

# The effect of cognitive load and hyperarousal on negative intrusive memories

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## Abstract

Clinical theories of post-traumatic stress suggest that encoding processes at the time of a trauma are critical in determining whether intrusive memories will develop. Potential mechanisms that might influence the development of intrusive memories were studied, as was objective memory performance. In an analogue design, 65 participants were randomised to three conditions (cognitive load, hyperventilation, and control), and then watched a film of traumatic content. Intrusive memories were recorded during the experimental phase and at 1-week follow-up. Support was found for the prediction that verbal cognitive load and hyperventilation would facilitate intrusion development immediately following exposure to the trauma film; however, this was not maintained at follow-up. Consistent with cognitive models of post-traumatic stress, thought suppression and the distress associated with intrusive experiences mediated the relationship between distress caused by the film and intrusions at 1-week follow-up. Objective memory testing indicated that the three experimental groups showed similar recall and recognition performance for the content of the film; however, relative to the control group, individuals in the cognitive load condition were significantly less able to place film scenes in the correct order.

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## Introduction

Following a traumatic event, it is common for individuals to re-experience the event in the form of intrusive thoughts and memories, and persistent intrusions are a hallmark feature of post-traumatic stress disorder (PTSD), one of the most common disorders to develop following traumatic events (American Psychiatric Association, 1994). In recent years, there has been an interest in understanding the mechanisms that result in unpleasant memories being experienced in an intrusive fashion. Much of this research has been conducted adopting a theoretical framework from the post-traumatic stress literature given that PTSD is characterised by unwanted memories of the traumatic event.

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In this context, cognitive and emotional processes during a traumatic event have been argued to be critical in determining how the event is experienced and whether intrusive memories are likely to develop and persist (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000). Accordingly, theoretical models of PTSD hold that individuals who are unable to make sense of their experience have difficulty encoding the experience in a logical manner, or experience confusion or dissociation at the time of trauma are at risk of developing a memory of the event that is not fully 'processed'. This refers to a memory that is incomplete or disjointed, which is associated with extremely strong affect and which is not placed into autobiographical context. That is, it is not remembered as a past event that is no longer dangerous, but as an event still associated with a sense of current threat. It has been hypothesised that a traumatic experience is processed through two memory systems labelled 'verbally accessible memory' (VAM) and 'situationally accessible memory' (SAM) (Brewin et al., 1996). Dual-representation theory of PTSD argues that information at the time of the trauma that receives a high level of cognitive processing is likely to be encoded in memory and later retrieved from the VAM system. That is, as an autobiographical representation of the event that can be voluntarily recalled. Owing to attentional capacity limitations, not all information encoded at the time of the trauma can be consciously processed in this fashion. This information is more likely to be stored in the SAM system which is primarily responsible for storing sensory-type information, including imagery, physical sensations, etc. The SAM system is more likely to be accessed automatically, in particular in response to external cues (e.g., seeing someone of similar appearance to one's assailant), as well as internal cues (e.g., heightened anxiety). It is the SAM system that is thought to be responsible for involuntary intrusive experiences such as unwanted memories and flashbacks (reliving of the traumatic experience).

There are great individual differences in the experience of intrusive memories, and clinical and experimental research is beginning to identify the critical processes involved. The majority of this work has used trauma films as an analogue stressor, given the obvious problems of experimental control for real trauma events. Researchers have found that placing attentional demands on the VAM and SAM systems during an analogue stressor (i.e., while watching a film of traumatic content) can increase and decrease intrusion frequency, respectively (Brewin & Saunders, 2001; Holmes, Brewin, & Hennessy, 2004). Consistent with dual-representation theory, tasks that place a cognitive load on the VAM system (e.g., counting backwards in 3 s) are hypothesised to prevent verbal information from being encoded comprehensively, hindering the development of a coherent, autobiographic narrative of the trauma experience, and such tasks have been found to result in more intrusive memories of the film over a 1-week period (Holmes et al., 2004). Similarly, visuo-spatial-type tasks that interfered with information being encoded in the SAM system resulted in participants experiencing fewer intrusions (Brewin & Saunders, 2001; Holmes et al., 2004; Stuart, Holmes, & Brewin, 2006).

A separate line of research suggests that intense hyperarousal and anxiety play an important role in the development of intrusive experiences following trauma. Information processing models of trauma response posit that fear networks are developed in which representations of memories, affective and somatic responses, and attributions of the trauma are readily activated in the individual because of sensitivity to trauma-related stimuli (Foa & Kozak, 1986; Harvey & Bryant, 2002). Thus, intense affect and its association with cues at the time of the trauma increases the likelihood that these cues will become prompts for later intrusions. There is also indirect evidence of a relationship between hyperarousal and reexperiencing symptoms in clinical samples. For example, PTSD participants have been observed to demonstrate greater autonomic responses during the writing of flashback accounts than of ordinary memories (Hellawell & Brewin, 2002), peritraumatic arousal predicts subsequent intrusive symptoms (Resnick, 1997), and chemically induced arousal elicits flashback and intrusive phenomena (e.g., Bremner et al., 1997; Kellner, Levengood, Yehuda, & Wiedemann, 1998). More recently, inducing hyperarousal via a hyperventilation provocation test has been shown to result in an increase in intrusive memories among individuals with acute stress disorder (ASD) relative to non-ASD trauma survivors (Hopwood & Bryant, 2006; Nixon & Bryant, 2005).

As discussed earlier, maladaptive processing of the traumatic event is argued to lead to memories that are incomplete, fragmented, and disorganised, and clinical studies of individuals with ASD and PTSD seem to support this (e.g., Foa, Molnar, & Cashman, 1995; Halligan, Michael, Clark, & Ehlers, 2003; Harvey & Bryant, 1999). A limitation of this research is that the exact, objective details of trauma are not known to the researchers; thus, it is difficult to be confident about the accuracy of the content of the memory. Experimental research with analogue

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