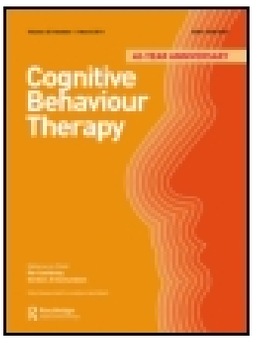

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Eye movement desensitization and reprocessing for mental health problems: a systematic review and meta-analysis

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ABSTRACT

There is no comprehensive meta-analysis of randomised trials examining the effects of Eye Movement Desensitization and Reprocessing (EMDR) on post-traumatic stress disorder (PTSD) and no systematic review at all of the effects of EMDR on other mental health problems. We conducted a systematic review and meta-analysis of 76 trials. Most trials examined the effects on PTSD (62%). The effect size of EMDR compared to control conditions was g = 0.93 (95% CI: 0.67–.18), with high heterogeneity (I^2= 72%). Only four of 27 studies had low risk of bias, and there were indications for publication bias. EMDR was more effective than other therapies (g = 0.36; 95% CI: 0.14–0.57), but not in studies with low risk of bias. Significant results were also found for EMDR in phobias and test anxiety, but the number of studies was small and risk of bias was high. EMDR was examined in several other mental health problems, but for none of these problems, sufficient studies were available to pool outcomes. EMDR may be effective in the treatment of PTSD in the short term, but the quality of studies is too low to draw definite conclusions. There is not enough evidence to advise it for the use in other mental health problems.

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EMDR; PTSD; anxiety disorders; meta-analysis; randomised trials; comparative outcome studies

Introduction

Eye Movement Desensitization and Reprocessing (EMDR) was developed in the late 1980s as a psychological treatment for post-traumatic stress disorder (PTSD) (Shapiro, 1989). It was based on the observation that the intensity of traumatic memories can be reduced through eye movements. While the patient focuses on the traumatic memory or thought, he or she simultaneously moves his or her eyes back and forth, following the movement of the therapist's finger. The exact mechanisms through which EMDR works are not yet clear and have been the subject of a lively debate and controversy for many years (McNally, 2013). Several researchers assumed that EMDR works through the

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cognitive behavioral elements that are included, most notably exposure to the traumatic memory, and that the eye movements do not have a specific contribution to the improvement of patients (Salkovskis, 2002). In other words, "what is effective in EMDR is not new, and what is new is not effective" (McNally, 1999). However, a more recent meta-analysis of dismantling studies, in which EMDR was compared with the same procedure without the eye movements, did suggest that the eye movements possibly do matter and contribute to the effects of EMDR (Lee & Cuijpers, 2013).

There is also theoretical and experimental work on the mechanisms of EMDR, with two underlying models having received the most attention and research support. The first model suggests that EMDR elicit an orienting response (Barrowcliff et al., 2004; Lee & Cuijpers, 2013; Schubert et al., 2010). The eye movements activate an "investigatory reflex" which first results in an alert response, and then, when it appears there is no threat, produces a sense of relaxation which inhibits negative affect associated with the traumatic memory. Furthermore, this reflex heightens alertness and facilitates exploratory behavior that makes cognitive processes more flexible and efficient (Lee & Cuijpers, 2013). The second well-examined model for how EMDR works is based on the fact that the working memory has only limited capacity (van den Hout et al., 2011). When a traumatic memory is activated in the working memory, and at the same time the patient has to focus on the movement of the fingers, the vividness and intensity of the memory are reduced. This "blurred" memory is restored in the long-term memory, leading to a less emotional reaction at future activation. Evidence for this model comes from studies that found that other dual tasks, such as mental arithmetic, may cause the same disrupting effects (see van den Hout et al., 2011).

Although EMDR was developed as a treatment for depression, it has been used since then in many other mental health problems, although these trials have never been examined in meta-analyses. The rationale for using EMDR in other disorders than PTSD is that traumatic memories, current stressful situations, and future difficulties play an important role in these disorders, and EMDR can help in processing these, for example, in bipolar disorder (Novo et al., 2014), conduct disorder (Soberman, Greenwald, & Rule, 2002) or eating disorders (Bloomgarden & Calogero, 2008).

Although EMDR received considerable skepticism from the scientific community when it first appeared in the late 1980s (Herbert et al., 2000; McNally, 2013), it has been examined since then in dozens of randomized trials. Several meta-analyses have indicated that it is an effective treatment of PTSD with large effect sizes compared to control conditions, and comparable effects compared to cognitive behavioral therapies (Boccia et al., 2015; Bisson & Andrew, 2007; Chen et al., 2014; Chen, Zhang, Hu, & Liang, 2015; Cusack et al., 2016; Ehring et al., 2014; Gillies, Taylor, Gray, O'Brien, & D'Abrew, 2013; Lee & Cuijpers, 2013; Moreno-Alcázar et al., 2017). Most treatment guidelines have included it as one of the evidence-based therapies for PTSD (Foa, Keane, Friedman, & Cohen, 2008; NICE, 2005; World Health Organization, 2016).

However, all meta-analyses of EMDR have included only a limited number of trials. The reasons for this may be that a considerable number of trials were not identified through the searches, that limited inclusion criteria were used or that not included trials were published only recently. A comprehensive, up-to-date meta-analysis of EMDR for PTSD is therefore germane. Furthermore, EMDR has not only been examined in PTSD, but also in many other mental health problems, including anxiety disorders, such as specific phobias, panic disorder, and social anxiety disorder, chronic pain, substance use

disorders, schizophrenia and test anxiety. No previous meta-analysis has focused on trials of EMDR for these mental health problems.

Therefore, the aim of this study was to conduct a comprehensive systematic review and meta-analysis of EMDR for any mental health problem in all age groups.

Methods

Identification and selection of studies

We searched five bibliographical databases (PubMed, PsycInfo, Embase, the Cochrane Register of Trials and Proquest) by combining search terms (both index terms and text words) for EMDR with search filters for randomized trials (deadline 2 November 2017). We also checked the references of earlier meta-analyses (Boccia et al., 2015; Bisson & Andrew, 2007; Chen et al., 2014, 2015; Cusack et al., 2016; Ehring et al., 2014; Gillies et al., 2013; Lee & Cuijpers, 2013; Moreno-Alcázar et al., 2017). Appendix A gives the full search string for PubMed.

We included (a) randomized trials in which (b) EMDR (c) aimed at any mental health problem (including, but not limited to, depression, anxiety, and substance abuse) (d) was compared to a control condition or any alternative treatment. An intervention was considered to be EMDR when it referred to EMDR as developed by Shapiro (1989). We included all age groups. The selection of studies was conducted independently by two researchers using Covidence (www.covidence.org) and disagreements were solved by discussion.

Risk of bias

Risk of bias of included studies was assessed using five criteria of the "Risk of bias" assessment tool, developed by the Cochrane Collaboration (Higgins et al., 2011). This tool assesses the following possible sources of bias in randomized trials: adequate generation of allocation sequence (such as using computer-generated random tables, instead of assigning patients by date of birth, or based on day of admission); concealment of allocation to conditions (for example, through central allocation by an independent person or the use of sealed envelopes); prevention of knowledge of the allocated intervention (masking of assessors); dealing with incomplete outcome data (this was assessed as low when intention-to-treat analyses were conducted or when less than 5% of the data were missing); and selective outcome reporting (this was assessed as low risk of bias in case of prospective registration and correspondence of primary outcomes between the trial registration and the paper; we considered registration to be prospective if it took place within a month from declared trial start). Some more specified rules for how risk of bias was assessed is given in Appendix B.

Assessment of risk of bias was done by two independent researchers (IAC and WY) and disagreements were solved by discussion.

Outcome measures

For each comparison, the effect size indicating the difference between the two groups at post-test was calculated (Hedges' g; Hedges & Olkin, 1985). Effect sizes were calculated by subtracting (at post-test or follow-up) the average score of the EMDR group from the

average of the comparison group, and dividing the result by the pooled standard deviation. Effect sizes of g = 0.20 are considered to be small, g = 0.50 as moderate and g = 0.80 as large (Cohen, 1988).

Because some studies had small sample sizes, we corrected the effect size for small sample bias (Hedges & Olkin, 1985). If means and standard deviations were not reported, we used the procedures from Borenstein, Hedges, Higgins, and Rothstein (2009) to calculate the effect size using dichotomous outcomes; if these were not available either, we used other statistics (such a *t*-value or *p*-value).

We focused on outcome measures that were the target of EMDR in that population (e.g. symptoms of PTSD when EMDR was examined in patients with PTSD, symptoms of depression when patients with depression was the target population). If more than one relevant measure for one mental problem was used, the mean of the effect sizes was calculated, so that each comparison yielded only one effect (using the methods from Borenstein et al., 2009).

Meta-analyses

To calculate pooled effect sizes, the Comprehensive Meta-Analysis (version 3.3.070) software was used. A random effects model was used in all analyses. Numbers-needed-to-be-treated (NNT) were calculated using the formulae provided by Kraemer and Kupfer (2006). The I^2-statistic was calculated as an indicator of heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003), with 25% indicating low, 50% moderate, and 75% high heterogeneity. The 95% confidence intervals around I^2 were calculated (Ioannidis, Patsopoulos, & Evangelou, 2007), using the non-central chi-squared-based approach within the heterogi module for Stata (Orsini, Bottai, Higgins, & Buchan, 2006). We also calculated the prediction interval (PI), which estimates where the true effects are to be expected for 95% of similar studies that might be conducted in the future (Borenstein, Higgins, Hedges, & Rothstein, 2017).

Subgroup analyses were conducted according to the mixed effects model (Borenstein et al., 2009), in which studies within subgroups are pooled with the random effects model, while tests for differences between subgroups are conducted with the fixed effects model. Metaregression analyses were conducted according to the Knapp–Hartung procedures using the restricted maximum likelihood approach as implemented in CMA (Borenstein et al., 2009).

Indications for publication bias were examined with Duval and Tweedie's trim and fill procedure (Duval & Tweedie, 2000), which yields an estimate of the effect size after the publication bias has been taken into account, and with Egger's test for the asymmetry of the funnel plot.

Results

Selection and inclusion of studies

The PRISMA flowchart describing the inclusion process, including reasons for exclusion, is presented in Figure 1. After examining 524 abstracts (356 after removal of duplicates), we retrieved 211 full-text papers. Seventy-seven trials met the inclusion criteria.

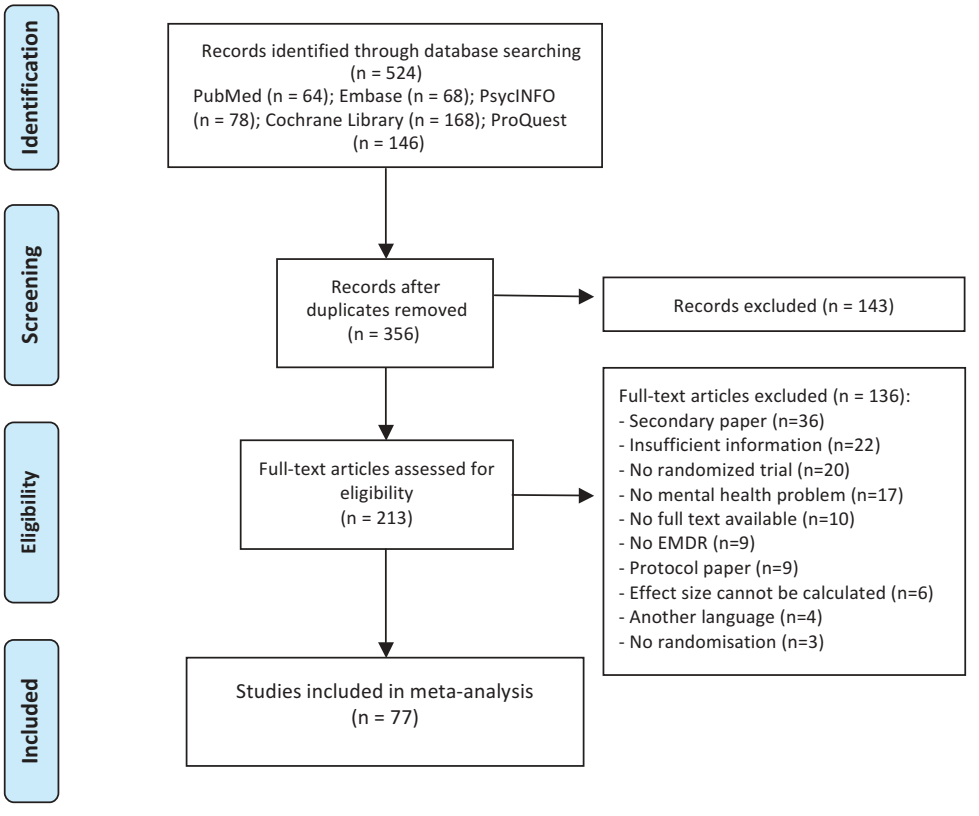

Figure 1. Flowchart for the inclusion of studies.

Selected characteristics of the 77 studies are given in Appendix C and references in Appendix D. 3,309 patients were included in the studies (1,447 in the EMDR conditions, 926 in the control conditions, 711 in other psychotherapy conditions, 169 in the dismantling conditions, and 56 in the pharmacotherapy conditions). Most studies (48) were aimed at (symptoms of) PTSD, 17 were aimed at anxiety, 3 at depression, and the other 9 were aimed at other mental health problems.

Risk of bias

An extended description of the risk of bias of included studies is given in Appendix C and the risk of bias graphs in Appendix B. In brief, sequence generation was rated as low risk of bias in 25 studies (32%), allocation concealment in 21 studies (27%), blinded assessment in 33 studies (43%) (36 studies used only self-report), and for incomplete outcome data, risk of bias was low in 27 studies (35%). Fourteen trials (18%) were publicly registered, and 5 of these were prospectively registered. Only one study was rated as low risk of bias on all criteria (Diehle, Opmeer, Boer, Mannarino, & Lindauer, 2015). When we excluded selective outcome reporting, 13 studies were rated as low risk of bias for the remaining four criteria, 23 studies met two or three criteria, and 41 met only one or none of the criteria.

For studies comparing EMDR with other therapies, we also examined researcher allegiance using four criteria adapted from Cuijpers et al. (2012). We rated allegiance as positive when (1) EMDR was the only therapy mentioned in the title; (2) the other therapy was explicitly described as a control condition; or if (3) there was an explicit hypothesis that EMDR was more effective.

EMDR for PTSD compared to control conditions

EMDR was compared to a control group (waiting list, care-as-usual, relaxation, other) in 30 comparisons. The overall effect size was g = 0.93 (95% CI: 0.67–1.18), with high heterogeneity (I^2= 72%, 95% CI: 58–80). The prediction interval (PI) was −0.29–2.15, indicating that 95% of the effect sizes of future studies would fall within this range. The effect size corresponds to a NNT of 2.04. The results of these analyses are reported in Table 1, and the forest plot is given in Figure 2.

Table 1. Effects of EMDR versus control groups on PTSD: Hedges' g[a]

		N_{comp}	g	95% CI	95% PI	I^2	95% CI	p	NNT
All studies		30	0.93	0.67 to 1.18	−0.29 to 2.15	72	58 to 80		2.04
One effect size per study (only highest)[b]		28	0.96	0.69 to 1.23	−0.30 to 2.22	73	59 to 81		1.99
One effect size per study (only lowest)[b]		28	0.92	0.65 to 1.19	−0.36 to 2.20	74	61 to 81		2.07
Only IES/IES-R as outcome		17	1.01	0.61 to 1.42	−0.62 to 2.64	79	66 to 86		1.91
Depression as outcome		18	0.83	0.58 to 1.08	−0.06 to 1.72	57	18 to 74		2.26
Four outliers excluded[c]		26	0.80	0.59 to 1.02	−0.06 to 1.66	54	21 to 70		2.34
Only studies with low risk of bias		4	0.96	0.20 to 1.72	−2.59 to 4.51	90	73 to 94		1.99
Subgroup analyses									
Diagnosis of PTSD	Yes	22	0.85	0.55 to 1.15	−0.41 to 2.11	73	57 to 81	0.31	2.21
	No	8	1.16	0.64 to 1.68	−0.48 to 2.80	71	22 to 84		1.70
Recruitment	Clinical samples	13	1.00	0.63 to 1.37	−0.32 to 2.32	75	53 to 84	0.71	1.91
	Other recruitment	17	0.87	0.52 to 1.23	−0.48 to 2.22	69	44 to 80		2.16
Target group	Adults in general	8	0.76	0.31 to 1.22	−0.61 to 2.13	65	0 to 82	0.37	2.44
	Military	4	1.07	0.30 to 1.84	−2.18 to 4.32	68	0 to 87		1.82
	Children	4	0.55	0.01 to 1.10	−1.71 to 2.81	63	0 to 85		3.31
	Specific trauma	7	1.41	0.75 to 2.07	−0.69 to 3.51	73	24 to 86		1.47
	Other	7	0.90	0.31 to 1.50	−1.10 to 2.90	84	67 to 91		2.10
Control group	Passive (waiting list)	18	1.13	0.83 to 1.44	−0.00 to 2.26	65	37 to 78	*0.03*	1.74
	Active (CAU, rel, oth)	11	0.60	0.23 to 1.45	−0.92 to 2.12	67	30 to 81		3.05
Country	USA	15	0.78	0.49 to 1.07	−0.12 to 1.68	49	0 to 71	*0.04*	2.39
	Other Western	9	0.67	0.27 to 1.06	−0.57 to 1.91	69	25 to 83		2.75
	Other	6	1.72	1.00 to 2.44	−0.65 to 4.09	78	38 to 88		1.29
Risk of bias	High (0–2)	23	0.92	0.62 to 1.22	−0.35 to 2.19	68	47 to 78	0.92	2.07
	Lower (3–5)	7	0.95	0.44 to 1.46	−0.77 to 2.67	83	62 to 90		2.01
Follow-up									
All studies		8	0.69	0.23 to 1.15	−0.79 to 2.17	75	41 to 86		2.67
Only 3 months follow-up		6	0.51	0.03 to 0.97	−0.89 to 1.91	56	0 to 80		3.55
Only low risk of bias		2	0.63	−1.13 to 2.40	[d]	96	[d]		2.91

CAU = care-as-usual; CI = confidence interval; EMDR = Eye Movement Desensitization and Reprocessing; IES-R = Impact of Events Scale-Revised; N_{comp} = number of comparisons; NNT = numbers-needed-to-treat; oth = Other; PI = prediction interval; PTSD = post-traumatic stress disorder; rel = relaxation; USA = United States of America.

[a]According to the random effects model.

[b]In two studies, EMDR was compared with two different control conditions (Carlson et al., 1998; Edmond et al., 1999). Because two effect sizes within one study are not independent of each other and may inflate heterogeneity, we conducted two sensitivity analyses. In the first, we only included the comparison with the largest effect size and in the second one we included only the smallest effect size.

[c]Acarturk et al., 2016; Ahmadi, Hazrati, Ahmadizadeh, & Noohi, 2015; Jarero et al., 2011; Ter Heide, Mooren, van de Schoot, de Jongh, & Kleber, 2016).

[d]Cannot be calculated when the number of studies is smaller than 3.

Italic values indicate a p-value smaller than 0.05.

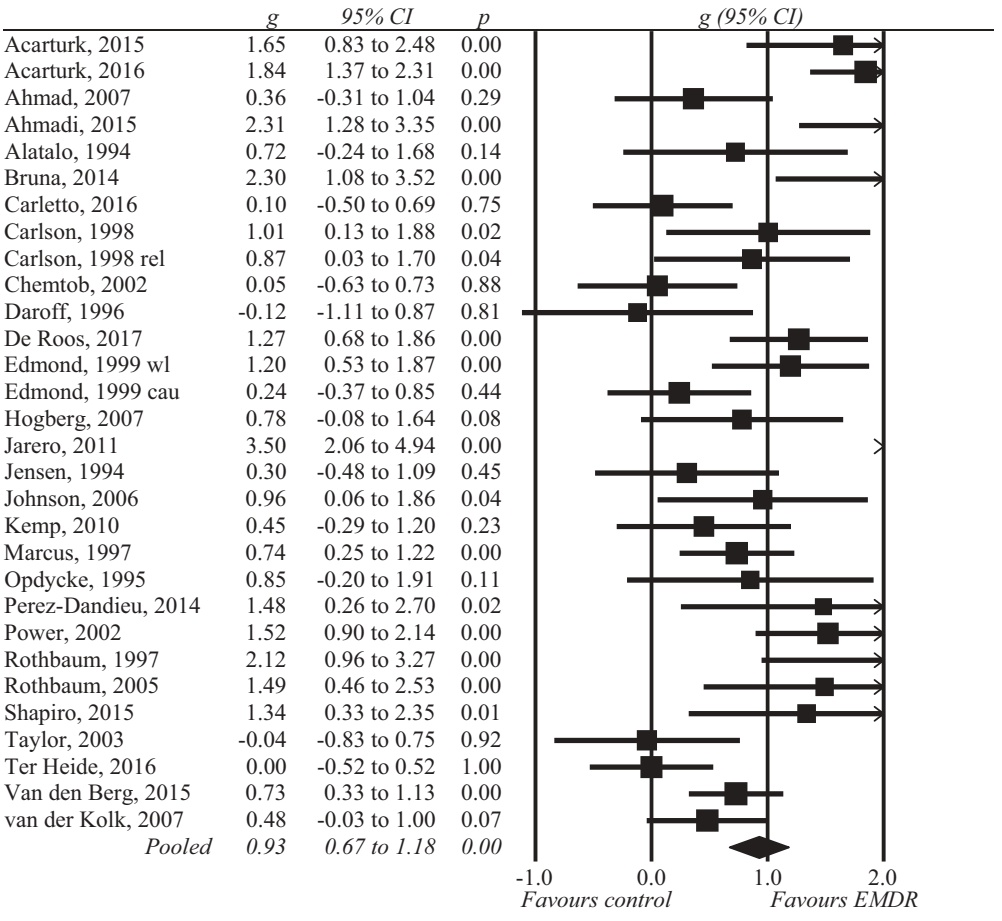

Figure 2. EMDR versus control for PTSD: Forest plot.

The most used outcome instruments were the Impact of Event Scale (IES) and the IES-R. The effect size based on this instrument alone was g = 1.01 (95% CI: 0.61–1.42; PI: −0.62 to 2.64; I^2= 79; 95% CI: 66–86; NNT = 1.91). In 18 studies, the effects of EMDR on depression were measured, which resulted in an effect size of g = 0.83 (95% CI: 0.58–1.08; PI: −0.06 ~ 1.72; I^2= 57; 95% CI: 18–74; NNT = 2.26). Exclusion of the four outliers resulted in a somewhat smaller effect size (g = 0.80; 95% CI: 0.59–1.02; PI: −0.06 to 1.66) and lower heterogeneity (I^2= 54; 95% CI: 21–70). Only four of the 27 studies met four criteria for low risk of bias (the pooled effect size of these studies was g = 0.96; 95% CI: 0.20–1.72).

Egger's test indicated significant publication bias (intercept: 1.88; 95% CI: −0.33 to 4.10; p = 0.046). Duvall and Tweedie's trim and fill procedure indicated four missing studies (see the funnel plot with imputed studies in Appendix E). The adjusted effect size (after imputation of the missing studies) was g = 0.76 (95% CI: 0.49–1.04).

Only 8 of the 28 studies reported follow-up data, and 7 of these were at 3 months follow-up (Table 1). The overall effect size at any follow-up point was g = 0.69 (95% CI: 0.23–1.15) with high heterogeneity (I^2= 75; 95% CI: 41–86). Only two of the eight studies had low risk of bias.

Subgroup analyses (Table 1) indicated that studies conducted in non-Western countries had higher effect sizes than studies in Western countries. Studies with a passive control condition (waiting list), had a significantly larger effect size than studies with an active control condition (such as care-as-usual, relaxation). No significant differences were found for other subgroup analyses. Meta-regression analyses indicated no significant association between the effect size and number of sessions (p = 0.07), time per session (p = 0.15), or total contact time between therapist and patient (p = 0.25).

EMDR for PTSD compared to other treatments

EMDR was compared with other psychological treatments for PTSD in 23 studies (Table 2, forest plot in Appendix F). The differential effect of EMDR was significant with g = 0.33 (95% CI: 0.13–0.54; PI: −0.45 to 1.17; NNT = 5.43), and moderate heterogeneity (I^2= 56; 95% CI: 22–71). After excluding one outlier (Jarero, Artigas, & Luber, 2011), the effect size

Table 2. Effects of EMDR versus other psychotherapies on PTSD: Hedges' g[a]

		N_{comp}	g	95% CI	95% PI	I^2	95% CI	p	NNT
All studies		23	0.33	0.13 to 0.54	−0.45 to 1.11	56	22 to 71		5.43
One outlier excluded[b]		22	0.25	0.09 to 0.41	−0.20 to 0.70	29	0 to 57		7.14
Only IES/IES-R		9	0.55	0.24 to 0.85	−0.32 to 1.42	55	0 to 77		3.31
Depression as outcome		12	0.24	−0.08 to 0.55	−0.83 to 1.31	70	37 to 82		7.46
Only CBT/PE		17	0.22	0.04 to 0.40	−0.23 to 0.67	27	0 to 59		8.06
Only studies with low risk of bias		8	0.07	−0.10 to 0.23	−0.13 to 0.27	0	0 to 56		25.00
Subgroup analyses									
Type of therapy	CBT/PE	17	0.22	0.04 to 0.40	−0.23 to 0.67	27	0 to 59	0.19	8.06
	Other	6	0.64	0.03 to 1.25	−1.38 to 2.66	77	34 to 88		2.86
Diagnosis of PTSD	Yes	15	0.27	0.04 to 0.50	−0.39 to 0.93	44	0 to 68	0.50	6.58
	No	8	0.43	0.02 to 0.85	−0.89 to 1.75	70	21 to 84		4.20
Recruitment	Clinical samples	11	0.16	0.01 to 0.32	−0.02 to 0.34	0	0 to 51	0.17	11.11
	Other recruitment	12	0.47	0.06 to 0.87	−0.92 to 1.86	69	34 to 81		3.85
Target group	Adults in general	9	0.15	−0.05 to 0.35	−0.09 to 0.39	0	0 to 54	0.26	11.90
	Children	4	0.13	−0.15 to 0.41	−0.48 to 0.74	0	0 to 68		13.51
	Specific trauma	5	0.76	−0.02 to 1.53	−2.03 to 3.55	80	38 to 90		2.44
	Other	5	0.51	0.03to~ 0.99	−1.02 to 2.04	60	0 to 83		3.55
Country	USA	9	0.50	0.19 to 0.82	−0.23 to 1.23	30	0 to 67	0.49	3.62
	Other Western	13	0.25	−0.01 to 0.52	−0.63 to 1.13	65	25 to 79		7.14
	Other	1	0.33	−0.66 to 1.32	[c]		[c]		5.43
Researcher allegiance	Yes	4	0.93	0.29 to 1.57	−1.87 to 3.73	75	0 to 89	*0.03*	2.04
	No/unclear	19	0.17	0.01 to 0.33	−0.18 to 0.52	17	0 to 52		10.42
Risk of bias	High (0–3)	15	0.56	0.25 to 0.87	−0.48 to 1.60	57	10 to 75	*0.01*	3.25
	Lower (4–5)	8	0.07	−0.10 to 0.23	−0.13 to 0.27	0	0 to 56		25.00
Follow-up[d]									
All studies		15	0.52	0.12 to 0.92	−1.03 to 2.07	82	70 to 88		
Two outliers excluded[e]		13	0.30	0.10 to 0.49	−0.12 to 0.72	21	0 to 59		
Only studies with low risk of bias		5	0.09	−0.11 to 0.29	−0.23 to 0.41	0	0 to 64		
3 months		10	0.81	0.19 to 1.43	−1.39 to 3.01	85	74 to 90	0.06	
>6 months		5	0.10	−0.33 to 0.52	−1.31 to 1.51	67	0 to 85		

CBT/PE = cognitive behavioural therapy/prolonged exposure; CI = confidence interval; EMDR = Eye Movement Desensitization and Reprocessing; IES-R = Impact of Events Scale-Revised; N_{comp} = number of comparisons; NNT = numbers-needed-to-treat; PI = prediction interval; PTSD = post-traumatic stress Disorder; USA = United States of America.

[a]According to the random effects model.

[b]Jarero et al., 2011.

[c]Cannot be calculated when the number of studies is smaller than 3.

[d]None of the studies were rated as low risk of bias.

[e]Jarero, Amaya, Givaudan, & Miranda, 2013; Rothbaum, Astin, Marsteller, 2005.

Italic values indicate a p-value smaller than 0.05.

dropped to g = 0.25 (95% CI: 0.09–0.41; PI: −0.20 to 0.70; NNT = 7.14; I^2= 29; 95% CI: 0–57), which was still significant. When we limited the analyses to the 17 studies comparing EMDR with cognitive behavioral and prolonged exposure therapies, the difference was still significant (g = 0.22; 95% CI: 0.04–0.40). However, for the eight studies with low risk of bias (studies met four criteria for low risk of bias), the effect size was almost zero and not significant (g = 0.07; 95% CI: −0.10 to 0.23).

We conducted a series of subgroup analyses (Table 2). Studies with low risk of bias had significantly smaller effect sizes than the other studies (p for difference = 0.01). Studies with lower risk of bias showed no significant difference between EMDR and other therapies. We also found that studies with researcher allegiance found significantly larger effect sizes (g = 0.93) than other studies (g = 0.17; p for difference: 0.03).

The 15 studies with follow-up data indicated significantly larger effects for EMDR at follow-up as well (g = 0.52; 95% CI: 0.12–0.92), although 10 of the 15 studies reported only outcomes at 3 months follow-up (g = 0.81; 95% CI: 0.19–1.43). The five studies with longer follow-up periods (6 to 15 months) found no significant benefit for EMDR (g = 0.10; 95% CI: −0.33 to 0.52). Five of the 15 studies had low risk of bias and these did not indicate a significant effect (g = 0.09; 95% CI: −0.11 to 0.29).

EMDR for other mental health problems

The effects of EMDR on anxiety disorders are reported in Table 3. The four studies examining the effects of EMDR versus control conditions for phobias (including social anxiety) found a significant effect (g = 0.76; 95% CI: 0.24–1.27; PI: −0.93 to 2.45; I^2 = 31; 95% CI: 0–77). The four studies on test anxiety also suggested positive effects (g = 1.46; 95% CI: 1.05–1.87; PI: −0.86 to 3.78; I^2 = 58; 95% CI: 0–84). However, none of these studies had low risk of bias. Because of the small number of studies, we did not conduct any additional analysis. EMDR was compared with other therapies in the treatment of anxiety disorders in nine trials, but only one had lower risk of bias (Staring et al., 2016). No significant difference between EMDR and other therapies was found.

Table 3. Effects of EMDR on anxiety disorders: Hedges' g[a]

		N_{comp}	g	95% CI	95% PI	I^2	95% CI	p[b]	NNT
EMDR vs. control [b]									
All studies		10	1.07	0.69 to 1.45	−0.03 to 2.17	52	0 to 75		1.82
Type of disorder	Phobias	4	0.76	0.24 to 1.27	−0.93 to 2.45	31	0 to 77	0.12	2.44
	Test anxiety	4	1.46	1.05 to 1.87	−0.86 to 3.78	58	0 to 84		1.43
	Other	2	0.76	0.22 to 1.31	[e]	0	[e]		2.44
EMDR vs. other therapies[c]									
All studies		9	−0.07	−0.31 to 0.17	−0.52 to 0.38	14	0 to 61		[25.00]
Type of disorder	Phobias	5	−0.09	−0.44 to 0.27	−0.70 to 0.52	2	0 to 65	0.69	[20.00]
	Test anxiety	2	0.28	−0.74 to 1.30	[e]	72	[e]		6.41
	Other	2	−0.20	−0.62 to 0.22	[e]	0	[e]		[8.93]

CI = confidence interval; EMDR = Eye Movement Desensitization and Reprocessing; N_{comp} = number of comparisons; NNT = numbers-needed-to-treat; PI = prediction interval.

[a]According to the random effects model.

[b]This *p*-value indicates whether the differences between subgroups were significant.

[c]None of the studies had low risk of bias.

[d]One study had low risk of bias (Staring et al., 2016).

[e]This cannot be calculated when the number of studies is smaller than 3.

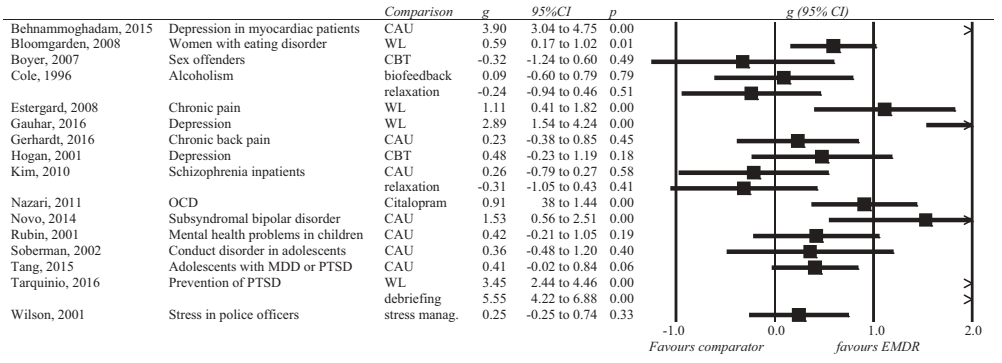

Figure 3. Effects of EMDR on other mental health problems than PTSD and anxiety disorders: Hedges' *g*.

Table 4. Dismantling studies of EMDR: Hedges' g[a,b].

	N_{comp}	*g*	95% CI	95% PI	I^2	95% CI	NNT
All studies	10	−0.04	−0.24 to 0.17	−0.29 to 0.21	0	0 ~ 53	[45.45]
EMDR vs EMDR w/o eye mov [c]	9	−0.07	−0.29 to 0.15	−0.34 to 0.20	0	0 ~ 54	[25.00]
Only PTSD	5	0.01	−0.28 to 0.30	−0.46 to 0.48	0	0 ~ 64	166.67
Only IES/IES-R	5	−0.03	−0.32 to 0.26	−0.50 to 0.44	0	0 ~ 64	[62.5]
Depression	4	−0.03	−0.56 to 0.49	−2.20 to 2.14	66	0 ~ 86	[62.5]
Only low risk of bias	2	−0.06	−0.39 to 0.27	[c]	0	[c]	

CI = confidence interval; EMDR = Eye Movement Desensitization and Reprocessing; IES-R = Impact of Events Scale-Revised; N_{comp} = number of comparisons; NNT = numbers-needed-to-treat; PTSD = post-traumatic stress disorder.
[a]According to the random effects model.
[b]None of the studies had low risk of bias.
[c]In the 10th study (Cusack & Spates, 1999), full EMDR was compared with EMDR without the explicit cognitive elements included in the treatment.
[d]This cannot be calculated when the number of studies is smaller than 3.

Sixteen trials (19 comparisons) examined the effects of EMDR for other mental health problems than PTSD and anxiety disorders. For each of these studies, the target groups, comparators, and effect sizes are given in Figure 3, but there were no disorders or target groups with sufficient studies to be pooled. Only one of the studies had low risk of bias (Gerhardt et al., 2016).

Dismantling studies

We found 10 dismantling studies, in which full EMDR was compared with EMDR in which one component was removed (partial EMDR). In all but one dismantling studies full EMDR was compared with EMDR in which the eye movements were not included. The pooled effect size of full versus partial EMDR was a non-significant g = −0.04 (95% CI: −0.24 to 0.17; prediction interval: −0.29 to 0.21), with zero heterogeneity (I^2 = 0; 95% CI: 0–53). The results are summarised in Table 4 (forest plot in Appendix G).

No indication for significant publication bias was found with Egger's test and Duvall and Tweedie's procedure. Similar effects were found when the results were limited to the five studies on PTSD. Only two studies had low risk of bias (Table 4).

Discussion

We conducted the first systematic review of randomized trials examining the effects of EMDR for any mental health problem. We identified a considerable number of trials (77), most of which were aimed at PTSD (62%). However, we also found a considerable number of trials aimed at other mental health problems. The studies in patients with PTSD indicated that EMDR has a large effect when compared to control conditions at the short term.

However, these positive findings were tempered by the fact that only a small minority of the included studies had low risk of bias. Only one of the comparisons had low risk of bias, and when one of the indicators for risk of bias (selective outcome reporting) was ignored, only four had low risk of bias. Risk of bias can be seen as the "weak spots" of randomized trials (Cuijpers, 2016), where the researchers (usually without intending that) can influence the outcomes of the study. When risk of bias is high, that means that the results should be considered with caution because they may not reflect the true effects of an intervention. In this case, almost all studies had some risk of bias, implying that we actually cannot be certain about the results.

Furthermore, heterogeneity was considerable. This resulted in prediction intervals which all had lower thresholds below zero, meaning that the range of studies was very broad and a new study can easily have a negative effect size. Subgroup and metaregression analyses did not point at possible sources of heterogeneity. Another problem was that the effects were hardly examined at follow-up.

EMDR was found to be significantly more effective than other therapies in the treatment of PTSD. However, these results are not convincing for a number of reasons. First, there were few studies with low risk of bias. Furthermore, studies with low risk of bias did not point at a significant difference between EMDR and other therapies. The difference between studies with low risk of bias and those with at least some risk of bias was significant and we found considerable indications for researcher allegiance. Because studies with low risk of bias found no difference between EMDR and other therapies, we conclude that there is not enough evidence to decide about the comparative effects of EMDR.

We found a considerable number of studies examining the effects of EMDR in other mental health problems. Several studies examined the effects of EMDR in anxiety. However, these studies were in different types of anxiety disorders and some compared EMDR to a control condition, while others compared it to another treatment. This resulted in small numbers of studies for each disorder and comparator. We did find that EMDR was effective in the treatment of phobias and of test anxiety. None of the other categories of anxiety disorders and comparators had sufficient studies to calculate pooled effect sizes. Furthermore, hardly any of the studies had low risk of bias, indicating the considerable uncertainty of these findings.

EMDR was also examined in a range of other mental health problems, including depression, eating disorder, alcoholism, pain, schizophrenia, OCD, bipolar disorder, and conduct disorder. However, there were not enough studies available for pooling in any of these categories. Although some of these studies indicated significant effects, the risk of bias was considerable (only one study had low risk of bias). Overall, we

conclude that there is not enough evidence for the use of EMDR for mental health problems other than PTSD.

We could not confirm the results of an earlier meta-analysis comparing EMDR with the same procedure but without the eye-movements due to a lack of studies (Lee & Cuijpers, 2013). That is probably caused by differences in inclusion criteria. We only included studies in participants with existing mental health problems and we only focused on clinical outcomes, while the earlier meta-analysis mainly included experimental studies with healthy participants and results on process measures. However, due to the fact that only few trials in the current study had a low risk of bias, the inability to reproduce the aforementioned previous findings does indicate that the difference between EMDR with and without eye movements may not be as robust as previously suggested.

This meta-analysis did not solve the controversy around EMDR. Whether or not EMDR actually works through the cognitive behavioral elements that are included, most notably exposure to the traumatic memory, cannot be established in randomized controlled trials. In fact, while it is relatively straightforward to examine if a psychological treatment works, it is a considerable challenge to show how such a treatment works (Cuijpers, Reijnders, & Huibers, 2019). Trials can show if a treatment works, but to show how a treatment works is much more complicated and requires an extensive range of different types of treatments (Kazdin, 2007). There are hardly any psychological treatments for which it has been shown how they work, and EMDR is not an exception from this perspective. In fact, as indicated in the introduction, there is quite some research on working mechanisms in EMDR, especially on the orienting response model and the limited capacity of the working memory (van den Hout et al., 2011). The original controversy on the effects of EMDR is therefore not solved, but the assumption that EMDR only works through the cognitive-behavioral elements seems to be too simple.

We conducted a meta-analysis according to the current standards for such studies. However, the results of a meta-analysis can never be better than the set of selected studies. This is clearly an issue here because the included studies had several limitations. We already mentioned the small number of studies with low risk of bias, the high heterogeneity in most comparisons, and the lack of studies examining longer-term effects. Especially the risk for selective outcome reporting and the small number of registered trials was striking. Another problem is that most trials had small sample sizes, with several having less than 10 participants in each condition. Future research should focus on high-quality, sufficiently powered, randomized trials with long-term effects. Without such studies, the effects of EMDR will remain as uncertain as they are now.

Despite these limitations, the results of this meta-analysis aid us in concluding that EMDR may be effective in the treatment of PTSD in the short term and possibly have comparable effects as other treatments. However, the quality of studies is too low to draw definite conclusions. Further, it is evident that the long-term effects of EMDR are unclear and that there is certainly not enough evidence to advise its use in patients with mental health problems other than PTSD.

Disclosure statement

No potential conflict of interest was reported by the authors.

Registration

The protocol for this meta-analysis was registered at PROSPERO (CRD42017080602).

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