Behaviour Research and Therapy 92 (2017) 94–105

Contents lists available at ScienceDirect

Behaviour Research and Therapy

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

Eye movement during recall reduces objective memory performance: An extended replication

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A R T I C L E I N F O

Article history:
Received 12 September 2016
Received in revised form
28 February 2017
Accepted 6 March 2017
Available online 9 March 2017

Keywords:
EMDR
PTSD
Eye movements
Memory performance
Fear generalization

A B S T R A C T

Eye Movement Desensitization and Reprocessing (EMDR) therapy for posttraumatic stress disorder involves making eye movements (EMs) during recall of a traumatic image. Experimental studies have shown that the dual task decreases self-reported memory vividness and emotionality. However valuable, these data are prone to demand effects and little can be inferred about the mechanism(s) underlying the observed effects. The current research aimed to fill this lacuna by providing two objective tests of memory performance. Experiment I involved a stimulus discrimination task. Findings were that EM during stimulus recall not only reduces self-reported memory vividness, but also slows down reaction time in a task that requires participants to discriminate the stimulus from perceptually similar stimuli. Experiment II involved a fear conditioning paradigm. It was shown that EM during recall of a threatening stimulus intensifies fearful responding to a perceptually similar yet non-threat-related stimulus, as evidenced by increases in danger expectancies and skin conductance responses. The latter result was not corroborated by startle EMG data. Together, the findings suggest that the EM manipulation renders stimulus attributes less accessible for future recall.

Eye movement desensitization and reprocessing (EMDR) is a treatment that successfully reduces symptoms of posttraumatic stress disorder (PTSD; $d = 1.43$, 95% CI [1.02, 1.83], Bradley, Greene, Russ, Dutra, & Westen, 2005), outperforms wait-list control conditions ($d = 1.25$, 95% CI [-0.97, 3.48], Bradley et al., 2005), and is equally effective as trauma-focused cognitive-behavioral therapy (TFCBT; Bisson et al., 2007; Bradley et al., 2005; Seidler & Wagner, 2006). Hence, it is recommended as a treatment-of-choice for PTSD (e.g., APA, 2004; NICE, 2005). However, about one-third of PTSD patients does not show clinical improvement (Bradley et al., 2005) and little is known about EMDR's mechanisms of change (e.g., Gunter & Bodner, 2008; Leer, Engelhard, & van den Hout, 2014). Gaining a better understanding of the processes that account for EMDR's outcomes is essential for treatment optimization in terms of efficacy, efficiency, patient selection, and individualization of treatment (Kazdin, 2007).

For a long time, many scholars were skeptical about the introduction of EMDR therapy, and particularly the vague theoretical rationale and lack of empirical support for the eye movement component (see Engelhard, 2012; e.g., Herbert et al., 2000; McNally, 1999; Lilienfeld, 1996; Lohr, Kleinknecht, & Tolin, & Barrett, 1995). Early reviews suggested that eye movements were not an essential component of treatment and that EMDR may be effective because it contains an exposure component. Recent years have seen a steep increase in experimental research addressing these issues (for a review, see Van den Hout & Engelhard, 2012). The laboratory model for investigating the EM component comprises three phases (Van den Hout, Muris, Salemink, & Kindt, 2001). At pre-test, healthy participants select and briefly recall a negative autobiographical memory, and rate its vividness and emotionality. During a subsequent intervention phase they visualize the memory for a fixed period of time, either with or without EM. Finally, at post-test, they

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http://dx.doi.org/10.1016/j.brat.2017.03.002

retrieve and re-rate the memory. A recent meta-analysis suggests that EM benefits – in terms of reductions in memory vividness/emotionality – are large in such experimental trials ($d = 0.74$, 95% CI [0.57, 0.91]), and small to medium in clinical trials comparing EMDR treatment with EM to EMDR treatment without EM ($d = 0.27–0.41$, 95% CI [0.07–0.13, 0.47–0.70]; Lee & Cuijpers, 2013).

Several explanations of these findings have been put forward (e.g., Gunter & Bodner, 2008). For example, the *investigatory-reflex* account purports that EM induces a strong sense of relaxation that can last up to 10 min and becomes associated with the trauma memory (e.g., Kuiken, Bears, Miall, & Smith, 2002). EM, however, was shown to be beneficial when conducted concurrently, but not just before memory recall (Gunter & Bodner, 2008), which contradicts the theory. Alternatively, the *increased hemispheric communication* account explains that EM during memory recall facilitates communication between the left and right brain hemispheres, which enhances memory retrieval and desensitization (Christman, Garvey Propper, & Phaneuf, 2003). However, vertical EM was demonstrated to be as effective as horizontal EM (Gunter & Bodner, 2008). Importantly, these findings are accommodated by a *working memory* account (Andrade, Kavanagh, & Baddeley, 1997). This theory posits that EM taxes working memory and thus competes for limited resources that are demanded by memory recall. As a result, recall of a memory while making EMs is less vivid and evokes less extreme emotional responses. Notably, changes in memory phenomenology are not only observed *during* EM (Andrade et al., 1997; exp. 4.; Kavanagh, Freese, Andrade, & May, 2001), but also immediately afterwards, i.e. when the cognitive load caused by EM had been removed, and at 24-h (Leer et al., 2014) and 1-week follow-up (Gunter & Bodner, 2008; exp. 2). EM benefits thus extend beyond the experimental/clinical session and corroborate the clinical observation of trauma memory amelioration following EMDR.

Robust and promising as the EM effects are, it has been acknowledged that most prior studies have relied on self-report measures, which are prone to demand effects (e.g., Kearns & Engelhard, 2015). Demand effects may also be expected in the control condition that involves mere recall (without EM), because most participants in the relevant studies are psychology students who are generally familiar with the clinical efficacy of imaginal exposure. Yet, most studies have not found strong effects of mere recall. Also, Gunter and Bodner (2008) demonstrated EM benefits when EM were performed during recall, but not when EM were performed before recall, which challenges a 'demand characteristics account'. Nevertheless, collecting non-self-report data, such as physiological or behavioral data, is essential for two reasons. First, it enables an evaluation of the scientific integrity of the existing and to be collected self-report data (Van den Hout, Bartelski, & Engelhard, 2013). Already, several changes in (Dutch) EMDR guidelines for treatment and training of therapists have been applied on the basis of self-report data (Beer et al., 2011). Cross-validation of previous research findings is thus valuable both theoretically and clinically. Second, non-self-report data may advance our understanding of *how* the EM component adds to EMDR's effectiveness. It has been proposed that EMs exert their long-term effects because they cause a loss in memory detail through memory reconsolidation (e.g., Maxfield, Melnyk, & Hayman, 2008; Van den Hout et al., 2010). This hypothesis, however, cannot be addressed by the mere assessment of subjective memory ratings, but rather calls for objective indexes of memory performance.

Non-self-report data have been reported in a small number of studies. One experiment demonstrated pre- to post-test reductions in potentiation of the startle blink reflex during negative ideation in an EM condition, but not in a control condition (Engelhard, van Uijen, & van den Hout, 2010). A second experiment in individuals with performance anxiety showed that EM during imagery of generic fear-related scripts, but not such imagery without EM, caused pre- to post-test heart rate deceleration (Kearns & Engelhard, 2015). Two studies including physiological endpoints did not collect data during separate pre- and post-tests involving memory recall. Barrowcliff, Gray, Freeman, and MacCulloch (2004) reported decreases in skin conductance in the course of the EM intervention. Schubert, Lee, and Drummond (2011) reported reduced heart rate from pre- to post-intervention baseline periods that did not comprise concurrent memory recall. However valuable, such experimental designs hamper the interpretation of changes in memory.

In addition, so far two studies have collected objective behavioral data (Van den Hout et al., 2013; Van Schie, Engelhard, & van den Hout, 2015). In the study by Van den Hout et al. (2013), participants encoded two detailed drawings of scenes. Subsequently, half of the participants recalled one of the images with EM, the other half recalled one of the images without EM. All participants were then presented with cutouts of the encoded images and with cutouts of other, unseen images. They were asked to indicate as fast and as accurate as possible whether each cutout was part of one of the encoded images. Results were that making EM during image recall, but not recall only, increased response latencies. It seemed unlikely that the result represented a shift in the speed-accuracy trade-off from speed to accuracy, because there was no effect of EM on decision accuracy. If response latencies reflect the extent to which memory attributes are retrievable, this experiment shows that the effect of EM on memory performance is not confined to self-report data. However, given that the images were hedonically positive (see Van den Hout, Eidhof, Verboom, Littel, & Engelhard, 2014), it is unclear whether the findings can be generalized to EMDR. In an extended replication by van Schie et al. (2015), participants learned relationships between neutral words and aversive pictures. Next, via a cued-recall procedure they were presented a cue word and prompted to recall the associated image, with or without EM. Finally, cue words were presented on screen surrounded by four cutouts of images. Participants were asked to identify which cutout had previously been paired with each cue word. The intervention failed to produce pre- to post-test changes in memory vividness and emotionality, and did not affect response latencies in the matching task. Presumably, suboptimal memory retrieval during the intervention explains their null finding.

Overall, it may be concluded that non-self-report data on EM are needed, yet scarce. The goal of the present study was to fill this lacuna. First, we set out to provide a conceptual replication of Van den Hout et al. (2013). To this end, we used a novel discrimination task (Experiment I). The second aim was to extend the findings by testing whether EM during recall reduces the objective performance of a hedonically negative memory. To this end, we used a fear generalization paradigm (Experiment II).

1. Experiment I

Experiment I examined the effect of EM on memory performance using a stimulus discrimination task. Following an encoding phase, participants recalled the image of a neutral male face either with EM (experimental condition) or without (control condition). Before and after the intervention they rated memory vividness. Directly after the intervention they were presented pictures of novel faces that perceptually resembled the original face, and indicated whether or not these images were identical to the original one. Based on Van den Hout et al. (2013) we predicted that EM during recall, relative to recall only, increases response latencies.