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Shorter communication

Tell me more: Can a memory test reduce analogue traumatic intrusions?

Julie Krans^{a,*}, Gérard Näring^a, Emily A. Holmes^b, Eni S. Becker^a^a Department of Clinical Psychology, Radboud University Nijmegen, Behavioural Science Institute, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands^b Department of Psychiatry, University of Oxford, Warneford Hospital, Oxford OX3 7JX, UK

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ABSTRACT

Information processing theories of post-traumatic stress disorder (PTSD) state that intrusive images emerge due to a lack of integration of perceptual trauma representations in autobiographical memory. To test this hypothesis experimentally, participants were shown an aversive film to elicit intrusive images. After viewing, they received a recognition test for just one part of the film. The test contained neutrally formulated items to rehearse information from the film. Participants reported intrusive images for the film in an intrusion diary during one week after viewing. In line with expectations, the number of intrusive images decreased only for the part of the film for which the recognition test was given. Furthermore, deliberate cued-recall memory after one week was selectively enhanced for the film part that was in the recognition test a week before. The findings provide new evidence supporting information processing models of PTSD and have potential implications for early interventions after trauma.

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Introduction

Although several studies have investigated the role of peri-traumatic processing in intrusion development, post-trauma processing has received less attention. However, experimentally investigating post-trauma processing is important because it relates to current clinical practice where treatment starts after a traumatic event has occurred. The present study investigated whether intrusive images from viewing an aversive film can be reduced by giving a neutral, verbal recognition memory test immediately post-film aimed to help structure verbal memory.

Intrusive images can be defined as mental pictures (and other sensations) that come into consciousness unwanted and uncontrollably. Intrusive images are a common form of re-experiencing a traumatic event (Speckens, Ehlers, Hackmann, Ruths, & Clark, 2007) and are a core feature of post-traumatic stress disorder (PTSD; American Psychiatric Association, 4th ed., text revision, 2000). Recent information processing theories of PTSD (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000) converge on the idea that intrusive images develop due to impaired information processing during the traumatic event (Holmes & Bourne, 2008). Normally, there is a balance between perceptual and verbal conceptual information processing, leading to memory

representations that incorporate perceptual features of an event within a conceptual framework. However, under extreme stress, the balance shifts towards perceptual processing, leading to memory representations with perceptual features but relatively lacking a conceptual framework. This lack prevents the representation from being integrated within autobiographical memory, making the perceptual memory representation harder to recall deliberately and more prone to intrude into consciousness involuntarily. PTSD specific models (i.e., Brewin et al., 1996; Ehlers & Clark, 2000) build on existing theories of “normal” autobiographical memory (e.g., Conway, 1996; Conway & Pleydell-Pearce, 2000) to specify trauma-specific memory processes.

Several experimental studies support an information processing account of PTSD. For example, it has been found that blocking the perceptual processing of an aversive film decreased subsequent intrusive images of the film (Brewin & Saunders, 2001; Holmes, Brewin, & Hennessy, 2004; Stuart, Holmes, & Brewin, 2006). Conversely, interfering with verbal conceptual processing during the encoding of an aversive film increased intrusive images (Holmes et al., 2004). Furthermore, individuals with a perceptual processing style developed more intrusive images from an aversive film compared to individuals with a conceptual processing style (Halligan, Clark, & Ehlers, 2002). For a review, see Holmes and Bourne (2008).

Most studies have been on information processing *during* an aversive event with little experimental research investigating intrusion development *post-event* (Butler, Wells, & Dewick, 1995; Wells & Papageorgiou, 1995). Direct efforts to enhance conceptual post-event memory integration in order to reduce intrusive images

* Corresponding author. Tel.: +31 24 3613030; fax: +31 24 3615594.

E-mail addresses: j.krans@psych.ru.nl (J. Krans), g.naring@psych.ru.nl (G. Näring), emily.holmes@psych.ox.ac.uk (E.A. Holmes), e.becker@psych.ru.nl (E.S. Becker).

have not been reported. Importantly, integrating a trauma representation in autobiographical memory is one goal of effective cognitive-behavioural treatment for PTSD (Degun-Mather, 2001; Ehlers & Clark, 2000; Kindt, Buck, Arntz, & Soeter, 2007). Also of clinical relevance is the consideration of early interventions following a traumatic experience. Cognitive-behavioural treatment (CBT) appears to be effective in the aftermath of trauma (Sijbrandij et al., 2007). Currently, clinical practice guidelines advise to offer CBT no sooner than 1 month post-trauma and only in cases of severe post-traumatic stress symptoms or acute stress disorder (National Institute for Health and Clinical Excellence, 2005). Up to now, there are no recommended interventions within the first month post-trauma. However, information processing theories of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000) suggest that interventions aimed at enhancing memory integration should be helpful in preventing intrusion development.

In sum, the role of post-event information processing in intrusion development has been neglected in experimental studies despite clear theoretical and clinical relevance. The present study aimed to experimentally explore the effect of enhancing memory integration on the development of intrusive images. To induce intrusive images, participants viewed an aversive film with traumatic content. We aimed to enhance memory integration by administering a verbal recognition memory test for one part of the film directly after viewing. The items on the recognition memory test were in chronological order, thereby allowing participants to think through the film in a structured and detailed way. The recognition memory test was thus used as an experimental intervention rather than an actual memory test. Although the items were statements about emotional events from the film, the wording of the statements was neutral. By administering the recognition memory test, information of the trauma film is rehearsed in a structured way. This should enhance the formation of verbally accessible and organized memories that can be retrieved deliberately and according to the theories reduce intrusive images. We hypothesized that participants would show fewer intrusive images of the film after one week for that part of the film for which they received the memory test, in contrast to the other part of the film, for which they did not receive the memory test. In addition, we hypothesized that participants' performance on a memory test for the film would selectively strengthen memory for the part of that film for which the recognition memory test had been administered earlier.

Method

Overview

After screening for exclusion criteria (described below), participants viewed the aversive film. The film consisted of two parts, which were shown in counterbalanced order. After the film, participants completed the recognition memory test for one part of the film according to random allocation. Questionnaires were administered at baseline and post-film. In the week following film viewing, participants reported their intrusions of the film in a diary. After one week, participants returned for a follow-up session.

Participants

All participants were psychology students in their first semester. They received course credit for participation. As required by the ethical committee (CMO approval number 2005/063), participants were informed about the graphic content of the film beforehand (as in previous studies by Holmes et al., 2004). Exclusion criteria were: panic attacks, panic disorder, PTSD, major depressive episode

Table 1

Number of participants for each combination of film version and recognition memory test version.

	Memory test version A	Memory test version B
Film version AB	13	13
Film version BA	15	11

(current and lifetime), social phobia, psychotic episode (current and lifetime), blood phobia, history of fainting and significant experience with road traffic accidents (RTA). Two participants terminated film viewing and did not complete the experiment. Total data from 57 participants were collected. Gender and age was equally distributed in the conditions (all $p > 0.05$). Table 1 displays the number of participants in every condition.

Materials

Aversive film

The aversive film from Hagenaaers, Van Minnen, Holmes, Brewin, and Hoogduin (2008), originally compiled by Steil (1996), was used. It contains four scenes showing the aftermath of real-life RTAs and has previously been shown to induce intrusive images (e.g., Holmes et al., 2004). Following the method of Stuart et al. (2006), the film was divided into two parts (or 'blocks') that were matched for the number of intrusive images they were likely to produce based on data from a pilot study with student participants, see Table 2. Matching for number of intrusive images instead of time of the film scenes was done to create a comparable "baseline" number of intrusions for both film blocks; with "baseline" meaning the number of intrusions had there not be any intervention at all. Accordingly, the film was divided in scenes 1–3 (Block A; 8 min and 53 s) and scene 4 (Block B; 2 min and 45 s). The film blocks were presented in counterbalanced order (AB or BA). The film was projected onto a smooth white wall and sound was presented through headphones.

Memory integration

The recognition memory test used to enhance memory integration was similar to the recognition memory test used in the one-week follow-up session of previous studies (e.g., Holmes et al., 2004). It contained statements (for example, "There were three doctors in white coats present at the scene") for which participants had to decide whether they were true or false. The items were presented in chronological order and the statements, although emotional in content, were neutral in formulation. To match the film blocks, there were two versions of the test: Version A (Film block A) and version B (Film block B).

Measures

Emotional impact of the film

This was measured with a mood questionnaire (Holmes et al., 2004). On a 0–10 point scale (0 = not at all, 10 = extremely), participants rated current happiness, fear, horror, depressed mood and anger. In addition, the Dutch version of the State-Trait Anxiety Inventory (Zelfbeoordelingsvragenlijst; Van der Ploeg, 1980) was used to assess state anxiety (STAI-S). This questionnaire contains 20

Table 2

Number of intrusive images from each scene of the aversive film in the pilot study.

	Part A		Part B	
	Scene 1	Scene 2	Scene 3	Scene 4
Intrusive images	34	20	30	85

items about the current level of anxiety, with ratings from 1 (almost never) to 4 (almost always) and is reported to have a good reliability and validity (Van der Ploeg, 1980).

Intrusive images

The intrusion diary was similar to the one in Holmes et al. (2004). Participants were given thorough instructions as to how to complete the daily diary and reported their intrusions of the film during the week after film viewing. The diary contained a definition of intrusive images and reminder instructions on how to keep the diary. Participants reported the content of each intrusion so it could be assigned to a specific film scene. Additionally, participants rated the distress of every intrusion on a scale from 0 (not at all distressing) to 100 (extremely distressing). To enhance compliance, participants were required to hand in one page of the diary every day.

Deliberate recall

At one-week follow-up, participants filled in a cued-recall memory test (Holmes et al., 2004) about the whole film. This contained two to four questions per scene and 12 items in total (e.g., “Which body parts were wounded and bleeding when the woman was freed from the minivan and was laying down on the stretcher?”).

Attention for the film

After the film, participants rated the attention they paid to the film on an 11-point scale (0 = not at all focused on the film, 10 = completely focused on the film).

Diary compliance

At follow-up, participants rated how often they thought they forgot to write down their intrusions, on a scale from 0 (never forgot to write down the intrusion) to 10 (always forgot to write down the intrusion) as in Holmes et al. (2004).

Demand characteristics

At follow-up, participants were asked about the goal of the study with an open-ended question.

Procedure

Participants filled in a demographic questionnaire, the mood ratings and the STAI-S and then viewed the aversive film. Participants were instructed to stay focused on the film, not to look away or mentally disengage and to view the film as if they were really there at the scene. They were informed that they could terminate the experiment at any time. Film version (AB or BA) was randomly assigned, with the restriction that an equal number of participants viewed each version. Immediately after the film ended, the recognition test was given. The version of the recognition test (A or B) was randomly assigned to participants, with the restriction that half of the participants who viewed either film version received test version A and the other half test version B (see Table 2). Participants then filled in the mood questionnaire, the STAI-S and the attention rating. During the week after film viewing, participants reported their intrusions of the film in the diary. At follow-up, they filled in the diary compliance rating, the cued-recall memory test and were asked about the perceived goal of the study.

Results

Outliers and compliance

Four participants failed to complete the intrusion diary and were deleted from the dataset. Data of the number of intrusions

were checked for outliers (more than three standard deviations from the mean) per condition (with recognition test versus without recognition test) using boxplots. One multivariate outlier was deleted from the dataset. Six univariate outliers were changed into the next extreme score minus one since the outliers were above the mean (Tabachnick & Fidell, 1996). The final dataset contained 52 participants (37 women and 15 men), with an average age of 19 years and 10 months (SD = 3 years and 6 months).

Control measures

Emotional impact

Repeated measures ANOVAs were conducted for all emotion variables. There was a significant decrease from pre-film to post-film for happiness, $F(1, 51) = 13.33$, $MSE = 1.59$, $p < 0.01$, $\eta^2 = 0.21$. There was a significant increase in horror, $F(1, 51) = 34.20$, $MSE = 1.76$, $p < 0.01$, $\eta^2 = 0.40$; depressed mood, $F(1, 51) = 14.15$, $MSE = 1.57$, $p < 0.01$, $\eta^2 = 0.22$; and state anxiety STAI-S, $F(1, 51) = 18.07$, $MSE = 23.47$, $p < 0.01$, $\eta^2 = 0.26$, but not in the single item anxiety rating, $F < 1$, or anger from the mood questionnaire, $F(1, 51) = 2.17$, $MSE = 0.54$, $p = 0.15$.

Attention for the film

The overall attention rating for the film was $M = 8.27$, $SD = 1.83$.

Diary compliance

The average diary compliance rating was $M = 1.98$, $SD = 1.11$, indicating a high level of compliance.

Experimental measures

Intrusion frequency

To test the effect of the memory test on the number of intrusive images, we performed a 2 (Task: recognition memory test versus no recognition memory test) \times 2 (memory test version: A or B) \times 2 (film version: AB or BA) mixed model ANOVA with test version and film version as a between-subject factors and Task as a within-subjects factor. The results showed a significant effect of Task on the number of intrusive images, $F(1, 48) = 5.67$, $MSE = 0.52$, $p = 0.02$, partial $\eta^2 = 0.11$. There was no significant effect of test version, $F < 1$, or film version, $F(1, 48) = 1.97$, $MSE = 1.14$, $p = 0.17$ and there were no interaction effects. As predicted, participants reported fewer intrusive images from scenes for which they had received the recognition memory test, $M = 0.46$, $SD = 0.73$, compared to scenes for which they had not received the recognition memory test, $M = 0.79$, $SD = 1.06$.

Intrusion distress

Table 3 presents the descriptive statistics for the summed and average distress ratings for the film block for which participants received a memory test and for the film block for which they received no test. Only participants who reported intrusions ($n = 44$) were included. Three univariate outliers were changed into the next extreme score minus one since the outliers were above the mean (Tabachnick & Fidell, 1996). To investigate whether the

Table 3

Descriptive statistics of the summed and average intrusion distress ratings for the tested and non-tested film block.

Measure	Film block without memory test	Film block with memory test
	<i>M</i> (<i>SD</i>) range	<i>M</i> (<i>SD</i>) range
Summed distress	74.58 (103.91) 0–350	51.53 (75.50) 0–270
Average distress	19.29 (21.89) 0–70	15.69 (19.14) 0–60

memory test affected intrusion distress, we performed a 2 (Task: recognition memory test versus no recognition memory test) \times 2 (memory test version: A or B) \times 2 (film version: AB or BA) mixed model ANOVA with test version and film version as a between-subject factors and Task as a within-subjects factor on both summed and average distress scores. The results show no significant main effect or interaction effects for the summed distress scores (all $p > 0.05$), although there was a trend for a main effect of Task, $F(1, 40) = 3.09$, $MSE = 3758.60$, $p = 0.087$, partial $\eta^2 = 0.07$. There were no significant main effect or interactions for the average intrusion distress ratings (all $p > 0.05$).

Deliberate recall

The mean score on the cued-recall test at follow-up was $M = 6.85$, $SD = 1.68$. To check if the reduction in intrusion frequency was likely to be because of a more integrated memory for the film, we performed a one-way ANOVA with test version (A, B) as the independent variable and cued-recall memory test performance at follow-up for scenes 1–3 (Film block A) as the dependent variable. This revealed significantly higher performance for participants who received the recognition memory test for scenes 1–3, $M = 5.68$ and $SD = 1.19$, than those who had received the test for scene 4, $M = 3.58$ and $SD = 0.97$, $F(1, 50) = 47.32$, $MSE = 1.20$, $p < 0.01$, $\eta^2 = 0.49$. An independent sample t -test indicated that participants who received the memory test for scene 4 (film block B) performed significantly better on the cued-recall memory test for scene 4 at follow-up, $M = 2.54$, $SD = 0.72$, than participants who received the memory test for scenes 1–3, $M = 1.79$, $SD = 1.10$, corrected $t(46.98) = -2.97$, $p = 0.01$, $d = 0.82$.

Demand characteristics

None of the participants mentioned modulation of intrusive images when asked for the goal of the study.

Discussion

The critical finding was that the recognition memory test administered immediately post-film selectively decreased the number of intrusive images, in line with our hypothesis. In addition, intrusive images from the film block for which participants received the memory test tended to have lower distress ratings than for the film block for which participants did not receive a memory test, although this finding did not reach significance. Furthermore, the recognition memory test selectively increased performance on the cued-recall memory test at one-week follow-up. We propose that by performing this recognition memory test immediately after an aversive film, the film's representations in memory become more integrated (i.e., not fragmented and isolated) with autobiographical memory, as measured by improved deliberate cued-recall performance. The findings are in line with information processing accounts of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000) suggesting that a trauma-memory representation becomes intrusive because it is fragmented and isolated from autobiographical memory. As to what the exact processes are that underlie the reduction in intrusive images and the enhanced deliberate cued-recall performance, it seems likely that a reduction of avoidance facilitated by the recognition memory test played a role.

The present study showed that a rather simple intervention (a structured, verbal recognition memory test) was effective in reducing one aspect of post-traumatic stress symptoms: intrusive images. The memory test contained factual information about the film, not specifically about the emotional parts, and provided a rehearsal opportunity. We suggest that this may have strengthened the conceptual memory for the film, reducing intrusions.

Future research should explore the exact cognitive mechanisms underlying memory integration. For example, it is possible that by presenting the memory test avoidance reduces, resulting in fewer intrusions. Another interesting question is whether active engagement is necessary or if passively reading information of an aversive event is sufficient for a reduction in intrusive images.

There are some general limitations to our study. First, generalization of our findings to actual trauma survivors is not warranted, since our study reported on a non-clinical sample exposed to an analogue traumatic situation (an aversive film). Further, the number of intrusive images was measured during only one week after film viewing. The general tendency was that participants did not experience any more intrusive images after this week. This may not reflect the actual time curve for non-analogue traumatic intrusions and more research is needed with prolonged follow-up measures.

To conclude, the finding that a recognition memory test reduces intrusive images from an aversive film is relevant for both theory and practice. The results of our study are encouraging for research moving beyond the debate related to the lack of successful early trauma interventions, such as critical incidence stress debriefing (e.g., Bisson, Jenkins, Alexander, & Bannister, 1997; Mayou, Ehlers, & Hobbs, 2000; Sijbrandij et al., 2007). That is, it may point to new target possibilities for developing evidence-based early crisis interventions for traumatic events. Our findings are supportive of the cognitive model of PTSD (Ehlers & Clark, 2000) and the dual representation theory (Brewin, 2001; Brewin et al., 1996). Both models suggest that intrusive images develop as a result of impaired peri-traumatic information processing, leading to isolated perceptual memory representations that relatively lack a verbal conceptual imbedding. Promoting verbal processing with a recognition memory test both reduced the frequency of intrusion images and enhanced deliberate recall, as would be predicted by these models. The findings from the current study encourage future research exploring the nature and role of memory integration immediately post-trauma in intrusion development. Our findings have potential clinical relevance since they indicate that it may be possible that interventions aimed at structuring and enhancing memory integration for an aversive event could be used to reduce intrusion development.

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