MEMORY, 2004, *12* (4), 403–415

Intrusive re-experiencing in post-traumatic stress disorder: Phenomenology, theory, and therapy

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The article describes features of trauma memories in post-traumatic stress disorder (PTSD), including characteristics of unintentional re-experiencing symptoms and intentional recall of trauma narratives. *Re-experiencing symptoms* are usually sensory impressions and emotional responses from the trauma that appear to lack a time perspective and a context. The vast majority of intrusive memories can be interpreted as re-experiencing of warning signals, i.e., stimuli that signalled the onset of the trauma or of moments when the meaning of the event changed for the worse. Triggers of re-experiencing symptoms include stimuli that have perceptual similarity to cues accompanying the traumatic event. *Intentional recall* of the trauma in PTSD may be characterised by confusion about temporal order, and difficulty in accessing important details, both of which contribute to problematic appraisals. Recall tends to be disjointed. When patients with PTSD deliberately recall the worst moments of the trauma, they often do not access other relevant (usually subsequent) information that would correct impressions/predictions made at the time. A theoretical analysis of re-experiencing symptoms and their triggers is offered, and implications for treatment are discussed. These include the need to actively incorporate updating information ("*I know now* . . .") into the worst moments of the trauma memory, and to train patients to discriminate between the stimuli that were present during the trauma ("*then*") and the innocuous triggers of re-experiencing symptoms ("*now*").

Intrusive re-experiencing is a core symptom of post-traumatic stress disorder (PTSD). It can take various forms, including intrusive images, flashbacks, nightmares, and distress and physiological reactions when confronted with reminders (American Psychiatric Association, 1994). Surprisingly, relatively little is known about the phenomenology of re-experiencing (for reviews see Reynolds & Brewin, 1998, 1999). Theorists concur in assuming that re-experiencing symptoms are due to the way trauma memories are encoded, organised in memory, and retrieved (e.g., Brewin, Dalgleish, & Joseph, 1996; Conway & Pleydell-Pearce, 2000; Ehlers & Clark, 2000; Foa & Rothbaum, 1998; Foa, Steketee, & Rothbaum, 1989; Keane, Zimmerling, & Caddell, 1985; van der

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The work described in this paper was funded by the Wellcome Trust. We thank Anne Speckens and the anonymous reviewers for their helpful comments.

http://www.tandf.co.uk/journals/pp/09658211.html DOI:10.1080/09658210444000025

Kolk & Fisler, 1995). However, there is considerable debate as to what the core features of trauma memories are.

In this paper, we will describe characteristics of intrusive re-experiencing and of the intentional recall of trauma memories in post-traumatic stress disorder (PTSD) that our research group have identified from systematic interviews with trauma survivors with PTSD, from treating trauma survivors with cognitive behavioural therapy,[1] and from initial empirical studies. We hope to show that a detailed look at the phenomenology of trauma memories has implications for the theoretical explanation and treatment of PTSD.

QUALITIES OF INTRUSIVE RE-EXPERIENCING

Thoughts versus sensation

In the early literature on PTSD, it was not uncommon to describe intrusive memories as intrusive thoughts. This is a misleading term, as research suggests that intrusive (spontaneously triggered, unwanted) memories mainly consist of relatively brief sensory fragments of the traumatic experience (Ehlers & Steil, 1995; Mellman & Davis, 1985; van der Kolk & Fisler, 1995).

> Examples 1 and 2: A man kept seeing headlights coming towards him (as he had seen them shortly before his head-on car crash); a rape victim was haunted by images of the assailant's eyes starring through the letterbox (as she had seen them before the assailant broke into her house)

Ehlers and Steil (1995), Ehlers, Hackmann, Steil, Clohessy, Wenninger, and Winter (2002), and Hackmann, Ehlers, Speckens, and Clark (in press) found that, regardless of the type of trauma, visual sensations were most common, followed by other sensory impressions (bodily sensations, sounds, smells, and tastes). It was not uncommon for intrusive *memories* to have several sensory components, but they were rarely described as thoughts. The above data were collected in specifically probing for repetitive unwanted memories about the trauma using instructions such as:

> After a traumatic event, many people have memories of the event that pop into their mind WHEN THEY DO NOT WANT THEM TO. Parts of the event may come to mind again and again. These are different for everyone. Do you have such unwanted memories that keep coming back?

Recent theoretical work suggests that intrusive memories should be distinguished from other non-memory cognitions that may also be experienced as intrusive, as these may be functionally distinct (Ehlers & Clark, 2000; Joseph, Williams, & Yule, 1997). Non-memory intrusive cognitions include evaluative thoughts about the trauma that may actually be more frequent than intrusive images or flashbacks (Reynolds & Brewin, 1998, 1999), and rumination (e.g., ''Why did it happen to me?'', ''How could the event have been prevented?'', or dwelling on how one's life has been ruined by the trauma) which is common in PTSD and is an important maintaining factor (Murray, Ehlers & Mayou, 2002). Past research has not always separated intrusive memories from rumination (e.g., Holman & Silver, 1998).

Lack of time perspective

Memories of specific autobiographical events are usually discussed in the literature as episodic memories, a concept introduced by Tulving to describe a memory system that makes possible the acquisition and retrieval of information about specific experiences that occurred at a particular time and place (see Tulving, 2002). Retrieval from episodic memory is unique in that it involves autonoetic awareness (the sense or experience of the self in the past).

The intrusive re-experiencing symptoms in PTSD appear to lack one of the defining features of episodic memories, the awareness that the content of the memory is *something from the past*. In a dissociative flashback the individual loses all awareness of present surroundings, and literally appears to relive the experience. The sensory impressions are re-experienced as if they were features of something happening right now, rather than being aspects of memories from the past. Also, the emotions (including physical reactions and motor responses) accompanying them are the same as those experienced at the time (''original''

[1] We will give case examples illustrating our observations from these studies. These summarise the descriptions given by the patient, and in some cases include links that the therapist made (e.g., between triggers and intrusive memories). Details of some of the examples are modified to prevent identification of patients, however, all important facts are accurate.

emotions) (Brewin et al., 1996; Ehlers & Clark, 2000; Foa & Rothbaum, 1998).

> Example 3: A woman who had been attacked by a bull saw a number plate with the letters ''MOO'' at a petrol station. This triggered a flashback during which she re-experienced the impending attack, and sprayed another customer with diesel fuel. At this time she was totally unaware that what she was experiencing involved material from memory.

In a less dramatic form, the lack of time perspective also appears to apply to other forms of re-experiencing, including intrusive images or distress in response to reminders. Patients may not lose all awareness of present surroundings, but their intrusions are accompanied by a sense of current threat and a sense of ''nowness'', i.e., the feeling that the sensations are experienced in the present rather than a memory from the past. Re-experiencing includes a phenomenon that Ehlers and Clark (2000) termed *affect without recollection*. Individuals with PTSD sometimes re-experience physiological sensations or emotions that were associated with the traumatic event *without* a recollection of the event itself (lack of source information, see Schacter, Norman, & Koutstaal, 1997; see also classical conditioning interpretations below).

> Example 4: A rape victim noticed that she was feeling extremely anxious while talking to a female friend in a restaurant, and only subsequently realised that the feeling was probably triggered by the presence of a man nearby who bore some physical resemblance to the rapist.

Lack of context

Van der Kolk and van der Hart (1991) suggested that intrusive trauma memories are relatively invulnerable to change. In line with this suggestion, Hackmann et al. (in press) systematically interviewed patients with PTSD about their intrusive memories and found that each patient experienced a small number of intrusions that occurred in a stereotyped, repetitive way. Ehlers and Clark (2000) observed that PTSD sufferers re-experience their original emotions and sensory impressions even if they later (either during the event or afterwards) acquire new information that contradicts the original impression.

> Example 5: A patient whose father committed suicide by shooting himself, kept re-experiencing a panicky urge to find him, and the feeling of responsibility for rescuing him that he had when he discovered the suicide note. At the time, he erroneously thought his father had taken sleeping tablets and could be saved if he acted quickly.

Of particular interest for understanding intrusive re-experiencing is the observation that patients may even have two intrusions that contradict each other, without any change in these intrusions over time.

> Example 6: A woman whose daughter died in a house fire while she was out, had frequent horrifying intrusions of seeing the curtains burning when she returned. She had assumed when she saw the curtains that her daughter was burning alive. However, she subsequently discovered that the daughter had been upstairs, and had been overcome by fumes. For many years, the patient experienced daily intrusions of the curtains burning. She also had intrusions of seeing the body of her daughter in the mortuary, with no sign of burns. Before treatment, she had never connected these two parts of the memory for the traumatic event.

As the example shows, when an intrusive memory is triggered, people with PTSD do not seem able to put it into context, and appear unable to access information that corrected or updated the impression and feelings they had at the time (e.g., the fact that the daughter did not burn alive), probably contributing to the lack of time perspective described above (see also Koriat, Goldsmith & Pansky, 2000).

Which of the intrusion characteristics predict PTSD?

In the initial aftermath of trauma, intrusive re-experiencing is common. Shalev (1992) found that the presence of these symptoms is not a good predictor of PTSD. Are certain characteristics of intrusive memories better at predicting PTSD than the presence of initial re-experiencing symptoms? Michael (2000) conducted two studies of assault survivors. Several characteristics of intrusive memories distinguished between survivors with and without PTSD and predicted subsequent PTSD severity. These included: distress caused by the intrusion; lack of time perspective (operationalised by the degree to which the

intrusion was experienced as something happening ''now''); and lack of context (operationalised by the degree to which it was experienced as isolated and disconnected from what happened before and afterwards) (for further predictors such as the interpretation of the intrusive memories see Ehlers & Steil, 1995; Steil & Ehlers, 2000).

CONTENT OF INTRUSIVE MEMORIES

Ehlers et al. (2002) examined the content of intrusive memories and found that they do not appear to be random fragments. They mainly represented stimuli that signalled the *onset* of the trauma or of the moments with the largest emotional impact. Ehlers et al. (2002) argued that they can be understood as stimuli that—through *temporal* association with the traumatic event—acquired the status of warning signals: stimuli that, if encountered again, would indicate impending danger. This would explain why intrusive memories induce a sense of serious current threat, as Ehlers and Clark (2000) suggested.

> Example 7: A woman who was raped in her home kept seeing the perpetrator standing inside her bedroom door as she had seen him when she woke up (before she was attacked).

The warning signal interpretation of intrusive memories was inspired by initial observations that intrusive memories did not appear to represent a simple replaying of the most distressing moments. For example, on the basis of research showing that central elements of highly emotional experiences are remembered best (Christianson, 1992a), one may have expected the rape survivor in Example 7 to re-experience sensations from the most distressing moments of her ordeal, for example, the taste connected with having to perform oral sex on the perpetrator—rather than the sight of the perpetrator *before* she was attacked.

The warning signal hypothesis extends previous attempts to explain re-experiencing with conditioning theories (e.g., Charney, Deutch, Krystal, Southwick, & Davis, 1993; Keane et al., 1985; Kilpatrick & Veronen, 1983; for a review of the role of imagery in human classical conditioning see Dadds, Bovbjerg, & Redd, 1997) in that it is designed to explain the particular content of intrusive memories. Classical conditioning theory may facilitate prediction of the kinds of warning signals that will be re-experienced (e.g., processes of temporal contiguity and predictive significance).

It is important to note that the ''warning'' stimuli reflect temporal association, rather than necessarily having a meaningful relationship to the trauma. Many seem to consist of markers of the situational context in which the trauma occurred. Markers of location may be understood as early warning signals that can be spotted from far away and avoided in the future.

> Example 8: A man who witnessed the suicide of a person who jumped in front of a train re-experienced the sight of railway tracks as he had seen them before the person jumped. He did not re-experience the sight of the train approaching, which had a closer relationship in meaning to the suicide.

In prolonged trauma, there may be several crucial moments when meanings change for the worse, each of which can be represented in re-experiencing. Furthermore, moments with the largest emotional impact do not necessarily occur during the trauma itself, but may occur later when the patient realises what could have happened, or when something gives the situation a more traumatic personal meaning. Ehlers et al. (2002) observed that even for intrusions that relate to moments during the course of the traumatic event or its aftermath, the content of the intrusion seems to follow the warning signal hypothesis. Like intrusions of stimuli that preceded the onset of the trauma, these intrusions appear to be mainly of stimuli that signalled a change in meaning to the worse, including stimuli that are not necessarily meaningfully related to this change.

> Example 9: A woman re-experienced a touch on her shoulder. After her accident she had been trapped in her car, but initially did not realise that she was hurt. A paramedic had touched her shoulder and asked whether she was all right. It was following this question that she felt pain and realised that she could be badly hurt.

Hackmann et al. (in press) subjected the warning signal hypothesis to an empirical test. They systematically interviewed PTSD patients about their intrusive memories and classified their content. Patients were asked to identify their main intrusion. A total of 92% of the patients' main intrusions could be classified as warning signals.

These either signalled the onset of the trauma (e.g., ''perpetrator standing with a knife next to my bed'' in a patient subsequently assaulted with the knife, 55%), or signalled a moment when the meaning of the event became more traumatic (e.g., ''seeing two policemen standing next to my bed''—the policemen later told the patient that others had died in the accident, 37%).

TRIGGERS OF RE-EXPERIENCING SYMPTOMS

Many theorists of PTSD have commented on the wide range of triggers of involuntary re-experiencing (e.g., Brewin et al., 1996; Ehlers & Clark, 2000; Foa et al., 1989). Most individuals with PTSD report that newspaper or TV reports of similar events provoke intrusions. Many report wide-ranging generalisation of fear to stimuli only loosely connected to the original traumatic stimulus (see Example 3).

Furthermore, as Ehlers and Clark (2000) observed, many of the trigger stimuli are cues that do *not* have a *strong meaningful* relationship to the traumatic event, but instead are simply cues that were *temporally associated* with the event (see also Charney et al., 1993; Keane et al., 1985), for example physical cues similar to those present shortly before or during the trauma (e.g., a pattern of light, a tone of voice); or matching internal cues (e.g., touch on a certain part of the body, proprioceptive feedback from one's own movements). People with PTSD are usually unaware of these triggers, so intrusions appear to come out of the blue. Ehlers et al. (2002) observed that triggers of intrusive memories are often stimuli that bear physical resemblance to stimuli that immediately preceded the ''warning signal'' that is later re-experienced (Example 11), or to the ''warning signal'' itself (Example 10).

> Example 10: A car crash survivor was relaxing in his garden when he suddenly became very anxious and had intrusions of headlights coming towards him. Only later he realised that these were triggered by a bright patch of sunlight on his lawn.

> Example 11: A woman whose car had been hit from behind, experienced intrusions of blue and yellow colours accompanied by strong fear when she was washing up and turned to the left to get the tea towel. After the impact, she had turned left to see what was happening and had seen that a blue and yellow bus had hit her car. Turning to the right did not trigger intrusions.

FEATURES OF INTENTIONAL RECALL OF TRAUMA MEMORIES

The memory fragmentation debate

Several theorists have suggested that trauma memories are different from other autobiographical memories (e.g., Brewin et al., 1996; Ehlers & Clark, 2000; Foa et al., 1989). For example, van der Kolk and Fisler (1995, p. 513) postulated that trauma memories are initially recollected in a sensory form ''without any semantic representation ... experienced primarily as fragments of the sensory components of the event''. Accordingly, several theorists have argued that one of the functions of PTSD treatment is the creation of an organised narrative with a beginning, middle, and end (e.g., Foa & Rothbaum, 1998; van der Kolk & Fisler, 1995).

Some studies have attempted to assess the degree of fragmentation by coding deliberately retrieved narrative accounts of traumatic events. Indices of fragmentation correlated with the severity of PTSD symptoms in cross-sectional (Amir, Stafford, Freshman, & Foa, 1998; Harvey & Bryant, 1999; Koss, Figueredo, Bell, Tharan, & Tromp, 1996), and prospective longitudinal studies (Halligan, Michael, Clark, & Ehlers, 2003). Foa, Molnar, and Cashman (1995) reported that patients' narrative accounts become more organised with exposure treatment, although not all changes in fragmentation indices are necessarily specific to patients who show clinical improvement (van der Minnen, 2002). Furthermore, Tromp, Koss, Figueredo, and Tharan (1995) recruited rape survivors and found that in contrast to other unpleasant and pleasant memories, accounts of rape memories were less clear, less vivid, and less detailed.

Critics of the memory fragmentation concept have argued that the so-called fragmentation of trauma memories is not surprising because in every autobiographical memory encoding is incomplete, and memory is always a reconstruction rather than an exact record (e.g., McNally, 2003). McNally (2003) points out that much about trauma memories can be explained by Easterbrook's (1959) finding that the focus of attention narrows during stress, and people appear to zoom in on central aspects, at the

expense of remembering peripheral details (Christianson, 1992a). As trauma is a period of extreme stress, one might expect people only to encode the most important elements, rather than blow-by-blow minutiae. And one would expect that the most important elements are remembered very well, as high levels of stress usually enhance rather than impair memory (Shobe & Kihlstrom, 1997).

Consistent with these critical evaluations of the fragmentation concept, nearly all trauma survivors seen by our research team remember the gist of what happened well (e.g., that they have been stabbed, or had a car crash), but show confusion about or inability to access some details, and are often unclear about the exact temporal order of the events. This in itself is not surprising, as many memories of other events have similar characteristics. For example, people remember the gist of what was said at a meeting rather than a word-by-word record of who said what. However, people do not usually have persistent intrusive memories of meetings. The crucial question remains why people with PTSD have persistent re-experiencing symptoms, and what aspects of trauma memories explain them.

The debate about memory fragmentation has been complicated by the inconsistent use of the term in the literature. Van der Kolk and Fisler's description (1995) seems to characterise intrusive (i.e., unwanted, *automatically triggered*) trauma memories, and the phenomenology of re-experiencing symptoms as described above largely appears to be consistent with their description. Most research studies on memory fragmentation have investigated *intentional* recall in the form of trauma narratives.

Equating these two aspects of trauma memories would assume that they both reflect a single memory trace. We think that this is a problematic assumption. What is retrieved from memory about a traumatic event depends on the retrieval route and on the different memory processes/systems involved (see also Tulving, 2001). Thus, when describing characteristics of trauma memories, one has to bear in mind that they may only apply to certain retrieval routes and memory processes/systems.

A further problem with the research on memory fragmentation concerns assessment. In the empirical studies cited above, memory fragmentation was usually operationalised by coding trauma narratives for the proportion of utterances of confusion about what was happening, lack of organised thoughts, incomprehensible/muddled descriptions, or repetitions; by using global measures of readability or comprehensibility, or by self-report. Overall, the preliminary results in support of a fragmentation of trauma memories point to a deficit in the cohesion of narratives that is related to the severity of PTSD. Whether or not trauma narratives are also less detailed than narratives of other emotional events is less clear. Porter and Birt (2001) asked undergraduates to write down a description of their most traumatic memory as well as a description of a positive event, and rated the number of details in the narrative among other characteristics such as vividness of the memories. The traumatic memories actually contained more details than the positive memories, rather than fewer as one may have expected on the basis of the fragmentation idea. There was no difference in coherence ratings. The non-clinical sample and the possible ceiling effects in coherence ratings may compromise conclusions on trauma narratives. Nevertheless, trauma memories may not differ from other emotional memories in the overall number of details that can be accessed.

These studies illustrate that different indices of fragmentation may give different results. None of the measures used so far is satisfactory, as they either included irrelevant aspects (e.g., the overall number of details is less relevant than ability to recall detail that is important for the meaning of the event, see below) and/or did not assess relevant aspects (e.g., subtle gaps in memory). Readability of narratives may reflect characteristics of the survivor such as verbal intelligence or education rather than characteristics of the particular trauma memory (especially if trauma narratives are not compared to narratives of other emotional events; Gray & Lombardo, 2001). Utterances of confusion may represent problems at encoding rather than problems with retrieval from memory. In addition, the fragmentation indices are probably not sensitive enough in measuring the extent to which people with PTSD experience and remember their traumatic event as a *series* of *disjointed* events rather than *one* single event organised by a *time-line* (see Example 6). We think that this disjointedness of trauma memories is crucial in understanding re-experiencing (see below). Self-report measures such as the one used by Halligan et al. (2003) may assess different aspects of fragmentation more comprehensively, but are limited by their reliance on introspection.

A further important problem is that the fragmentation of the whole trauma narrative is less relevant for explaining re-experiencing than the fragmented recall of those time points that are later re-experienced.

> Example 12: A patient appeared to have very coherent memory of a fatal car crash and reported that he could remember the accident in great detail, in a ''frame by frame'' fashion. His main intrusion was the sound of the crash. When he relived the event in therapy, he retrieved a detail that he had not remembered when thinking about the event before: After the impact (i.e., after the sound), he had seen the other driver collapsed over her steering wheel, realised she was dead, and thought he had killed her (although the accident was not his fault).

Similarly, Hellawell and Brewin (2002) distinguished between parts of trauma narratives that were like ordinary autobiographical memories, and parts that are accompanied by a marked sense of reliving, which they termed ''flashback memories'', and other authors have described as ''hot spots'' (i.e., most emotional points) during reliving (e.g., Ehlers & Clark, 2000; Foa & Rothbaum, 1998). A first empirical investigation that assessed hot spots and unintentional intrusive memories independently, did indeed find a close relationship (Holmes, Grey, & Young, 2003).

Thus, the most emotional parts of the intentional recall of the trauma are most relevant for the fragmentation debate, and for re-experiencing. We suggest that problems with what people with PTSD intentionally recall of the trauma may maintain PTSD in two ways: first, by affecting their appraisals of the event, and second, by preventing information stored in memory from being updated with subsequent information that corrects predictions (including a ''felt sense'' of what was going to happen) made at the time.

Influence of trauma recall on appraisals

Problematic appraisals of the traumatic event may be linked to different aspects of what people recall of the trauma (1) confusion about the time course of events, (2) problems in accessing important details of the event, (2) problematic recall stemming from encoding errors at the time of the event.

Confusion about the temporal order of an event can crucially affect its meaning and its implications for the future.

> Example 13: A man who had been assaulted by a group of people developed a strong fear of being attacked again by people of the same ethnic group. His fear was dramatically reduced when he reconstructed the order of events and remembered that he had actually punched one of the group members first.

An inability to retrieve details of a traumatic event is not a problem if the detail is irrelevant for the meaning of the event. This will apply to many details of traumatic events as it does to details of memories of other events (McNally, 2003). However, our observations in treating patients with PTSD show that difficulty in accessing a particular detail can make a crucial difference for the personal meaning of the event.

> Example 14: A patient who had been run over by a motorbike felt responsible, as she thought that if she had walked faster the bike would not have hit her. When visiting the site of the accident she remembered that the motorbike had actually tried to pass in front of her rather than behind her as she had assumed.

Furthermore, some patients do not even remember aspects that one would consider a central element of the experience.

> Example 15: A rape victim was ashamed about complying with the perpetrator's instructions. When she relived the event in treatment she remembered that the assailant had threatened her with a knife. An objective observer would call the knife a central element, and as such it should be remembered well (Christianson, 1992a; Easterbrook, 1959), yet the patient did not initially access this information.

There are different interpretations of this phenomenon. First, one may argue that the inability to remember the knife was related to avoidance of thinking about the most frightening parts of the event. Second, the problem with the intentional recall of this central information may be related to problems at encoding, in that extreme arousal and/or confusion during trauma may compromise the differentiation of what is central and what is peripheral.

Similarly, during the traumatic event, individuals may not have enough cognitive capacity to

decide that some very threatening aspects are not true, and thus encode them as real, or to encode the source of information accurately (see also Koriat et al., 2000).

> Example 16: A rape victim remained convinced that she was unattractive because the rapist had repeatedly told her so. The extreme distress she experienced made it impossible for her to appreciate that this was simply a strategy that the rapist used to humiliate her.

> Example 17: Some political prisoners start to believe that they are criminals after traumatic interrogations involving torture (Ehlers, Maercker & Boos, 2000).

This appears to include frightening images that people may experience during trauma. People with PTSD may respond to such images (and develop re-experiencing symptoms) as if they were a true part of the event, even if they later realised that they were an image rather than reality.

> Example 18: A football fan was caught in a fight between football hooligans and the police. He had an image of the police smashing up his car and was terrified by this image. Subsequently, he developed flashbacks to the image and extreme anxiety when seeing police officers.

Disjointedness and lack of updating/ linking to other information

When patients with PTSD initially relive the trauma in treatment, they appear to retrieve it in separate, disjointed parts, rather than as segments of an integrated memory. We have observed that when PTSD sufferers remember a particularly distressing segment (''hotspots''), they do not access other relevant (usually subsequent) information that corrected impressions they had or predictions they made at the time. (Note that the term prediction is used to include a ''felt sense'' of what might happen, not just conscious thoughts.)

> Example 19: A patient who thought that he was going to die during an assault, and would never see his children again, was not able (whilst recalling this particularly distressing moment) to access the fact that he actually survived and still lived with his children. This part of the memory elicited overwhelming sadness.

The disjointedness in intentional recall of the most distressing parts of the traumatic experience (''hotspots'') resembles the lack of context information that we described above as one of the characteristics of intrusive trauma memories. Our clinical observations suggest that the hotspots and intrusive memories are closely linked. A systematic study by Holmes et al. (in press) supports this view. Similarly, Holman and Silver (1998) observed that temporal disintegration at the time of the trauma—whereby the present moment becomes isolated from the continuity of past and present time—was associated with subsequent distress.

THEORETICAL EXPLANATION

Ehlers and Clark (2000) built on recent research on non-trauma autobiographical memories to explain re-experiencing symptoms. Despite an abundance of retrieval cues, people are usually not flooded by involuntary memories in their everyday life. As Conway and colleagues have demonstrated (e.g., Conway & Pleydell-Pearce, 2000), this is because autobiographical events are elaborated and incorporated into an autobiographical memory knowledge base. The elaboration enhances the ease of intentional retrieval through higher-order meaning-based retrieval strategies, and *inhibits* cued retrieval through direct triggering by stimuli associated with the event (see Conway & Pleydell-Pearce, 2000; Markowitsch, 1995). When an autobiographical memory enters consciousness, it comprises both specific information about the event *and* context information.

Ehlers and Clark (2000) proposed that in PTSD one of the problems is that trauma memories are not fully elaborated in this way (see also Brewin et al., 1996; Foa et al., 1989; Rachman, 1980). They are inadequately integrated into their context in time, place, and subsequent and previous information. This explains the problems described above with intentional recall, the ''here and now'' quality (no context in time), and the absence of links to subsequent information (e.g., ''I did not die'') described earlier. It also contributes to triggering by matching cues, as the inhibitory effect of elaboration is lacking.

In order to fully explain the easy triggering of re-experiencing symptoms, the wide range of triggers and the phenomenon of *affect without recollection*, Ehlers and Clark (2000) suggested

that two further memory processes are involved: perceptual priming (enhanced ability to identify objects as a result of a prior encounter) and associative learning (see also Charney et al., 1993; Keane et al., 1985, Kilpatrick & Veronen, 1983). These two memory processes underlie *expectations* (note that we use this term more broadly than those involving conscious thoughts) about what stimuli the individual will encounter (priming) and what will happen next (associative learning). Together, they make it likely that the individual will notice external (e.g., visual or auditory cues) or internal (e.g., posture, feelings, arousal) stimulus configurations that are trauma reminders, and respond to them with automatically triggered re-experiencing symptoms.[2] Figure 1 illustrates how the combination of these processes leads to re-experiencing symptoms.

Ehlers and Clark (2000) proposed that people with PTSD have strong perceptual priming for stimuli that they encountered shortly before and during the trauma. There is a processing advantage and reduced perceptual threshold for these stimuli. Cues associated with the trauma that directly trigger memories of the event (as the inhibitory effect of elaboration/integration into context is lacking) are more likely to be noticed. Implicit memory traces are not well discriminated from other memory traces (Baddeley, 1997). Therefore vague physical similarity would be sufficient for the perception of stimuli as similar to those present during the trauma (poor stimulus discrimination) and thus for the triggering of intrusions, even if the context in which the stimulus configuration is observed is very different (see Example 10).[3]

In other cases, re-experiencing symptoms are connected to the trigger stimulus by associative learning (see Example 11). As retrieval from associative memory is cue-driven and unintentional, individuals may just experience the emotional response associated with the trigger stimulus, and may not always be aware that their emotional reaction is due to activation of the trauma memory (*affect without recollection*).

As discussed above, intrusive memories are usually of stimuli that can be understood as warning signals, stimuli that predicted the onset of the trauma, or a moment when meaning changed for the worse. These considerations show that re-experiencing symptoms ''make sense'' in that they can be understood as the result of processes that help to warn the organism of impending danger. Perceptual priming sets up the expectation that the individual may encounter again a stimulus configuration such as the one encountered shortly before/at the onset of the traumatic event or its worst moments. Associative learning serves to inform the individual what is likely to happen next, and trigger the corresponding emotional responses so that a behavioural response can be quickly activated.

The pattern of preferential identification of cues that resemble those predicting the traumatic event and strong emotional response to these triggers appears to be an adaptive response shortly after trauma, as the individual needs to re-evaluate the safety of his/her environment. Many people will quickly recover as they process the trauma, and establish an elaborated autobiographical memory for it. They notice that the triggers are false alarms and do not signal current threat. However, in some individuals re-experiencing will persist, for two reasons.[4]

First, if individuals fail to put the trauma memories into their context and update them with subsequent information (e.g., in Example 10, ''I did not die in the head-on car crash, and I have seen headlights many of times before and after the crash without having an accident''), re-experiencing to trigger cues (bright spots in dark background) will persist (they will remain predictors of ''I am going to die'').

Second, individuals may not be aware of the triggers of re-experiencing symptoms. Failure to identify triggers makes it difficult for the patient to discriminate such triggers from the stimuli that

[2] See also Tulving's notion, 2001, 2002, that perceptual information from personal experience can be retrieved independent of the episodic memory system, without autonoetic remembering, and case examples of patients who do not have a memory of the trauma, but still show fear responses to reminders or intrusive images (e.g., Christianson, 1992b).

[3] Experimental studies from our laboratory have found that assault survivors with PTSD show stronger priming for traumatic material than those without PTSD (Michael, Ehlers, & Halligan, 2004). Furthermore, analogue studies have shown that stimuli occurring in a traumatic context were more strongly primed than stimuli occurring in a neutral context. Enhanced priming predicted the occurrence of PTSD-like intrusions (Michael & Ehlers, 2004). Thus, there is experimental evidence pointing to perceptual priming as one mechanism underlying intrusive memories in PTSD.

[4] Note that, in addition, the Ehlers and Clark (2000) model specifies other maintaining factors in PTSD, overly negative apprraisals of the trauma and/or it sequelae, and dysfunctional behaviours and cognitive strategies.

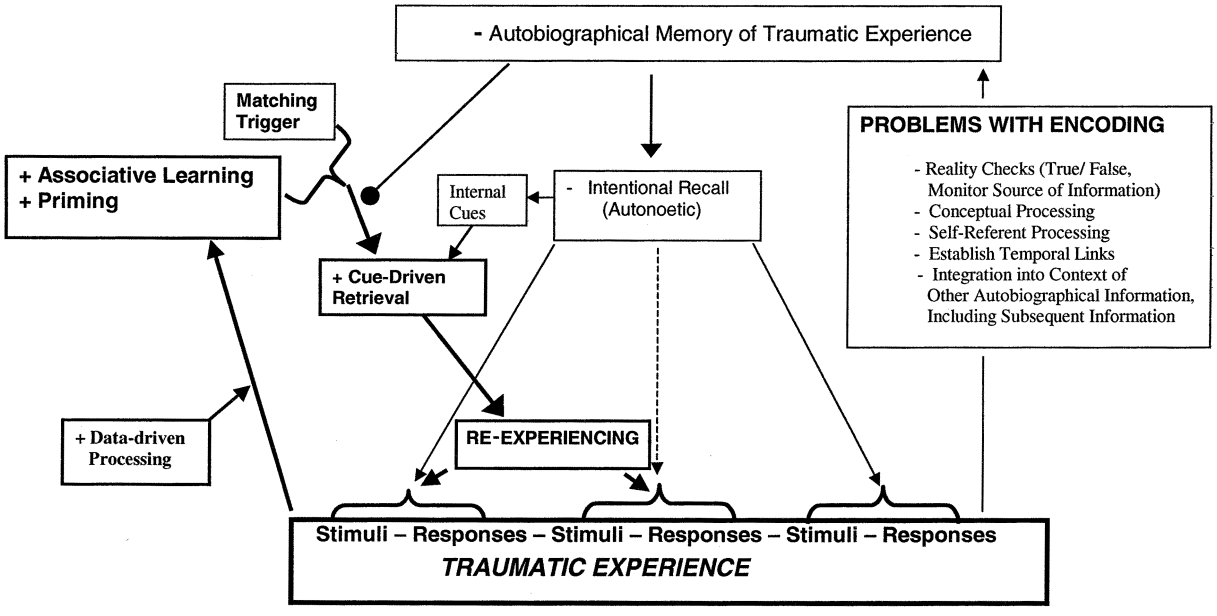

Figure 1. Encoding of the traumatic experience (arrows pointing upwards) and its retrieval from memory (arrows pointing downwards) in people with PTSD, according to the Ehlers and Clark (2000) model. Strong processes are indicated with +, bold printing, and fat arrows; weak or deficient processes with –, plain text, and thin arrows. Pointed arrows indicate facilitation, round arrows inhibition. Dashed arrows represent difficult access.

For simplification, the traumatic experience is presented as a series of stimuli and responses (including sensations, emotions, thoughts). People with PTSD show strong perceptual priming for stimuli that they perceived shortly before and during the trauma; and strong associative learning of stimulus–response or stimulus–stimulus patterns. On the other hand, problems with encoding the traumatic experience result in a poorly elaborated autobiographical memory for the event that is inadequately linked to other autobiographical information.

The three memory processes interact and lead to the easy triggering of re-experiencing symptoms: Strong perceptual priming (1) and associative learning (2) facilitate cue-driven retrieval to matching triggers. As the autobiographical memory is poorly elaborated (3), there is little inhibition of cue-driven retrieval of elements of the experience that lacks the context information of other autobiographical memories. Furthermore, intentional recall of parts of the experience may indirectly trigger re-experiencing symptoms by providing cues for cue-driven retrieval.

Intentional recall with autonoetic awareness may be hampered in several ways, depending on the nature of the encoding problems. Recall tends to be disjointed and relevant (usually subsequent) information may not be accessed when recalling the worst parts of the experience; recall may omit parts of the experience; there may be confusion about the order of events in time, or the source and truth-value of information; and the resulting recall may lack the perspective of time (see Examples 12 to 19 in text).

they encountered during the trauma, and to learn that there is no present danger.

IMPLICATIONS FOR TREATMENT

The study of intrusive and intentionally retrieved trauma memories, and their theoretical analysis, has led us to develop an effective version of cognitive behavioural therapy for PTSD (Ehlers & Clark, 2000). The treatment has been evaluated in two randomised controlled trials and shown to be highly effective (effect sizes of 2.5 and above in intent-to-treat analyses) and acceptable (overall drop-out rate across studies of less than 2%) (Ehlers et al., 2003, in press). The treatment disseminated well into a clinical trauma service, with similarly high effect sizes (Gillespie, Duffy, Hackmann, & Clark, 2002). We will briefly describe the therapeutic strategies used to decrease re-experiencing symptoms. The interventions are based on the theoretical analysis described above. Other elements of the treatment not described here deal with problematic appraisals of the trauma and its sequelae, and with dysfunctional behaviours and cognitive strategies that maintain PTSD (see Ehlers & Clark, 2000).

Updating and integrating trauma memories

The features of recall of trauma memories in PTSD described above (difficulty in accessing important details, confusion about the order of events, difficulty in accessing information that

updated impressions/predictions made at the time of the trauma, and disjointed recall), suggest that it is necessary for patients to reconstruct exactly what happened, after the trauma. For many trauma survivors, this happens during natural recovery, when they think over or discuss the experience. For those who do not recover spontaneously, the reconstruction and elaboration of what exactly happened during the traumatic event is an important treatment goal. Various effective ways of achieving this have been developed, e.g., repeated imaginal reliving (Foa & Rothbaum, 1998) or writing a trauma narrative (Resick & Schnicke, 1993).

Building on these techniques, Ehlers and Clark (2000) suggested that a particularly efficient way of updating trauma memories and putting them into their context is to (1) identify the moments during the trauma that create the greatest distress and sense of ''nowness'' during recall (''hotspots'') through imaginal reliving (or writing a narrative) and discussion of intrusive memories, (2) identify information that updates the impression the patient had at the time either by identifying the course, circumstances, and outcome of the trauma or by cognitive restructuring, and (3) actively incorporate the updating information into the hot spots using verbal and imagery techniques.

> Example 20: A motorbike rider was hit by a car. His main intrusion was of flying through the air. The intrusion was linked to the worst moment, which happened shortly afterwards, when he saw an image of himself in pieces and thought he was dead. In therapy, updating information was incorporated into the trauma narrative at the point when he had this image. This was first done by verbally reminding himself of the updating information ''I now know I am alive and my body is complete'' and by touching his legs and body when coming to this point. Furthermore, the patient did an image transformation of joining his body together and getting up from the ground.

Grey, Young, and Holmes (2002) have recently elaborated on therapeutic techniques to achieve the incorporation of updating information.

Identifying and discriminating triggers of intrusions

As described above, patients with PTSD are often not aware of perceptual cues that trigger intrusive memories. Education and training in the identification of triggers and stimulus discrimination is helpful. Patients need to learn the discrimination between the ''then'' and the ''now'', i.e., the present stimuli that trigger intrusions and those encountered during the trauma. They need to learn to realise when they encounter these stimuli that these are just reminders of the event and do not indicate danger now, as they occur in a different context. In our treatment protocol (Ehlers & Clark, 2000), patients are instructed to observe triggers of intrusive memories, and to pay close attention to the differences between the harmless trigger and its present context (''now'') and the stimulus configuration that occurred in the context of trauma (''then''). It can be useful to instruct the patient to repeatedly bring on intrusive memories to practise this discrimination.

> Example 21: A woman who had been raped experienced flashbacks when attempting intercourse with her partner. In therapy, the similarities and differences between the ways the rapist (''then'') and her partner (''now'') touched her and the context of these sensations were highlighted, and she practised staying aware of the differences when being with her partner.

CONCLUSIONS

This paper has shown that it is important to consider features of unintentional and intentional recall when characterising trauma memories in PTSD. Laboratory experiments on eyewitness testimony using paradigms requiring intentional recall had suggested that central elements of traumatic experiences should be remembered best (Christianson, 1992a; McNally, 2003), and that details may be remembered less well. While this pattern is overall consistent with the trauma narratives given by patients with PTSD, it does not explain the content of re-experiencing symptoms. A warning signal interpretation appears to fit their content better. Furthermore, problems with what is intentionally recalled contribute to problematic appraisals of the trauma, and are thus important in understanding the psychopathology of PTSD. Investigations into the phenomenology of intrusive memories and intentional recall of trauma memories led to a new theoretical model and treatment approach. A central element of treatment involves the active incorporation of information that updates and corrects the predictions made at the worst

moments of the trauma through verbal and imagery techniques. This information is either derived from knowledge of how the event and its consequences unfolded, or on cognitive restructuring of misperceptions and misinterpretations. Other CBT approaches have either relied on repeated exposure to the trauma narrative or on cognitive restructuring outside the imaginal exposure to deal with the worst moments of the trauma. In our experience, the active integration of the updating/corrective information into the trauma memory is usually necessary for the patient to achieve full benefit from the intervention. This observation matches the finding that before treatment patients do not access the updating/corrective information when remembering the worst moments, as the trauma appears to be retrieved as disjointed segments that are inadequately integrated into their context.

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