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The nature of intrusive memories after trauma: the warning signal hypothesis

Anke Ehlers [a,*], Ann Hackmann [b], Regina Steil [b], Sue Clohessy [b], Kerstin Wenninger [b], Heike Winter [b]

[a] *Department of Psychology, Institute of Psychiatry, King's College London, De Crespigny Park, London SE5 8AF, UK*

[b] *Department of Psychiatry, Oxford University, Oxford, UK*

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Abstract

Individuals who had experienced a range of different traumas were asked to describe the quality and content of their intrusive memories. Visual intrusions were the most common, and thoughts were uncommon. Intrusion quality varied little with type of trauma. Intrusive memories commonly consisted of stimuli that were present immediately before the traumatic event happened or shortly before the moments that had the largest emotional impact (i.e., when the meaning of the event became more traumatic). It is suggested that intrusive memories are about stimuli that through temporal association with the trauma acquired the status of warning signals, i.e., stimuli that if encountered again would indicate impending danger. This explains why intrusive memories are accompanied by a sense of serious current threat. The warning signal hypothesis may be useful in guiding therapists in identifying the moments with the largest emotional impact that will need reprocessing in treatment, and in educating patients about the nature of reexperiencing symptoms.

Although intrusive memories are a core symptom of posttraumatic stress disorder (PTSD), relatively little is known about their nature and content (for reviews, see Reynolds & Brewin 1998, 1999). Preliminary research suggested that intrusive memories mainly consist of sensory fragments of the traumatic experience (Ehlers & Steil, 1995; Mellman & Davis, 1985; Van der Kolk & Fisler, 1995). It remains as yet unclear *which* of the sensory impressions from a trauma will be reexperienced. One hypothesis is that the most traumatic aspects of the event should be remembered best, e.g., somatosensory sensations when assaulted. In line with this hypothesis,

* Corresponding author. Tel.: +44-20-7848-5032; fax: +44-20-7848-0591.
E-mail address: a.ehlers@iop.kcl.ac.uk (A. Ehlers).

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laboratory studies on memory for upsetting events have demonstrated that central cues are usually well remembered, whereas memory for peripheral details is poor (Christianson, 1992a). A possible mechanism for this effect is a narrowing of attention in traumatic situations (Christianson, 1992b). Similarly, Foa and Riggs (1993) suggested that high anxiety and arousal may lead rape victims to focus their attention on central aspects such as the assailant's knife and may make it impossible for them to fully process the situation, leading to fragmented memories.

To test the hypothesis that intrusive trauma memories represent the most traumatic aspects of the ordeal, we asked individuals who had experienced a range of traumas to describe the quality of their intrusive memories. If intrusive memories are a representative fragment of the traumatic experience, one would expect the quality of the intrusion to vary with the nature of the trauma. For example, one may expect that people who witness traumatic events as part of their profession (e.g., ambulance service staff) will reexperience relatively few somatosensory sensations and mainly visual, acoustic or olfactory sensations representing their traumatic impressions during the exposure to the traumatic scene. In contrast, one would expect people who experienced physical or sexual assault to have a high proportion of somatosensory intrusions. The results are described in Part 1 of this paper.

To further our understanding of the content of intrusive memories, we interviewed patients with PTSD who had experienced a range of different traumas to describe the content of their intrusive memories. The results are described in Part 2.

1. Part 1

1.1. Method

1.1.1. Participants

1.1.1.1. Childhood sexual abuse study Thirty-five female survivors of childhood sexual abuse were recruited from a study of Wenninger and Ehlers (1998). Mean age was 36 years (SD=8.7). Eighty-six percent met DSM-IIIR symptom criteria for PTSD, as determined by the Posttraumatic Stress Symptom Scale (PSS-SR; Foa, Riggs, Dancu, & Rothbaum, 1993).

1.1.1.2. Ambulance service staff study Fifty-six paramedics and technicians from the Oxfordshire Ambulance NHS Trust (77% men) were recruited from a study of Clohessy and Ehlers (1999). Mean age was 35 years (SD=8.7). Twenty-one percent met DSM-IIIR symptom criteria for PTSD, as determined by the PSS-SR.

1.1.1.3. Road traffic accident study 1 Sixty-four survivors of road traffic accidents (36% men) were recruited from a study of Winter (1996). Mean age was 43 years (SD=12.4). Sixty-four percent met DSM-IIIR symptom criteria for PTSD, as determined by the PSS-SR.

1.1.1.4. Road traffic accident study 2 One-hundred and fifty survivors of road traffic accidents (41% men) were recruited from a study of Steil and Ehlers (2000). Mean age was 43 years

(SD=13.9). Forty-eight percent met DSM-IIIR symptom criteria for PTSD, as determined by the PSS-SR.

1.1.2. Intrusion questionnaire

Participants were asked to describe their typical intrusive memories of the traumatic event. They were asked to indicate what qualities the memories had. They could endorse more than one quality. The exact form of the questionnaire varied slightly between studies. For simplicity, the results are based on the presence/absence of qualities in each of the studies.

1.2. Results

Table 1 presents the proportion of participants who endorsed different qualities of intrusive memories. Across types of trauma, the distribution of qualities was similar. Visual intrusions were most common. Thoughts were relatively uncommon. There were no consistent differences across studies in the qualities endorsed by participants with and those without PTSD.

2. Part 2

2.1. Method

Patients with PTSD who were assessed for treatment were asked to describe the content of their typical intrusive memories. They had experienced a range of traumas (e.g., accidents, combat, rape, physical assault, rescue operations).

2.2. Results

The interviews suggested that intrusive memories often consisted of stimuli that were present immediately *before* the traumatic event happened or shortly *before* the moments that had the largest emotional impact.

Table 1
Quality of intrusive memories: percent participants that endorsed each quality[a]

	CSA	A&E	RTA1	RTA2
Visual	97	87	70	83
Sounds	51[b]	48	38	54
Smell	51[b]	48	N/A	N/A
Bodily sensations	66	60	28	50
Actions	N/A	65	30	22
Thoughts	26	60	36	45

[a] Participants could endorse more than one quality. CSA: child sexual abuse survivors; A&E: ambulance service staff; RTA: road traffic accident survivors; N/A: not assessed in that study.

[b] Assessed jointly as sounds or smells.

Examples:

- A patient who had repeatedly been indecently assaulted kept reexperiencing the sight of the perpetrator waiting for her in the corridor where the assaults happened.
- A patient who had been repeatedly attacked by a motor bike driver kept seeing wheels coming towards him as he had seen them when he was lying on the ground.
- 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.
- A patient who had experienced a head-on car crash at night kept seeing headlights coming towards her.
- Another motor vehicle accident patient kept seeing the other car come around the corner shortly before the accident happened.
- A physician who had tried to resuscitate a young child in a shop kept seeing a crowd of people (who had been standing around the child) as she had seen them when coming into the shop.
- A Vietnam veteran kept seeing the faces of children as he had seen them before he shot them.

In none of these cases did the patient reexperience the sensations they had during the traumatic event itself (e.g., being touched by the perpetrator, pain when being hit by the motor bike, feeling impact of the crash).

Note that during short events, such as accidents, the moments with the largest emotional impact do not necessarily occur during the traumatic event itself, but may occur somewhat later when the patient realizes what could have happened or when something gives the situation a more traumatic personal meaning. In prolonged trauma, there may be several moments when the meaning of the event changes for the worse, each of which can be represented in reexperiencing.
Examples:

- A patient who had experienced a motor vehicle accident kept reexperiencing the worried face of her mother when she came to visit her in hospital. It was only then that she had realized that she may have died during the accident.
- A further accident survivor experienced intrusive images of two policemen as he had seen them after waking up from a coma. The policemen had come to inform him that five other people who had been involved in the accident had died.
- A man who fell from great height when working on a building site kept seeing beams above him as he had seen them when lying on his back after the fall. At that moment, he thought that he had lost his legs.
- A rape victim kept reexperiencing the sight of a smashed beer bottle that the perpetrator had used to make her pretend she was his girlfriend when he walked her home after raping her.
- A woman reexperienced a paramedic touching her shoulder and asking whether she was alright when she was trapped in her car after an accident. This was the moment when she realized that she may be paralysed.

Auditory intrusions or other sensory impressions appeared to mainly be reexperienced when none of the visual input at the time predicted the traumatic event (for example, in the dark or when being attacked from behind) or when the other distinct sensory impressions were the first sign that something was wrong.

Examples:

- A patient whose car was hit from behind kept hearing the sound of crunching metal.
- A rape victim who was attacked from behind kept feeling hands being put over her eyes.
- An ambulance worker kept reexperiencing the smell of gun powder that he had smelled when entering the home of a person who committed suicide.

If the intrusions were about things other people had said during the event, they were as if the patient heard the words exactly in the way they were said at the time including tone of voice, rather than experiencing thoughts about the meaning content of what was said, underlining the sensory nature of the intrusion. For example, a childhood sexual abuse survivor kept hearing the perpetrator saying "Get me the sugar cube" (which he had said shortly before the assault).

3. Discussion

Intrusive memories of trauma are often referred to as "intrusive thoughts". The present data, in line with previous reports, show that this is misleading because these intrusions consist mainly of sensory impressions (Ehlers & Steil, 1995; Mellman & Davis, 1985; Van der Kolk & Fisler, 1995).

The predominance of visual recollections across all types of trauma is remarkable because one may have assumed that the most traumatic aspects of the event (and thus the most emotional) would be remembered best. This does not seem to be the case. The intrusive memories are usually *not* about the pain and other physical sensations during the worst part of the trauma. At first sight, this result appears to contradict the conclusion from eye witness research that central information from the trauma is remembered well whereas peripheral information is poorly remembered (Christianson, 1992a). However, this research builds on memory tests such as free recall that require *voluntary* retrieval (explicit memory tests). Thus, while this research may help explain what patients describe in trauma narratives, it may not explain the content of the *involuntary* intrusive memories. The case examples given in this paper suggest that, contrary to the eye witness research, stimuli that are peripheral to the meaning of the event may be the stimuli that are reexperienced as intrusive memories.

A closer look at the content of intrusions suggested that they are not random fragments of the experience. They mainly appeared to represent stimuli that were present shortly before the moments with the largest emotional impact. 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.

Associative learning is an "intelligent" process that singles out stimuli with the highest information value in terms of *temporal* association (Rescorla, 1988). One would therefore expect that of the stimuli that accompany a traumatic event, those that lead to salient and distinct sensations and that occur shortly *before* the moments with the largest emotional impact, are likely to acquire warning signal quality and thus be reexperienced.

It is important to note that the "warning" stimuli selected through associative learning reflect

temporal association, but do not necessarily have a meaningful relationship to the trauma. Many seem to consist of markers of the situational context or location in which the trauma occurred. For example, a patient who witnessed the suicide of a person who jumped in front of a train reexperienced the sight of railway tracks as he had seen them before he saw the person jump. He did not reexperience the sight of the train approaching the person, which would have a closer relationship in meaning to the death of the person. Markers of location or context such as the railway tracks may be understood as early warning signals that can be spotted from far away and can be avoided in the future.

A case described by Christianson (1992b) supports our analysis.[1] Christiansen describes the case of a rape patient who had intrusive images of "bricks along a path" although she had complete amnesia for the event. From the confession of the rapist it was known that the rapist had dragged her from a path with crumbled bricks onto a meadow where the rape occurred. In this example, and in some of the examples given above, there is no meaningful relationship between the intrusion and the trauma, and the relationship is one of association in time and space.

The stimuli that are identified as "warning signals" will often be of a visual nature because of the predominance of the visual system in humans. In evolutionary terms, visual cues offer the advantage that can be detected from far away, thus making them valuable as early indicators of impending danger. Other sensory impressions may acquire the role of "warning signals" if there is limited visual input or if these are the most distinct stimulus predicting the occurrence of the trauma.

A good example is provided in Reemtsma's (1997) autobiographical account of his kidnapping and captivity. After his release, he had distressing intrusions of a knocking sound. His kidnappers had knocked at the door of the cellar when bringing him food, water, etc. When they knocked, he had to lie down immediately with his face to the floor and make sure he did not see them, knowing he would be killed if he did. In this example, auditory cues had the highest information value in predicting the traumatic experience.

The intrusive memories of the trauma and its associated cues described in this paper are not the only intrusions in PTSD. This has been carefully documented by Reynolds and Brewin (1998, 1999) who found that patients with PTSD reported intrusive thoughts more frequently than intrusive images or flashbacks as their main intrusive cognition. They also reported what Reynolds and Brewin termed "elaborative cognitions", i.e. elaborations of the original experience. In our experience, such intrusions are usually linked to preoccupations with appraisals of the trauma and its sequelae, rather than representing trauma *memories* (see also Joseph, Williams, & Yule, 1997). For example, a patient who suffered from PTSD after an accident kept having intrusive images of seeing himself in a wheel chair. This intrusion was related to his appraisal "I am useless and unable to lead a normal life", and to an earlier experience of having to use a wheel chair temporarily after a previous accident. In other cases, the elaboration may consist of adding features to the original experience that were not present during the trauma, but that seem plausible to the patient. For example, a patient who was attacked by another patient in hospital became afraid of

[1] Christianson (1992b) offers another explanation for the case example and suggests that the victim may have focussed her attention on the path and the bricks during the rape to make her ordeal more tolerable. However, this explanation does not apply to many of our case examples.

men in suits although the perpetrator had worn a hospital gown (see also Bryant, 1996, for a discussion of pseudomemories after head injuries).

Other common examples of *non-memory* intrusions in PTSD include intrusions related to preoccupations with other people involved in the trauma. These are usually related to feelings of anger or guilt. For example, an assault survivor kept having intrusions about killing the assailant and going to prison afterwards. A patient who had been injured in a road traffic accident due to careless driving of another person kept ruminating about this person and about how he could stop him from driving and injuring other people. This type of intrusion appears to be of different quality to reexperiencing the original traumatic event. Although they can take the form of images and can include other sensory components, they are more abstract and present an elaboration of what happened rather than the original experience. These intrusions appear to fit the label "intrusive thoughts" better than the intrusions of the traumatic event itself.

If the warning signal hypothesis of intrusive memories receives further empirical support, it may have implications for the treatment of PTSD. First, rather than viewing intrusions just as a symptom of PTSD, their content may guide the therapist in identifying the moments with the greatest emotional impact that will need reprocessing in treatment.

Second, the warning signal hypothesis is useful in educating patients with PTSD about intrusive memories. Many patients worry that having uncontrollable intrusive memories means that they are going crazy, will fall apart, will never get over the trauma, etc. (e.g., Ehlers & Steil, 1995; Clohessy & Ehlers, 1999; Steil & Ehlers, 2000). Cognitive behavioural treatments usually educate the patient that intrusive memories are very common after traumatic events, but usually no particular explanation about their content is given. The warning signal hypothesis can be used to normalize intrusions in that it offers patients an explanation for their content and gives a positive alternative interpretation for their occurrence. Rather than a sign of impending insanity, intrusive memories are interpreted as resulting from a learning mechanism designed to enable the organism to spot future threat.

Third, the warning signal hypothesis provides insights into the nature of triggers of intrusive memories, and a rationale for the use of stimulus discrimination procedures in overcoming them. Triggers often appear to be stimuli that bear physical resemblence with stimuli that immediately preceded the "warning signal" that is later reexperienced or with the "warning signal" itself. An example for the first type of trigger is Reetmsma's observation that his intrusions of a knocking sound were often triggered by him hearing footsteps (during his captivity, he had heard footsteps approaching the door of the cellar before the kidnappers knocked at the door). An example of the second type of trigger is the observation of a motor vehicle accident patient that a patch of sunlight on a lawn triggered intrusions of headlights coming towards him.

In therapy, patients have to learn the discrimination between the "then" and the "now", i.e., the stimuli that trigger intrusions and those that are reexperienced happened to be present at the time of the trauma, but do not indicate danger now. In our treatment protocol (Ehlers & Clark, 2000), patients are instructed to observe the triggers that bring on intrusive memories and to pay close attention to the differences between the harmless trigger ("now") and the stimulus 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. A prison guard who had been punched in the face by a prisoner and had nearly lost his eye sight used this procedure effectively. The intrusive memories of a fist coming towards him were triggered if anything moved closely towards

his face. In therapy, the patient was asked to repeatedly move his finger towards his eyes and to practise the distinction between the harmless finger ("now") and the fist coming towards him ("then"). This led to a rapid decline in intrusive memories, and a reduced fear response to things that approached his face.

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