Journal of Behavior Therapy and Experimental Psychiatry 60 (2018) 78–86

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

Imagining trauma: Memory amplification and the role of elaborative cognitions

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ARTICLE INFO

Keywords:
PTSD
Memory
Intrusions
Trauma analogue

ABSTRACT

Background and objectives: Trauma victims, such as war veterans, often remember additional traumatic events over time: the "memory amplification effect". This effect is associated with the re-experiencing symptoms of post-traumatic stress disorder (PTSD), including frequent and intrusive images of the trauma. One explanation for memory amplification is that people gradually incorporate new, imagined information about the trauma with what they actually experienced, leading to an amplified memory for what actually happened. We investigated this proposal here.

Methods: Participants viewed highly negative and graphic photographs and recorded their intrusions. Critically, we instructed some participants to elaborate on their intrusions—that is, we asked them to imagine details about the trauma beyond what they actually witnessed. We assessed memory for the traumatic photos twice, 24-h apart.

Results: The elaboration condition experienced fewer intrusions about the photos compared to the control condition. Furthermore, the elaboration condition were less susceptible to memory amplification compared to controls.

Limitations: The use of negative photos allowed experimental control, however does not permit generalization of our findings to real-world traumatic experiences.

Conclusions: Our findings suggest that *effortful* imagination of new trauma-related details leads to a reduction in intrusions and an increased tendency to *not* endorse trauma exposure over time. One explanation for this finding is that elaboration enhanced conceptual processing of the trauma analogue, therefore reducing intrusions. Critically, this reduction in intrusions affected participants' tendency to endorse trauma exposure, which is consistent with the reality-monitoring explanation for memory amplification.

1. Introduction

Trauma survivors—such as veterans—can be inconsistent when remembering past events, usually by remembering *additional* traumatic events (civilian death) over time—termed the "memory amplification" effect (Southwick, Morgan, Nicolaou, & Charney, 1997). Memory amplification is associated with the re-experiencing symptoms of post-traumatic stress disorder (PTSD), including intrusive trauma-related images (Roemer, Litz, Orsillo, Ehlich, & Friedman, 1998). People with PTSD also often experience involuntary elaborative non-memories (thoughts or images about non-experienced event details; Reynolds & Brewin, 1998), such as mental imagery from similar events witnessed in the media. Thus, one explanation for amplification is that people gradually incorporate imagined trauma-related information into their memory, causing difficulty in distinguishing experienced and non-experienced events and a tendency to endorse exposure to non-experienced events. Accordingly, enhancing imagination of trauma-related details should also encourage memory amplification. We investigated this proposal.

The memory amplification effect arises in diverse samples, including 9/11 disaster restoration workers (Giosan, Malta, Jayasinghe, Spielman, & Difede, 2009) and witnesses to a school shooting (Schwarz, Kowalski, & McNally, 1993). For example, Giosan and colleagues asked 9/11 restoration workers whether they experienced (yes/no) stressful events (seeing human remains), on two occasions one year apart. Workers answered "yes" more often at the second assessment and this increase was associated with PTSD symptom severity. Other studies have replicated the typically small, but significant relationship between

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https://doi.org/10.1016/j.jbtep.2018.04.003
Received 21 September 2017; Received in revised form 24 April 2018; Accepted 30 April 2018
Available online 03 May 2018
0005-7916/

PTSD symptoms and number of no-to-yes changes, including correlation coefficients of 0.26 [0.22, 0.30] (King et al., 2000) and 0.32 [0.17, 0.60] (Southwick et al., 1997). Importantly, this relationship is usually stronger when focusing on re-experiencing symptoms exclusively (Giosan et al., 2009; Roemer et al., 1998).

Although field research suggests PTSD may contribute to memory amplification, these studies cannot test the mechanism(s) underlying this association. Recently, we investigated the memory amplification effect in the laboratory (Oulton, Takarangi, & Strange, 2016). Participants viewed negative photos (e.g., mutilation) and then completed two recognition tests—identifying photos as "old" (previously seen) or "new" (previously unseen)— one week apart. Participants' ability to distinguish old and new photos (i.e., their sensitivity) decreased over time. Further, among participants exhibiting memory amplification—responding "old" to more photos over time—re-experiencing symptoms were associated with memory amplification ($r = -0.28$, *95%* CI [-0.48, −0.05]).

One possibility is that re-experiencing symptoms *causally* contribute to memory amplification (King et al., 2000; Oulton, Strange, Nixon, & Takarangi, in press; Strange & Takarangi, 2012). Specifically, people might mistake information they imagine—via re-experiencing symptoms—with what actually occurred. Indeed, people commonly determine a memory's origin using heuristics (e.g., familiarity; Johnson, Hashtroudi, & Lindsay, 1993) and if internally-generated information is familiar and vivid, people can mistake this information as a memory of a true experience (Johnson et al., 1993). Memory amplification may reflect an accumulation of these errors. Consider, for example, a veteran who frequently experiences intrusions that include details he did not actually experience during service. These cognitions may encourage an impression that he experienced many distressing experiences during service. Consequently, when asked about his trauma exposure, he might experience difficulty distinguishing experienced and non-experienced events and endorse exposure to non-experienced events that are only vaguely familiar. Put differently, due to reality-monitoring errors, the veteran might lower his response criterion (how much evidence required to endorse trauma exposure) because he assumes the probability of exposure is higher than reality, and his memory accuracy might decline. Indeed, supporting the reality-monitoring explanation, intrusions often contain imagined details. People sometimes experience "worst case scenario" intrusions (Merckelbach, Muris, Horselenberg, & Rassin, 1998) that are exaggerated trauma-related, image-based cognitions and cognitions involving plausible extensions of the trauma (Reynolds & Brewin, 1998). Yet no research has investigated the reality-monitoring explanation experimentally.

Further, intrusions could cause memory amplification via several pathways. For example, intrusions might motivate people to justify their distress, causing a liberal response bias. Alternatively, the internal generation of new details *per se* might cause amplification. We investigated the latter possibility here. Specifically, we examined whether *elaborating* on intrusions about graphic photos—imagining details beyond what was witnessed—would enhance memory amplification. We anticipated this process would increase the opportunity for reality-monitoring errors, thereby encouraging memory amplification.

To test this prediction, following Oulton et al. (2016), participants viewed negative photos and, later completed a recognition test on two occasions, 24 h apart. However, some participants received instructions encouraging imagination of new, trauma-related information between these memory tests.

2. Method

2.1. Participants

We predetermined a target sample size of at least 48 participants per condition, which we rounded to at least 50; a precision analysis (Cumming, 2013) revealed this sample size was sufficient to obtain a target margin of error (the half width of the target confidence interval) of 0.4, based on an estimated medium effect ($d = 0.50$). Overall, 126 participants completed the study. We excluded two participants who completed the second test more than 60 h after the first test, 13 who did not experience intrusions,[1] two who misinterpreted instructions and three who inadvertently received the wrong test or diary. Thus, our final sample consisted of 106 participants (35.8% male); 75 university students, who received course credit or an honorarium and 31 community members who received an honorarium. Participants were aged 18–56 ($M = 24.85$, *95% CI* [23.14, 26.56]); most identified as Caucasian (including White; 66.0%); others as Asian (11.3%), mixed ethnic origin (6.6%), European (5.7%), Hispanic (4.7%), African (1.9%) or Other (3.8%).

2.2. Materials

2.2.1. Trauma analogue

We selected 70 IAPS photographs (Lang, Bradley, & Cuthbert, 2008) and 10 additional photos (Krans, Langner, Reinecke, & Pearson, 2013) of negative scenes (mutilation) and divided them into four sets of 20 target photos (see Oulton et al., 2016) matched on valence and category membership; how well each photo matched the overall "theme" of the photos ($Fs < 1$). Participants saw two sets (40 target photos) at encoding. Photos appeared for 500 ms on five, randomly timed, occasions during encoding. Thus, each photo appeared for 2.5 s total. An additional 20 negative photos—10 IAPS photos and 10 photos from Krans et al.—acted as primacy and recency buffers (same for every participant), presented only once for 500 ms, and never appeared at test. Sets were counterbalanced across participants such that each combination was presented equally.

2.2.2. Trauma history screen (THS)

We administered the THS (Carlson et al., 2011) to assess exposure to high magnitude stressor (HMS) events (sudden events that cause extreme distress in most people exposed), traumatic stressor (TS) events (HMS events associated with extreme distress) and events associated with persisting posttraumatic distress (PPD events). The THS has excellent temporal stability (HMS events: $r = 0.93$; PPD events: $r = 0.73$) and strong convergent validity (Carlson et al., 2011). After completing the THS, participants completed the PTSD checklist for DSM-5 (Weathers et al., 2013) in relation to their most distressing event. In the current study, Cronbach's alpha for PCL-5 scores was 0.93.

2.2.3. Beck depression inventory (BDI-II)

We used the 21-item BDI-II (Beck, Steer, & Brown, 1996) to measure depression symptoms experienced during the past two weeks. Participants rated items on a Likert scale (0 = *I do not feel like a failure*, 3 = *I feel I am a total failure as a person;* range: 0–63). Internal consistency ($a = 0.93$; Beck et al., 1996) and construct validity among university students (Oliver & Burkham, 1979) is good. Cronbach's alpha for BDI-II scores was 0.90 for our study sample.

2.2.4. State-trait anxiety inventory-trait scale (STAI-T)

We used the 20-item STAI-T (Spielberger, Gorsuch, & Lushene, 1970) to measure participants' stable propensity to experience anxiety. Participants rate items ("*I feel nervous and restless*") from 1 (*almost never*) to 4 (*almost always*) (range: 20–80). Test-retest reliability ($r = 0.88$) (Barnes, Harp, & Jung, 2002) and concurrent validity with other anxiety questionnaires is good (Spielberger et al., 1970). Internal consistency was high for our study sample (Cronbach's alpha = .91).

[1] To ensure all participants within the elaboration condition were exposed to the experimental manipulation, across both conditions we included only participants who reported at least one intrusion during either the monitoring period or 24-h delay.