



Sexual Assault and Memory

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We found to our great surprise ... that each individual symptom immediately and permanently disappeared when we had succeeded in bringing clearly to the light the memory of the event...when the patient had described the event in the greatest possible detail and had put the affect into words....

—Breuer & Freud, 1893–1898/1955, p. 6

Memory for a sexual assault is dynamic and reconstructive; it is not fixed or indelible. What is encoded in memory depends on a person's past, the event itself, and processing of that event. What is remembered depends on encoding of the event and the later retrieval of the event as well as related content such as previous similar experiences. Memory for a sexual assault is not like a series of photographs or a digital recording. Even if photographs or recordings were available, these would only show one perspective of what happened and not necessarily depict the perspective of the assault survivor, which depends on where his or her attention was focused and many other factors such as the role of repeated retrieval. Memory for a sexual assault and memory functioning are also directly related to persistent assault-related psychopathology such as depression and posttraumatic stress disorder (PTSD)

and its treatment. Some of the best evidence-based treatments for assault-related psychopathology focus on revisiting or re-examining the memory of the event. Indeed, as seen by the quote from Breuer and Freud above, the understanding of the crucial role of memory in recovery following trauma is not a new view.

A complex, dynamic conceptualization of memory following a sexual assault requires understanding the processes involved in the strong encoding of emotional events and the physiological factors that alter this encoding. It also requires understanding the role of retrieval and re-experiencing as well as the acceptance of the fact that any form of memory is susceptible to unintentional memory distortions and actual errors. There are also general memory effects involved beyond the memory for the assault itself, including attention to threat, working memory deficits, and lack of specificity for memory of autobiographical events. Finally, memory is often the target for some of the strongest evidence-based treatments for assault-related psychopathology. These processes will be reviewed over the course of this chapter.

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Encoding of a Sexual Assault

Enhanced memory for stressful events is a normal and, in many circumstances, an adaptive function of human cognitive functioning. By forming strong memory traces that are easily remembered and enduring of potentially life-threatening events, humans are more likely to be able to recognize and avoid similarly dangerous situations in the future (e.g., Lazarus, 1991). It is well-established that emotional arousal enhances the storage of memory (Christianson & Loftus, 1991), with numerous studies demonstrating that emotional events, both positive and negative, are recalled better than neutral events (e.g., Walker, Skowronski, & Thompson, 2003). Neurobiological theories suggest that humans are evolutionarily wired to remember emotionally arousing experiences such as sexual assault (e.g., McGaugh, 2013; Müller & Pilzecker's, 1900). Historically Müller and Pilzecker's (1900) perseveration-consolidation theory of memory posited that neural processes involved in memory formation are initiated during an event, but it is the perseveration of these processes over time that leads to the consolidation of memory in long-term storage. Recent research has firmly established that lasting memories are formed through a gradual, time-dependent memory consolidation process, whereby the strength of memory may be influenced by endogenous processes such as endogenous stress hormones and neuromodulators occurring after the event (McGaugh, 2013). Importantly, this opportunity for the modulation of memory strength serves an adaptive function, allowing emotional arousal to strengthen memory for our most important experiences.

The amygdala, activated in response to an emotional stimulus, modulates activity in the hippocampus and other brain regions responsible for consolidating an experience into long-term memory (McGaugh, 2013; Phelps, Delgado, Nearing, & LeDoux, 2004). Fittingly, when a memory associated with emotion is undergoing consolidation and the amygdala is more activated, the degree of amygdala activation during encoding is positively correlated

with later memory recall (e.g., McGaugh, 2004). In other words, an individual experiencing high stress or distress as an event is being encoded will likely encode a more persistent, durable memory due to greater amygdala activation modulating hippocampal encoding processes. McGaugh's (2013) modulation hypothesis posits that following an emotionally arousing experience, high levels of endogenous stress hormones and neuromodulators such as epinephrine and cortisol interact with the amygdala. The interaction between stress hormone systems and the amygdala promotes memory storage, resulting in particularly strong and long-lasting memories for important information encountered during a stressful event (e.g., McGaugh, 2013).

There is substantial evidence that glucocorticoids (e.g., cortisol, corticosterone) and the noradrenergic system (e.g., epinephrine, norepinephrine) modulate the consolidation of emotional memory following their release from the adrenal medulla (e.g., epinephrine, norepinephrine) and cortex (e.g., glucocorticoids) (e.g., de Quervain, Schwabe, & Roozendaal, 2017). The basolateral amygdala (BLA), specifically, appears critical in this modulation of memory consolidation. Infusions of β -adrenoreceptor agonists into the BLA block memory-enhancing effects of epinephrine (e.g., Liang, Juler, & McGaugh, 1986), and glucocorticoid receptor agonists administered into the BLA enhance emotional memory in a dose- and time-dependent manner (e.g., Roozendaal, Okuda, Van der Zee, & McGaugh, 2006). Critically, the memory-enhancing effects of glucocorticoids appear contingent on endogenous noradrenergic activity in the BLA (Roozendaal et al., 2006). Glucocorticoids bind to glucocorticoid receptors in noradrenergic neurons in the brainstem (e.g., Roozendaal, Quirarte, & McGaugh, 2002). This then triggers norepinephrine release in the BLA and initiates a noradrenergic cascade thought to modulate the prefrontal cortex, hippocampus, and other brain regions involved, ultimately leading to enhanced memory. The timing of glucocorticoid arousal and noradrenergic activity appears important, in that increases in cortisol

levels must occur in tandem with release of noradrenaline (e.g., Joëls, Fernandez, & Roozendaal, 2011).

Numerous studies have demonstrated that increased activity in the amygdala in response to viewing emotional stimuli predicts better recall (e.g., Kensinger, Addis, & Atapattu, 2011). Experimental research has also found that inducing the release of stress hormones during a learning phase (e.g., administering shocks) and post-learning administration of stress hormones enhances memory for the learned material (e.g., Hupbach & Fieman, 2012). Taken together, the amygdala, hippocampus, and stress hormones are consistently implicated as neurobiological processes associated with enhanced memory for emotional events, ensuring that highly emotional experiences such as sexual assault will be retained in memory.

Physiological responses and memory. Beside the release of endogenous stress hormones, immediate physiological responses to sexual assault may include sexual arousal or responses to physical or biological insult, including head injuries resulting in loss of consciousness or loss of oxygen (e.g., strangulation), as well as intoxication by drugs (e.g., rohypnol) or alcohol. These factors influence what a person initially encodes and therefore stores in their memory of the assault, with the potential for enhancing or impairing effects depending on the characteristics of the assault and the nature of the physiological responses.

Some may experience unwanted sexual arousal (e.g., lubrication, orgasm) in response to sexual stimulation that occurs during the assault (e.g., Levin & van Berlo, 2004). These responses are understood not as an indication of consent or enjoyment of the assault, but rather as an automatic physical response to sexual stimulation. In one small unpublished study of sexual assault survivors, 21% reported some form of physical response; and, of these women, a substantial number of the rapists attempted to produce sexual arousal (see Levin & van Berlo, 2004). Laboratory studies of the effects of sexual arousal on memory encoding have been mixed, with some finding that exposure to sexual stimuli

impaired memory functioning (e.g., Laier, Schulte, & Brand, 2013), and others finding enhanced memory for sexually arousing stimuli (e.g., Wright Jr & Adams, 1999). However, these studies differ dramatically from an actual sexual assault by presenting sexually arousing stimuli to consenting participants with no substantial threat to life or well-being present. Further, it is not clear whether the observed effects were attributable to sexual stimulation as opposed to the broader cognitive, emotional, and physical aspects of sexual arousal.

Any biological insult or injury during a sexual assault that results in loss of consciousness will prevent the encoding of events during the period of unconsciousness, as an unconscious individual cannot attend to details in their environment. For example, a survivor who is choked by an assailant to the point of unconsciousness will not encode, and thus will be unable to recall, any information about events that occurred during the period of unconsciousness. In the case of head injuries that do not result in loss of consciousness, the presence and magnitude of impairments in memory storage depends on the extent to which the head injury damaged parts of the brain involved in memory encoding such as the temporal lobe (McGaugh, 2013).

Alcohol intoxication also affects consciousness and arousal. In general, alcohol has been shown to impair the formation of long-term memories, following a dose-response curve (e.g., White, 2003). However, studies of individuals who consumed alcohol during the encoding of a hypothetical sexual assault scenario have found that, although they remembered fewer overall details, they did not differ from alcohol-free controls in their ability to accurately recall key aspects of the scenario, including the perpetrator's identity (Flowe, Takarangi, Humphries, & Write, 2016). In line with McGaugh's (2013) modulation hypothesis, it may be that intoxication at the time of an assault may impair encoding of fewer peripheral details of the assault (e.g., objects within the room where they assault occurred), but central details of the assault, such as the perpetrator's general description, may be encoded.

Strong memory storage of sexual assaults may put individuals at risk for developing chronic, trauma-related difficulties such as PTSD. Indeed, trauma severity and higher levels of physiological arousal in the immediate aftermath of a trauma have been shown to modestly predict who will develop PTSD (e.g., Bryant, Harvey, Guthrie, & Moulds, 2000; Ozer, Best, Lipsey, & Weiss, 2003) and physiological arousal has been shown to play a significant role in the link between stress hormones and emotional memory, particularly in individuals with PTSD (e.g., Nicholson, Bryant, & Felmingham, 2014). However, characteristics of the trauma and the intensity of physiological responding to the trauma do not fully explain who will develop PTSD, suggesting memory storage strength is not the only factor influencing risk of PTSD.

Allocation of attention and memory. Attention plays a fundamental role during a sexual assault in terms of influencing what is encoded and then remembered. In general, attending to something enhances the likelihood of it being encoded in memory and retrievable later (Chun & Turke-Browne, 2007). What is attended to can be narrowed in on small details or can be broader in scope, open to taking in a range of information. During traumatic events, attention is thought to narrow to the most threatening aspects of the encounter. Loftus (1979) coined the term “weapon focus” to account for the narrowing of attention to the most salient features of the environment to the exclusion of other details. Consistently, as the most central features become the focus of attention, these details are best remembered; on the other hand, encoding and later recalling more peripheral details can be hindered (e.g., Christianson & Loftus, 1991).

One theory of weapon focus emphasizes the role of stress and arousal during emotional events, which may narrow overall attentional processing, restricting attention to central aspects of the event at the expense of peripheral events (Christianson & Loftus, 1991). Consistent with this hypothesis, in a meta-analytic review of the weapon focus literature, Steblay (1992) found larger effect sizes in studies that reported higher levels of autonomic arousal. Alternatively, details that stand out or are unusual or unexpected may call for increased attention and subsequent better

memory recall (e.g., Loftus & Mackworth, 1978; Pickel, 1998); conversely, details that appear in context that would be expected are not as well recalled (e.g., Pickel, 1999). Thus, attentional focus during a sexual assault will determine what is encoded for later memory storage and the weapon focus effect may help explain why survivors of sexual assault report that they do not remember some of the more tangential details but clearly remember the more salient, unexpected, or anxiety-eliciting features of the event.

Event processing and memory. The way that a sexual assault is encoded and processed may also affect later retrieval of the memory, with potential implications for post-trauma adjustment. Encoding and storage of autobiographical events occurs through associating the event with semantically and temporally related experiences, placing the event within a broader autobiographical memory base (Roediger, 1990). For example, a general category may be sexual experiences, which includes specific life events, shared and unique event characteristics, and general sexual knowledge. This associative, conceptual processing facilitates intentional retrieval by increasing the number of meaningful associations by which to retrieve the memory through higher-order, meaning-based strategies (Roediger, 1990). However, during a traumatic event, individuals may engage in data-driven processing, that is, focused on perceptual and sensory elements, resulting in poorly elaborated, perceptual memory traces. These perceptual memory traces (e.g., the smell of the perpetrator’s breath) are thought to lack the conceptual detail necessary to integrate the memory within autobiographical memory, resulting in impaired intentional retrieval of some aspects of the event and also increasing the chance that trauma-related cues will trigger the memory, leading to increased experiencing of intrusive symptoms (e.g., Ehlers & Clark, 2000).

Memory Phenomena After Sexual Assault

Intrusive memories. It is not uncommon for sexual assault survivors to have intrusive memories, defined as intense, brief, and vivid often image-

based recollections of a specific autobiographical event (Brewin, Gregory, Lipton, & Burgess, 2010) that typically emerge involuntarily, “out of the blue,” and include strong sensory components (Ehlers, Hackmann, & Michael, 2004). For instance, intrusions for a sexual assault survivor may include images of the perpetrator’s face, body odor, smells, sounds, or the feeling of having hands placed over their eyes. Intrusive memories can be triggered by a range of internal and external stimuli, such as physical bodily sensations, objects, or situations, and lack of awareness of triggering cues can sometimes make intrusive memories seem to pop up out the blue (e.g., Ehlers et al., 2004).

The mere presence of intrusive memories is not considered pathological. In fact, intrusive memories are common immediately after sexual assault and typically decline in frequency and intensity over time (Rothbaum et al., 1992). For some individuals, these intrusive memories persist (reliving: 45.4%; flashbacks: 46.2%) and contribute to significant distress and functional impairment (PTSD: 47%; Rothbaum et al., 1992). Trauma survivors with PTSD report a distinct “here and now quality” of their trauma memories and associated emotional response compared to those without PTSD (e.g., Kleim, Graham, Bryant, & Ehlers, 2013). Sexual assault tactics may also influence intrusions, with forcible rape associated with highest risk for developing PTSD and depression after assault, and incapacitated rape (e.g., lack of consciousness/awareness or ability to control behavior) associated with lower likelihood of remembering the event well (e.g., Zinzow et al., 2010). Intrusive memories can have downstream effects, increasing guilt or shame about the assault, low self-esteem, or a sense of loss of control, which interferes with functioning in work and interpersonal relationships, including loss of interest or avoidance of sex (e.g., Jaycox, Zoellner, & Foa, 2002).

There are various theories that seek to account for the development and persistence of intrusive memories. Dual representation theory (e.g., Brewin et al., 2010) posits that poor integration between contextual representations of memory (“C-reps”) and sensory representations of mem-

ory (“S-reps”) make individuals vulnerable to involuntary retrieval via intrusive re-experiencing. Similarly, Ehler’s cognitive theory (e.g., 2000) posits that sensory-perceptual encoding of the trauma in the absence of conceptual organization leads individuals to have fragmented sensory details (e.g., images of the perpetrator’s face) that are poorly integrated within a larger autobiographical memory context and highly susceptible to popping up as involuntary intrusions. A dynamic retrieval model of intrusions (Marks, Franklin, & Zoellner, 2018) emphasizes the role of retrieval processes in the pathological persistence of trauma-related intrusions. This model argues that the process of re-experiencing itself alters retrieval processes, such that distress caused by the unwanted memories actually increases retrieval strength, creating a vicious cycle where distressing memories become more and more vulnerable to involuntary retrieval over time, and, conversely, decreasing distress associated with intrusive memories decreases the retrieval strength of these unwanted memory traces.

Although intrusive re-experiencing is a common phenomenon across all kinds of traumatic events, some studies suggest that sexual assault survivors in particular are at risk for higher-re-experiencing symptoms (Kelley, Weathers, McDevitt-Murphy, Eakin, & Flood, 2009). A systematic review of predictors of intrusions found that higher pre-existing anxiety and depression, and tendencies towards negative appraisals increased risk for intrusions, and data-driven processing (bottom-up processing focused on perceptual and sensory elements) predicted higher intrusions (Marks et al., 2018). Further, post-event negative appraisals (e.g., I should have been able to stop the rape) predicted higher intrusions, whereas conceptual processing (top-down processing focusing on meaning) predicted lower intrusions (Marks et al., 2018). Clinically, this suggests that directly targeting post-event negative appraisals and encouraging contextual processing that focuses on making meaning from the event may decrease risk for persistent and distressing intrusive memories of the trauma.

Many sexual assault survivors, like most trauma survivors, will go to great lengths to

avoid or push away intrusive memories of the trauma, using cognitive strategies such as suppression, defined as intentionally stopping thoughts, and rumination, defined as focusing on distress in a passive, repetitive manner. These post-event strategies are commonly believed to increase risk for intrusive memories, though evidence is mixed. Some have found that instructions to “not to think about” being sexually assaulted increased the likelihood of generating assault-related thoughts (e.g., Shipherd & Beck, 1999); whereas other have not (e.g., Rosenthal & Follette, 2007). Notably, poorer executive functioning was found to moderate the effect of these strategies (e.g., suppression, negative dwelling, self-punishment) on subsequent intrusions (Bomyea & Lang, 2016). In other words, higher cognitive capacity may mitigate the otherwise detrimental effect of these thought regulation strategies.

Fragmented memories. Several theories posit that fragmented and disorganized recall of traumatic events is a crucial causal mechanism for PTSD. Typically, narrative fragmentation and disorganization refer to abnormalities of sequence, coherence, and content when intentionally recalling a detailed trauma memory (e.g., van der Kolk, 1987). According to these theories, trauma memories are uniquely encoded and processed in autobiographical memory, separated from the overall memory network, and are thus difficult to recall intentionally. Similarly, related memory theories (e.g., Ehlers et al., 2004; Ehlers & Clark, 2000) argue that PTSD results from incomplete processing and a memory representation dominated by perceptual details and lacking meaning and self-referential perspective (i.e., “inability to establish a self-referential perspective while experiencing the trauma that can be integrated into the continuum of other autobiographic memories in time.” p. 330; Ehlers & Clark, 2000). Dissociation, typically including phenomena such as depersonalization, derealization, and emotional numbing, during the traumatic event may be one process that interferes with encoding of the full trauma memory, resulting in a trauma memory representation that is experienced as vivid flashbacks and intrusive images but is unable to be recalled in a cohesive

and organized way (e.g., Brewin, Dalgleish, & Joseph, 1996; Ehlers et al., 2004). These theories are consistent in suggesting that integrating and organizing the traumatic memory is necessary for recovery from PTSD.

Research evaluating fragmentation theories is generally mixed. Although dissociation is reported by survivors of both adult (e.g., Dancu, Riggs, Hearst-Ikeda, Shoyer, & Foa, 1996) and childhood sexual abuse (e.g., Draijer & Langeland, 1999), an extensive review of the literature found that dissociation was related to perceived trauma narrative fragmentation, but not actual fragmented recall (Bedard-Gilligan & Zoellner, 2012). Existing studies in diverse trauma-exposed samples do not robustly support narrative fragmentation as predictive of PTSD or uniquely related to trauma narratives compared to other narrative types (Crespo & Fernandez-Lansac, 2016). In assault survivors, specifically, two studies have shown a prospective relationship between higher trauma narrative fragmentation and development of PTSD symptoms (Amir, Stafford, Freshman, & Foa, 1998; Halligan, Michael, Clark, & Ehlers, 2003). However, in adult survivors of childhood sexual abuse (Greenhoot, Sun, Bunnell, & Lindboe, 2013), although deficits in organization were related to increased PTSD and depression, other narrative elements such as positive aspects of the narrative were more strongly related. Across studies, coding measures vary widely both in their methods (e.g., linguistic coding, rater coding) and their definitions of fragmentation. Further, self-report and objective coding measures of fragmentation often do not converge (e.g., Bedard-Gilligan & Zoellner, 2012) and may be measuring distinct constructs. Conclusions that can be drawn are also limited by not controlling for factors such as verbal ability and distress during narrative recall that may cause narratives to appear fragmented or disorganized (Gray, Pumphrey, & Lombardo, 2003).

Importantly, studies that have explored memory fragmentation as a mechanism underlying reduction of PTSD symptoms during treatment have produced mixed findings and have not shown robust changes with fragmentation following PTSD treatment (e.g., Kindt et al., 2007; Moulds & Bryant, 2005; van Minnen, Wessel, Dijkstra, & Roelofs, 2002). One of the largest

and most empirically rigorous studies to date that included sexual assault survivors did not find changes in fragmentation, measured with both self-report and objective measures, to be related to either treatment response or treatment type (psychotherapy vs. pharmacotherapy), arguing against the notion that trauma memories need to become less fragmented and more organized for symptom recovery following trauma (Bedard-Gilligan, Zoellner, & Feeny, 2017). Taken together, treatment studies do not consistently suggest fragmentation as a crucial mechanism of recovery from PTSD.

Memory amnesia and forgetting. Due to the emphasis on trauma memories as separated from an individual's overall memory system, fragmentation theories are often utilized to explain the occurrence of traumatic amnesia, or the complete inability to recall a traumatic event for significant periods of time, even when the memory was encoded and in the absence of physical explanations for forgetting (e.g., blackout, head injury). Much of the research in this area has examined forgetting in adult survivors of childhood sexual abuse (Schefflin & Brown, 1996), although at least one study has looked at those who have experienced adult sexual assault (Mechanic, Resick, & Griffin, 1998), demonstrating that self-reported deficits in memory were more commonly reported immediately 2 weeks after assault but decreased by 3 months.

The phenomenon termed "motivated forgetting" posits that it can be adaptive and functional for individuals to forget aversive experiences, including sexual assault. It has been argued that individuals, particularly those with a history of trauma exposure or dissociation, are prone to forget traumatic experiences, especially those involving betrayal by a close or trusted person, out of a wish to avoid or repress painful memories and emotions (e.g., Freyd, 1994). Research exploring this phenomenon is decidedly more mixed, with two studies by DePrince and Freyd (2001, 2004) finding that, following instructions to remember words, those higher in trait dissociation recalled fewer trauma words and more neutral words during a divided attention task, while those lower in trait dissociation displayed the opposite pattern of

remembering more trauma and fewer neutral words. Of note, a replication of this study found no significant interaction effect for trait dissociation and word type (neutral, trauma) under conditions of divided attention (Deville et al., 2007). In addition, several other studies using directed forgetting paradigms have not found consistent differences in directed forgetting for those with varying levels of trauma exposure and dissociation (e.g., McNally, Metzger, Lasko, Clancy, & Pitman, 1998; Patihis & Place, 2018). When manipulating dissociation, the standard directed forgetting effect also disappears, arguing that the impact of dissociation may be more on encoding or impairing repeated rehearsal than on forgetting per se (Zoellner, Sacks, & Foa, 2003). Interestingly, studies done by Moulds and colleagues have demonstrated increased directed forgetting of trauma-related words in survivors with acute stress disorder in the acute phase following trauma exposure compared to those without acute stress disorder (Moulds & Bryant, 2005), although this enhanced forgetting effect disappeared after 1 year (Moulds & Bryant, 2008), suggesting that the effects are temporary and do not persist over the period of natural recovery where chronic, persistent PTSD emerges (typically 1–3 months post trauma). Collectively, there is little empirical evidence to support the notion of motivated forgetting as a process that is predicted by trauma exposure or dissociation.

Still, although most trauma victims report remembering traumatic experiences, a significant minority will report amnesia for all or parts of the traumatic experience (Loftus, Garry, & Feldman, 1994; Wolf et al., 2012, 2017). For example, 14.3% of a national sample of trauma exposed veterans reported an inability to recall important details about the traumatic event (Wolf et al., 2017). However, it is worth noting that much of what is termed "traumatic amnesia" may actually be better accounted for by mechanisms such as normal forgetting, nondisclosure, incomplete encoding of the memory, and infantile amnesia (i.e., expected lack of memory before age three; e.g., McNally, 2005). Thus, the issue of amnesia and sexual abuse or assault remains contentious. At the very least, limitations of memory and its

reconstructive nature must be considered in regard to expected recall of sexual assault and abuse.

False memories. In the 1990s, memories of sexual abuse recovered in psychotherapy sparked a divisive debate in the field of psychology regarding the validity of recovered memories, referred to as the “memory wars” (Crews, 1995). Proponents of the validity of recovered memory argued that dissociation at the time of the traumatic event leads to traumatic amnesia, resulting in loss of memory which may later be recovered (e.g., Dalenberg, 2006). Others argued that suggestive therapeutic techniques fostered the development of false memories, given memory fallibility (e.g., Lindsay & Read, 1994). Today, many scholars express skepticism about the validity of recovered memories (Patihis, Lilienfeld, Ho, & Loftus, 2014).

Memory is not thought to involve perfect recollection of past events, but rather a flexible, reconstructive process that is prone to error (Brewer, 1986). These errors range from a failure to recall certain aspects of an event (i.e., errors of omission) to the recall of inaccurate information (i.e., errors of commission) or even entirely false autobiographical memories, as in the case of implanted memories of childhood sexual abuse (Hyman & Loftus, 1998; Loftus, 2003). Across studies, a significant minority (30.5% false memory rate) of individuals can indeed come to remember events that never happened (Scoboria et al., 2017).

Evidence from false memory research carries important implications for the accuracy of memory for traumatic events; namely, while high emotion has been shown to enhance memory, it does not inoculate the memory from distortion or forgetting (Laney & Loftus, 2010). Certainly, memories for traumatic events are also subjective to forgetting and contain errors and distortions, as demonstrated by significant instability in the consistency of retrospective reports for childhood sexual abuse (e.g., Fergusson, Horwood, & Woodward, 2000; Ghetti et al., 2006). Trauma-exposed individuals, particularly those who go on to develop PTSD, may be especially vulnerable to laboratory-induced false memories, as evi-

denced by higher incidences of commission errors (Vasterling, Brailey, Constans, & Sutker, 1998) and higher susceptibility to false memories for previously unrepresented words (e.g., Zoellner, Foa, Brigidi, & Przeworski, 2000). However, van Giezen, Arensman, Spinhoven, and Wolters (2005) conducted a review of longitudinal studies examining autobiographical memory for traumatic events specifically and found that traumatic events tend to be remembered with more consistency than non-traumatic events. Furthermore, higher severity traumas and interpersonal traumas, such as sexual assault, were more consistently remembered. Notably, they also found that memory for traumatic events was subject to memory inflation, or the tendency to provide more details at later time points. This tendency may be a result of improved memory with repeated recall but may also be a result of PTSD, as higher PTSD symptoms have been linked to increased memory inflation (e.g., Giosan, Malta, Jayasinghe, Spielman, & Difede, 2009).

The relationship between confidence in memory and accuracy of memory is complex. A recent series of studies demonstrated that more confidence is related to more accuracy, except in recognition tasks in which the stimuli presented highly resemble (but are not the same) as the experienced stimuli; in these situations, high confidence in memory is not correlated with accuracy (DeSoto & Roediger III, 2014; Roediger III & DeSoto, 2014). In eye-witness testimony, findings support the notion that low confidence predicts low accuracy and high confidence predicts high accuracy if confidence is assessed at the time of the initial identification and not weeks, months, or even years later (Wixted, Mickes, Clark, Gronlund, & Roediger III, 2015).

Taken together, research on the role of emotion in memory and evidence from the false memory literature suggest that while highly emotional events like sexual assault tend to be remembered better than non-emotional events, traumatic experiences are also subject to memory distortion and forgetting, consistent with a reconstructive view of memory. Notably, an event being strongly encoded and susceptible to errors are not incompatible, especially when considering that

any memory for an event is reconstructed and reconstruction is a complex retrieval process integrating many pieces of information and relying on current and past cognitive functioning.

Memory Corollaries Associated with Sexual Assault or Related Psychopathology

There are also more general memory functioning impairments commonly observed in sexual assault survivors, particularly for those with related psychopathology, such as PTSD.

Working memory. Working memory capacity (WMC) refers to the amount of information an individual can hold in working memory at one time (Diamond, 2013) and is typically measured by tasks requiring a person to hold distinct pieces of information in mind while simultaneously manipulating the information. Individuals with PTSD exhibit deficits in working memory capacity that do not seem to be accounted for by trauma exposure alone (e.g., Morey et al., 2009) and deficits in the related capacity of verbal memory (e.g., memory for words on a word list read out loud; Gilbertson et al., 2006). Further, structural and functional impairments in brain regions implicated in WMC, such as decreased hippocampal volume (e.g., Karl et al., 2006) and decreased activation in the dorsolateral prefrontal cortex (e.g., Morey et al., 2009), have been seen in individuals with PTSD as compared to trauma-exposed controls. Although there is a clear association between PTSD and WMC deficits, it is not clear whether these deficits reflect a pre-trauma risk factor or are a consequence of the disorder. Some well-done studies argue for a pre-existing vulnerability factor (e.g., Gilbertson et al., 2006), yet improvement of PTSD symptoms is also associated with increases in WMC (e.g., Mozzambani et al., 2017) and increases in hippocampal volume (e.g., Bremner, Elzinga, Schmahl, & Vermetten, 2007).

Attentional focus toward threat. After sexual assault, there are shifts in attentional processes with the development of trauma-related psychopathology. Individuals with anxiety show atten-

tional biases towards threat, defined as differential allocation of attention towards threat relative to neutral stimuli, including an attentional bias towards trauma-related stimuli in PTSD (e.g., Lee & Lee, 2012). In addition to enhanced threat detection, individuals with PTSD may also experience increased difficulty disengaging from trauma-related stimuli (e.g., Pineles, Shipherd, Mostoufi, Abramovitz, & Yovel, 2009). Both attentional bias towards trauma-related cues and difficulty disengaging from trauma-related stimuli may alter retrieval of information.

Despite attentional biases towards trauma-related information, individuals with PTSD do not consistently show better memory recall of trauma-related information compared to those who are trauma-exposed but without PTSD or those without a history of trauma (e.g., McNally et al., 1998). This paradox may be explained by the vigilant-avoidance hypothesis where, after initial attention towards threat, individuals with anxiety subsequently direct attention away from threat (Mogg, Bradley, Miles, & Dixon, 2004). This attention away may, in turn, interfere with detailed processing, elaboration, and encoding of information. In individuals with PTSD, some studies are consistent with this vigilance-avoidance hypothesis (e.g., Adenauer et al., 2010) while others only find attention towards threat (e.g., Kimble, Fleming, Bandy, Kim, & Zambetti, 2010). Finally, these processes have implications for the maintenance of PTSD after sexual assault given that quick avoidance of trauma reminders may impede emotional or more elaborative processing, important for inhibitory learning and the reduction of fear (e.g., Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014).

Interpretation bias. Following sexual assault, information processing biases towards trauma-related information may cause individuals to feel as if they are in a state of current threat, influencing the trajectory of recovery following trauma (e.g., Dalgleish, 2004; Ehlers & Clark, 2000). Selective attention to threat may lead to disruptions in subsequent processing stages, resulting in interpretive biases (White, Suway, Pine, Bar-Haim, & Fox, 2011). Interpretation bias, or the tendency to interpret novel information from the

environment as threatening, often occurs after individuals have been sexually assaulted. For example, Elwood, Williams, Olatunji, and Lohr (2007) rated the threatening film clips as more predictable and as more quickly increasing in risk than those who had not been assaulted. These biases may be even more pronounced among individuals who go on to develop psychopathology, with higher threat-related interpretation bias among individuals with PTSD (e.g., Amir, Elias, Klumpp, & Przeworski, 2003).

Autobiographical memory. Autobiographical memory refers to individual person's recollections of his or her life (Williams, Conway, & Cohen, 2007). These memories can be specific to a particular moment and context or more general autobiographical memories referring to events with similar characteristics or events over an extended period of time (e.g., going out with friends on my 21st birthday versus birthday parties I have had). Notably, when instructed to recall specific memories, individuals with PTSD tend to narrate general memories of events, termed overgeneral memory, even with repeated instruction or prompting in relation to a positive and negative cue word (e.g., happy, hurt), including those with PTSD after sexual assault; this deficit is also seen with individuals with major depressive disorder and may be an effect of psychopathology or trauma exposure (Barry, Lenaert, Hermans, Raes, & Griffith, 2018; Moore & Zoellner, 2007).

Overgeneral memory following sexual assault and related psychopathology may serve to reduce or dampen the emotional focus and allow avoidance of specific memories. The CaRFAX model (Williams, 2006) argues that cues capture cognitive resources through the activation of ruminative, repetitive thinking and truncates the search for specific autobiographical memories both through reduced executive capacity and functional avoidance of emotional material. Reduced autobiographical memory specificity has also been presented as an affect-regulating strategy and as avoidant coping style (e.g., Herman, Ostrander, Mueller, & Figueiredo, 2005), serving as a protective mechanism that buffers the emotional pain associated with traumatic experiences

and may reflect a learned memory retrieval blocking (Williams, 2006). Overgeneral memory functioning has been linked to impaired problem solving (Williams, 2006) and delayed recovery from affective disorder episodes (Serrano, Latorre, Gatz, & Montanes, 2004).

Implications for Treatment of Sexual Assault-Related Psychopathology

Of the empirically-supported treatments for PTSD (Cusack et al., 2016), both prolonged exposure (PE; Foa, Rothbaum, Riggs, & Murdock, 1991) and cognitive processing therapy (CPT; Resick & Schnicke, 1992) were both developed for addressing psychopathology following sexual assault. These and other empirically-supported psychotherapies such as narrative exposure therapy (NET; e.g., Neuner, Schauer, Klaschik, Karunakara, & Elbert, 2004) and trauma-focused cognitive behavioral therapy in children (TF-CBT; e.g., Cohen, Deblinger, Mannarino, & Steer, 2004) include an explicit focus on the memory for the traumatic event. These interventions can be more broadly understood within a network model of memory, where trauma memories fit into an overarching schema, defined as a packet of information associated with a specific concept (e.g., walking the dog, dangerous men, rape). These associations affect memory, providing filters that drive subsequent retrieval (e.g., Norman, Newman, & Detre, 2007). Specifically, the more meaningfully-related pieces of information are to one another and grouped together during repeated memory retrieval, the better new information can be retrieved. This refers to what is termed elaborative processing.

One candidate for shifting and elaborating the meaning of the memory for the traumatic event may be negative beliefs about one's self, others, and the world. Indeed, in PTSD treatment, meaning changes differentially underlie symptom changes in exposure therapy compared to pharmacotherapy (e.g., Cooper, Zoellner, Roy-Byrne, Mavissakalian, & Feeny, 2017). This is also consistent with an inhibitory learning approach.

With new inhibitory learning, new meanings among associations are created that alter future retrieval, inhibiting associations that inappropriately signal threat and instead promoting new, more flexible or ambiguous meaning associations that are linked with more adaptive responses (Craske et al., 2014). Thus, across psychotherapies, a common hypothesized mechanism involves creating new meaning via effortful retrieval as a way to shape future, adaptive memory retrieval and reduce trauma-related psychopathology. For example, in prolonged exposure therapy, when a sexual assault survivor repeatedly revisits the memory of the rape via imaginal exposure, she may come to alter her beliefs that “I should have prevented the rape; I’m such a weak person” as she recalls details of the perpetrator’s hand on her throat, feeling short of breath, his verbal threats of killing her, and how she thought he really could kill her. Her new associative meanings may be something akin to, “I did what I needed to do to survive; if I didn’t acquiesce, I would have been killed.” This may help explain the process observed by Breuer and Freud; adaptive memory retrieval can facilitate recovery.

Limitations of Understanding Memory for Sexual Assault

Obviously, from a legal perspective, there is a push to “know the truth.” Historical and current failures to believe the memories of sexual assault survivors make many reticent to come forward. Recognizing that memories are complex and dynamic, include gaps and sometimes errors, ought not be used against sexual assault survivors, but instead provide a general framework for understanding the range of sexual assault memories. This ought to allow for a more flexible understanding of the range sexual assault memories can take and reduce inaccurate, misguided judgments about what “ought to be remembered.”

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