

Comparative Efficacy, Speed, and Adverse Effects of Three PTSD Treatments: Exposure Therapy, EMDR, and Relaxation Training

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The authors examined the efficacy, speed, and incidence of symptom worsening for 3 treatments of posttraumatic stress disorder (PTSD): prolonged exposure, relaxation training, or eye movement desensitization and reprocessing (EMDR; $N = 60$). Treatments did not differ in attrition, in the incidence of symptom worsening, or in their effects on numbing and hyperarousal symptoms. Compared with EMDR and relaxation training, exposure therapy (a) produced significantly larger reductions in avoidance and reexperiencing symptoms, (b) tended to be faster at reducing avoidance, and (c) tended to yield a greater proportion of participants who no longer met criteria for PTSD after treatment. EMDR and relaxation did not differ from one another in speed or efficacy.

Posttraumatic stress disorder (PTSD) occurs when (a) an individual experiences a traumatic event, (b) reacts with intense fear, helplessness, or horror, and (c) develops particular symptoms that persist for at least a month (American Psychiatric Association, 2000). Recent factor analytic studies have indicated that there are four basic dimensions of PTSD symptoms: Reexperiencing (e.g., nightmares, flashbacks), avoidance (e.g., efforts to avoid thinking about the trauma), numbing of general responsiveness (e.g., restricted range of affect), and hyperarousal (e.g., exaggerated startle response; Asmundson et al., 2000; King, Leskin, King, & Weathers, 1998). In the general population, PTSD has a lifetime prevalence of about 8%, making it a common disorder (American Psychiatric Association, 2000).

Much remains to be learned about the comparative efficacy of PTSD treatments. The present study examined three interventions: exposure therapy (in vivo and imaginal exposure to trauma-related stimuli), relaxation training, and eye movement desensitization and reprocessing (EMDR). Exposure therapy was selected partly because it is an established PTSD treatment (Chambless & Ollendick, 2001) and so is a benchmark for comparing other therapies. EMDR was examined because of claims that it is faster and more effective than other treatments (Shapiro, 1999). Relaxation training was selected because it is a potentially useful but understudied intervention.

Despite evidence supporting the efficacy of exposure therapy, little is known about the breadth and speed of its effects, particularly in comparison to other treatments. Exposure therapy emphasizes the reduction of avoidance (through repeated exposure exercises), and so it may be superior to other treatments in reducing avoidance but not necessarily better at reducing other features of PTSD such as numbing symptoms. Moreover, exposure might not be beneficial for all patients. Tarrier et al. (1999) reported that 31% of patients treated with imaginal exposure experienced a worsening of PTSD symptoms from pre- to posttreatment. The validity of this claim has been debated (Devilley & Foa, 2001; Tarrier, 2001). Further research is needed to assess whether symptom worsening is more common for exposure therapy compared with other treatments.

Relaxation training involves instructing the patient in various relaxation exercises, which are used at times of anxiety or distress. As a treatment for PTSD, there is little information on the breadth or speed of its effects or on the incidence of symptom worsening. Marks, Lovell, Noshirvani, Livanou, and Thrasher (1998) found that relaxation training was moderately effective in reducing the

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global severity of PTSD symptoms. Although these investigators found that relaxation tended to be less effective than exposure therapy, the effects of relaxation are noteworthy because PTSD often remains unchanged in the absence of treatment (Taylor et al., 2001; van Etten & Taylor, 1998). Relaxation might exert its effects by reducing hyperarousal symptoms. Once hyperarousal is reduced, the patient may be less distressed by trauma-related stimuli and, therefore, less avoidant. Thus, relaxation training might encourage therapeutic exposure, even in the absence of formal exposure exercises.

EMDR is a complex treatment that incorporates many different interventions, including imaginal exposure (under conditions of divided attention), free association, and other techniques (Shapiro, 1995). The main intervention requires the patient to recall trauma-related memories while also attending to some form of external oscillatory stimulation. Stimulation is typically induced by the therapist moving a finger from side to side across the patient's field of vision, which induces eye movements. Sets of eye movements are induced until distress is reduced.

Meta-analyses suggest that EMDR and exposure therapy are equally effective, as assessed by broad measures of psychopathology (Davidson & Parker, 2001; van Etten & Taylor, 1998). The meta-analyses were based largely on early EMDR studies, many of which had important methodological limitations (Foa & Meadows, 1997; Shapiro, 1999). Therefore, the meta-analytic findings are best regarded as a source of hypotheses to be tested in methodologically improved trials.

A handful of PTSD studies have directly compared EMDR with some form of exposure therapy. The results have been mixed; some research suggests that exposure-based treatment is more effective than EMDR (Devilley & Spence, 1999), whereas other studies suggest that EMDR is somewhat more effective (Ironson, Freund, Strauss, & Williams, 2002; Lee, Gavriel, Drummond, Richards, & Greenwald, 2002; Vaughan et al., 1994). Each of these studies has important methodological limitations, which raises concerns about the validity of the findings.

Vaughan et al. (1994) did not use the current version of EMDR, and their exposure therapy differed markedly from the way this treatment is usually implemented (Devilley, in press). Ironson et al. (2002) failed to assess treatment outcome with structured PTSD interviews. Such interviews are widely regarded as the best way of assessing PTSD symptoms (e.g., Tarrier, 2001). None of the other studies reported whether their interviews were reliably administered. In three studies the therapists administered the outcome assessments instead of using blind, independent evaluators (Devilley & Spence, 1999; Ironson et al., 2002; Lee et al., 2002). Only two studies reported whether their interventions differed in treatment integrity (Devilley & Spence, 1999; Lee et al., 2002), and even those studies offered no data on whether the integrity ratings were reliable. In both studies it appears that treatments differed in integrity, which raises concerns about whether some of the therapies were not properly implemented.

Information about the comparative speed, efficacy, and probability of adverse effects of PTSD treatments is important in guiding clinicians and in helping patients make informed choices. The present study was intended to advance our knowledge of PTSD treatments in several ways. We sought to avoid the methodological problems of previous studies, and assessed each of the four dimensions of PTSD symptoms—reexperiencing, avoidance, numb-

ing, and hyperarousal—to determine whether treatments differed in their effects. Unlike previous studies, we gathered session-by-session data on the four dimensions, which enabled us to assess the speed of treatment effects. We assessed symptoms commonly associated with PTSD (depression, dissociation, and trauma-related guilt and anger) to further investigate the breadth of treatment effects. We also examined whether treatments differed in the proportion of patients whose symptoms worsened after treatment. Previous studies have generally failed to assess the effects of stressors (which can exacerbate PTSD symptoms) or the effects of extraneous treatments (e.g., changes in the dose or type of medication) during treatment and follow-up. Such factors can confound the evaluation of the treatments under investigation. These factors were examined in the present study.

Method

Participants

Participants were recruited from physician referrals and from advertisements in the local media. Inclusion criteria were (a) *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000) diagnosis of PTSD as the primary (most severe) presenting problem, (b) age over 18 years and ability to provide written informed consent, and (c) willingness to suspend any concomitant psychological treatment and to keep doses of any psychotropic medication constant throughout the course of the study. Exclusion criteria were mental retardation, current psychotic disorder, and commencement or change in dose of psychotropic medication within the past 3 months.

A total of 299 prospective participants contacted our clinic and received a telephone screening interview. Of these, 164 passed the interview and were invited to the clinic. Sixty participants met the inclusion–exclusion criteria and entered treatment. Forty-five participants completed treatment. For the 60 people entering the study, the mean age was 37 years ($SD = 10$ years) and 75% were women. Most (77%) were Caucasian and most (78%) had completed some form of college education. Forty-two percent were employed full-time or part-time outside of the home, 15% were students, 5% were full-time homemakers, 13% were unemployed, and 25% were supported by some form of disability assistance. Forty-two percent were married or cohabiting, 32% were single, and 27% were separated or divorced.

Almost all 60 participants (97%) had chronic PTSD (i.e., > 3 months; American Psychiatric Association, 2000), with a mean duration of 8.7 years ($SD = 10.8$). Forty-eight percent were taking some form of psychotropic medication. Most participants (65%) had experienced more than one type of traumatic event. The most common forms were sexual assault (45%), transportation accidents (43%), physical assault (43%), and being exposed to a sudden death (e.g., witnessing a homicide, 22%). The most common coexisting mental disorders were major depression (42%), panic disorder (31%), and social anxiety disorder (12%).

Measures

Primary outcome measures were those assessing the four PTSD dimensions (reexperiencing, avoidance, hyperarousal, and numbing) and the rating of whether the participant met *DSM-IV-TR* criteria for PTSD after treatment. Secondary outcome measures were those assessing commonly associated PTSD symptoms (trauma-related guilt, trauma-related anger, dissociative symptoms, and depression). For each of the primary and secondary outcome measures, higher scores indicate greater psychopathology.

Structured interviews. Intake diagnoses for Axis I disorders were established by the Structured Clinical Interview for *DSM-IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1996). Severity of PTSD symptoms over the past week was assessed by the Clinician Administered PTSD subscales (CAPS; Blake et al., 1997). Recent factor analytic studies of the CAPS and similar scales (Asmundson et al., 2000; King et al., 1998) indicate that the 17 core PTSD symptoms represent four dimensions: reexperiencing (CAPS Items 1–5), avoidance (Items 6 and 7), numbing (Items 8–12), and hyperarousal (Items 13–17). We constructed CAPS to measure each of these dimensions. An additional CAPS item—trauma-related guilt over acts of commission or omission—was included as a secondary outcome measure. Dissociative symptoms were measured by the three CAPS dissociation items (depersonalization, derealization, and reduction in awareness of one's surroundings). Each CAPS scale consisted of the mean of the item scores. Mean scores were computed so each scale would have the same range (0 to 8), thereby facilitating comparisons across scales.

For the posttreatment and follow-up CAPS interviews, questions were added to assess the occurrence of stressful life events during treatment and follow-up (e.g., job loss, financial difficulties, diagnosis of a severe medical condition). Questions also were added to assess whether there had been any change in the dose or type of psychotropic medication during treatment or follow-up and whether the participant had any mental health consultations during treatment or follow-up (apart from those occurring in our treatment program). Psychiatrist appointments for the purpose of medication management were classified as mental health consultations because some form of symptom-focused counseling is often included in those appointments.

Self-report questionnaires. Severity of PTSD symptoms over the past week was assessed by the PTSD Symptom Severity Scale, which is part of the Posttraumatic Stress Diagnostic Scale (Foa, 1995). The Symptom Severity Scale contains 17 items corresponding to each of the *DSM-IV-TR* PTSD symptoms. As with the CAPS, we divided this scale into four subscales, assessing each of the four PTSD dimensions. Severity of depression was measured by the Beck Depression Inventory (Beck & Steer, 1987). Trauma-related anger was assessed by an item assessing the frequency of anger about trauma-related events over the past week. This item was rated on a 4-point scale ranging from 0 (*not at all*) to 3 (*almost always*). Treatment credibility, as perceived by the participant, was measured by the Reactions to Treatment Questionnaire (Borkovec & Nau, 1972), which was administered to participants at the beginning of Session 2 (i.e., after they had received the treatment rationale and understood what treatment entailed).

Treatments

Protocols. Participants meeting study criteria were randomized to eight 90-min individual sessions of either exposure therapy, EMDR, or relaxation training. Detailed treatment manuals were used for each treatment. Exposure and relaxation manuals were based on Marks et al. (1998), and EMDR was based on Shapiro (1995). Marks et al.'s exposure protocol is essentially the same as Foa's widely used prolonged exposure treatment (Foa et al., 1999; Foa & Rothbaum, 1998), except Foa includes breathing retraining whereas Marks does not.

Exposure therapy involved four sessions of imaginal exposure to traumatic events, followed by four sessions of in vivo exposure to harmless but distressing trauma-related stimuli. Exposure exercises were hierarchically arranged, from least to most distressing stimuli. Exposure exercises occupied about 60 min of each 90-min session. During imaginal exposure, participants were asked to talk in the first-person and present tense about the traumatic event and what it meant to them at the time and also what they saw, heard, smelled, felt, and tasted. Imaginal exposure was repeated several times per session, with particular focus on the most disturbing aspects of the event. Sessions were audiotaped and participants were asked to listen to the tapes for an hour each day for the first 4 weeks of treatment.

In vivo exposure consisted of therapist-assisted exposure conducted within sessions and exposure homework assignments. The latter consisted of live exposure for an hour each day for 4 weeks. For example, a participant with PTSD arising from a traffic collision might be encouraged to return to the scene of the accident. Driving exercises might also be used as exposure exercises; that is, beginning with driving on quiet residential streets and progressing to more fear-evoking driving situations. When trauma-related stimuli were located far from the clinic, the therapist sometimes arranged to meet with the participant (out of the clinic) for in-session in vivo exposure (e.g., meeting at the site of a traffic collision). In other instances, in-session in vivo exposure was conducted by identifying trauma-related stimuli that were close to the clinic and readily accessible (e.g., in vivo exposure to men exercising at a nearby fitness center for a participant who had been sexually assaulted at a school gymnasium).

Relaxation training involved practicing three different relaxation exercises; one per session for the first three sessions. The participant then selected an exercise to practice in subsequent sessions. This consisted of either one of the three exercises or some combination thereof. Relaxation training occupied about 60 min of each 90-min session. In each session a relaxation script was read by the therapist. The script was audiotaped, and the participant was asked to listen to it for an hour each day.

EMDR followed the procedures and phases described by Shapiro (1995). During the first session participants were trained in the Safe Place exercise, which is a coping strategy for reducing distress. This exercise was practiced as a homework assignment and used thereafter as needed. If there was sufficient time in the first session, processing of a traumatic memory was initiated, which continued in subsequent sessions. The participant was asked to recall the memory and its associated features (e.g., negative self-statements) and then lateral sets of eye movements were induced by the therapist moving her finger across the participant's field of vision. The participant then reported any thoughts, feelings, or images that arose. This new material typically became the focus of the next set of eye movements. The process continued until the distress evoked by the memory had subsided. Other EMDR methods (e.g., cognitive interweave) were used as indicated. If problems with eye movements were encountered (e.g., if they induced headaches), then an alternative form of oscillatory stimulation, hand tapping, was used (Shapiro, 1995).

Therapists. Two female therapists were randomly assigned patients from the three treatment conditions, under the ongoing supervision of a doctoral-level psychologist (Steven Taylor), who also ensured that the therapists were adequately trained to deliver the three treatments. Both therapists had completed Levels I and II training from the EMDR Institute. Therapist 1 was a master's-level psychotherapist who had practiced EMDR for 6 years. She had 12 years of experience using cognitive-behavioral interventions for psychological trauma and 14 years of experience using relaxation training. Therapist 2 was a doctoral-level clinician with 6 years experience with exposure therapy and 2 years experience with relaxation training. She completed Level I and II training with the EMDR Institute for the purpose of the study.

Procedure

Assessment of participants. Potential participants contacting the clinic were screened for inclusion-exclusion criteria during a telephone screening interview. Those passing the screen were invited to the clinic for an evaluation consisting of the SCID-IV, CAPS, and self-report questionnaires. At the beginning of each treatment session, participants completed the PTSD Symptom Severity Scale to assess symptoms over the past week. One month after treatment ended, participants were reinterviewed with the CAPS and completed the self-report outcome measures (posttreatment assessment). Three months later, the CAPS and self-report measures were administered again (follow-up assessment). All interviews were conducted by clinic staff, who were blind to the participants' treatment assignment.

Reliability of interview measures. Interviews were audiotaped to assess interrater reliability of the ratings made by the clinic staff. A doctoral-level

psychologist independently rated audiotapes of 12 SCID-IV interviews and 12 CAPS interviews. The SCID-IV interviews consisted of a random sample of participants included or excluded from the study. CAPS interviews were a random sample of pre- or posttreatment interviews (12 different participants). The agreement between raters for the diagnosis of PTSD was 92% ($\kappa = .80$). Ratings on the primary CAPS outcome measures were compared by computing intraclass correlations. The results indicated a high degree of interrater reliability: reexperiencing .93, avoidance .84, numbing .85, and hyperarousal .80.

Treatment integrity. Treatment sessions were videotaped for treatment integrity ratings (and for treatment supervision). Each tape contained a single treatment session. Randomly selected videotapes of each therapist and treatment condition were used to assess treatment integrity. There were seven assessors. Assessor 1, who was also the treatment supervisor, rated 235 tapes (80 exposure, 75 EMDR, and 80 relaxation sessions), representing 59% of all treatment sessions. Assessors 2–7 each independently rated randomly selected subgroups of the tapes rated by Assessor 1. Assessors 2–4 were experienced EMDR therapists who rated 11, 11, and 8 different EMDR tapes, respectively. Assessors 5–7 were experienced in exposure therapy and relaxation training. They each rated 6 different exposure tapes and 6 different relaxation tapes.

Assessors used a protocol to rate the adequacy of interventions and to identify protocol violations. For each assessor and videotape, three dichotomous (yes–no) variables were coded: (a) whether treatment-nonspecific components such as therapist warmth and rapport were adequate; (b) whether treatment-specific components (e.g., imaginal exposure exercises) were implemented adequately; and (c) whether the session contained a nonprotocol intervention, such as cognitive restructuring during exposure therapy.

Intrater reliability was assessed by comparing, within each treatment condition, Assessor 1 with the group of other assessors. Reliability was assessed in terms of percentage agreement because kappa was not defined for several comparisons. For nonspecific factors, interassessor agreement was 100% in each treatment condition. Agreement for treatment-specific factors was as follows: EMDR 97%, exposure 89%, and relaxation 94%. For ratings of nonprotocol violations, interassessor agreement was EMDR 87%, exposure 89%, and relaxation 89%.

Results

Bonferroni corrections were not used because they inflate Type II errors. The alpha level for all tests was .05 (two-tailed). Significance tests were supplemented by effect size analyses (eta-square tests).

Preliminary Analyses

The number of trial entrants and number of treatment completers were as follows: EMDR 19, 15; exposure therapy 22, 15; relaxation training 19, 15. The proportion of dropouts did not differ across treatments: $\chi^2(2, N = 60) = 0.86, p > .1, \eta^2 = .01$. Dropouts and completers did not differ on demographics, trauma type, PTSD duration, or pretreatment scores on the primary or secondary outcome measures ($ps > .05$).

Treatments did not differ in participant-rated credibility: $F(2, 51) = 0.36, p > .1, \eta^2 = .01$. Treatments also did not differ in the percentage of sessions containing nonprotocol interventions (assessor rated): $\chi^2(2, N = 235) = 4.29, p > .1, \eta^2 = .02$; EMDR 5%, exposure 5%, relaxation 0%. There was no difference between treatments in the proportion of sessions judged to be acceptable in terms of treatment-nonspecific factors: $\chi^2(2, N = 235) = 1.95, p > .1, \eta^2 = .01$; percentage of acceptable sessions: EMDR 100%,

exposure 99%, relaxation 100%. The treatments differed significantly in the proportion of sessions judged to be acceptable in terms of treatment-specific factors: $\chi^2(2, N = 235) = 6.91, p < .05, \eta^2 = .03$; EMDR 100%, exposure 94%, relaxation 99%. Although statistically significant, the effect size indicates that differences among treatments accounted for a small fraction of the variance. Covarying out the differences in treatment integrity did not alter the pattern of treatment outcome results reported later in this article. There were no differences between therapists for any treatment or treatment outcome variable ($ps > .1$).

Outcome for Treatment Completers

Proportion of participants no longer meeting criteria for PTSD.

Figure 1 shows the proportion of participants who no longer met *DSM-IV-TR* criteria for PTSD at (a) posttreatment, (b) follow-up, and (c) posttreatment and follow-up (i.e., sustained). Exposure was superior to relaxation at each of the posttreatment, follow-up, and sustained variables, $\chi^2(1, N = 30) > 5.40, ps < .02, \eta^2 > .18$. EMDR and relaxation did not differ from one another for any of these assessments, $\chi^2(1, N = 30) < 1.22, ps > .1, \eta^2 < .04$. There were trends for exposure to be superior to EMDR (Figure 1), but these were not statistically significant, $\chi^2(1, N = 30) < 2.73, ps > .05, \eta^2 < .10$.

Outcome for the four PTSD dimensions. Figure 2 shows that CAPS scores declined from pretreatment to follow-up in each treatment condition. For each of the four dimensions and each treatment condition, these reductions were significant: relaxation, $t(14) > 3.55, p < .005, \eta^2 > .47$; EMDR, $t(14) > 3.66, p < .005, \eta^2 > .49$; exposure, $t(14) > 4.52, p < .001, \eta^2 > .59$.

For each dimension (as assessed by the CAPS), outcome was further assessed by a repeated-measures analysis of covariance (ANCOVA). The pretreatment value was the covariate, and treatment condition was the between-subjects factor. The within-subjects factor was a time condition, referring to changes from posttreatment to follow-up. This analytic approach, which combines data from posttreatment and follow-up, was chosen because

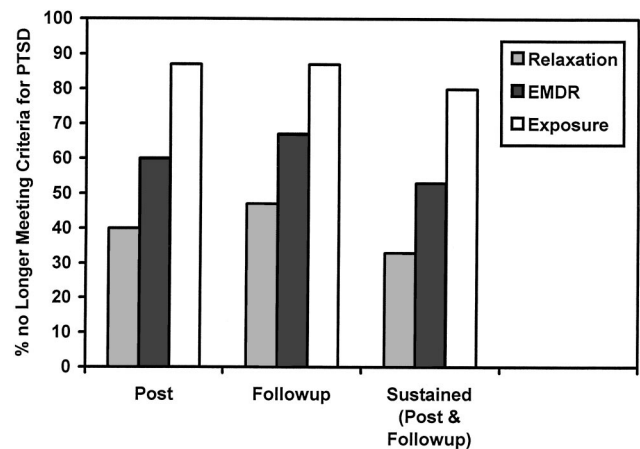


Figure 1. Percentage of participants no longer meeting *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.) criteria for posttraumatic stress disorder (PTSD) after treatment. (Sustained = no longer met criteria at posttreatment (post) and follow-up.) EMDR = eye movement desensitization and reprocessing.

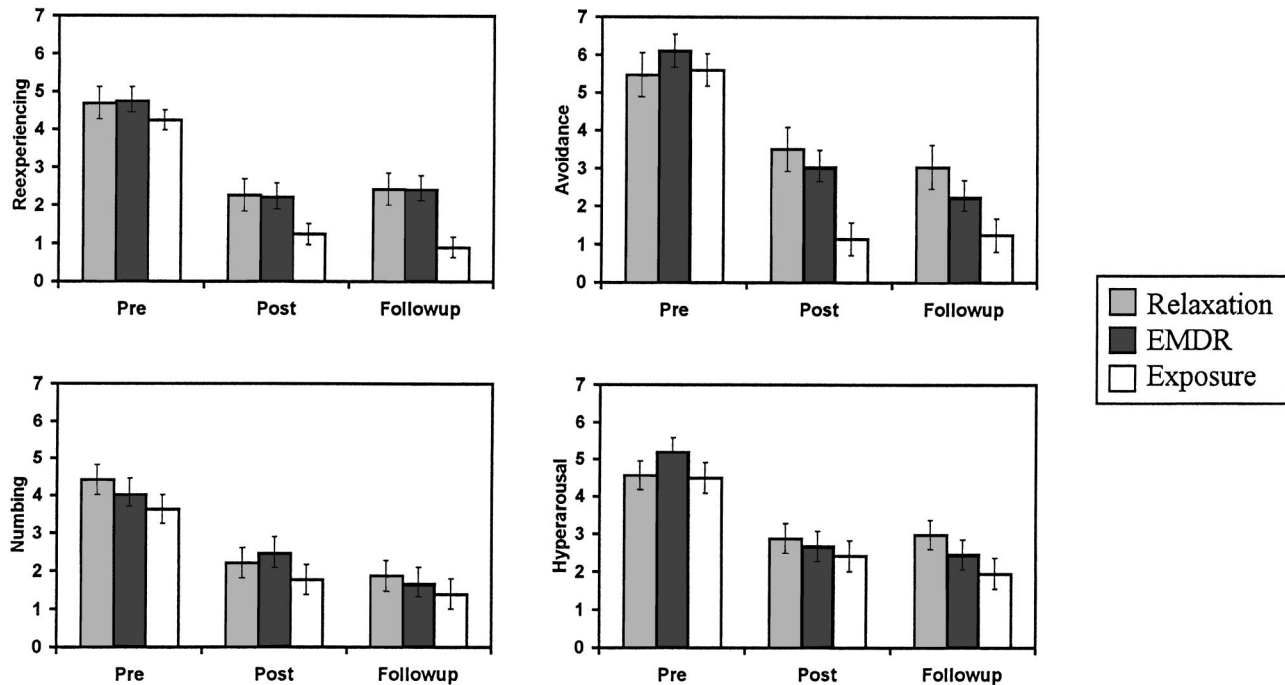


Figure 2. Means and standard errors for the four posttraumatic stress disorder (PTSD) dimensions, as assessed by the Clinician Administered PTSD Scale. Pre = pretreatment; Post = posttreatment; EMDR = eye movement desensitization and reprocessing.

it is more informative, powerful, and economical than performing separate analyses of posttreatment and follow-up data (Overall & Atlas, 1999). Treatment differences in efficacy and durability of treatment gains from posttreatment to follow-up can be examined in a single ANCOVA (i.e., as treatment main effects, time main effects, and Treatment \times Time interactions). The interactions indicate whether treatments differ in the durability of therapeutic effects. In the absence of Treatment \times Time interactions, outcome is assessed by treatment main effects, in which treatments are compared on the mean of posttreatment and follow-up values (adjusting for pretreatment values).

There was a significant time main effect for numbing, $F(1, 42) = 7.39, p < .01, \eta^2 = .15$, but not for the other PTSD dimensions, $F(1, 42) < 1.47, p > .1, \eta^2 < .03$. There were no significant Treatment \times Time interactions, $F(2, 42) < 0.68, p > .1, \eta^2 < .03$. These results, along with those in Figure 2, indicate a common pattern for the three treatments; from posttreatment to follow-up, numbing symptoms tended to decline, whereas reexperiencing, avoidance, and hyperarousal remained stable.

There were significant treatment main effects for reexperiencing and avoidance, $F(2, 41) > 4.14, p < .01, \eta^2 > .17$, but not for numbing and hyperarousal, $F(2, 41) < 1.31, p > .1, \eta^2 < .07$. For reexperiencing symptoms, exposure therapy was significantly more effective than both relaxation training, $F(1, 27) = 7.92, p < .01, \eta^2 = .23$, and EMDR, $F(1, 27) = 7.01, p < .02, \eta^2 = .21$. Similarly, for avoidance, exposure was more effective than relaxation training and EMDR: respectively, $F(1, 27) = 12.53, p < .001, \eta^2 = .32$; and $F(1, 27) = 4.61, p < .05, \eta^2 = .15$. EMDR and relaxation did not differ on reexperiencing, $F(1, 27) = 0.03, p > .1, \eta^2 = .00$, or avoidance, $F(1, 27) = 1.59, p > .1, \eta^2 = .06$.

Clinically significant change. To assess clinically significant change, we used a simple but useful method described by Jacobson and Truax (1991). For each of the four PTSD dimensions, as measured by the CAPS, we defined clinically significant change as a reduction in scores of at least two standard deviations. Participants were classified as to whether they met this criterion. We examined each dimension separately instead of the CAPS total score because our focus was on whether the treatments differed on the four dimensions.

Table 1 shows a general trend for exposure therapy to have the highest percentage of participants with clinically significant change. A number of these trends reached statistical significance. At follow-up, exposure outperformed relaxation on (a) reexperiencing, $\chi^2(1, N = 30) = 5.00, p < .03, \eta^2 = .17$, (b) avoidance, $\chi^2(1, N = 30) = 7.03, p < .01, \eta^2 = .24$, and (c) hyperarousal, $\chi^2(1, N = 30) = 4.82, p < .03, \eta^2 = .16$. For the sustained variable (i.e., clinically significant reductions at posttreatment and at follow-up), exposure therapy outperformed (a) relaxation training on reexperiencing, $\chi^2(1, N = 30) = 4.82, p < .03, \eta^2 = .16$, (b) EMDR on reexperiencing, $\chi^2(1, N = 30) = 6.53, p < .01, \eta^2 = .22$, (c) relaxation on avoidance, $\chi^2(1, N = 30) = 4.82, p < .03, \eta^2 = .16$, and (d) EMDR on avoidance, $\chi^2(1, N = 30) = 4.82, p < .03, \eta^2 = .16$. EMDR and relaxation training did not significantly differ from one another on any of the variables in Table 1.

Symptom worsening. We used Tarrier et al.'s (1999) criteria to define "worsening" as those treatment completers in which the CAPS total score increased over time. Worsening from pre- to posttreatment occurred in none of the EMDR or exposure participants and in only 1 relaxation participant. The difference among treatments was not significant, $\chi^2(2, N = 45) = 2.05, p > .1, \eta^2 =$

Table 1
Percentage of Participants with Clinically Significant (≥ 2 Standard Deviations) Reductions in Symptoms, as Assessed by the Clinician Administered PTSD Scale

Measure	Post	Follow-up	Sustained (post and follow-up)
Reexperiencing			
Relaxation	53	40	33
EMDR	53	47	27
Exposure	80	80	73
Avoidance			
Relaxation	40	40	27
EMDR	33	60	27
Exposure	67	87	67
Numbing			
Relaxation	40	47	33
EMDR	33	53	27
Exposure	47	53	33
Hyperarousal			
Relaxation	33	27	26
EMDR	40	40	20
Exposure	47	67	47

Note. PTSD = posttraumatic stress disorder; Post = posttreatment; EMDR = eye movement desensitization and reprocessing.

.05. Worsening from pretreatment to follow-up occurred for 1 EMDR participant, 1 relaxation participant, and no exposure participants, $\chi^2(2, N = 45) = 1.05, p > .1, \eta^2 = .02$. Treatments also did not differ in symptom worsening from posttreatment to follow-up, $\chi^2(2, N = 45) = 0.76, p > .1, \eta^2 = .02$.

Speed of change. This was examined for treatment completers using the self-report PTSD Symptom Severity Scale, assessed at the beginning of each therapy session, and at posttreatment and follow-up. For each of the four PTSD symptom dimensions, a repeated-measures ANCOVA was used to compare treatments in the speed and magnitude of treatment-related change. The covariate was the score obtained before the beginning of treatment (i.e., at the beginning of Session 1). The within-subject factor was time, representing changes in scores from Session 2 to follow-up. The between-subject factor was treatment condition, representing differences between conditions during the period of treatment and follow-up.

Scores declined significantly for all three treatments, $F(1, 42) > 6.67, p < .005, \eta^2 > .13$. Treatment \times Time interactions were nonsignificant, $F(2, 42) < 1.47, p > .1, \eta^2 < .08$. The treatment main effect was significant only for avoidance, $F(2, 41) = 5.06, p < .01, \eta^2 = .20$. For this variable, exposure was significantly more effective than relaxation, $F(1, 27) = 8.84, p < .006, \eta^2 = .25$. Although there was a trend for exposure to be more effective than EMDR, this was not statistically significant, $F(1, 27) = 3.24, p > .05, \eta^2 = .11$. Relaxation and EMDR did not differ in their effects on avoidance, $F(1, 27) = 1.92, p > .1, \eta^2 = .07$. Results indicate that exposure tended to work faster in reducing avoidance, as indicated by an initially larger reduction after Session 1 (graphs of session-by-session mean scores are available on request). The same pattern of results was obtained when we reanalyzed the data using hierarchical linear and nonlinear modeling (Raudenbush, Bryk, & Congdon, 2000).

Secondary outcome measures. Table 2 shows the results for the secondary outcome measures. For each treatment, the mean

scores significantly declined from pretreatment to follow-up for guilt, anger, and depression, $t(14) > 2.31, p < .05, \eta^2 > .27$. Dissociative symptoms significantly declined for exposure and relaxation, $t(14) > 2.25, p < .05, \eta^2 > .27$. There was a trend in the same direction for EMDR, $t(14) = 1.96, p = .07, \eta^2 = .22$.

We analyzed the treatment main effects (averaged across post-treatment and follow-up) and the time effects (changes from post-treatment to follow-up) by performing a repeated-measures ANCOVA for each variable. The pretreatment score served as the covariate. Treatment main effects were nonsignificant for all variables, $F(2, 41) < 1.02, p > .1, \eta^2 < .06$, and the Treatment \times Time interactions were also nonsignificant, $F(2, 42) < 2.14, p > .1, \eta^2 < .10$. These results indicate that the treatments did not significantly differ at posttreatment or follow-up and that the treatments did not differ in the changes in scores from posttreatment to follow-up.

The time main effect was nonsignificant for all variables except for depression. Scores on that variable tended to decline from posttreatment to follow-up, $F(1, 42) = 4.50, p < .01, \eta^2 = .10$. With this exception scores tended to remain stable between post-treatment and follow-up.

Effects of stressors. Treatment completers were classified according to whether they experienced stressful events (e.g., marital conflict, financial difficulties) during treatment or follow-up. The treatments did not differ in the proportion of participants experiencing stressors during treatment, $\chi^2(2, N = 45) = 1.22, p > .1, \eta^2 = .03$. Consistent with previous research (Taylor et al., 2001), stressors during treatment were common in the present study: relaxation 87%, EMDR 87%, exposure 73%. The treatments differed in the occurrence of stressors during follow-up, $\chi^2(2, N = 45) = 6.74, p < .04, \eta^2 = .15$. The proportions of participants experiencing stressful life events during the follow-up interval were as follows: relaxation 80%, EMDR 53%, and exposure 93%. The only significant difference was between EMDR and exposure, $\chi^2(1, N = 30) = 6.14, p < .02, \eta^2 = .21$.

Table 2
Means (and Standard Deviations) for Secondary Outcome Measures

Measure	Pre		Post		Follow-up	
	M	SD	M	SD	M	SD
Depression						
Relaxation	26.3	11.1	21.0	13.8	16.7	10.8
EMDR	26.4	10.0	16.4	9.1	14.4	11.0
Exposure	23.2	7.8	13.0	10.6	12.7	8.9
Dissociative symptoms						
Relaxation	1.2	1.1	0.1	0.4	0.6	1.0
EMDR	1.7	2.0	0.7	1.7	0.6	1.5
Exposure	1.7	1.6	0.7	1.4	0.6	1.3
Trauma-related guilt						
Relaxation	2.3	2.8	0.4	1.5	0.4	1.1
EMDR	3.6	3.5	1.8	2.7	0.5	1.5
Exposure	3.2	3.0	1.0	1.9	0.8	1.4
Trauma-related anger						
Relaxation	2.1	1.1	1.1	1.0	1.4	1.0
EMDR	1.9	1.2	1.1	1.0	0.9	1.0
Exposure	2.3	0.7	1.1	1.1	0.9	1.0

Note. Pre = pretreatment; Post = posttreatment; EMDR = eye movement desensitization and reprocessing.

If stressful events exacerbate PTSD symptoms, then the outcome at follow-up might be biased in favor of the treatment associated with the fewest stressors (EMDR) and against the treatment associated with the most frequent stressors (exposure therapy). To assess this possibility, we recomputed the results for the four CAPS PTSD dimensions, with two covariates added (presence vs. absence of stressors during treatment, and presence vs. absence of stressors during follow-up). Neither covariate was a significant predictor of outcome for any PTSD dimension; $t(39) < 1.26, p > .1, \eta^2 < .04$. Therefore, the pattern of treatment outcome results remained unchanged after controlling for stressors.

Effects of extraneous treatments. Treatment completers were classified according to whether they consulted an external mental health professional (counselor, psychologist, or psychiatrist) during the course of our study. Results indicated that participants generally adhered to our study requirements, with very few treatment completers seeing a counselor either during our treatment (2%) or during follow-up (4%). Similarly, few completers saw a nonstudy psychologist during our treatment (4%) or during follow-up (7%). Somewhat more participants saw a psychiatrist during our treatment (9%) or during follow-up (18%), usually for medication management. Our three treatments did not differ in the frequency of any of these three types of consultations during our treatment, $\chi^2(2, N = 45) < 4.19, p > .1, \eta^2 < .09$, or during follow-up, $\chi^2(2, N = 45) < 2.14, p > .1, \eta^2 < .05$.

Treatment completers were further classified according to whether their dose of psychotropic medication increased, decreased, or remained unchanged (i.e., unchanged dose or no medication) from pre- to posttreatment and from posttreatment to follow-up. Doses remained stable for most participants during treatment (87%) and during the follow-up interval (77%). The three treatment conditions did not differ in medication stability during treatment, $\chi^2(4, N = 45) = 7.96, p > .05, \eta^2 = .10$, or follow-up, $\chi^2(4, N = 45) = 3.06, p > .1, \eta^2 = .08$. Covarying out changes in medication did not alter the pattern of results.

Intent-to-Treat Analyses

Intent-to-treat analyses for the four PTSD symptom dimensions were based on all 60 participants, using the last available treatment outcome assessment. For treatment completers, this consisted of their follow-up scores (recall that scores did not significantly change from posttreatment to follow-up). The self-report PTSD Symptom Severity Scale was used for these analyses because this scale was administered at the beginning of each treatment session and thereby provided the last available data points for treatment dropouts. For each of the four PTSD symptom dimensions, outcome was assessed by an ANCOVA, with the pretreatment score serving as the covariate and the last available data point as the outcome variable. The three treatments did not differ on any of the outcome measures, $F(2, 56) < 2.44, p > .05, \eta^2 < .08$. Taken with the results for treatment completers, which suggest some advantages to exposure, the intent-to-treat results reflect the fact that group differences are diluted when dropouts are included (most of whom received little or no treatment).

Discussion

Previous studies have shown that PTSD tends to persist in the absence of treatment (e.g., Taylor et al., 2001; van Etten & Taylor, 1998). Our sample consisted of people with longstanding PTSD, so the changes from pre- to posttreatment were unlikely to be due to the mere passage of time. Therefore, it is noteworthy that all three treatments were associated with reductions in PTSD symptoms. These findings suggest that all three treatments were efficacious (to various degrees) in reducing PTSD.

As in previous studies (e.g., van Etten & Taylor, 1998), we found that the PTSD treatments were also associated with reductions in depression. Few other PTSD studies have comprehensively evaluated the effects on other features commonly associated with PTSD, such as dissociative symptoms and trauma-related anger and guilt. We found all three treatments to be associated with reductions in these symptoms.

Our treatments did not differ in the incidence of symptoms worsening, defined by Tarrier et al.'s (1999) criteria. Contrary to Tarrier et al.'s claim, we found that symptom worsening was rare, regardless of treatment type. Further research is required to identify the conditions under which symptom worsening is least likely to occur. Therapist skill may be an important factor. Skilled therapists, for example, may be better able to guide the pacing and difficulty of exposure exercises. Some lesser skilled therapists might tend to push participants to attempt exposure exercises that are too distressing to endure, resulting in aborted (and brief) exposures to intensely distressing stimuli. Such experiences of failed exposure may promote future avoidance and, therefore, be countertherapeutic.

Although our three treatments were similar in several of their effects, there were some noteworthy differences. For treatment completers, exposure therapy, compared with EMDR and relaxation training, tended to be most efficacious in reducing reexperiencing and avoidance symptoms and worked more rapidly in reducing avoidance. Exposure therapy also tended to yield the highest proportion of participants who no longer met *DSM-IV-TR* criteria for PTSD.

There are several strengths and limitations to our study. In terms of strengths, our study met all of Foa and Meadows' (1997) gold standards for methodologically sound treatment outcome research. That is, we used clearly defined target symptoms; reliable and valid measures; blind evaluators; adequately trained assessors; manualized, replicable, and specific treatments; unbiased assignment to treatment; and evaluation of treatment adherence. As per the recommendations of Foa and Meadows, we also had more than one therapist deliver the treatments to separate therapist effects from treatment effects. To our knowledge, ours is the first study of EMDR for PTSD that meets all of Foa and Meadows' gold standards.

The present study also has its limitations. Our sample tended to have severe, chronic PTSD, so it remains to be seen whether our findings generalize to milder, less entrenched symptoms. Although our sample size was as large as or larger than those of many other PTSD treatment studies, it would have been desirable to have had an even larger sample to conduct regression analyses to identify predictors of outcome for each treatment condition.

Our finding that exposure therapy tended to be more effective than relaxation training is consistent with Marks et al. (1998). Our

finding that exposure therapy tended to be more effective than EMDR is consistent with some studies (e.g., Devilly & Spence, 1999) but not others (e.g., Lee et al., 2002). The methodological limitations of previous research may account for the inconsistencies. For example, unlike many other studies comparing EMDR with exposure-based treatments, we used blind, independent evaluations to assess treatment outcome, and we established that our treatments were satisfactorily delivered (for extended discussions of the limitations of previous studies see, for example, Devilly, in press; Foa & Meadows, 1997; Maxfield & Hyer, 2002).

Although our study was not intended to investigate treatment mechanisms, the findings suggest some avenues for identifying important treatment ingredients. Given the efficacy of exposure therapy, along with the importance of exposure in teaching PTSD sufferers not to fear harmless, trauma-related stimuli (i.e., exposure to corrective information; Foa & Rothbaum, 1998), the question arises as to whether exposure is an important ingredient in relaxation training and in EMDR. As mentioned in the introduction, relaxation might work by reducing hyperarousal; once the person feels calmer, he or she may be less likely to avoid trauma-related stimuli. In other words, relaxation exercises might facilitate in vivo exposure, even in the absence of exposure exercises provided by a therapist. This could be tested by comparing (a) relaxation training plus antiexposure instructions with (b) relaxation training without any explicit exposure instructions. If relaxation training works largely by promoting naturally occurring exposure, then the effects of relaxation should be severely undermined by antiexposure instructions. The same may be true of EMDR: "Evidence suggests that the eye movements integral to the treatment, and to its name, are unnecessary" (Davidson & Parker, 2001, p. 305), which raises doubt about the value of other sorts of oscillatory stimulation used in EMDR, such as hand tapping.¹ A further concern is the lack of a convincing rationale for expecting eye movements and hand tapping to reduce PTSD (Foa & Rothbaum, 1998). The effects of EMDR may be due largely to imaginal exposure during sessions, which in turn may facilitate naturally occurring in vivo exposure. Some evidence suggests that imaginal exposure plays an important role in EMDR (e.g., Devilly, in press). The effects of naturalistic in vivo exposure could be assessed by comparing EMDR (as routinely used) with EMDR with antiexposure instructions (i.e., instructions to avoid all forms of in vivo exposure). The importance of naturalistic in vivo exposure would be revealed by the extent to which the efficacy of EMDR is undermined when such exposure is reduced.

¹ Some clinical investigators, however, continue to believe that eye movements are clinically useful (Maxfield, in press).

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