cells, cell size ranged from 23 to 29 participants per cell. Based on values calculated above, this gave us sufficient power to detect medium affects for all of our main outcome variables.

Data Reduction and Preliminary Data Analysis

Data were checked for accuracy, plausibility, presence of univariate and multivariate outliers, assumptions of normality, and correlations among key variables using the SPSS statistical package. Accuracy was explored by first examining descriptive statistics (e.g., mean, standard deviation, range) of continuous variables and frequencies of categorical variable responses to look for implausible values. Data were explored for the presence of outliers examining box plots and by using Cook's distance procedure, a measure of univariate outlier influence, and Mahalanobis distances, a measure of multivariate outlier influence. Next, assumptions of normality were examined both by inspecting histograms and with skew and kurtosis values. Where data were significantly skewed transformations were considered (e.g., square root, logarithmic) to meet normality distribution assumptions before analyses were carried out. In addition, missing data was explored and considered and is described below.

Missing Data

Missing data for self-report measures (MCQ fragmentation outcome, covariates) was minimal (less than 5% on all measures); therefore we used list wise deletion in analyses involving these variables (Graham, 2009). Missing data for narrative coding outcomes occurred only for 4 participants that were missing one of two of the narratives. Two participants had missing narrative data due to operator error (i.e., provided narratives were not successfully recorded by the research staff). A third participant returned for session 2 but requested not to provide a second narrative and a fourth participant failed to attend session 2. Given the reliance of dependent variables on the presence of audible narratives we considered deleting these four cases entirely from the data set. However, given that one valid narrative was available for each of these participants we chose to leave these participants' data in the sample and list wise deletion was used for analyses where narrative-dependent measures from the missing narrative were included.

Randomization Check

To determine that the randomization was effective and to examine differences between the High and Low DES groups, we looked for differences for demographic variables (e.g., race, ethnicity, age), using a between-subjects 2 (Group: High DES, Low DES) x 3 (Retrieval Condition: RP, NRP, NP) omnibus F test and chi-square analyses for categorical variables. Variables were included as covariates if groups or conditions differ significantly on the variable under evaluation and the variable correlates significantly with key dependent variables (Tabachnick & Fidell, 2001). The

only group difference detected was for gender X^2 (2) = 8.35, $p < .05$.Therefore gender was used as a covariate in subsequent analyses. See values for demographic variables in Table 1.

Film manipulation check.

To ensure that the film had the expected emotional effect, we conducted a series of paired t-tests comparing pre-film and post-film ratings of state emotion (SUDS, negative affect as measured by the PANAS). On average participants reported significantly higher SUDS ratings post-film (M = 55.34, SE = 2.19) than pre-film (M = 23.91, SE = 1.85), $t(159) = 14.28$, $p < .001$, higher ratings of negative affect post-film (M = 25.33, SE = .69) than pre-film (M = 13.36, SE = .53), $t(159) = 17.76$, $p < .001$, more dissociative experiences post-film (M = 15.13, SE = .77) than pre-film (M = 8.18, SE = .55), $t(156) = 9.42$, $p < .001$., and less positive affect post-film (M = 23.07, SE = .53) than pre-film (M = 25.53, SE = .70), $t(160) = 3.66$, $p < .001$. Results indicate that participants found the film distressing, confirming findings of our initial pilot data.

Exploration of Covariates

As recommended by Tabachnick and Fidell (2001), potential covariates (e.g., cognitive ability, imagery ability, distress, anxiety, dissociation, and trauma exposure) identified to be theoretically related to independent or dependent measures were also examined for correlation with main outcome measures, to determine covariates for analyses. As predicted, our measure of cognitive ability, the WAIS estimate from the SILS, was significantly correlated with narrative-based dependent measures (e.g.,

coded fragmentation indices, metamemory fragmentation indices, memory for film stimuli). Therefore, as planned, analyses were conducted using the WAIS estimate generated by the SILS as a covariate. Given that we chose to include data from as many subjects as possible to increase power to find effects, stimuli sets were not equally represented across all groups. Therefore the variable of stimuli set was an additional covariate in all analyses. Although trait dissociation was hypothesized to be a strong predictor of our outcome variables, our measure of trait dissociation (DES) was not significantly correlated with any of the main outcome variables. The proposed analyses were conducted with the DES Group variable as planned. Group effects were reported when significant.

General Analytic Strategy

Overall, main hypotheses were evaluated by submitting data to a series of omnibus 2 (Group: RP, NRP) x 2 (Condition: High DES, Low DES) univariate analysis of covariance tests (ANCOVA) controlling for cognitive ability (SILS), stimuli set, and sex, to control for Type 1 error. Subsequent analyses were conducted by submitting data to a 2 (Group) x 3 (Condition) ANCOVA, to evaluate the effect of the novel P condition. Significant main effects and interactions were explored by conducting simple main effects analyses.

Free Recall Test

Hypothesis 1: Facilitation Effect. As seen in prototypical RIF studies, at both Session 1 and Session 2, we hypothesized that a standard facilitation effect would be observed such that practiced events (RP+) from the retrieval practice condition (RP)

would be recalled more frequently than the same events in the no practice (NRP) condition. To evaluate this hypothesis, a one-way ANCOVA test was conducted comparing RP and NRP conditions allowing for control of key variables. A subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

Hypothesis 2: RIF Effect. As seen in prototypical RIF studies, if selective retrieval practice increases retrieval strength, at both Session 1 and Session 2, we hypothesized that unpracticed events (RP-) in the RP condition would be recalled less frequently than the same events unpracticed in the NRP condition. To evaluate this hypothesis, a one-way ANCOVA was conducted comparing RP and NRP conditions again allowing control of key variables. A subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

Narrative Fragmentation

Hypothesis 3: Fragmentation Effect. Using both rater coded (Global rating, fragmentation coding) and metamemory (MCQ, Global self-report fragmentation) indices, if retrieval practice increases retrieval strength of practiced events inhibiting memory for other events, we hypothesized that film narratives generated by participants in the retrieval practice (RP) condition would be more fragmented than film clip event narratives generated by participants in the no practice condition (NRP) at both Session 1 and Session 2. Using a between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, we hypothesized that there would be a main effect of condition. Given the potential impact of dissociative encoding on fragmentation, we also

hypothesized a main effect of group. Further, we predicted the two main effects would be modified by a group x condition interaction; such that individuals in the high DES group in the RP condition would have a more fragmented narrative than those in the NRP conditions. Again, a subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

Intrusions

Hypothesis 4: Intrusion Effect. If increasing retrieval strength of events through retrieval practice functions to increase the likelihood of intrusions for practiced events, over a 72-hour diary monitoring period, participants in the retrieval practice condition (RP) would experience more intrusive thoughts compared to participants in the no practice condition (NRP). Therefore, using a between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, we hypothesized a main effect of condition. Given that the potential impact of dissociative encoding on intrusions, we also hypothesized a main effect of group (Dissociation Effect on Intrusions). Further, these two main effects would be modified by a group x condition interaction; such that individuals in the high DES group in the RP condition would report more intrusive thoughts and distress than those in the NRP condition. A subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

Furthermore, we predicted that intrusion content, which events from the film are experienced as intrusions, would demonstrate a RIF pattern of results as well.

Facilitation Effect. We predicted practiced events (RP+) in the RP condition

would occur more frequently as intrusions than the same events in the NRP condition showing a facilitation effect. To test this hypothesis, a univariate ANCOVA was conducted comparing recall for practiced events in the RP condition (RP+) with the same events in the NRP condition. A subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

RIF Effect. More importantly, we predicted RP- events in the RP condition would occur as intrusions less frequently than the same events in the NRP conditions. To test this hypothesis, a univariate ANCOVA was conducted comparing recall for unpracticed events in the RP condition (RP-) with the same events in the NRP conditions. A subsequent ANCOVA was conducted with addition of the P condition, as indicated above.

Table 1. Demographic characteristics.

	Full Sample		Condition					
	(*N* = 161)		NRP (*n* = 53)		P (*n* = 53)		RP (*n* = 55)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	19.87	3.53	19.68	2.30	19.79	3.67	20.13	4.33
Gender (% Female)	55.9		71.7*		45.3*		50.9*	
% Caucasian	49.7		43.4		56.7		49.1	
% Asian–American	32.9		35.8		35.8		27.3	
% African-American	6.2		9.4		1.9		7.3	
% ESL	24.8		26.4		22.6		25.5	
% Reported Seen Film	9.9		7.5		9.4		12.7	
Estimated WAIS IQ (SILS)	114.79	5.22	114.21	5.78	115.51	4.78	114.67	5.07
Years of Education	13.14	1.18	13.23	1.19	13.08	1.24	13.11	1.12

Note. * Differ at a significant level, $p < .05$.

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Table 2. Self-report Measures.

	Full Sample (N = 161)		Condition					
			NRP (n = 53)		P (n = 53)		RP (n = 55)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Trauma Exposure	70.8		66.0		73.6		72.7	
% Reporting Criterion A	49.7		43.4		50.9		54.5	
% Meeting PTSD Dx on PDS	5.0		1.9		7.5		5.5	
PTSD Severity Scores (PDS)	5.56	6.94	4.92	6.75	6.54	7.98	5.15	6.01
Trait Dissociation (DES)	13.78	8.87	12.93	9.28	13.89	7.73	14.48	9.51
Depression (BDI-II)	9.01	6.99	9.74	7.62	8.50	6.29	8.78	7.07
Trait Anxiety (STAI-T)	46.43	5.19	47.0	4.91	46.31	4.82	46.02	5.79
State Anxiety (STAI-S)	44.20	5.23	43.5	5.89	44.49	5.39	44.58	4.74
Anxiety Sensitivity (ASI)	17.16	7.52	16.87	8.52	17.23	7.61	17.36	6.45
Thought Suppression (WBSI-R)	63.89	18.80	65.10	18.1	63.57	17.31	63.04	15.17

Note. No significant group differences for these measures was observed.

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Table 3. Correlations of measures of fragmentation and self-report questionnaires.

	Intrusions	GFrag S1	GFrag S2	Frag S1	Frag S2	M Frag S1	M Snaps S1	M Frag S2	M Snaps S2	M Diso S1	M Int S1	M Diso S2	M Int S2
Intrusions	1.00	.14	**.17***	-.02	.06	.00	-.03	.05	.11	.00	.10	.02	**.51****
GFrag S1	.14	1.00	**.53*****	**.46****	**.48****	.14	.03	.08	.12	.11	**.16***	.11	.04
GFrag S2	**.17***	**.53*****	1.00	**.46****	**.55****	.07	-.01	.11	-.06	.10	.10	.09	.03
Frag S1	-.02	**.46*****	**.46*****	1.00	**.82*****	.09	.04	.06	-.02	.10	.06	.05	.00
Frag S2	.06	**.48*****	**.55*****	**.82*****	1.00	.02	.06	.05	.03	**.17***	.10	.07	.02
MFrag S1	.00	.14	.07	.09	.02	1.00	**.16***	**.40*****	**.24****	**.28*****	.11	**.23****	.08
Snaps S1	-.03	.03	-.01	.04	.06	**.16***	1.00	.13	**.35*****	-.04	**.16***	.00	.09
MFrag S2	.05	.08	.11	.06	.05	**.41****	.13	1.00	**.20****	**.29****	.10	**.52****	.04
Snaps S2	.11	.12	-.06	-.02	.03	**.24****	**.35****	**.21****	1.00	-.09	**.19***	.01	**.30****
MDiso S1	.00	.11	.10	.10	**.17***	**.28*****	-.04	**.29*****	-.09	1.00	.14	**.51*****	-.01
MInt S1	.10	**.16***	.10	.06	.10	.11	**.16***	.10	**.193***	.14	1.00	**.17***	**.47*****
MDis S2	.02	.11	.09	.05	.07	.23**	.00	.520**	.01	.507**	.167*	1.00	.04
MInt S2	**.51*****	.04	.03	.00	.02	.08	.09	.04	**.299*****	-.01	**.47*****	.04	1.00
Clarity S1	-.01	**-.18***	**-.21****	**-.28*****	**-.28*****	-.13	**.27*****	-.13	**.27*****	**-.46*****	.11	**-.24****	.06
Vivid S1	.06	**-.18***	-.15	**-.20***	**-.18***	-.07	**.22****	-.13	**.24****	**-.36*****	.05	**-.21****	-.01
Coher S1	-.02	-.07	-.08	-.03	-.07	-.05	.08	-.09	**.16***	**-.35*****	.05	**-.16***	.04
Sens S1	.12	**-.16***	-.14	-.14	-.10	.06	.10	.04	**.18***	-.15	**.157***	-.09	.15
Emot S1	.01	.05	-.04	-.04	-.01	.02	.04	.13	.15	-.01	**.41*****	.10	.196*
Clarity S2	.07	-.02	-.08	-.04	-.02	-.02	.13	**-.36*****	**.32*****	**-.28*****	.14	**-.58*****	**.21****
Vivid S2	.09	-.07	-.03	-.06	-.02	-.03	.12	**-.26****	**.28*****	**-.29*****	.07	**-.47*****	.08

Note. *** Correlation is significant at the 0.001 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).

Table 3 cont.

	Intrusions	G Frag S1	G Frag S2	Frag S1	Frag S2	M Frag S1	M Snaps S1	M Frag S2	M Snaps S2	M Diso S1	M Int S1	M Diso S2	M Int S2
Coher S2	.01	-.07	-.09	-.05	-.02	-.10	.04	**-.30*****	**.25****	**-.29*****	.02	**-.39*****	.08
Sens S2	.07	-.09	-.15	-.12	-.09	-.03	.10	**-.30*****	**.18***	**-.16***	.08	**-.38*****	**.16***
Emot S2	.15	.02	.00	-.06	-.02	.08	.14	.13	**.28*****	.02	**.38*****	.05	**.38*****
DES	-.12	.06	-.01	-.04	-.05	.12	.09	.00	.02	**.17***	**.17***	.03	.03
SUDS Pst	.11	.06	-.06	-.02	.01	.01	.02	.15	.09	**.20*****	**.36*****	**.31*****	**.27*****
SUDS Pk	**.16***	.06	-.07	-.05	-.01	.09	.03	.15	.10	**.19***	**.37*****	**.26*****	**.32*****
WAIS	.13	**-.18***	**-.34*****	-.14	**-.27*****	-.05	.00	-.01	.05	-.12	.03	-.13	.03
WBSI	.00	.05	.02	.13	.10	**.22****	.02	.07	.00	.09	.14	**.16***	.10
Absorption	-.02	.02	-.04	.06	.04	-.02	.09	-.04	-.07	-.05	.07	-.06	.06
BDI-II	-.05	-.02	.01	.02	.01	.10	.00	.09	-.08	.10	.03	.11	.00
ASI	-.03	.10	.03	.05	.03	.15	-.01	.00	.14	.09	.07	.10	.10
STAI State	-.06	.00	.05	.05	.08	-.03	**.16***	-.01	.05	-.07	.10	.04	.03
STAI Trait	.00	-.05	-.01	-.08	-.05	.08	.14	.08	.13	.12	.04	**.19***	.04
PDS	.16	.06	.08	.00	.02	.01	.02	.03	-.16	.12	.08	**.19***	.13
Int Av Dis	.12	.03	.06	.04	.03	.03	**.17***	.03	**.22****	-.11	**.36*****	.01	**.39*****
Int Pk Dis	**.25****	.02	.03	.03	-.03	.07	.16	.07	**.21****	-.13	**.38*****	.03	**.50*****
Int Av Viv	.14	**-.16***	-.11	-.05	-.02	.05	**.24****	-.09	**.19***	-.07	**.17***	-.02	**.38*****
Int Pk Viv	**.25****	-.14	-.12	-.04	-.04	.04	**.23****	-.09	**.19***	-.09	**.19***	-.01	**.39*****
Int Av Now	.06	.03	.03	.10	.06	.16	.13	-.01	**.24****	-.04	**.26****	-.03	**.40*****
Int Pk Now	.13	.03	.02	.09	.05	**.19***	.14	.03	**.23****	-.02	**.29*****	.02	**.42*****

Note. *** Correlation is significant at the 0.001 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).

Results

Free Recall Test

To examine the effects of group and condition on overall recall of items from the film, a series of 2 (Group: High DES, Low DES) by 2 (Condition: RP, NRP) ANCOVAs were conducted controlling for cognitive ability (SILS), stimuli set, and sex. The main dependent variables in these analyses were proportions of items recalled in the different categories. For ease of interpretation the immediate and 72-hour tests were analyzed separately. Subsequent analyses were conducted by submitting data to a 2 (Group: High DES, Low DES) x 3 (Condition: RP, P, NRP) ANOVA, to evaluate the effect of the novel P condition. Significant main effects and interactions were explored by conducting simple main effects analyses. Table 3 display means and standard deviations of memory recall by condition and Session.

To examine hypothesis 1, that practice effects would be seen based on condition (RP, NRP), we conducted an ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, comparing percent of practiced events (RP+) recalled by condition (RP, NRP). There was a significant main effect of condition on percent recall of practiced items at Session 1 without covariates $F(1, 105) = 64.46$, $p < .001$, as well as after controlling for sex, stimulus set, cognitive ability $F(1, 95) = 19.77$, $p < .001$. Similarly there was a significant effect at Session 2, both without covariates $F(1, 104) = 68.05$, $p < .001$ and after controlling for sex, stimulus set, cognitive ability $F(1, 102) = 73.35$, $p < .001$. A paired t-test indicated that percent recall of practiced items did not differ from Session 1 to Session 2 $t(104) = -.07$, ns. Together results indicate that

practiced items in the practiced group (RP+) were recalled significantly more frequently than the same items in the group receiving no practice (NRP) but that recall of these items did not change over the 3-day diary period.

To evaluate the effect of the P condition, analyses were repeated with all 3 groups entered into the model. A significant effect of group $F(2, 149) = 38.92$, $p < .001$ was detected for Session 1. Simple effects analyses indicated that in addition to replicating the above analysis that the RP condition recalled more practiced events than the NRP condition ($M = 20.87$, $SE = 2.42$), the P condition recalled a smaller proportion of "practiced" items than did the RP condition ($M = 5.50$, $SE = 2.39$) and a higher percentage of these items than the NRP condition ($M = 15.37$, $SE = 2.49$). A significant effect of group $F(2, 147) = 38.09$, $p < .001$ was also detected for Session 2. Simple effects analyses again revealed that the RP recalled more practiced items than the NRP condition ($M = 20.11$, $SE = 2.34$), the P condition recalled a smaller proportion of "practiced" items than did the RP condition ($M = 6.34$, $SE = 2.31$) and a higher percentage of these items than the NRP condition ($M = 13.78$, $SE = 2.39$). No other main effects or interactions reached significance. Taken together the RP group recalled more practiced (RP+) items than both the NRP condition and the P condition. This finding suggests that additional contact with the stimuli through passive viewing increased recall for these events, but that active retrieval of the events appeared to increase recall further.

To examine hypothesis 2, that if selective retrieval practice increases retrieval strength, then unpracticed events (RP-) in the RP condition would be recalled less

frequently than the same events unpracticed in the NRP condition, we conducted an ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, comparing the percent of unpracticed events in the practice condition (RP-) with percent recall of the same events in the no-practice (NRP) condition. Analyses showed no significant effects for group on recall of unpracticed items at Session 1 or Session 2. Results with and without covariates (i.e., sex stimulus set, cognitive ability, sex) yielded a similar pattern of non-significant findings. A paired t-test indicated that percent recall of unpracticed items did not differ from Session 1 to Session 2.

To evaluate the effect of the P condition, analyses were repeated with all 3 groups. No main effects or interactions reached significance for Session 1 or 2. Together results indicate that unpracticed items from the practice group (RP-) were not recalled less frequently than the same events in the group not receiving practice, and recall of these items did not change over the 3-day diary period.

Narrative Fragmentation

To examine hypothesis 3, or the effect of retrieval practice on narrative fragmentation, we conducted ANCOVA analyses on coded (experimenter rated, coded) and metamemory (MCQ, TMQ, Global Metamemory) fragmentation indices. Means and standard deviations of fragmentation measures are provided in Tables 4 and 5. If retrieval practice increases retrieval strength of practiced events, inhibiting memory for other events, we hypothesized that film narratives generated by participants in the retrieval practice (RP) condition would be more fragmented than film clip event narratives generated by participants in the no practice condition (NRP) at both Session

1 and Session 2.

Experimenter Rated/Coded Fragmentation Indices

To examine the hypothesis that practice effects would be seen on global ratings of fragmentation, we conducted an ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, comparing experimenter-rated global indices of fragmentation by condition (RP, NRP). No significant main effects or interactions were detected for Session 1 or 2. Analyses run with and without covariates yielded similar non-significant findings. To evaluate the effect of the P condition, analyses were again repeated with the P condition entered. No significant main effects of interaction were detected for Session 1 or 2.

Coded Fragmentation Indices

Prior to coding of narratives for fragmentation, each narrative was divided into chunks as described above. A fragmentation index was calculated for each narrative as described above and included the chunks considered to be repetitions, disorganized thoughts, and unfinished thoughts as a percentage of chunks for each narrative.

To examine practice effects on fragmentation ANCOVAs were conducted controlling for cognitive ability (SILS), stimuli set, and sex, based on condition (RP, NRP). No significant main effects or interactions were detected for Session 1 or 2.

To evaluate the effect of the P condition, ANOVAs were conducted on percentage of fragmentation with all three groups entered into the analyses. No main effects or interactions were detected at Session 1. A significant effect of Condition $F(2, 147) = 3.94$, $p < .05$ was detected for Session 2. Simple effects analyses indicated that

the P condition had less fragmented narratives than both the NRP condition (*M* = 4.00, *SE* = 1.57) and the RP condition (*M* = 3.59, *SE* = 1.53) but the RP and NRP conditions did not differ. No other main effects or interactions were detected for Session 2.

Metamemory Fragmentation.

To examine global metamemory fragmentation ratings a between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, was conducted for Session 1 and Session 2 controlling for cognitive ability, stimuli set, and sex. No significant main effects or interactions were detected for Session 1 or 2.

To examine effects of the P condition, a between-subjects 3 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, was conducted for Session 1 and Session 2 controlling for cognitive ability, stimuli set, and sex. There was a main effect of Group, $F(1, 150) = 4.39$, $p < .05$ with participants in the High DES group reporting more fragmented memory for the film (M = 5.50, SE .30) than those in the Low DES group. (M = 4.60, .30) at Session 1. No other significant main effects or interactions were detected for Session 1 or 2.

Participants also provided information regarding the "snapshot quality" of their memory for the film stimuli as a single global rating. To examine snapshot quality ratings a between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, was conducted for Session 1 and Session 2 controlling for sex, stimuli set, and WAIS estimates

generated from the SILS. No significant main effects or interactions were detected for Session 1 or 2.

To examine effects of the P condition, a between-subjects 3 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVA was conducted for Session 1 and Session 2 controlling for sex, stimuli set, and WAIS estimates generated from the SILS. No significant main effects or interactions were detected for Session 1 or 2.

Metamemory for the quality of the film memory was assessed using the subscales of the MCQ (Clarity, Vividness, Coherence, Sensory, Emotion). Between-subjects 2 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVAs were conducted for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex. No significant main effects or interactions were detected.

To evaluate effects of the P condition, between-subjects 3 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVAs were conducted for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex. No significant main effects or interactions were detected.

Metamemory for Disorganization and Intrusions was assessed using the subscales of the TMQ. Between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVAs were conducted evaluating metamemory Disorganization for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex. An effect of Group was detected, $F(1, 99) = 3.96$, $p < .05$, with High DES participants endorsing more Disorganization ($M = 1.19$, SE .09) than Low DES participants ($M = .95$, $SE = .09$) at Session 1. No other significant main effects or

interactions were detected at Session 1 or 2.

To evaluate effects of the p condition, between-subjects 3 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVAs were conducted for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex. Again, at Session 1 Disorganization differed by Group $F(1, 150) = 4.31$, $p < .05$ with those in the High DES group reporting more Disorganization (M = 1.12, SE = .07) than those in the Low DES group (M = .91, SE = .07) at Session 1. No other significant main effects or interactions were detected for Session 1 or 2.

Between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVAs were conducted evaluating metamemory Intrusions for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex.

Differences in Intrusions by Group approached significance at Session 1 $F(1, 154) = 3.90$, $p = .051$, with those in the High DES group reporting more Intrusions of film content (M = 1.30, SE = .09) than those in the Low DES group (M = 1.04, SE = .09), but only for Session 1. No other main effects or interactions were detected for Session 1 or 2.

To evaluate effects of the P condition, between-subjects 3 (Condition: RP, P, NRP) x 2 (Group: High DES, Low DES) ANCOVAs were conducted evaluating metamemory Intrusions for Session 1 and Session 2 controlling for cognitive ability (SILS), stimuli set, and sex. A main effect of Group was detected, $F(2, 150) = 4.91$, $p < .05$, with those in the High DES endorsing more items related to intrusive reexperiencing (M = 1.28, SE = .07), than did those in the Low DES group (M = 1.06,

SE = .07) at Session 1. No other significant main effects or interactions were detected for Session 1 or 2.

As in past studies using the distressing film paradigm, the film stimuli successfully produced intrusions of memory in our sample (*M* = 4.29, *SD* = 3.68, *Mode* = 2.00) with only nine participants indicating they had no distressing intrusions over the 72-hour period. Intrusions of material from all 24 events were represented in reported intrusions as well.

Hypothesis 4: Intrusion Effect. If increasing retrieval strength of events through retrieval practice functions to increase the likelihood of intrusions for practiced events, over a 72-hour diary monitoring period, participants in the retrieval practice condition (RP) would experience more intrusive thoughts compared to participants in the no-practice condition (NRP).

To examine effects of practice on intrusions a between-subjects 2 (Condition: RP, NRP) x 2 (Group: High DES, Low DES) ANCOVA controlling for cognitive ability (SILS), stimuli set, and sex, was conducted. No significant main effects or interactions were detected for Session 1 or 2. To examine the effect of the P condition, a between-subjects 3 (Condition: RP, NRP, P) x 2 (Group: High DES, Low DES) ANCOVA was conducted. No significant main effects or interactions were detected for Session 1 or 2.

We examined the hypothesis that the pattern of intrusion content would demonstrate the RIF pattern as well. To first examine if facilitation effects would be seen based on condition (RP versus NRP) we conducted an ANCOVA controlling for

cognitive ability (SILS), stimuli set, and sex, comparing percent of practiced events (RP+) recalled by condition (RP, NRP). There was a significant main effect of condition on intrusions of practiced events, after controlling for cognitive ability (SILS), stimuli set, and sex, $F(1, 98) = 13.03$, $p < .001$ indicating a facilitation effect with regard to intrusions. Specifically, the RP condition reported more intrusions of the practiced events than did the NRP condition for the same events.

To evaluate effects of the P condition, a between-subjects 3 (Condition: RP, P, NRP) x 2 (Group: High DES, Low DES) ANCOVAs was conducted evaluating intrusions of practiced and unpracticed events controlling for cognitive ability (SILS), stimuli set, and sex. A main effect of Group was detected, $F(2, 148) = 5.59$, $p < .01$ for practiced events. Simple effects analyses replicated the above analyses. The RP condition reported more intrusion ($M = 2.83$, $SE = .31$) of practiced events (RP+) than did the NRP condition ($M = 1.35$, $SE = .32$) for the same events. No other main effects or interactions were detected.

We then conducted an ANCOVA comparing the percent of unpracticed events (RP-) recalled by condition (RP, NRP). There was a significant main effect for condition after controlling for cognitive ability (SILS), stimuli set, and sex $F(1, 98)$ $F = 5.24$, $p < .05$. This pattern is representative of the RIF Effect. That is, unpracticed events (RP-) were more likely to occur as intrusions in the NRP condition than in the RP group (RP-). This finding indicates that the unpracticed items in the RP condition (RP-) were inhibited by recall of the practiced items (RP+) for unintentional recall.

To evaluate effects of the P condition, a between-subjects 3 (Condition: RP, P,

NRP) x 2 (Group: High DES, Low DES) ANCOVA was conducted evaluating intrusions of unpracticed events controlling for cognitive ability (SILS), stimuli set, and sex. No main effects or interactions were detected. Although the omnibus test was not significant with the P condition added to the model, pairwise comparisons in the form of simple effects verified the main effect detected above.

Table 4. Indices of memory (free recall) by condition and time point

	Session 1						Session 2					
	NRP (n = 52)		P (n = 53)		RP (n = 55)		NRP (n = 52)		P (n = 52)		RP (n = 54)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Narrative Length (sec)	10.30	5.83	12.56	6.50	12.37	5.01	9.55	5.21	11.06	6.14	12.53	6.14
% Items Recalled	17.53	8.15	26.16	11.25	29.30	12.54	17.50	8.22	25.19	11.09	28.80	11.83
% Practiced Items	17.25	8.57	32.28	13.98	37.67	16.34	17.79	7.98	31.22	13.92	37.35	15.20
% Unpracticed Items	17.79	8.19	19.96	9.06	20.82	9.53	17.59	8.88	19.11	8.88	20.17	9.26

Table 5. Coded fragmentation indices by condition and time point.

	Session 1						Session 2					
	NRP (*n = 52*)		P (*n* = 53)		RP (*n* = 55)		NRP (*n = 52*)		P (*n* = 52)		RP (*n* = 54)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Number of Chunks	307.37	186.71	385.57	240.86	390.24	171.83	309.42	199.19	342.81	220.63	410.31	206.90
Repetition	3.68	2.85	3.07	2.46	4.05	2.75	3.26	3.10	3.09	2.04	3.98	3.10
Disorganized Thought	2.87	2.46	2.89	1.95	2.44	2.34	2.46	1.87	2.27	1.65	2.01	2.03
Organized Thought	.62	.79	.88	.86	.74	.74	.43	.61	.60	.59	.56	.63
Unfinished Thought	27.19	6.94	25.46	6.13	26.75	6.50	27.23	6.61	23.80	5.94	26.84	6.98
Sensation	.23	.45	.33	.70	.34	.46	.26	.81	.45	.78	.47	1.03
Feeling	.10	.38	.04	.17	.01	.04	.02	.10	.02	.08	.03	.17
Action	20.96	8.18	21.76	6.44	22.03	7.06	21.03	7.68	23.88	7.50	20.95	7.38
Dialogue	7.29	4.03	9.63	3.44	10.42	4.12	8.12	4.78	10.15	3.91	9.74	3.59
Detail	14.40	4.71	14.12	5.08	11.91	4.73	13.79	4.67	14.42	5.13	12.69	5.82
Speech Filler	22.67	8.02	21.81	7.75	21.31	8.64	23.40	8.02	21.33	7.96	22.73	8.65
Percent Fragmentation	33.73	8.52	31.43	7.45	33.24	8.08	32.94	8.43	29.15	6.64	32.83	8.80
Global Fragmentation	5.98	2.49	5.60	2.03	6.27	2.61	5.65	2.49	4.85	2.15	5.54	2.90

Table 6. Metamemory fragmentation indices for sessions 1 and 2 by condition.

	Session 1						Session 2					
	NRP (n = 53)		P (n = 53)		RP (n = 55)		NRP (n = 53)		P (n = 52)		RP (n = 54)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Clarity (MCQ)	24.69	4.33	25.96	3.62	26.28	3.99	20.72	5.40	20.67	4.31	21.63	4.22
Vividness (MCQ)	29.10	5.20	30.81	5.16	29.89	4.43	27.16	5.44	27.22	5.62	29.04	5.23
Coherence (MCQ)	41.35	8.94	43.44	7.62	41.57	8.11	40.29	9.30	40.68	8.60	40.77	9.27
Sensory (MCQ)	15.90	3.84	15.62	3.79	15.85	3.34	13.05	3.26	13.01	3.31	13.21	3.33
Emotion (MCQ)	15.21	3.08	14.15	2.97	15.15	3.22	13.73	3.48	12.87	3.19	13.57	3.43
Disorganization (TMQ)	1.11	.68	.90	.58	1.03	.45	1.74	.89	1.60	.72	1.49	.61
Intrusions (TMQ)	1.21	.67	1.17	.57	1.14	.61	.99	.57	1.02	.58	.89	.61
Global Fragmentation	5.45	2.67	4.55	2.41	5.24	2.84	5.91	2.65	5.42	2.39	5.84	2.62
Snapshot Quality	62.64	20.51	62.74	18.41	63.64	15.91	58.17	22.90	56.54	21.04	57.59	20.46

Discussion

The current study was designed to test the hypothesis that, rather than peritraumatic processes (e.g., dissociative encoding, heightened arousal) resulting in pathological memory states (i.e., memory fragmentation), normative post-trauma processes could account for distressing intrusion of traumatic memory. To examine this hypothesis a paradigm taken from cognitive psychology, retrieval-induced forgetting (Anderson, Bjork, & Bjork, 1994) was applied to the process of memory for a distressing film clip. Retrieval of film content was manipulated via laboratory instructions for differential retrieval practice of film events. The main intent of the study was to manipulate recall in the lab to approximate the type of repetitive retrieval seen for traumatic memory in individuals with PTSD, to measure the effect of differential retrieval on distressing intrusions of memory. In addition, given the widespread influence of fragmentation as a construct in theories of PTSD we examined the influence of differential retrieval on the types of indices commonly examined in narrative fragmentation studies, both through experimenter coded indices and assessment of metamemory.

The RIF paradigm, as it was developed and used primarily to examine recall of word lists, examines differential recall within subjects and examines only retrieval practice against no practice. Given the distressing nature of the stimuli and our desire to examine intrusions, we chose to use a between subjects design to be able to examine fragmentation of memory as well as intrusions of film content, something that would have been problematic to measure in a within subjects design. In addition, we added a

novel presentation condition (P) to control for amount of contact with the stimuli. This condition viewed the same stimuli that the practice condition was asked to retrieve; with instruction to only attend to the stimuli as they had in the original viewing of the film clip. This condition allowed us to examine the impact of effortful memory retrieval practice above that of mere additional exposure to stimuli.

As predicted, we detected the RIF effect on intrusions, or unintentional recall, of events from a distressing film. Specifically, we saw a facilitation effect; participants who engaged in retrieval practice of a subset of events from the film were more likely to experience intrusions of the practiced events than those who did not engage in retrieval practice. More importantly, we also detected the RIF effect; participants in the practice condition were less likely to experience intrusions from the subset of items they did not practice than the no practice group did for these same items. While some debate over the mechanism of the RIF effect is ongoing (MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003; Perfect et al., 2004), the majority of studies suggest that the recall of unpracticed items is lower as practice inhibits related unpracticed material (Anderson & Levy, 2007; Camp, Pecher, & Schmidt, 2007; Racsmány & Conway, 2006). A mere interference effect would predict that practiced events would be recalled more frequently than those in the no practice condition, but that unpracticed events should be recalled as frequently as those in the no practice condition. The manipulation was successful at shifting the content of intrusions reported by participants, suggesting that repeated retrieval of certain segments of memory can increase the likelihood of intrusions and function to inhibit the likelihood of unpracticed segments of memory.

As expected, the RIF effect on intrusions was not seen for the P control condition. This finding suggests that it is intentional retrieval of material rather than amount of contact with stimuli that changes retrieval strength. It is noteworthy, however, that the P condition not only did not differ from the NRP condition, as expected, but the P condition also did not differ in amount of practiced or unpracticed items recalled compared to the RP condition. Values were intermediary suggesting, not surprisingly, additional contact with the stimuli did increase memory for the material. The P condition in the current study was somewhat novel and again, was intended to control for additional exposure to stimuli, particularly with regard to intrusions and fragmentation. Not typically used in studies of RIF, the p condition is similar to a "listener" condition in an exploration of RIF by Cuc, Koppel, and Hirst (2007). These authors examined the RIF effect in those giving speeches of study material as well as those asked to participate as listeners. Facilitation and RIF effects were seen both from the more active speakers, as well as the less active listeners. Authors concluded that the RIF effect extended to listeners as they were likely engaging in covert rehearsal (i.e., retrieval) of the stimuli in a manner similar to that of the speakers. This effect emerged when the listeners were instructed to monitor the speech for accuracy, attending to the content of the speech, but not when they were asked to monitor the fluidity of the speaker's responses. Somewhat analogous to the listener condition, participants in our P condition likely engaged in some level of retrieval during the viewing of film events, even though they were not specifically instructed to engage in recall or retrieval, particularly given that participants were aware there would be a test of memory at the

end of the session.

Unlike results for unintentional recall, the RIF effect was not seen for effortful recall of stimuli in this study. For the free recall task the prototypical facilitation effect was observed; practice of stimuli resulted in higher recall for practiced events. However the RIF effect, or higher recall of RP- by the NRP group than that of the RP group, was not observed. For the free recall task it appeared that the amount of contact with the stimuli had an impact on overall recall as all groups differed significantly from each other in the amount of items recalled. The P condition recalled significantly more items than did the NRP condition and the RP condition recalled more events than did either the NRP or P conditions. This occurred for items in general and for both practiced items. This finding indicates that additional contact with the stimuli increased recall of practiced events, and that retrieval practice further increased recall over that of passive viewing of the stimuli.

Although the prototypical RIF effect with word list stimuli is considered a highly robust effect, certain boundary conditions have been identified that either reduce or eliminate the effect (see Garcia-Bajos, Migueles, & Anderson, 2009). Valence has been under evaluation for effects that hinder or eliminate RIF. Our study used stimuli that were specifically selected to be emotionally distressing that varied notably from stimuli used to examine RIF in past studies. In traditional word list studies, the RIF paradigm has been examined using negatively valenced words and the results of these studies appear mixed. Some studies have investigated valence specifically related to psychopathology. For example, Moulds and Kandris (2006) found that dysphoric

participants showed the RIF effect for neutral but not negative words. When examining RIF effects in social phobia, Amir, Coles, Brigidi, and Foa (2001) found that participants did not show the RIF effect for negative social words. These findings suggest not only valence but personal relevance of stimuli blocked inhibition. Blix and Brennen (2012) examined the impact of neutral, positive, negative, and trauma-specific words in participants reporting a history of sexual assault and non-traumatized controls. Previous trauma exposure did not appear to impact results. Rather, across groups the RIF effect was observed for neutral words, but not for words in any of the emotion categories. Findings suggest valence and not personal relevance impacted RIF. Garcia-Bajos, Migueles, and Anderson (2009) used a stimulus set that was a closer approximation to the stimuli used in the present study. They showed a short (105 second) bank robbery video that showed armed bank robbers holding up a bank and shooting a security guard before grabbing a bag of money and leaving for a getaway car. Not intended to examine valence, per se, the study had the goal of examining potential RIF effects for high- and low-typicality actions. In their investigation, RIF effects were seen for low-typicality items, those less related to the schema of a bank robbery, but not for high-typicality items (Garcia-Bajos, Migueles, & Anderson, 2009). Authors suggest this finding confirms that highly integrated script knowledge protects high-typicality actions from inhibitory processes, as measured in the RIF paradigm. Findings do demonstrate that the RIF effect can be produced with a negatively valenced film, at least for some types of items. However, the intention and findings of the study assert that features of memory can significantly impact the ability of material

to be inhibited. Their film stimulus was notably very short, particularly in comparison with the 17-minute film stimuli used in the current investigation, and was likely considerably less distressing. However, if our manipulation impacted events in a similar manner, RIF seen with low-typicality events, our study was not designed to detect them as items of memory were not evaluated for level of typicality or salience prior to their use. Brown and colleagues (2011), in a series of two experiments, examined RIF for combat-related words and then combat-related stories in veterans with and without PTSD. Unlike studies finding emotional stimuli and personally relevant stimuli reduced the RIF effect, this examination found the RIF effect for combat-related material across groups. In addition, the RIF effect, as measured here, was actually enhanced for the group with PTSD as compared to the non-PTSD control. This study suggests negative valence with word and more complex stimuli may not eliminate the RIF effect under certain conditions and may actually enhance the effect. However, Brown and colleagues' (2011) study used highly personally relevant negative stimuli and likely reflected the interaction of personal relevance and valence. This feature is highly relevant to the premise tested in the current study. Taken together, findings from studies that examined the impact of negative valence on the RIF effect are mixed.

The film stimuli used in the current study cannot only be considered to have negative valence, it was chosen for its distressing nature. To understand the impact of the distressing nature of events in our stimuli on our results we examined the relationship between the frequency of intrusion of specific events and their frequency

of recall. While these constructs were correlated, there were clearly both a) events that were frequently recalled that did not occur with high frequency as intrusion and b) events that had a lower frequency of recall that occurred with high frequently in the form of distressing intrusion. This phenomenon was likely the result of the high salience and distressing nature of some events and the high salience and lack of distress of others.

From the pattern of results, a possible interpretation is that the salience of some items increased the likelihood of intentional free recall regardless of retrieval practice. For example, the two events most frequently reported as an intrusion were the graphic murder of one character by being bashed in the head repeatedly and the graphic sexual assault of another character where the perpetrator put a gun in her bra and underpants. The likelihood that those events would be left out of a participant's narrative is quite low, as these two events are highly salient and highly distressing. We intentionally developed our memory coding procedure to test memory for smaller items within events to give a more sensitive measure of recall, so that events that were highly salient might still be impacted by the manipulation, with the possibility that fewer or more details of each event might be sensitive to the manipulation. For example, we expected that highly salient events would likely be represented in all of the narratives, but that components of the event would be more likely to occur with practice and less likely to occur if not practiced in the practiced condition. However, this may have not been sufficient to overcome the salience and level of distress of these events.

A further boundary condition germane to our study design has to do with the

interrelatedness of items/stimuli used for retrieval and test. When the items to be recalled are highly integrated with one another, (i.e., word associates related to a cue) the RIF effect can be eliminated entirely (Anderson & McCulloch, 1999; Bjork & Bjork, 2006). Explanations of this phenomenon suggest the stronger the association between the cue and target the greater the retrieval strength, minimizing the retrieval competition necessary for inhibition. Studies using the distressing film paradigm most frequently use distressing scenes, for example car accidents or scenes from fire (e.g., Brewin & Saunders, 2001; Halligan, Clark, & Ehlers, 2002;Holmes, Brewin, & Hennessy, 2004). Our stimuli consisted of highly related events in a film clip that together tells a cohesive story. This was done intentionally to allow for testing for potential narrative fragmentation. While RIF has been demonstrated using a 105 second film of a bank robbery as discussed above (Garcia-Bajos, Migueles, & Anderson, 2009), again the effect was only seen for low-typicality items, things that were more distinct, salient, or perhaps less expected. The high-typicality items, evaluated separately in this study, did not produce the RIF effect. The research design of the bank robbery study precludes examination of RIF across item type, so it is unclear if the RIF effect would be seen across stimuli types within a negatively valenced film stimulus with a cohesive story.

To address the question of integration on the RIF effect, Chan (2009) conducted two related studies communicated in the same article. The first tested memory for two stories, one about the history of the Shaolin Buddhist temple, and another about the Big Bang theory. The author manipulated instructions during the initial learning (encoding)

phase. In the high-integration condition participants were told to integrate the materials within each article. In the low-integration condition participants were told that they would read facts and that the facts would be presented in no particular order. In their second study the author used short statements about objects and location (e.g., the painting is in the nursery) varying whether statements were clustered by the location of the objects (i.e., all nursery items together) or if they were presented out of order. Results were mixed, but when the integrative instructions were combined with a longer (24-hour) delay, testing of some of the stimuli appeared to improve recall for untested material, a phenomenon called retrieval-induced facilitation. A number of factors in this study complicate the interpretation and application of results; however, it is of interest that under certain conditions retrieval can enhance recall of unpracticed material. It is possible that the interrelatedness of the items in the film stimuli used in the current study, all elements of a coherent story, may have thwarted the inhibition of items by recall of others explaining the lack of the RIF effect for effortful recall.

We did observe the RIF effect for unintentional recall (i.e., intrusions) which would indicate that the cohesiveness, if it was in some way responsible for the lack of inhibition in free recall, did not impact the paradigm equally for the two different dependent measures of memory. Unintended, and likely unwanted, recall is quite distinct from effortful recall and we would expect variables to have the ability to influence one and not the other. Clearly intrusions of memory are highly impacted by the distressing nature of the content of memories and likely more so than effortful recall.

In addition, although fragmentation as a mechanism underlying PTSD has seen mixed empirical support, we hypothesized that a manipulation of retrieval would impact the ratings of fragmentation of the provided narratives of the film stimuli, suggesting that fragmentation is more of an artifact of differential recall than an etiological mechanism of PTSD. If manipulation of retrieval was associated with fragmentation then an implication could be drawn that fragmentation, when it is detected, could be the result of post-trauma cognitive style rather than peritraumatic memory processes. However, this hypothesis was not supported. Narratives in this study did not differ with regard to fragmentation either through experimenter-coded indices or by metamemory judgments; indicating that differential retrieval did not produce notably different levels of fragmentation as was measured here. While we had anticipated that fragmentation would be impacted by differential retrieval practice, the finding that fragmentation did not differ by condition is not surprising given the lack of compelling support for fragmentation as an active etiological or maintenance factor for PTSD (Bittinger, 2005; Zoellner & Bittinger, 2004).

In this study, fragmentation indices were notably related to cognitive ability, measured here as an approximation of WAIS scores generated from the Shipley Institute of Living Scale, a proxy for intelligence used in research settings. Outcomes based on memory and linguistic structures are, by their nature, influenced by cognitive/verbal ability. Few of the studies examining fragmentation with trauma exposed and PTSD populations controlled for the effects of cognitive ability/IQ/education level on fragmentation (Amir, Stafford, Freshman, & Foa, 1998;

Gray & Lombardo, 2001; Jelinek, et al., 2009). Amir and colleagues (1998) found lower reading level (lower grade level and higher reading ease) did not predict initial PTSD symptoms but predicted chronic PTSD symptoms at three months post trauma. Authors controlled for education level in their analyses, however education level is likely a poor proxy of cognitive ability. In the two published studies to control for level of cognitive ability, initial associations of fragmentation and PTSD were detected; however these effects fully disappeared when a covariate related to cognitive ability was entered into analyses (Gray & Lombardo, 2001; Jelinek et al., 2009). In the current sample, indices of fragmentation were significantly correlated with the WAIS approximation of the SILS (See Table 3). The finding that indices of fragmentation were associated with cognitive ability is consistent with of studies that found fragmentation was more associated with cognitive ability than posttraumatic psychopathology. Given that lower intelligence has been associated with PTSD (e.g., Macklin et al., 1998; McNally & Shin, 1995; Silva et al., 2000; Vasterling, Brailey, Constans, Borges, & Sutker, 1997, Vasterling et al., 2002), it is possible that intelligence could be driving the association between level of articulation measured in structural studies and PTSD symptoms. Although the meaning of this association is unclear, the two constructs do have a relationship. In the current study, participants were not selected based on trauma exposure or PTSD and represent a typical undergraduate population. The level of control allowed by choosing a non-clinical sample, and testing memory for a controlled event, allowed for the examination of fragmentation outside of typical confounding variables. Level of fragmentation did not

differ by group, and did not differ from other variables such as level of distress in response to either the stimuli or the retelling of the story. Our findings add to a growing body of literature suggesting fragmentation may be more an artifact of cognitive ability than it is meaningfully associated with psychopathology.

We had proposed that we would observe significant effects of Group based on a median split of DES (i.e., trait dissociation) scores. Overall the DES was not significantly correlated with the majority of outcome measures. We observed an effect for group with the High DES participants providing higher ratings of metamemory for disorganization and intrusions at Session 1. However these effects were not found at Session 2, only 72 hours later. Our study design allowed for the comparison of metamemory for more subjective measures of fragmentation. No effects for coded fragmentation were seen with regard to DES Group at Session 1 or 2.In addition, no effects for intrusions, as logged in participants' diaries were detected with regard to DES group. DES groupings were included in the study design, to be able to detect differences suggested by dissociative encoding hypotheses of PTSD. Our results are consistent with the majority of studies of fragmentation and dissociation (see Bedard-Gilligan & Zoellner, 2012) that differences in narrative fragmentation related to dissociation are seen for metamemory and not more objective measures. Findings challenge the dissociative encoding hypothesis that altered encoding of memory during trauma leads to memory abnormalities underlying etiology and maintenance of the disorder. While theories that incorporate the dissociative encoding hypothesis began as early as those of Janet (1907) and Freud (Breuer & Freud, 1895/1986) and remain

prominent today (e.g., Brewin, Dalgleish, & Joseph, 1996; Brewin, 2001; van der Kolk & van der Hart, 1989; van der Kolk, 1987, 1994, 1996, 1997) the role of dissociation as key mechanism has been strongly questioned (see Bryant, 2007).

Although this study was designed to examine key variables thought to underlie intrusive reexperiencing of memory, a number of limitations should be considered when evaluating the findings. Translating the RIF paradigm to memory for film stimuli and further combining this research paradigm with the distressing film paradigm presented challenges to develop stimuli that controlled for features that might have unintended impact on the range of dependent variables under study here, including impact on intrusions. Not only did the film need to be sufficiently distressing to produce intrusions of memory, but to test memory for the film clip the stimuli needed sufficient plot and number of events that differed from one another to facilitate manipulation and accurate testing of memory for events.

Typical RIF paradigms use fairly neutral word lists to explore the effects of differential retrieval on memory. Word lists are typically associated with a single construct (e.g., fruits, animals), and are not strongly positively or negatively valenced. Therefore, resulting stimuli sets are easily controlled for other potentially confounding features (e.g., length, frequency of usage) allowing a clearer view of the effect of the manipulation. In the current investigation, stimuli sets, created to equate length and number of memory items for each event as well as to equate the frequency of event occurring in the practice or no practice condition, appear to have noticeable differences in the level of salience and distress of the items selected for practice. Examination by

stimuli set indicated that percent recall and frequency of reported intrusions was different for the sets of stimuli. Specifically, three of the 24 events had high levels of reported intrusions across conditions. These events were all designated as practice events in both stimuli sets A and D. Not only did they have the three events most commonly reported as intrusions, overall those conditions reported much more intrusions than did the other two. It appears that these two stimuli sets practiced more distressing events and that sets B and C had more of the less distressing events. Events themselves were fairly short and we did not ask participants to rate their level of distress to each event. Therefore, control for level of distress was not an option. We also did not evaluate items for salience and as noted above, this factor is likely impacting results as well. Analyses were conducted controlling for stimuli set, however, additional pilot testing of the stimuli would have allowed for a more even distribution/manipulation of distressing events.

A further limitation is that in order to measure memory for the film at time one, all participants regardless of condition were asked to give a very complete accounting of the film prior to leaving the lab. The memory test, therefore, was an additional recall/retrieval task and may have diluted the impact of the retrieval manipulation. Studies have begun to look at the durability of the RIF effect over time (e.g., Garcia-Bajos, Migueles, & Anderson, 2009; Potts, Law, Golding, & Groome, 2012), and the impact of multiple testing sessions (e.g., initial test and later retest). Earlier studies of RIF suggested that there was a rather short window for RIF effects with RIF appearing to dissipate by 24 hours (e.g., MacLeod & Macrae, 2001). However, later studies have

found RIF effects to endure when tested 24-hours after the practice phase (e.g., Migueles, and Garia-Bajos, 2007) and at a week post practice (e.g., Garcia-Bajos, Migueles, & Anderson, 2009; Storm, Bjork, Bjork, & Nestojko, 2006). Duration of the effect beyond a short period is an important finding given that a short-lived impact would have less applicability to the types of real-world phenomena, such as intrusions of memory. Findings from previous work suggest both that the length of time from study to test and multiple testing sessions can impact potential RIF effects, however the direction and magnitude seen in prior studies varies. While initial fragmentation could have been captured by this test of memory, the effect on intrusions and memory/recall at Session 2 were likely strongly impacted by the act of recalling the film "…in as much detail as possible…" Importantly, the studies where the RIF effect has been seen over longer periods of time have had both an initial test and a subsequent (e.g., 1 week) test of memory (e.g., Garcia-Bajos, Migueles, & Anderson, 2009; Migueles, Garcia-Bajos, 2007). To answer the question in the current paradigm, subsequent study could be conducted both with and without a recall test at Session 1 to determine the impact of multiple testing sessions.

This study was designed as an analogue of the effects of actual trauma on memory. The analogue nature of the experimental design falls down in a few key aspects. The process of retrieval of traumatic material is likely a circular and iterative process evolving over time (i.e., a positive feedback loop). The impact of repeated truncated memory search is likely set in motion very soon after a trauma. However, PTSD-like experiences are fairly normative soon after trauma (e.g., Breslau et al.,

1991; Kessler et al., 1995) and the true onus of the field is to determine the mechanism underlying the failure of natural recovery, by definition a process that takes months to years. The very short time between that manipulation and test for effects (72 hours) is likely an insufficient time for potential amplification of the effects of differential retrieval on memory processes.

Finally, although the film was rated as being distressing and was chosen based, among other features, on the portrayal of multiple events that would meet the objective criteria for PTSD, the stimuli was a theatrical depiction of events and clearly the distress elicited was markedly below what would be experienced in an actual trauma. Further, although we manipulated participants' retrieval of film events in the laboratory, we could not control for participants' natural behaviors during the laboratory portions of the study, and certainly not during the period between sessions. More specifically, the application of the RIF study to the understanding of etiological and maintenance factors in PTSD here, is based on the premise that individual differences in private behavior (i.e., cognitive style), particularly at the trait level, may underlie intrusive reexperiencing of memory. Further, that this difference may help explain some of the variance in the occurrence, or lack thereof, of natural recovery after trauma exposure. Our sample, then, would also naturally differ on the types of unobservable behaviors that may be at play in shaping memory, and these trait behaviors could be competing with the laboratory manipulation. Anticipating this issue, we attempted to measure constructs believed to be relevant, however, capturing the nature and frequency of this behavior may be beyond the power of the self-report

questionnaires administered. More simply stated, individual differences in cognitive style likely to predispose individuals to PTSD post-trauma may have worked to weaken the effect of a simple laboratory manipulation. The question of how to assess these unobservable behaviors remains. Finding ways to assess the behavior of individuals in the very early post-trauma phase could be a useful next step, noting however that cognitive processes are likely sensitive to observation and are often not under the awareness of the individual.

It is similarly likely that certain events depicted in the film stimuli (e.g., sexual assault where perpetrating character places gun in the bra and underwear of the victim character) were so distressing that the practice manipulation was not sufficiently powerful to override the nature of the portrayed event. It appears, then, that although a simple free recall task did not produce the prototypical RIF effect, when the task was effortful recall, that the manipulation of practice did impact the unintentional recall of events, in the form of intrusions.

This study was the first to examine the potential that RIF may be an etiological or maintenance mechanism underlying intrusive reexperiencing in PTSD. An analogue sample was used as the premise being investigated is that, rather than elaborate and highly disorder-specific mechanisms, intrusions are likely the result of normative cognitive processes. This premise is supported by the findings that, although PTSD is the only disorder for which distressing intrusions of memory are required to reach criteria for the disorder (DSM-IV: APA, 2000), distressing unwanted intrusions of memory occur across disorders (Brewin, 1998; Brewin, Hunter, Carroll, & Tata, 1996;

Carlier, Voerman, & Gersons, 2000; Day, Holmes, & Hackmann, 2004; Hackmann, Clark, & McManus, 2000; Kuyken & Brewin, 1994; Reynolds & Brewin, 1999, Speckens, 2003) in normal populations (Berntsen & Hall, 2004; Brewin, Christodoulides, & Hutchinson, 1996) as well as by individuals reporting no criterion A trauma (e.g., Gold, Marx, Soler-Baillo, & Sloan, 2005). The current study demonstrated that unintentional memory retrieval, in the form of intrusions, can by influenced by differential retrieval practice. Additional research designs are needed to more fully understand the influence of factors such as interrelatedness and level of distress on both the RIF paradigm itself, and the ability of differential retrieval to influence the number and content of intrusions.

Finally, the inclusion of indices of fragmentation and measures of dissociation in the current study failed to support fragmentation as an important construct related to intrusions or dissociation. Overall previous studies of fragmentation have demonstrated that the construct has the ability to distinguish groups of individuals with PTSD from those without and to predict PTSD symptoms, however, fragmentation does not appear to move with recovery, indicating that it may be a pre-morbid difference rather than a result of trauma exposure, per se. Results of the current investigation demonstrated that individual differences in cognitive ability are strongly correlated with the construct of fragmentation, measured in a number of ways. This finding is consistent with studies where apparent fragmentation effects disappear after controlling for cognitive ability. Therefore the current study, although analogue in nature, in concert with findings of previous studies of fragmentation, question the premise that there is s functional role of

memory fragmentation in PTSD. Finally, findings suggest that dissociation appears unrelated to coded indices of fragmentation but somewhat related to metamemory reports, an effect that dissipated over 72 hours. This finding is consistent with overall findings of studies examining dissociation and fragmentation. As such, the current findings further call into question theories of PTSD premised on dissociative encoding.

With the lack of support for theories related to peritraumatic encoding disturbances and the role of memory fragmentation in PTSD, alternative etiological and maintenance mechanisms require further exploration. Given initial intrusive reexperiencing after trauma can be considered normative, the majority of trauma-exposed individuals report the cessation of these experiences (i.e., natural recovery), and pre-morbid factors explain only a small amount of variance in natural recovery, the role of post-trauma factors need to be further explored. Response to early post-trauma experiences, such as reaction to intrusive experiencing (e.g., differential retrieval/recall) as a key mechanism, is promising and warrants further examination.

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Appendix A: Fragmentation coding manuals

Global Narrative Coding Manual

High Scoring Items (7-10 range)

- Meta-memory statements of unknowing for complete events
- Sections of incoherent speech
- Unfinished/unrelated thoughts
- Significant statements of uncertainty
- Repetitions of full thoughts

Medium Scoring Items (4-6 range)

- Unfinished thoughts
- Meta-memory statements for dialogue or details
- Helpful context missing
- Awkward manner of speech
- Repetitious chunks of dialogue

Low Scoring Items (1-3 range)

- Speech fillers
- Single word repetitions
- Clarifications or minor corrections
- Misused words
- Stuttering
- Minor “I think” or “or something statements”

To arrive at a score, each narrative was read through by a trained coder and given a tentative score based on the overall impression of fragmentation. The coder would then read through the narrative a second tome marking each occurrence of items listed above, and assign a score based on the type and amount of items indicative of fragmentation that occurred in the narrative. For example, the coder would compare the two scores and if there was a discrepancy, would read through a third time to decide on an appropriate final score.

The primary coder met weekly with the PI and another trained coder to compare and discuss scores of narratives coded for reliability. The primary coder was blind to participants’ condition, time point of the narrative, and which narratives would be chosen for reliability coding.

Appendix B: Fragmentation coding manual

Fragmentation Coding Manual

Guidelines for coding for fragmentation were adapted from Foa, Molnar, and Cashman (1995)

Audiotaped narratives were transcribed for coding. The transcribed narrative was then parsed into individual statements in a process referred to as "Chunking". A chunk is a clause which may include an action, but is divided such that all words pertain to one and only one thought..We expanded upon the original guidelines by specifying the particular language that is usually seen in each narrative, as well as include guidelines for dealing with grammar mistakes and inconsistencies.

Coders then assigned each individual chunk as belonging to one of 10 hierarchical categories. Each chunk was given only one code. When more than one code applied to a chunk, a hierarchy indicated which code would be used. The hierarchy was (in ascending order of importance): Speech fillers (e.g., Um, uh), Details (e.g., The ground was dry, she was wearing a hat), Dialogue (e.g., She told him to get her some ice, He's screaming Roy), Action (e.g., He gets the gun from the ground, She runs outside the door), Sensations (e.g., I can see that she has a knife behind her back, My heart began to pound), Feelings (e.g., It was scary for me, I was disgusted with that part), Unfinished thoughts (e.g., He wasn't sure if…, He's not doing…,), Organized thoughts (e.g., Because he thought he was in power, She probably realized that this was the only way), Disorganized Thoughts (e.g., I think he was grabbing for the gun, I'm not sure if that's right, I don't remember how she got out), and Repetitions (i.e., Thoughts which repeat previously mentioned content within 5 chunks).

Coders met weekly with the PI to compare and discuss coding for narratives assigned for reliability to address potential drift.

Chunking Guidelines

Chunking Rules:

A chunk is a clause which may include an action but which is divided such that all words pertain to one and only one thought.

Chunking is guided by, but not limited to, locating subject-verb phrases. Coherence of a chunk comes first but if a thought can easily be attached to a thought above or below - attach it below.

1. A second chunk may be an elaboration of a previous thought.

2. In the case of actors, an elaboration or specification of exactly who the actor is remains one single chunk. Identity elaborations (e.g., "He, the old man…") or clarifications (e.g.,

The guy with the cowboy hat, the one that threw up on the bed…") stay together as long as they can reasonable be inferred that they are referring to the same subject. Generally an actor will be stated in both the initial statement and the addition (e.g., "The blue, the guy in the hat" is not one chunk). Exceptions for "Blonde, and brunette, which are both details and colloquially used to refer to actors. This also applies towards references to actors in passing. (e.g., The man with the gun goes towards the two hostages, the man in the blue shirt and the guy with the hat./) It is also possible that the participant will go back to referring to the individual with a vaguer detail. (e.g., "The guy with the blue hat, he goes…"). When a participant presents an actor(s) with the intent only to describe or provide details about that actor(s), the subsequent details stay together with the actor(s). If they are used as identifying markers for a subsequent action or location (e.g., The man with cowboy boots and a woman wearing overalls are in a motel) they stay together.

3. Additional details about an object are maintained as one chunk. Keywords to look for, "with" "that is" "that are" "and"(Additional Details) "Until" "After" "Before" (Temporal Placement details) but NOT, "which." Metaphorical additional details "like, as if, etc." are chunked if they are the only or last detail of the object. Elaborations involving verbs are chunked with their corresponding "and." (e.g., and he is adjective and adjective/ and action/ and action

4. Any repetition of a previous chunk is a new chunk. This includes all exact matching dialogue. (e.g., Do it, do it) except from when it is known from the film that certain phrases are repeated. (Help Help!)

5. Causal statements such as "if-then" (as well as compound causal statements), "in order to," "because," "but", "and", "so", etc., are generally considered as two chunks except in the case of dialogue when the participant is directly quoting something from the film.

6. Unfinished clauses are considered as separate thoughts and comprise one separate chunk per thought (unfinished thoughts = sentences attempted but not complete). Give the participant the benefit of the doubt, if possible, in determining whether the sentence could have continued on to a logical conclusion.

7. Gender changes in specifying an actor, or other obvious shifts in meaning should be chunked out.

8. The phrase "and then," if not followed by an event, also indicates an unfinished thought.

9. If an "and" is repeated before a new thought (and and then it…), chunk the initial "and" in isolation. Also chunk trailing "ands" in isolation.(He's going to the store/ and,/ but then it goes….) Also note that "and then" is always chunked.

10. Implied dialogue takes precedent over rule #5 and is kept together unless the speaker is changed or restated. (e.g., “He says that he’s going to get some ice and that he will do it if she does something else for him.” “He says he‘s going to get some ice./ He says that she had better give him a show).

11. “Self-dialogue” (thinking aloud) is chunked according to normal rules. Dialogue of other people is a single chunk, unless the dialogue is disrupted by repetitions or unfinished thoughts, which are chunked out.

12. Phrases of organization such as “meanwhile,” “as” and “as this is happening” are retained with the chunk and only that chunk they are meant to organize. Other chunk rules are in effect and do not change if there is an organizational phrase. Scene changes are considered phrases of organization. If the chunk presenting the organizational phrase is broken up due to any of the other rules it functions along subsequent chunks that would otherwise be kept together as a result of the organizational phrase.

13. Grammatical errors are not cause for the beginning of a new chunk unless the participant recognizes the error and corrects his or herself.

14. If uncertainties used as modifiers within the statement come before the statement of fact, then it is not separated into chunks and is coded according to the hierarchy as a disorganized thought. If however the uncertainty follows a completed statement of fact it is chunked separately and coded accordingly. Look for “I think” “and something” “or something” “I believe” “I guess.” It can also sometimes be more direct such as “I don’t know.” Always chunk at “or” unless it comes in a statement that the participant made clear is uncertain with one of the above statements or the word “either” (e.g., I don’t know if he goes outside or stays inside).

15. In the beginning scene, should a participant set the scene or setting, descriptions of separate concepts referring to the scene or setting are kept together. These can include the sky (Color, Clarity), Temperature (Humidity), Landscape (Fauna, Ground). Statements such as, “There’s also a hotel there, and a sign with a palm tree as well” while referring to distinct objects are nevertheless retained within the scene/setting chunk. All further details of these objects are considered elaborations and chunked normally. “(e.g., Okay so the scene beings in the desert and there’s a lot of sand and dust, it’s hot and dry. There’s some cactuses, and also a hotel in the distance with a gas station./ It’s got yellow doors and there’s a group of people standing outside the gas station.).

16. Listing streams of disorganization (e.g., “that’s not right, / I got it all wrong,/ I made a mistake) are broken up.

17. Commands or descriptions of involuntary action are all kept together (e.g., "He has to go to the ice machine and get some ice for his wife and…" "He tells her to get on her knees and give him some sugar and make it count."

18. Chunk out any instance where the participant is talking about the characters cognitions. (He thinks…

Coding Guidelines

REPETITIONS

The category of repetition was thought to be the most direct index of fragmentation, and therefore this category was assigned the highest priority. An utterance was considered to be a repetition when it was repeated more than once within five lines.

There must be at least two matching words repeated in the repeated chunk for it to be coded a repetition. This is often an actor and a verb but any two word combination can be coded as a repetition. (Note: contractions are considered two words.) If the thought is subsequently finished, then the completed chunk takes the code normally. If the thought is again unfinished then it is coded as repetition UNLESS there is new information added.

"An he's going" ***- unfinished thought***
/"he's going" ***- repetition***
/to get ice" ***- action***

"She told her she can/ ***- unfinished thought***
/she can ***- repetition***
/go to the store" ***- dialogue***

"*He gets into the –****unfinished thought***
/He gets into – ***repetition***
The man with the hat he gets into his face." – ***<u>action</u> (new information added)***

To the, with the, is the, etc. - Articles of speech in combination (two words or more), are considered repetition, when **consecutive**. However, they are not considered repetition when <u>"within five lines" not including speech fillers,</u> (interrupted by other statements) when the participant has clearly gone on to another idea. (See section on single-word repetitions below.)

"And the" ***-unfinished thought***
/"And the" ***– repetition***

"And the" ***– unfinished thought***
/She sits on the bed and waits. ***– action***
/And the girl in the bathroom comes out. ***– action***
/And the ***– unfinished thought (not repetition)***

/She sees the blond woman dead." ***– detail***

-For completed thoughts The two thoughts must occur within five chunks of each other not including speech fillers. In addition, there cannot be any new information in the repeated chunk. However, it can be stated slightly differently.

"You can hear a voice" – ***sensation***
/"There's a voice playing" – ***repetition***

In addition, participants may also summarize a sequence of thoughts in one chunk. So long as no new information is given and at least one part of this summary has been stated within the five line rule it is coded as repetition

"*and he was shot in the neck* – ***action***
/uh ***–speech filler***
/so he was stabbed in the thigh and shot in the neck ***-repetition***

Small changes of tense

"There's – ***unfinished thought***
/um – ***speech filler***
/uh – ***speech filler***
/really intense music that goes on - ***detail***
/that's going on" - ***repetition***

General Idea Repeated

"…let go" - ***action***
/"Let free for now"- ***repetition***

Separated by Text – within 5 lines of text

Additional thoughts can occur between the first chunk and a repeated chunk that pertain to the initial chunk – as long as it is within 5 chunks. Speech fillers DO NOT count in the 5 lines.

"An she invites Jimmy the roadie in" - ***action***
/"And first he's confused" - ***detail***
/"because he doesn't recognize her." - ***organized thought***
/"She invites him in" - ***repetition***

Single word repetitions

One word articles or conjunctions are not coded as repetition, unless they are stated more than twice. When the last incident appears, then it is NOT chunked separately. Articles and conjunctions are: **a, an, the, and, is, but, for, nor, or, so**.

"*The* - ***unfinished thought***
/*The guy goes to the store.*" – ***action***

The - ***unfinished thought***
/The - ***repetition***
/The guy goes to the store - ***action***

When the single word repetition is not a particle, two repetitions of a word *are* enough to code it as a repetition and they do not need to be consecutive. Proper nouns and pronouns follow the two occurrence rule. For example:

Roy – ***unfinished thought***
/Roy - ***repetition***
/I don't know what happened next. - ***disorganized thought***

In the bathroom she/ -***unfinished thought***
/uh - ***speech filler***
/she - ***repetition***
/tries to make an escape/" -***action***

DISORGANIZED THOUGHTS

Utterances which imply confusion or disjointed thinking are coded as disorganized thoughts. Examples of disorganized thoughts are: "I don't remember how my leg got cut." "I don't know where he took me next." And "I don't know why he said that."

Disorganized thoughts can begin with *I believe* and *I think.* Chunks are disorganized thoughts when phrases of "I think, I guess, I believe, etc." are attached to **known information**. Known information is anything that is directly stated or seen in the film. Chunks are **not** coded as disorganized thoughts when the "I believe" or "I think" are about something the participant has inferred and is not a known fact.

"I think the sister opens the door"- ***disorganized thought***
"I think the brother of the sister drags him into the motel room." - ***disorganized thought***

When chunks with "I think, I guess, I believe, etc." consist of unknown or inferred information they are not disorganized thoughts and are most likely coded as a detail.

"I think the young brunette is her daughter" – ***detail***
"I think it is late afternoon." - ***detail***

Disorganized thoughts can also come at the end of an otherwise complete thought, and when they do, they are chunked on their own line. Since the phrasing of the first thought is complete it

is coded normally. The second thought implies confusion (disorganization) related to the previous full thought. and is coded <u>on its own</u> as a disorganized thought.

"and he goes to get some ice **- *action***
*/I think."***- *disorganized thought***

In addition, the usage of "and something," "or everything," etc. when they come at the end of a thought is dependent on the usage of "or" and "and." "Or something, everything, stuff like that" is coded as disorganized thought, and "and something, everything, stuff like that" is coded as detail

"And he's/ ***-unfinished thought***
*/like –****speech filler***
*/interested in her –****organized thought***
*/and everything" –****detail***

*"And he says he'll go get ice" –****dialogue***
*"/or something." –****disorganized thought***

When there is no "or" or "and" as in, "something like that" then it defaults to the hierarchy and is coded as disorganized thought.

"He says that his wife's in that room, so maybe another room perhaps/ –dialogue
*/something like that" –****disorganized thought***

Another possible instance of a disorganized thought is the usage of "*or"*. Generally *or* is chunked down and represents the start of a disorganized thought (i.e., an admission of uncertainty).

And then he goes to the back **- *action***
/or the ice machine **- *disorganized thought***

And he says well my wife's in that room **- *dialogue***
/or something like that **- *disorganized thought***

When an "or" phrase includes an "either" or "neither" the phrase is not chunked at the "or" and represents a single chunk.

So <u>either</u> he gets ice for his wife or for some other reason. – ***disorganized thought***

Other instances of disorganization occur when the participant is vague about objects or location made clear in the film.

"He picks up something off the ground at some point." **- *disorganized thought***
"He puts something against his neck." – ***disorganized thought***

"Screaming, talking, arguing," about "something" is coded as action unless there is more to indicate that it is disorganized.

"She says something." ***–action***
"She says something that I don't remember." ***–disorganized thought***

Immediate corrections are not coded as disorganized thoughts unless there's an "or" in the beginning

"And the girl ***–unfinished thoughts***
/no the guy goes to get ice." ***–action***

Corrections about complete thoughts are not disorganized unless there's an "or" in the alternate chunk.

"And the girl goes to get ice ***–action***
*/no wait the guys goes to get ice"****-action***

Disorganized Markers

"I don't remember"
"I don't know" (including when describing people)
"I'm uncertain" (including when describing people)
"I'm not sure"
"I guess" "I believe" "I think" "or" - coder needs to look further at the context
"something" (when it is clear the participant does not know what)
"I'm not sure, but the next thing I remember…"
"What happens next" (when the participant is questioning themselves)

ORGANIZED THOUGHTS

An utterance indicating realization, decision making, reasoning, hypothesis-setting, or planning is codes as an organized thought. Examples of organized thoughts include "I am keeping my eyes closed so I can't identify him and he won't have to kill me." And "If I let myself go numb it won't hurt anymore."

Thoughts beginning with "*because, in order to, so that"* are always coded as an OT, as these chunks show some type of reasoning or hypothesis setting.

However, emotions of the characters are coded as detail, even though to an extent they must be inferred.

Chunks which attempt to explain the motivation, rationale or subtext for another chunk are always coded as Organized Thoughts even if the chunk is a detail.

"She breaks out the window above the toilet ***–action***
so she can escape." ***–organized thought***

"*He goes and grabs a stick off of the ground.* ***–action***
/because the other guy got in front of the other guy." ***–organized Thought***

Thoughts with <u>*It appears, I believe, probably, seems, it seems to be*</u>, should be examined for the content of the chunk to determine if it is an organized thought or another category (e.g., detail). When the participant uses the phrases listed above when referring to details or identities of the actors, they are coded as detail.

"Her pants appear to be blue." **- *detail***
*"She asks, I believe, to go to the bathroom."***- *disorganized thought***
"The old blonde lady is, I think, the girl's mother." **- *detail***
"He's probably interested in that girl." - *(hypothesis)* - ***organized thought***
"And he's, I'm assuming, her husband and the band leader." **- *detail***

<u>UNFINISHED THOUGHTS</u>

Chunks that involve a sentence attempted but not completed or just single words relating to ideas. Unfinished thoughts are often followed by the completed idea, with is then categorized accordingly. For example, "So then he…/…didn't…/" would be coded as two unfinished thoughts.

Thoughts which stop without a proper conclusion (typically an unfinished sentence) are coded as unfinished thoughts. This can occur both at the stoppage of a sentence by a speech filler or with a half word. Words attempted but not completed, a/k/a stutters (e.g., "Fr From" the "Fr) are unfinished thoughts rather than a speech filler. Note that stutters are not speech fillers but are coded as unfinished thoughts. Unfinished words and stutters carry no meaning other than to indicate an unfinished thought, and therefore have no bearing on any other code. Due to the artificiality of "chunks", it is important to consider the context of some chunks which may be dependent on a previous chunk and the meaning is carried through.

"And fr **- *unfinished thought***
/ from there they go to the store." **- *action***

"And he goes to get – ***unfinished thought***
um – ***speech filler***
ice for his wife" **- *action***

Incoherent thoughts (seemingly incomplete or nonsensical) that do not appear to have context will each be coded as an unfinished thought.

He opened – ***unfinished thought***
/she opened – ***unfinished thought***

/um – ***speech filler***
/gun was – ***unfinished thought***
/Roy was standing" ***- action***

When an unfinished thought is then subsequently finished, the remaining portion of the thought takes the code for the full thought.

"He bent down" – ***unfinished thought***
/um – ***speech filler***
/to get a stick." ***- action***

Similarly for dialogue, when the dialogue is cut off in some way, the completed part of the dialogue is coded as dialogue.

"And then Hoss says that he forgets – ***unfinished thought***
/he forgot to tell the man that – ***unfinished thought***
/that's their roadie whose name is Jimmy." – ***dialogue***

There is a distinction between an elaboration of a previous thought and the stoppage of a thought to add or change a component of a thought before fully completing it.

"And there's a doll/ ***-unfinished thought***
*"A stuffed doll of some kind."****-detail***

"And there's a doll/ ***-detail***
*/a stuffed doll."****-detail***

FEELINGS

Feelings were conceptualized as unpleasant emotions such as humiliation, fear, shock, and dissociative experiences such as numbing or freezing. Examples of utterances coded as …feelings included, "I am frozen with fear," "I am scared to death," and "I couldn't feel my body anymore."

Literally expressions of what the participant is feeling.

"This part was disgusting!" ***- feeling***
"I was too scared to look." ***- feeling***

SENSATIONS

Utterances were coded as sensations when they made reference to one of the five senses.

Literally expressions of what the participant (not the actors in the film) perceives. It must have a sensory word such as *saw, heard, taste, etc.* or phrasing that indicates a sense is being used. The participant can include other perceivers as well.

"I saw there was a sign." ***- sensation***
"I/you hear/heard…" ***- sensation***
"We hear music playing." ***- sensation***
"The audience hears music playing." ***- sensation***

ACTIONS

Utterances involving descriptions of action. Examples of action: "He is walking ut of the front door." and "He started undressing me".

Chunks with a verb of some action that is observable and can potentially affect the course of the film.

Chunks in passive tense (that explain something done to an actor) are also actions

"He was shot." ***- action***
"She is shoved onto a bed." ***- action***
"They are lead outside by the long haired man." ***- action***

When an action is followed by an elaboration of the action, the elaboration is typically a detail.

"He is executed ***- action***
/shot to the back of the head." – **detail**

The lack of action is considered a detail (statements that someone doesn't do something or is almost doing something):

"She doesn't answer" ***-detail***
"*She's almost crying"* ***–detail***

However, stopping an action and reiterating an action are coded as actions:

"And he stops in his tracks." ***– action***
"They continue driving." ***-action***

DIALOGUE

Any described verbalizations made were coded as dialogue.

Any chunk with a verb that denotes something being said along with some details of that speech OR quotes that are recognizable as being from the film.

"They are talking about the night before and what happened at the bar" – ***dialogue***
"She's screaming for help" ***– dialogue***
"The sister meows" –***dialogue***

"*He hits him in the head/* ***-Action***
/and says, I'm the devil." ***-dialogue***

Verbs that are interpreted as speech require detail of that speech for it to be coded as dialogue, unless the contents of the speech is known when in reference to something previously mentioned

"He swears at her" ***- action***
"They are talking" – ***action***
"They are talking about if the bad man is going to kill them." – ***dialogue***

"She tells her to say, thanks babe I had a really great time" –***dialogue***
"And so the other lady <u>*does so.*</u>*"* –***dialogue***
(Note that if an action is included in the first part as in "She tells her to kiss her and say thanks…" the subsequent chunk is coded as action.)

A participant may also explain cognition as a result of hearing something that the actor in the film says. These are coded as detail.

"He thinks he's got the wrong room." ***–detail***
"He wants her to undress" – ***detail***

<u>DETAIL</u>

Any utterances that did not meet definitional criteria for any of the above categories were assigned to the *details* category. This includes utterances involving description such as, "His eyes are blue," "He has a mask on his face," and "It is midnight."

Any thought that describes people, places, objects, location, position or even the film itself and does not fall into any of the categories above. They can be listing streams of detail that go on so long as they pertain to one subject.

Details include emotional states and the transition to emotional states (even though they are, in a way inferred), such as:

"He is really angry" - ***detail***
"She is frantic." - ***detail***

Speech not pertaining to the narrative or are expressions of the participants feelings about the narrative are coded as detail

"I'm sorry" ***–detail***
"Can I have a tissue" ***–detail***
"Oh wait," "Hold on," ***-detail***

Meta-statements about a characters overall behavior are coded as Detail and NOT Action

"He's being intimidating to them" ***–Detail***

SPEECH FILLERS

Speech fillers are always chunked down to a new line. Sometimes this creates an unfinished thought. When this happens and the unfinished thought is then completed, the completion is coded as the intent of the full thought.

"She opened the – ***unfinished thought***
/umm – ***speech filler***
/door" – ***action***

When a speech filler breaks up a thought, it matters if the chunk that takes the non-pathological code is coherent on its own. For the purposes of coding, actions that have additional details attached after the action that are subsequently broken off as a result of a speech filler will only be coded as unfinished thoughts if the subsequent detail begins with a preposition.

"*She opened the door to the house –****unfinished thought***
/um ***–speech filler***
/with the band inside" ***– action***

Descriptive elaboration words such as "in, with" "that is" "that are" "and"(Additional Details) "Until" "After" "Before" (Temporal Placement details) generally stay with the subject it's describing. If they become detached as a result of a speech filler as in the example above, the chunk above the speech filler is still automatically an unfinished thought. .

Dialogue is treated the same way when it call comes from the same actor. Lists of quotations or subjects of speech broken up by speech fillers is not unfinished

"He tells him that he's Willy Wonka – ***dialogue***
you know – ***speech filler***
That it's my chocolate factory ***–dialogue***
*um –****speech filler***
And that he's in charge." ***-dialogue***

*"He says no" –****dialogue***
*/uh –****dialogue***
/I have a wife" ***-dialogue***

Examples of typical speech fillers: *Um, uh, ah, let's see, like, but anyway, er, hmm, you know*

Other notes about coding:

The usage of temporal organizational words such as "Meanwhile, while, when, as, after, before, during, at the same time" usually denote two thoughts with one thought used to temporal place when a second thought occurs. The thought **without** one of these words is usually the main thought of the chunk to be coded.

> "And **when** the guy goes to get ice(1), the lady starts to meow.(2)" – ***dialogue***
> "The guy struggles to get the gun(2) **while** his friend picks up a stick(1)" –***action***

In each case, the thought with (2) is what gets coded.

Meanwhile and **at the same time** are unique in that they can stand as their own in a thought with only one item to code.

> "Meanwhile the girls in the motel room are starting to get antsy." – ***detail***
> "At the same time there's a bunch of people near the motel unpacking luggage." – ***action***

These almost serve as scene changes using the previous scene and all of its thoughts as a benchmark for when the next scene occurs. For the purposes of chunking, **meanwhile** will only be kept with two thoughts if there is at least a **when, while, as, before, during** or **after** present within the chunk. For **at the same time**, it must be followed by **as,** or **that,**

> "Meanwhile **as** the three men are in the desert back in the motel room there are the three ladies." – detail: NOTE that in this example, **meanwhile** is entirely unnecessary.

> "The two guys are walking out into the desert at the same time that the guy is walking behind them with the gun." – action; NOTE that in this example, **at the same time** is also unnecessary

For the purposes of coding, the chunkers will determine how to chunk the thoughts with **meanwhile** and **at the same time.**

~Finally a quick way to determine which part of the chunk takes the code read the chunk and put a comma where you naturally pause or take a breath and code the portion without the meantime word.

> **1. Coherence of chunks takes precedent**
> **2. When chunks can go either up or down, attach them to the lower chunk**

Appendix C: Metamemory fragmentation components (MCQ; Johnson et al., 1988)

Sensory
My memory for the event:
-involves visual detail: *1 = little or none; 7 = a lot*
-involves sound: *1 = little or none; 7 = a lot*
-involves smell: *1 = little or none; 7 = a lot*
-involves touch: *1 = little or none; 7 = a lot*
-involves taste: *1 = little or none; 7 = a lot*

Vividness
My memory for this event is: *1 = black and white; 7 = entirely color*
Overall vividness is: *1 = vague; 7 = very vivid*
My memory for the location wehre the event takes place is: *1 = vague; 7 = clear/distinct*
General setting is: *1 = unfamiliar; 7 = familiar*
Relative spatial arrangement for objects in my memory for the event is: *1 = vague; 7 = clear/distinct*
Relative spatial arrangement of people in my emmory for the event is: *1 = vague; 7 = clear/distinct*

Clarity
My memory for this event is: *1 = dim; 7 = sharp/clear*
My memory for the event is: *1 = sketchy; 7 = very detailed*
I remember what I thought at the time: *1 = not at all; 7 = clearly*
Overall, I remember this event: *1 = hardly; 7 = very well*
Do you have any doubts about the accuracy of your memory for this event: *1 = a great deal of doubt; 7 = no doubt whatsoever*

Coherence
Order of events is: *1 = confusing; 7 = comprehensible*
Story line is: *1 = simple; 7 = complex*
Story line is: *1 = bizarre; 7 = realistic*
My memory- for the time when the event takes place is: *1 = vague; 7 = clear/distinct*
-For the year is: *1 = vague; 7 = clear/distinct*
-For the season is: *1 = vague; 7 = clear/distinct*
-For the day is: *1 = vague; 7 = clear/distinct*
-For the hour is: *1 = vague; 7 = clear/distinct*
The event seems: *1 = short; 7 = long*
I remember events relating to this memory that place:
- in advance of the event: *1 = not at all; 7 = yes, clearly*
-after the event: *1 = not at all; 7 = yes, clearly*

Emotion
I remember how I felt at the time when the event took place: *1 = not at all; 7 = definitely*
Feelings at the time were: *1 = not intense; 7 = very intense*
As I am remembering now, my feelings are: *1 = not intense; 7 = very intense*

VITA

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