



Vividness of general mental imagery is associated with the occurrence of intrusive memories

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ABSTRACT

Background and objectives: Intrusive memories of traumatic events constitute a core feature of post-traumatic stress disorder. However, the association of pre-traumatic factors with post-traumatic intrusive memories is still only poorly understood. The current study investigated the extent to which vividness of general mental imagery prior to an analogue stressor is positively associated with occurrence of intrusive images following such a stressor.

Methods: Sixty-seven participants were exposed to video material depicting the aftermath of serious road traffic accidents. Additionally, participants filled in questionnaires on mental imagery, affect, peri-traumatic processing style, and intrusive memories.

Results: Vividness of mental imagery before the analogue stressor correlated positively with the amount, vividness, and emotional distress due to intrusive images shortly after the analogue stressor and on the subsequently five days. Importantly, mental imagery assessed pre-stressor was associated with intrusive memories independently of trait anxiety and depression as well as participants' emotional response to the video. Peri-traumatic data-driven processing was also related to intrusive memories but not to the vividness of pre-stressor mental imagery.

Limitations: An analogue design was used. Results need to be replicated in a prospective design with survivors of traumatic events according to DSM-IV criteria.

Conclusions: The findings indicate that high levels of vividness of general mental imagery may contribute to the development of intrusive imaginal memories following exposure to traumatic events.

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1. Introduction

Intrusive memories of traumatic events are a hallmark symptom of post-traumatic stress disorder (PTSD) (American Psychiatric Association, 2000). Importantly, intrusive memories have been found to mainly consist of sensory, mostly visual, impressions that have a strong thematic association to traumatic events and are associated with lack of context and the sense of reliving the event as though it was occurring in the present (Hackmann, Ehlers, Speckens, & Clark, 2004; Michael, Ehlers, Halligan, & Clark, 2005). In addition, post-traumatic intrusive memories can be triggered involuntarily by a wide range of stimuli associated with the traumatic event and cause strong psychophysiological and emotional reactions (Reynolds & Brewin, 1999).

Cognitive models of PTSD propose that the development of intrusive memories is partly due to the way in which trauma-related

information is processed and encoded during the trauma. For example, in their cognitive model of PTSD Ehlers and Clark (2000) suggest that a predominance of data-driven (i.e., perceptual) processing during the trauma and a lack of conceptual processing should be related to the development of intrusive memories. In addition, a number of characteristics of the trauma memory should then lead to intrusive memories being easily triggered, including a lack of integration into the autobiographic memory system, high perceptual priming for trauma-related stimuli, and strong conditioned associations.

In their Dual Representation Theory, Brewin, Dalgleish, and Joseph (1996) similarly suggest that intrusive memories are due to the formation of strong sensory-bound representations and weak contextual representations (see also Brewin, Gregory, Lipton, & Burgess, 2010; for an updated version of this model). Specifically, they propose that the traumatic event is represented in two memory systems operating in parallel, a verbally accessible memory (VAM) system comprising contextually bound representations (C-reps) and a situationally accessible memory (SAM) system comprising

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sensory-bound representations (S-reps). C-reps comprise information that was consciously experienced and attended to during the trauma. These representations are fully contextualized and can be retrieved voluntarily. S-reps, on the other hand, are thought to consist of information related to the traumatic event that has been processed predominantly at a lower sensory or perceptual level and can only be accessed involuntarily by matching cues. In sum, according to this theory intrusive memories in PTSD, which typically consist of sensory impressions, are easily triggered by matching cues, and are experienced as happening here-and-now, are thought to be due to the traumatic event mainly being encoded in the form of S-reps, whereby only few C-reps are formed. In the absence of inhibitory control by C-reps, S-reps can then be easily triggered by matching cues.

These theoretical ideas are supported by findings from different lines of research. For example, self-reported levels of data-driven processing have been found to be associated with intrusive memories and/or PTSD symptom severity following real-life traumatic events (Ehring, Frank, & Ehlers, 2008; Halligan, Michael, Clark, & Ehlers, 2003; Murray, Ehlers, & Mayou, 2002) and an analogue trauma (Halligan, Clark, & Ehlers, 2002).

An important issue that has only rarely been addressed in earlier research concerns individual differences that may predispose individuals to develop high levels of intrusive memories following a traumatic stressor. Kosslyn (2005) has offered a model that emphasizes the role of pre-stressor mental imagery on the development of PTSD. Specifically, he suggests that individuals who generally tend to experience vivid and lifelike imagery are at higher risk of processing a traumatic stressor in a way that leads to frequent intrusive memories of this event and the development of PTSD. Kosslyn (2005) hypothesis is based on a comprehensive model on the role of mental imagery in reflective thinking and memory. In the current context, two assumptions are particularly relevant. The first premise is that mental images are constituted of the same kind of representations that were generated during the actual perception, yet they are generated from stored representations in memory. In fact, there is evidence that mental imagery is represented in most of the brain areas as during the first phase of perception (Ganis, Thompson, & Kosslyn, 2004). As a consequence, vivid imagery can trigger similar physiological reactions as direct perception. Therefore, individuals who are prone to experiencing vivid imagery pre-trauma can be expected to also develop vivid imagery of the traumatic event, which should then also activate the fight and flight system, leading to strong physiological responses as well as a heightened perception of *nowness* of the memory. A second assumption made by Kosslyn (2005) is that individuals with a general ability to experience vivid mental imagery may generally process events less in a verbal and/or conceptual way, leading to poorer declarative representations of these events. As declarative knowledge competes with mental imagery for retrieval, the lack of the former can be expected to contribute to increased experience of the latter.

To our knowledge, only very few studies to date have investigated whether a general ability to form vivid mental imagery is related to higher risk for the development of PTSD symptoms following a stressor. A handful of studies have investigated mental imagery ability among individuals currently suffering from PTSD and results have been contradictory. Stutman and Bliss (1985) reported that Vietnam veterans with high PTSD scores had higher mental imagery levels than those with low PTSD scores. However, other authors have failed to replicate this result (Karatzias, Power, Brown, & McGoldrick, 2009; Laor et al., 1999). A study by Bryant and Harvey (1996) also did not indicate higher visual imagery ability among individuals with PTSD as compared to those without PTSD. Yet, this study revealed a link among individuals with PTSD

between mental imagery vividness and intrusive memories only. Finally, Jelinek et al. (2010) reported that individuals with recovered PTSD displayed lower levels of generalised mental imagery than individuals with current PTSD and those without PTSD. Importantly, these studies are limited by their cross-sectional nature. Investigating mental imagery in individuals currently suffering from PTSD makes it impossible to disentangle whether characteristics of mental imagery are a risk factor for PTSD or a consequence of having the disorder. Instead, studies using a prospective longitudinal design including a pre-trauma assessment point are needed. To our knowledge, no published study looking at mental imagery and PTSD has used such a design.

In the absence of prospective longitudinal studies, which are very time- and cost-intensive, results from analogue studies can be informative (see Ehring, Kleim, & Ehlers, 2011; for the discussion of methodological aspects related to the different designs). In this context, the trauma film paradigm appears particularly promising, whereby a film depicting traumatic scenes is used as an analogue stressor. Extensive research has shown that this paradigm is suitable to induce intrusive visual memories in healthy individuals and that it allows investigating mechanisms involved in the development and/or maintenance of these memories (Holmes & Bourne, 2008; Weidmann, Conradi, Groeger, Fehm, & Fydrich, 2009). To our knowledge, only two studies to date have investigated the association of pre-stressor mental imagery with analogue post-traumatic intrusive cognitions using the trauma film paradigm (Davies & Clark, 1998; Krans, Naring, Speckens, & Becker, 2011). Davies and Clark (1998) used an unpublished questionnaire to assess the ability to arouse anxious mental imagery. The study revealed that a greater ease of bringing anxious images to mind was not associated with film-induced intrusions. The authors, however, used a very global assessment of intrusive memories as the dependent variable that did not differentiate between intrusive images as compared to verbal intrusions. However, there is evidence that different mechanisms are involved in the development of verbal thoughts versus images (Hagenaars, Brewin, van Minnen, Holmes, & Hoogduin, 2010). Krans et al. (2011) assessed the association between spontaneous use of mental imagery in daily life and intrusion development following exposure to either (1) watching a stressful film with scenes of road traffic accidents or (2) listening to a verbal report about the same traffic accidents. The study revealed that in both groups frequency of intrusive visual images was significantly and negatively associated with spontaneous use of imagery in daily life. Study results further showed that in the listening condition only (and thus not in the watching condition), frequency of intrusive visual images was significantly and positively associated with visual processing style (as opposed to verbal processing style). The authors of this study did not measure general ability to experience mental images. In sum, there is no conclusive evidence to date as to whether a general ability to experience vivid mental imagery is related to increased levels of intrusive visual recollections following a traumatic event.

The aims of the current study were threefold. First, it was aimed to replicate earlier findings regarding an association between data-driven, i.e., predominantly perceptual, processing during an analogue stressor and the development of intrusive visual memories related to the stressor. The second aim was to test Kosslyn (2005) assumption that a general ability to experience vivid mental imagery is a risk factor for the development of intrusive memories following a stressor. Based on the theoretical ideas described above, it was expected that this relationship should not only exist for the number of intrusive memories experienced, but also for the vividness of these memories as well as the distress experienced as a consequence. In addition, it was hypothesized that these variables should correlate over and above trait levels of anxiety and depression

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