EMDR Works . . . But How? Recent Progress in the Search for Treatment Mechanisms

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[Headnote]

Eye movement desensitization and reprocessing (EMDR) is a highly scrutinized but efficacious psychotherapy commonly used in the treatment of posttraumatic stress disorder. Despite much theorizing and speculation, EMDR's mechanism of action remains unspecified. This article reviews several accounts of how EMDR works to reduce symptoms and/or aid memory reprocessing, including disruption of a traumatic recollection in working memory, increased psychological distance from the trauma, enhanced communication between brain hemispheres, and psychophysiological changes associated with relaxation or evocation of a rapid-eye-movement-like brain state. Several gaps in knowledge are also identified: The working memory account has received considerable support but has yet to be evaluated using clinical samples. How psychological distancing translates into symptomatic improvement is unclear. Psychophysiological effects of EMDR are well demonstrated but leave open the question of whether they constitute a treatment mechanism or an outcome of memory processing. Multiple mechanisms may work to produce treatment gains in EMDR; hence, an integrative model may be necessary to capture its myriad effects.

Keywords: eye movements; EMDR; psychotherapy; treatment mechanism

Eye movement desensitization and reprocessing (EMDR) remains controversial (e.g., Hertlein & Ricci, 2004). Although EMDR is now considered an established treatment for posttraumatic stress disorder (PTSD)-one that is at least as effective as cognitive-behavioral alternatives (e.g., Bradley, Greene, Russ, Dutra, & Westen, 2005)-many researchers and practitioners continue to view it with skepticism. Part of the controversy stems from uncertainty about whether eye movements are an active treatment component (see Davidson & Parker, 2001). There is of yet no well-supported account of how eye movements or other forms of bilateral stimulation (e.g., auditory tones, tapping) might alter patients' experience of their traumatic memories and thereby contribute to EMDR's efficacy. Fortunately, a number of candidate mechanisms have recently been proposed.

One general hypothesis is that EMDR evokes a mind-brain state that enables traumatic memories to be effectively processed (see Stickgold, 2002). Shapiro (2001; Solomon & Shapiro, 2008) has long maintained that EMDR facilitates the processing of traumatic memories such that they become integrated with adaptive information during treatment (e.g., "I am safe now"). Indeed, the integration of such information into memory has been described in other efficacious treatments of PTSD (e.g., Foa & Rothbaum, 1998). However, how eye movements might facilitate memory processing has not yet been specified in detail (Maxfield, 2008).

Eye movements or other dual tasks have a number of beneficial effects on patients' phenomenological experiences of their traumatic memories as well as on their physiology. Eye movements can reduce the vividness, emotionality, and completeness of unpleasant or traumatic memories, at least when performed while memories are held in mind (e.g., Gunter & Bodner, 2008; Maxfield, Melnyck, & Hayman, 2008). Performing eye movements may also have other salutary effects on cognitive processes in that they appear to enhance both episodic memory (Propper & Christman, 2008) and cognitive flexibility (Kuiken, Bears, Miall, & Smith, 2002). Hence, the effects of EMDR on patients' cognitive processes might drive the improvements in how they experience their traumatic memories.

Eye movements are also associated with physiological changes during EMDR sessions, including decreased heart rate/skin conductance, increased high-frequency heart rate variability (parasympathetic tone), and increased finger temperature and breathing rate (Sondergaard & Elofsson, 2008). These changes have been variously interpreted as evidence of dearousal or reciprocal inhibition (e.g., Aubert-Khalfa, Roques, & Blin, 2008), the evocation of the orienting response (Armstrong & Vaughan, 1996), or the triggering of a rapid-eye-movement (REM)-like state that facilitates the processing of traumatic memories (Stickgold, 2002, 2008). Although EMDR may produce cognitive shifts that help patients reprocess their traumatic memories or otherwise relate to them more adaptively, EMDR's physiological profile may also serve as a curative factor.

The goal of this article is to describe the major accounts and evidence for how eye movements and other dual-task procedures contribute to EMDR's treatment effects (see Table 1 for a list of the accounts and proposed mechanisms of action). Although some of these accounts have been challenged (see Gunter & Bodner, 2008; Sondergaard & Elofsson, 2008), it is unlikely that any single-mechanism account will adequately capture all of EMDR's beneficial effects. EMDR probably includes a number of active treatment components. These components likely interact in complex ways that we have only just begun to understand.

Disruption in Working Memory Aids Memory Reprocessing

A number of analogue therapy studies have found that voluntary eye movements performed while unpleasant *memories* are held in mind lead the *memories* to be rated as less vivid, emotional, and complete (termed eye-movement benefits; Gunter & Bodner, 2008). According to the *working memory* account, these benefits occur when a concurrent competing task (i.e., eye movements or another task requiring attention) taxes the finite pool of *working memory* resources required to hold a *memory* in mind. The account predicts benefits only when patients must divide their attention between a *memory* and the competing task (e.g., Andrade, Kavanagh, & *Baddeley*, 1997). Thus, benefits should not carry over to *memories* that were not held in mind during a dual-task trial. Gunter and Bodner (2008) confirmed this prediction by showing decreases in ratings of vividness, emotionality, and completeness of unpleasant *memories* (relative to an initial baseline) for participants who made eye movements while holding a *memory* in mind but not for those who made eye movements after focusing on a *memory*.

The working memory account also posits that a distractor task need only require sufficient working memory resources to interfere with holding a memory in mind. Consistent with this notion, Maxfield et al. (2008) found that fast eye movements produced greater benefits than slow eye movements. From a working memory perspective, eye movements provide a suitable distractor task, but there is otherwise nothing special about them. Indeed, Gunter and Bodner (2008) found that copying complex geometric shapes while holding an unpleasant memory in mind produced benefits that were larger than those obtained through eye movements.

Working memory is usually conceptualized as a multicomponent system. According to *Baddeley's* (2000) model, it includes a central executive that performs higher-order cognitive functions (e.g., planning, problem solving). This central executive is actively involved in relatively complex cognitive tasks and also when attention is divided (e.g., Kane & Engle, 2002). Gunter and Bodner (2008) found that eye movement benefits were negatively correlated with scores on a measure of central executive capacity, consistent with the view that this general processor is responsible for complex forms of multitasking. *Working memory* also includes a number of modality-specific subsystems, including a visuospatial sketch pad where images are held in mind, and an episodic buffer that performs an integrative function across sensory modalities when complex *memories* are recapitulated. Kemps and Tiggemann (2007) found that visual dual tasks have a larger effect on visual *memory* components than auditory components and vice versa. It is therefore possible that eye movement benefits can result from interference at either the central executive level and/or a specific subsystem level.

Although useful, the working memory account remains largely descriptive. How patients accomplish the multitasking that occurs during dual-task trials needs to be specified. Although the working memory account proffers a mechanism that can help patients process traumatic memories, the relationship between disruption in working memory and outcomes in EMDR has yet to be examined. Decreases in subjective distress ratings during EMDR sessions have been associated with positive clinical outcomes (Kim, Bae, & Park, 2008), but a more direct test of the working memory account will require memory ratings to be collected over the course of treatment and then examined as potential outcome predictors. In addition, all the studies supportive of the working memory account have used analogue samples; hence, its applicability to clinical samples or traumatic memories within the context of PTSD remains to be investigated.

Finally, the working memory account also has yet to specify how decreases in memory ratings translate into recovery from PTSD. Holding a degraded memory in mind may help shift beliefs about the dangerousness of experiencing painful memories and associated affect, which may enable reprocessing to occur (Gunter & Bodner, 2008). EMDR is also said to encourage the elicitation of additional nontraumatic material (e.g., safety cues) associated with long-term memories (e.g., Shapiro, 2001). The degradation of a traumatic memory may permit information from episodic memory to become integrated with the original image, thereby enabling desensitization and reprocessing (Maxfield et al., 2008).

Distancing From a Trauma and Increasing Attentional Flexibility

The degradation of a traumatic image held in working memory may provide patients with a healthy sense of distance from a traumatic event (Gunter & Bodner, 2008; Maxfield et al., 2008). However, no study has examined the relationship between eye movement benefits and gaining distance/detachment from a traumatic experience. Shapiro (2001) suggests that optimal memory processing occurs when patients maintain their focus on trauma material while extending their conscious awareness to what is occurring in the present moment (e.g., the therapist in the room). To this end, patients in EMDR are instructed to observe their experiences without evaluating them and to avoid forcing any form of processing. This approach resembles other efficacious psychotherapeutic practices that seek to foster mindfulness, acceptance, and metacognitive awareness (e.g., Lee, 2008).

Distancing responses refer to reports that a traumatic event can now be observed from a detached perspective. Lee, Taylor, and Drummond (2006) found that these responses were associated with greater levels of symptom improvement in EMDR. Eye movements appear to naturally elicit a distancing process in EMDR, whereas explicit distancing instructions are not effective in the absence of eye movements (Lee, 2008). Interestingly, Lee et al.'s findings suggest that EMDR works differently than prolonged exposure treatment for PTSD. Patients in prolonged exposure treatment are encouraged to relive the trauma experience in as much detail as possible and are asked to attend to traumatic memory components. This reliving experience is essentially the antithesis of detached processing. Although prolonged exposure treatment is as effective as EMDR, the two may arrive at similar outcomes through different therapeutic processes. Sondergaard and Elofsson (2008) claim that EMDR often works more quickly than prolonged exposure, is assumed to be less distressing, and is preferred by many patients and therapists. Although these claims are open to debate, detached processing might explain why EMDR can work more quickly while being better tolerated than exposure.

Metacognitive therapy for anxiety and depression (Wells, 2009) is another therapeutic approach that seeks to foster patient detachment from aversive internal experiences. Patients are trained to become metacognitively aware of their own thought processes. One technique for achieving this goal is detached mindfulness, which requires patients to adopt a detached observer perspective when they notice anxiogenic or depressogenic cognitions. The concept of detached mindfulness appears to closely resemble the detached processing that occurs in EMDR, suggesting that EMDR may also foster metacognitive awareness.

Metacognitive treatment approaches also include attention training (Wells, 2009), during which patients practice shifting and dividing their attention between various loci (e.g., different objects or sounds). Such training may enhance attentional flexibility and other executive control processes, which may in turn increase metacognitive awareness and disrupt the maladaptive patterns of self-focused attention that maintain negative affect. Attention training remains a relatively new and untested technique, but Wells's (2009) initial results are encouraging. EMDR also requires patients to practice dividing their attention between a traumatic memory and performing eye movements or another distractor task. Thus, EMDR may work to train working memory and increase attentional flexibility in addition to having more direct effects on patients' traumatic memories. Kuiken et al.'s (2002) finding that eye movements increase cognitive flexibility supports this possibility. The attentional flexibility hypothesis could be further tested by assessing it (and other executive control processes) before and after a dual-attention task is performed. Changes in attentional flexibility could then be measured and examined as potential predictors of outcome in EMDR sessions.

Increased Hemispheric Communication

Propper and Christman (2008) reviewed evidence that horizontal eye movements can enhance the retrieval of episodic memories and suggested that increased hemispheric communication is the underlying mechanism. In their account, EMDR enhances episodic retrieval of trauma memories and associated content, which in turn facilitates reprocessing. Based on earlier findings that hemispheric communication is associated with decreased stress and worry (e.g., Compton & Mintzer, 2001), they also suggested that EMDR might decrease the distress associated with traumatic recollections. Indeed, therapists often report that EMDR helps patients bring autobiographical episodic memory information to mind. The idea that eye movements enhance the retrieval of material from long-term memory is also consistent with Shapiro's adaptive information-processing model. Moreover, the idea fits well with Maxfield et al.'s (2008) proposal that during EMDR, traumatic recollections are disrupted in working memory and then integrated with other long-term memories.

Gunter and Bodner (2008) tested the proposal that hemispheric communication reduces the distress associated with traumatic memories by comparing horizontal and vertical eye movements. Vertical eye movements do not enhance hemispheric communication, yet they decreased memory emotionality as effectively as horizontal movements. Therefore, hemispheric communication does not appear to be responsible for the phenomenological changes to traumatic recollections that are induced by a dual task. Whether hemispheric communication mediates treatment gains in EMDR via some other mechanism (e.g., enhanced episodic retrieval) has yet to be directly examined. If hemispheric communication mediates treatment gains in EMDR, gains should be greater with a protocol that requires horizontal saccades than one that requires either vertical or smooth pursuit eye movements.

Psychophysiological Accounts: Relaxation, Orienting Response, and REM-Like States

Theorists have long suggested that eye movements and related dual tasks may produce specific psychophysiological changes that could underlie EMDR's efficacy (Shapiro, 2001). Consistent with this possibility, many studies have found that the eye movement component of EMDR sessions has psychophysiological effects (for a review, see Sondergaard & Elofsson, 2008). Most of these studies suggest that eye movements are associated with dearousal (a relaxation response), that is, increased parasympathetic (relative to sympathetic) nervous system functioning. However, eye movements are also associated with increased finger temperature and breathing rate-physiological manifestations that are not associated with decreased arousal. At least one analogue therapy study (Gunter & Bodner, 2008) found that eye movement trials were associated with decreased parasympathetic nervous system functioning compared to eyes-stationary control trials, which is not consistent with the proposal that eye movements are dearousing. It is unclear whether this discrepancy is due to the populations studied (nonclinical vs. clinical) or procedural or methodological differences between studies (e.g., arousal measure used, timing of arousal measurement). The bulk of the evidence to date suggests that eye movements are associated with a dearousal response during an EMDR session, albeit one that occurs in the presence of some other physiological indicators (e.g., increased breathing rate).

Sondergaard and Elofsson (2008) also reviewed several possible explanations for the physiological effects of eye movements. The orienting-response account states that dual-task stimulation elicits a reflex response in the presence of any stimulus that constitutes a potential threat (e.g., MacCulloch & Feldman, 1996). The orienting reflex manifests as an initial "freeze response" that is rapidly replaced with a feeling of relaxation. This relaxation response then acts to desensitize a traumatic memory. EMDR's physiological profile is not consistent with an orienting response explanation, however. Sondergaard and Elofsson (2008) note that the orienting response should be associated with decreased finger temperature, increased skin conductance, and decreased breathing rate-the opposite of what is typically found. MacCulloch and Feldman (1996) proposed that the orienting response is also associated with a reflexive exploration phase in which attention, executive functioning, and other cognitive processes become more focused, efficient, and flexible. Given that eye movements increase cognitive flexibility (Kuiken et al., 2002), changes in the orienting response could drive these benefits.

The REM account of eye movement physiology (Stickgold, 2002) proposes that eye movement trials in EMDR produce a brain state akin to that produced during REM sleep. REM sleep serves a number of adaptive functions, including memory consolidation. Noting the parallels between REM sleep and EMDR, Stickgold (2002, 2008) proposed that EMDR reduces PTSD symptoms by transforming emotionally charged autobiographical memories into a more generalized semantic form. Although REM sleep does not have a well-defined static autonomic profile (Elofsson, von Scheele, Theorell, & Sondergaard, 2007), Sondergaard and Elofsson (2008) argued that EMDR's physiological profile fits well with the REM account. For example, both EMDR and REM sleep produce increased finger temperature. The prediction that eye movement trials help convert autobiographical memories into semantic memories is also testable. Although extant studies of eye movement benefits have used only general memory ratings, more comprehensive measures of memory characteristics (e.g., the Autobiographical Memory Questionnaire; Talerico, LaBar, & Rubin, 2004) could be used to examine whether eye movements alter particular aspects of traumatic memories. For example, the number of sensory details present in a memory should decrease if eye movements convert episodic/autobiographical memories into semantic memories.

A third account suggests that eye movements work via reciprocal inhibition; that is, they induce a relaxation response (e.g., increased parasympathetic tone) that is physiologically incompatible with the anxiety that arises from thinking about a traumatic memory. Repeated pairings of a traumatic memory and a relaxation response eventually extinguish the anxiety response initially associated with the memory. Sondergaard and Elofsson (2008) concluded that existing physiological data support the reciprocal inhibition account, although the claim that EMDR is a fortified version of standard relaxation-based treatments is at best incomplete. A specific mechanism must underlie the efficient desensitization that occurs in EMDR, given that other relaxation techniques (e.g., deep breathing, progressive muscle relaxation) are not likely to be particularly effective on their own in treating PTSD.

Sack, Hofmann, Wizelman, and Lempa (2008) found that eye movements produce dearousal that is proportional to a patient's reports of decreased distress. In turn, reports of decreased distress were associated with decreased PTSD symptoms. However, the physiological changes that were associated with eye movements were not directly related to symptom improvement. Sack et al. argue that EMDRrelated dearousal is likely a consequence of successful memory processing. It is possible that dearousal and other aspects of EMDR's psychophysiological profile may not be treatment mechanisms per se but are instead indicators of successful memory processing. That is, dearousal should occur across treatment sessions in any efficacious treatment of PTSD. Although the psychophysiological effects of EMDR still need further examining, the same can also be said of any other clinical treatment.

Toward an Integrative Model of How EMDR Works

We do not yet understand in detail how any given psychotherapy works, and EMDR is certainly no exception. Responding to critics' call for a logical explanation of how the treatment works, researchers have proffered numerous treatment mechanisms grounded in basic psychological constructs (e.g., attention/concentration, memory, REM sleep) and/or existing theories of how other efficacious treatments work (e.g., cognitive restructuring, mindfulness, reciprocal inhibition). Researchers are now actively testing the accounts outlined in this article. In general, the field appears to be graduating from demonstrating that EMDR works to developing increasingly sophisticated attempts to determine how it works.

Not all of the reviewed accounts have been tested in a genuine treatment context. Nonetheless, analogue therapy studies have provided some support for both working memory and psychophysiological accounts of EMDR. The relationship between therapeutic mechanism and treatment outcome has been examined for the detached processing and psychophysiological accounts, leading to the suggestion that EMDR's distancing and psychophysiological effects facilitate therapeutic memory processing. Proponents of the working memory and hemispheric communication accounts will also need to link proposed mechanisms (e.g., disruption in working memory, enhanced episodic retrieval) to treatment study outcomes. Demonstrating that a mechanism statistically mediates the relationship between treatment and outcome is essential, but the temporal relationships between mediators and outcomes must also be assessed. To demonstrate causality, changes in the proposed mechanism must precede symptom change (Kazdin, 2007). We advise investigators to use established measures of proposed mechanisms; to measure the proposed treatment mechanism before, during, and after treatment; and to assess more than one possible mechanism in a given study (Maxfield, 2008).

Most accounts of EMDR were developed to explain the same set of phenomena; hence, wedging them apart empirically will likely prove challenging (Shapiro, 2001). Although specific proposals such as the orienting response, hemispheric communication, and working memory disruption lend themselves to testable predictions (Gunter & Bodner, 2008), searching for one transcendent account of how EMDR works may obfuscate the possibility that multiple mechanisms are at work. Researchers will likely need to consider interrelationships between proposed treatment mechanisms to obtain an integrative understanding of how EMDR works.

In one possible integrative model (Figure 1), the dual-task component of EMDR disrupts a memory image in working memory, which in turn leads the patient to feel a greater sense of distance from the associated traumatic experience. Disruption in working memory and associated distancing may constitute the beneficial memory reprocessing that is said to take place in EMDR, and such reprocessing may produce concomitant psychophysiological changes (e.g., Sondergaard & Elofsson, 2008). Memory reprocessing and psychophysiological changes may then work in concert to ameliorate PTSD symptoms. Other possibilities doubtlessly exist. In particular, evocation of an REM-like psychophysiological state might be substituted (or might supplement) for disruption in working memory or distancing at the memory processing stage.

Conclusion

Some commentators have criticized EMDR's proponents for implementing a treatment before its mechanism of action has been specified (e.g., Herbert et al., 2000). On the other hand, healing professions have a long history of implementing efficacious treatments before their mechanisms of action are understood, and one can argue that EMDR should be no exception. However, a more proactive response is to postulate possible mechanisms of action and then to test these mechanisms using both analogue and treatment samples. So far, EMDR's proponents have responded vigorously to critics with many creative and potentially useful ideas about how the treatment works. It is our hope that critics and proponents will continue to evaluate their respective claims with the same vigorousness until a consensus is reached.

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