

Intrusive Trauma Memory: A Review and Functional Analysis

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SUMMARY

Our contribution to this special issue focuses on the phenomenon of intrusive trauma memory. While intrusive trauma memories can undoubtedly cause impairment, we argue that they may exist for a potentially adaptive reason. Theory and experimental research on intrusion development are reviewed and possible functions of intrusive trauma memory are explored. These functions include aiding emotional processing, preventing future harm and protecting the coherence of the self. The issue of intrusive images in other disorders than posttraumatic stress disorder is briefly addressed. This review suggests that the study of function is important for a nuanced view on the modulation of intrusive trauma memory in both experimental psychopathology and clinical treatment. Copyright © 2009 John Wiley & Sons, Ltd.

Our lives are full of experiences and events that have a lasting impact on us. Many of these are expected or planned for like going to college, getting married, starting a family, and the passing away of our parents. Such momentous events (Pillemer, 1988) can be negative, positive, or both, but we are usually able to cope with them. Some events, however, have such an impact that our adaptive skills may fail and we become ‘traumatized’. One consequence of traumatic events (like other momentous events, at least initially) is the subsequent unwanted re-experiencing in the form of intrusive memories. Although it is undoubtedly crucial to investigate ways to reduce these unwanted memories, the main question raised in this paper is: ‘Why would we have intrusive trauma memories at all?’ This question is inspired by Baddeley (1988), who argued not only to look at underlying basic mechanisms of cognitive phenomena, but also to try and understand what functions they may serve. Especially in literature on psychopathology, the main interest has been to reduce intrusive trauma memories. But why would we have intrusive trauma memories at all? What is their function? And what do we lose when we succeed in reducing intrusive trauma memories without taking into account possible adaptive functions? As Baddeley (1988) suggested, whenever we find a really replicable memory phenomenon, we should ask ourselves what its function may be. The current paper presents a review of the

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theory and experimental findings followed by an exploration of potential functions of intrusive trauma memory.

INTRUSIVE TRAUMA MEMORY

Intrusive trauma memories are rich multi-modal mental images of highly detailed sensory impressions of the traumatic event including sights, sounds, feelings and bodily sensations. Examples of intrusive trauma memories are seeing the driver's face before a car crash (Lilley, Andrade, Turpin, Sabin-Farrell, & Holmes, 2009), an image of 'brother with head [cut] open, wobbling' (Holmes, Grey, & Young, 2005), or the sound of a child screaming (Holmes et al., 2005). In contrast to when a trauma survivor thinks back to the event deliberately, intrusive trauma memories come into consciousness unbidden. Often, people feel powerless against them. In order to understand intrusive trauma memories, models have been developed that specifically focus on full-blown posttraumatic stress disorder, that is PTSD (Brewin, Dalgleish, & Joseph, 1996; Brewin & Holmes, 2003; Ehlers & Clark, 2000). However, it has long been argued (Horowitz, 1969) that the underlying mechanisms that are involved in the development of intrusive trauma memories are similar for both psychiatric levels and sub-threshold levels of posttraumatic stress. For example, Holmes (2004) illustrated that the features of intrusive images may be similar for experiencing actual trauma, witnessing trauma and seeing a TV news report about a traumatic event such as 11 September 2001 (Holmes, Creswell, & O'Connor, 2007). Mace (2007) has proposed that intrusive memories are found in everyday mental life and as part of psychological disorders as well. Accordingly, intrusive trauma memories may vary from mildly distressing images to full-blown flashbacks where the trauma survivor is completely absorbed in the memory and temporarily loses touch with the here-and-now. In terms of functionality, intrusive trauma memories may have features that are not necessarily shared with non-traumatic involuntary recall. For example, the content of intrusive trauma memories does not seem to change very much and can persist to intrude over a long period of time. These memories are cue-activated automatically which can make intrusion relatively frequent.

Trauma and posttraumatic stress disorder (PTSD)

Examples of events meeting the clinical criteria for 'trauma' are natural disasters, interpersonal violence and torture, and road traffic accidents. These events are considered 'traumatic' if the person experiences or witnesses actual or threatened death, serious injury or threat to one's or others' integrity (American Psychiatric Association, 2000). The person also needs to experience an intense negative emotional reaction at the time of trauma. For example, a soldier may witness a death but not experience intense fear, or horror, or helplessness. Then, the event would not count as traumatic. In reaction to trauma, several typical symptoms can emerge that are important in the diagnosis of PTSD (APA, 2000). These include re-experiencing of the traumatic event (e.g. in the form of intrusive trauma memories, nightmares and distress in reaction to trauma reminders), avoidance behaviour related to the index trauma (e.g. avoiding conversations, places and objects, and a general emotional numbing response) and symptoms of hyperarousal (e.g. startle response, sleeping problems, hypervigilance). The diagnosis of PTSD is considered when these

symptoms persist for more than 1 month and cause significant impairment in various life domains (APA, 2000).

Posttraumatic stress is an important area of research because of the high lifetime risk of experiencing a traumatic event. Some studies have found lifetime risks as high as 89.6% (Breslau, Kessler, Chilcoat, Schultz, Davis, & Andreski, 1998). However, only a small proportion of trauma survivors subsequently develop full blown PTSD. Kessler, Sonnega, Bromet, Hughes, and Nelson (1995) estimated the lifetime prevalence of PTSD at 7.8% in an American sample, while Creamer, Burgess, and McFarlane (2001) found a 12-month prevalence of 1.3% in an Australian sample. Some types of trauma are more likely to elicit PTSD than others. Generally, rape and physical abuse pose a high risk for PTSD, while people seem less at risk after traffic accidents or natural disasters. Kessler et al. (1995) found PTSD rates for rape victims of 65% for men and 46% for women, and 22% for men and 49% for women in cases of physical abuse. Creamer et al. (2001) reported a similar pattern. In contrast, PTSD prevalence rates after traffic accidents of 6.3% for men and 8.8% for women, and of 3.7% for men and 5.4% for women after natural disasters have been reported (Kessler et al., 1995). In sum, intentional harm seems to be more likely to produce post-traumatic stress symptoms. This finding may provide a clue as to the function of intrusive trauma memories. For example, events involving human violence may be perceived as more under our control (and thus that we have lost control) than, for example an earthquake. Intrusive trauma memories of human violence may provide information that can prevent from future harm (see our discussion on warning signals later on).

While a traumatic event is necessarily the starting point of PTSD symptoms, it is obviously not a sufficient explanation. Interestingly, the risk factors with the greatest predictive power for PTSD appear to be psychological. More recent meta-analyses indicate that information processing during and after the traumatic event is critical (Brewin, 2003; Ozer, Best, Lipsey, & Weiss, 2003). We now review three theoretical models that explain intrusive trauma memories from an information processing perspective. The first model is not specific for PTSD but provides an account of intrusive trauma memories based on a model of autobiographical memory in general, in line with our continuum view. The second and third models aim to explain the full range of PTSD symptoms, including intrusive memories, from a clinical perspective. They have proven very fruitful in the development of successful PTSD treatment and have sparked a bulk of experimental research that is also very important from a continuum perspective.

Cognitive models of PTSD

The Self-Memory-System (SMS) model of autobiographical memory (Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagini, 2004) suggests that intrusive trauma memories are encoded in the episodic memory system as episodic memories. These memories are detailed 'experience-near' records that are high in sensory-perceptual detail. What is encoded (in general and during a traumatic event) is determined by the 'working self'. The 'working self' is a complex goal hierarchy that organizes information in line with currently active goals, comparable to the central executive function in working memory (Baddeley & Hitch, 1994; Conway, Singer, & Tagini, 2004). Episodic memories remain in their characteristic form while the goal they reflect is still active or relevant. They are activated by cues that bare perceptual similarities with the memory. If not lost, episodic memories are slowly integrated with more abstract levels of autobiographical knowledge,

which prohibits cued-activation (i.e. unwanted intrusion) of the specific episodic memory. The more abstract levels of autobiographical knowledge form the 'long-term self' that encompasses an autobiographical knowledge base and a 'conceptual self'. The first is an organization of autobiographical information in different levels of abstraction into themes or time-periods (i.e. general events, life-time periods, and life story schema). The conceptual self contains schemas, scripts, beliefs, and values about the self, others, the world, and the relations between them. Thus, the integration of episodic memories into more abstract goal structures consists of changes in these structures. As a basic rule, the goal structures in the SMS are resistant to extreme goal change and only allow for gradual change in order to protect self-coherence (Conway, Singer, et al., 2004). A traumatic event, by definition, poses a direct and extreme threat to the goal structure of the SMS. As a consequence, the traumatic event remains an intrusive episodic memory that is high in sensory detail. In contrast to clinical models of PTSD, described below, the SMS model (Conway & Pleydell-Pearce, 2000; Conway, Singer, et al., 2004) does not assume qualitatively different mechanisms for traumatic memories, but rather states that traumatic information may have more 'difficulties' along the way to become a 'normal' autobiographical memory.

The dual representation theory (DRT) by Brewin et al. (1996) suggests that traumatic information is encoded in two different memory systems: Situationally Accessible Memory (SAM) and Verbally Accessible Memory (VAM). SAMs are perceptual memories that are automatically triggered by internal or external cues that match sensory perceptual features (i.e. intrusive trauma memories). In contrast, VAMs are the result of conscious processing of the traumatic event and they can be retrieved deliberately and consciously. Ideally, SAMs are integrated with VAMs to form a coherent and elaborate trauma narrative. Under extreme stress, however, the conscious processing that leads to VAMs is impaired (Brewin et al., 1996). As a result, there is relatively more trauma information encoded in the SAM system and very little in the VAM system. Intrusive trauma memories occur now because the cued-activation of SAMs is not inhibited by VAMs.

The cognitive model of PTSD by Ehlers and Clark (2000) provides the basis of their highly successful cognitive therapy treatment for PTSD (Ehlers, Clark, Hackmann, McManus, & Fennell, 2005). In this model, 'data-driven' processing predominates during a traumatic event while 'conceptual' processing is impaired. Data-driven processing involves sensory information like sight, smell, touch, sounds and bodily sensations. In contrast, conceptual processing of the traumatic event places the traumatic information in a more abstract form by creating a coherent trauma narrative that is chronological and meaningful. A central concept in the cognitive model of PTSD is a 'sense of *current* threat' that people experience when having an intrusive trauma memory. The sense of current threat exists due to a lack of chronological context in trauma memory so that the threat in the past is not distinguished from the present situation.

Discussion about the differences between PTSD specific theories (e.g. Brewin et al., 1996; Ehlers & Clark, 2000) and more general models of autobiographical memory (e.g. Conway & Pleydell-Pearce, 2000) has long historical roots (Horowitz, 1969; Rubin, Boals, & Berntsen, 2008). The SMS model (Conway & Pleydell-Pearce, 2000; Conway, Singer, et al., 2004) aims to provide a holistic view on autobiographical memory and many of its phenomena and 'touches on' intrusive trauma memory as well. Just as all goal-relevant information, traumatic information is encoded into an episodic memory system. However, the trauma information is not easily integrated in the autobiographical knowledge base because this would require extreme changes in the goal structures. Therefore, traumatic

information remains at this highly perceptual level prone to automatic cued-activation, that is intrusive memories. In contrast, the DRT (Brewin et al., 1996) suggests *differential encoding* of trauma information into SAMs and VAMs. The cognitive model of PTSD by Ehlers and Clark (2000) contains some parallels to the SMS model and suggests that (trauma) information is encoded as episodic memories. Additionally, the model suggests a role for peri-traumatic processing (data-driven versus conceptual) that is not described in the SMS model. What becomes clear from all three models is that information processing and encoding are thought to play an important role in intrusion development. Many experimental studies of intrusive trauma memory have been carried out, which permits and calls for a functional analysis of this phenomenon (Baddeley, 1988).

Studying trauma in the laboratory

Support for the role of peri-traumatic processing in intrusion development comes from experimental studies that have made use of the 'trauma film paradigm' (Holmes & Bourne, 2008). A 'trauma film' refers to a film that depicts an event that is considered as traumatic according to the DSM-IV-TR (Criterion A1; APA, 2000). Typically, healthy participants view a trauma film under one of several controlled conditions. Before and after film viewing, questionnaires are administered to measure variables of interest. During the week after film viewing, participants record their intrusive images of the film in a diary and return for a follow-up session. In support of the utility of this paradigm, it has been found that intrusive memories elicited in a laboratory environment are in many respects similar to naturalistic intrusive memories (Schlagman & Kvavilashvili, 2008).

In order to manipulate information processing during encoding, participants can perform a concurrent task during film viewing. Using this dual-task approach, manipulations can be tailored to compete for specific resources, for example for perceptual or verbal processing of the film (Holmes & Bourne, 2008). In a study by Stuart, Holmes, and Brewin (2006), participants viewed a trauma film while modelling plasticine shapes as a dual task during one part of the film. During the rest of the film, participants performed no extra task apart from film viewing. The modelling clay task is thought to rely on limited resources of visual and spatial information processing which would interfere with visuospatial encoding of the film and thus reduce intrusion frequency. As predicted, participants reported fewer intrusive images after 1 week for the film part during which they were performing the visuospatial task compared to the film part during which they performed no extra task. This effect has also been shown for other visuospatial tasks, like complex pattern tapping (e.g. Holmes, Brewin, & Hennessy, 2004) and was upheld when contrasted with a non-visuospatial task with a comparable cognitive load (Krans, Näring, Holmes, & Becker, in press). The findings support a facilitating role of peri-traumatic perceptual processing in intrusion development.

Findings pertaining to the role of peri-traumatic verbal conceptual processing are more mixed. Holmes et al. (2004; Experiment 3) found that participants who were counting backwards in 3's while viewing a trauma film reported *more* intrusive images of the film compared to participants who performed no extra task. This supports the DRT (Brewin et al., 1996) and the cognitive model of PTSD (Ehlers & Clark, 2000) in that interfering with verbal conceptual processing is thought to *increase* intrusion frequency. Bourne, Frasquilho, Roth, & Holmes (submitted) recently replicated this finding with a variation on the counting backwards task. However, Krans, Näring, and Becker (2009) found the opposite effect: Participants who were counting backwards in 3's reported *fewer* intrusive

images compared to participants in a no task control condition. Pearson, Sawyer, and Holmes (2008) found a similar pattern of results. In two experiments, they varied the cognitive load of concurrent verbal or visuospatial tasks and found that intrusion frequency varied according to the cognitive load of the task (with higher cognitive load tasks reducing intrusion frequency) irrespective of task modality. However, Pearson et al. (2008) used static IAPS pictures instead of a trauma film, which makes comparison with earlier findings difficult. Studies that fail to show a modality-specific effect are in line with single-representation models of autobiographical memory like the SMS model (Conway & Pleydell-Pearce, 2000). In this model, cognitive load would reduce the capacity of the working self to guide and direct the encoding of the trauma film. Initial support for the SMS model (Conway & Pleydell-Pearce, 2000) comes from a study by Sutherland and Bryant (2008). As traumatic events pose a threat to the self, a discrepancy between an ideal and actual self-emerges. This discrepancy creates goals that are represented in the working self in order to reduce the threat posed by the trauma (Conway & Pleydell-Pearce, 2000; Conway, Singer, et al., 2004). As the working self-modulates retrieval it was expected that threat-related memories are more easily recalled in case of trauma. Indeed, Sutherland and Bryant (2008) found that trauma survivors who reported more discrepancy between an ideal and actual self on a questionnaire also reported more trauma-related memories in response to positive cue words.

Krans, Näring, Holmes, and Becker (2009) used the trauma film paradigm to study analogue post-trauma processing. Immediately after film viewing participants received a memory test for only one part of the film. As predicted, 1 week later, participants reported *fewer* intrusive images for the film part for which they did the memory test compared to the part for which they had not done a test. Additionally, deliberate cued-recall after 1 week was *better* for the film part that was tested the week before. These results indicate that the rehearsal of analogue trauma information decreases intrusions and increases deliberate cued-recall (see also Holmes, James, Coode-Bate, & Deepro, 2009).

In sum, several studies have shown that visuospatial processing of trauma information is an ingredient in the formation of intrusive trauma memories (e.g. Holmes et al., 2004). Further, the conceptual integration of trauma information may prohibit this development (Krans et al., 2009). In turn, the idea that sensory information may be more important in aiding survival *during* a traumatic event than elaborate conceptual processing is intuitive. Thus, the 'heightened' sensory information processing that is thought to later result in distressing intrusive trauma memories may be viewed as adaptive at the time. Thus, we know a little about how intrusive trauma memories come into existence but we really do not know why.

BUT WHAT THE HELL IS IT FOR?

The question posed in the header has historical roots starting in the late 1970s and 1980s (e.g. Baddeley, 1988; Bruce, 1989; Neisser, 1978). More recently, several researchers have further encouraged students of memory to think about function in addition to mechanism (e.g. Bluck, 2003). The main question of this special issue: 'But what the hell is it for?' may seem somewhat counterintuitive in relation to intrusive trauma memories. Naturally, we do not want trauma survivors to suffer from distressing and impairing intrusive memories of their experience. However, we would like to argue that, at least initially, intrusive trauma memory may serve important functions related to survival of the physical and

psychological self. Two of the broad categories of autobiographical memory (AM) functions proposed by Bluck (2003) are especially important in the discussion of intrusive trauma memories: the self-function and the directive function. The first includes continuity of the self as the same person throughout time and a sense of identity (Barclay, 1996). This continuity relies on knowledge of the self in the past and as projected in the future. Directive functions of AM guide our behaviour through problem solving, predicting future events and interpreting the past (Bluck, 2003).

Trauma memories as originating events

Before we turn to intrusive trauma memories specifically, we first would like to discuss a potential function of trauma memory in general. Intrusive trauma memory may be best viewed as a part of a rich array of posttraumatic reactions that together can have great impact on people's lives. Often, trauma survivors report feeling like a different person after the traumatic event. This personal change relates to what Pillemer (1988) called 'originating events' in his categorization of the types of ways that memories can serve directive functions. The originating event is (often retrospectively) perceived as a cause for life changes and has a motivational (i.e. directive) function (Pillemer, 1988). Bluck, Dirk, Mackay, and Hux (2008) reported that death-related events (although not necessarily traumatic) are often seen as originating events. While negative effects of trauma are obvious, trauma victims have also reported positive outcomes. 'Posttraumatic growth' describes positive outcomes from the struggle with trauma that surpass the pre-trauma level (Zoellner & Maercker, 2006). Trauma victims may report feeling mentally stronger, having a higher appreciation for life, more intimate relationships and new life priorities and values (Tedeschi, Park, & Calhoun, 1998). For example, in a study of burn victims it was found that some participants experienced a renewed self-esteem by overcoming the trauma and having to focus on inner qualities instead of appearance (Andreasen & Norris, 1972). Trauma memory may serve as a reminder of an originating event when new values, life priorities, or personal growth are established.

Unfortunately, a traumatic event can also function as an originating event in a more negative way. For example, a woman who was raped by an acquaintance decided not to pursue a career in clinical psychology because she thought that the incident was proof that her judgment of character was too poor (Ehlers & Clark, 2000). Trauma survivors with PTSD may report the feeling of having changed for the worse, feeling alienated from others (Ehlers, Maercker, & Boos, 2000) and experience a sense of foreshortened future (APA, 2000). In line with this, Rubin et al. (2008) found a positive correlation between PTSD symptoms and a measure of the impact of an event on life values and identity.

By discussing the functional value that traumatic events may have we have set the scene to further explore potential functions of *intrusive* trauma memory as a part of a rich array of posttraumatic reactions, experiences and behaviours.

Emotional processing

Brewin et al. (1996) have suggested that intrusive trauma memories may serve a self- and directive function by supplying the trauma survivors with detailed sensory and physiological information about the event. Intrusive trauma memories that are activated can become the focus of conscious attention, during which the meaning of the event can be contemplated and cause and effect relations may be defined (directive function). This is

central to emotional processing of the traumatic event that is targeted at restoring core beliefs about safety and control in relation to the self, others and the world (self-function). From a neuropsychological perspective, Brewin (2001) has suggested that consciously processed trauma memory (i.e. VAM system) is based on hippocampal activity whereas intrusive trauma memories are related to amygdale processing. The function of intrusive trauma memory may be to transfer detailed sensory trauma information to the 'hippocampally-based VAM system' (Brewin, 2001; p.381), for without flashbacks this information would remain dormant in memory. In sum, intrusive trauma memories provide a source of trauma-related information that is needed for the emotional processing of the traumatic event.

Warning signal hypothesis

One step further, intrusive trauma memory may serve another directive function (Bluck, 2003) by helping to prevent future harm. This 'warning signal hypothesis' (Ehlers, Hackmann, Steil, Clohessy, Wenninger, & Winter, 2002) was formulated based on observations that intrusive trauma memories are often of moments just before the traumatic event. For example, a car accident survivor reported a recurrent intrusive memory of headlights coming towards her, just before the collision (Ehlers et al., 2002). Sometimes intrusive memories are of moments when the meaning of the traumatic event becomes clear. Another road traffic accident survivor reported an intrusive memory of her mother's worried face in the hospital that made her realize that she could have been killed in the crash (Ehlers et al., 2002). Intrusive trauma memories thus provide information of impending danger or threat.

The examples of intrusive trauma memories described above reflect moments of the highest emotional impact that are known as 'hotspots' (Ehlers & Clark, 2000; Grey & Holmes, 2008; Grey, Holmes, & Brewin, 2001; Holmes et al., 2005). Interestingly, not all moments of a traumatic event become intrusive. For example, an assault could last an hour, but just two moments may intrude as flashbacks. These hotspots (i.e. moments of the highest emotional impact) give us a clue as to which parts of the trauma become intrusive and which do not, while an analysis of their content helps indicate why. In a study by Holmes et al. (2005), PTSD patients were asked to report the hotspot moments and their intrusive memories of the traumatic event. The hotspot moments were matched with the intrusive trauma memories for every participant. The results showed that 77.6% of the intrusive trauma memories matched the reported hotspots. In a recent replication this match was 83% (Grey & Holmes, 2008). In line with the warning signal hypothesis (Ehlers et al., 2002), the cognitive themes of hotspots reflect physical threat and psychological threat to the self (Grey & Holmes, 2008; Holmes et al., 2005). In other words, intrusive trauma memories often reflect the moments at which one's survival or psychological integrity is questioned.

Although the warning signal function of intrusive trauma memory can clearly be adaptive, in actual PTSD warning signals may generalize to cues that are actually safe. For example, a functional warning cue would be the sight of blood, which indicates a potential threat. But consider a trauma survivor whose warning cues generalize to any red object. The sight of red clothing might then elicit unwanted intrusive memories and a feeling of current threat (Ehlers & Clark, 2000). The feeling of current threat from 'false' (i.e. overgeneralized) warning signals along with an interpretation of that feeling as actual

danger enhances the generalization of threat cues and activation of intrusive trauma memories in a vicious cycle (Ehlers et al., 2002).

Protection of self-coherence

Conway, Meares, and Standart (2004) have suggested that intrusive trauma memories may play a role in the protection of self-coherence. This argumentation is based on the SMS model of autobiographical memory (Conway & Pleydell-Pearce, 2000; Conway, Singer, et al., 2004). As discussed earlier, this model states that traumatic information directly threatens self-related goals and the coherence of the self. Therefore, this information will not be easily integrated within the autobiographical knowledge base and the conceptual self. The traumatic information remains an experience-near sensory-detailed record in the episodic memory system and is activated automatically by cues that share sensory features with the memory record. The integration of trauma information into the long-term self (i.e. autobiographical knowledge base and conceptual self) requires dramatic changes in goal structures. Because these changes come at high cognitive and emotional costs integration is avoided in order to protect the current self-coherence (Conway, Singer, et al., 2004; Greenwald, 1980). Intrusive trauma memories reflect the goal structure that the self is trying to protect and thus aid in 'holding on' to current beliefs. An example provided by Conway, Meares, et al. (2004) is of the intrusive trauma memory experienced by a professional driver after a car accident in which he was a passenger. The intrusive trauma memory was associated with the victim's belief that he had the time to react and prevent the crash. However, factually, there had been no opportunity for him to do anything. During treatment, the intrusive trauma memory appeared to function as a protection of the belief that he was in control of events. Accepting that he had actually been powerless defied his need for control and would require a drastic change in his goal structure and self (especially as a professional driver). From this viewpoint, the intrusive trauma image reflected the need to preserve a sense of personal control, which is adaptive.

Conway, Meares, et al. (2004) report other examples in which the meaning of the intrusive trauma memory was in line with the current goal system. On a critical note, the authors state that distortions are not always present in intrusive trauma memories. In general, intrusive trauma memories may help to delay the radical change in the long-term self that is needed in order to integrate the traumatic information. They may serve a signal-function that indicates that something is wrong in the interaction between experience and goal structure. However, research is needed to support this suggestion of function.

Intrusive images and memories across psychological disorders

Recent research and practice in clinical psychology highlights that intrusive images also present a significant phenomenon in several other psychological disorders other than PTSD (see Hackmann and Holmes, 2004, for an overview). For example, highly emotional involuntary images *linked to trauma* can occur across the anxiety disorders such as social phobia and obsessive-compulsive disorder (Hirsch & Holmes, 2007). Strikingly, it appears that patients with bipolar disorder may have as frequent trauma flashbacks as patients with PTSD (Holmes, Geddes, Colom, & Goodwin, 2008; Tzemou & Birchwood, 2007). In the area of psychosis, the impact of trauma memories (e.g. to prior hospitalizations) has also been highlighted (Morrison, 2004). Conway, Meares, et al. (2004) argue that intrusive mental imagery *in general* is strongly related to personal goals in the working self. Thus,

intrusive images and memories in different psychological disorders may share similar functions. Mental imagery may bring autobiographical knowledge to life to facilitate or prepare for an action response (Holmes et al., 2008). We therefore suggest that our argumentation so far has wider applicability beyond PTSD to other clinical areas where it is now realized that sudden intrusive sensory memories pose a problem. It is important, both theoretically and practically, to continue the study of intrusive imagery as a phenomenon both regardless and with special regard to different psychological disorders. The functional approach provides a useful lens for doing so.

SUMMARY AND IMPLICATIONS

Following a long tradition in clinical psychology, we have adopted a continuum view of intrusive trauma memory in which intrusions can occur from mildly distressing everyday images to full-blown flashbacks in PTSD. This is strongly related to the continuum perspective proposed by Holmes (2004) in which intrusive images are found in experimental settings, in response to media broadcastings, witnessing a traumatic event as well as in trauma survivors. While intrusive trauma memories are very distressing and knowledge about how to reduce their impact are highly valuable, it should also be considered what functions might be lost when we succeed in reducing them. In relation to the phenomenon of intrusive trauma memory we therefore explored the central question 'But what the hell is it for?' While in full-blown PTSD intrusive trauma memories reflect a maladaptive response contributing to the disorder, the basic underlying mechanisms (e.g. high sensory imagery, automatic retrieval in response to cues) may reflect the way in which our memories are adaptively set up to help us learn from and navigate through our intense emotional experiences.

Intrusive trauma memory is one part of a rich array of possible posttraumatic reactions. A traumatic event as a whole may function as an originating event (Pillemer, 1988). Whereas positive changes may arise in posttraumatic growth (Zoellner & Maercker, 2006), on the pathological side of the continuum trauma survivors can also feel they have changed for the worse, or have a sense of foreshortened future (Ehlers et al., 2000). Within this larger mechanism, intrusive trauma memory has its own specific functions.

The first function of intrusive trauma memory that we identified was aimed at the emotional processing of a traumatic event. Intrusive trauma memories may provide an opportunity to highlight important trauma information (specifically sensory and physiological details) that would not have been available through deliberate recall. By directing conscious attention towards an active intrusive trauma memory, a rich record of the trauma can be constructed.

The second function that we discussed is a warning signal function. Intrusive trauma memories may provide information about impending danger and may prepare the person for action by an associated feeling of current threat (Ehlers et al., 2002). Basically, this is potentially a helpful and adaptive function. But when danger cues generalize to cues that are actually safe, intrusion frequency is elevated and can become impairing. In order to recover, the person needs to re-evaluate the 'true' informational value of each cue. One component of treatment is to distinguish between danger signs in the past and safety signs in the present (Ehlers & Clark, 2000).

The third possible function of intrusive trauma memory was suggested by Conway, Singer, et al. (2004). Intrusive trauma memories and their distortions may function to

protect the status quo of the self's goal structure and thus self-coherence. Intrusive trauma memories reflect the self's active goals at time of the trauma that in turn reflect firmly held beliefs about the self that are challenged by the traumatic event. Changes in the self's goal structure may be avoided to maintain self-coherence by intrusive trauma images (Conway, Singer, et al., 2004). Although intrusive trauma memories are often distressing they may be more pleasant than giving up self-coherence, and in that sense can be seen as adaptive. As does the warning signal hypothesis, the function of self-coherence suggests that there may be valuable information in research of the content of intrusive trauma memories as, for example, the reported hotspot studies (e.g. Grey & Holmes, 2008).

While some theoretical models have suggested a functionality of intrusions (e.g. Brewin et al., 1996; Conway & Pleydell-Pearce, 2000; Ehlers & Clark, 2000), it needs to be highlighted that little research has tested these ideas directly. At the time of Baddeley's question 'But what the hell is it for?' (1988) there was a growing interest in applying specific experimental paradigms to the study of different memory phenomena. However, the everyday relevance of such research was not always taken into account. Baddeley (1988) argued for contemplation on possible functions in order to identify research topics that really matter to the lives of human beings. While the link between experimental study of memory phenomena and its social relevance is not always clear, where clinical disorders are concerned there is a clear imperative to better understand the underlying processes. As noted, intrusive trauma memories can be highly distressing and impairing. Therefore, research on the aetiology and function of intrusive trauma memories is clearly important for the development of more effective treatments. The studies on intrusion development that we reviewed in the introduction are clearly socially relevant, and even suggest new experimentally-driven ways of working with intrusive memories that appear very unlike traditional psychological therapies (Holmes et al., 2009; Mackintosh, Woud, Postma, Dalgleish, & Holmes, submitted; Lang, Moulds, & Holmes, 2009; Lilley et al., 2009). In light of the clinically relevant phenomenon of intrusive trauma memory, we need to study the function in order to achieve a nuanced view on the possibilities and consequences of changing intrusion development in psychological treatment and research.

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