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# How eye movements in EMDR work: Changes in memory vividness and emotionality

Arne Leer*, Iris M. Engelhard, Marcel A. van den Hout

*Department of Clinical & Health Psychology, Utrecht University, P.O. Box 80140, 3508 TC Utrecht, The Netherlands*

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ABSTRACT

*Background and objectives:* Eye movements (EM) during recall of an aversive memory is a treatment element unique to Eye Movement Desensitization and Reprocessing (EMDR). Experimental studies have shown that EM reduce memory vividness and/or emotionality shortly after the intervention. However, it is unclear whether the immediate effects of the intervention reflect actual changes in memory. The aim of this study was to test whether immediate reductions in memory vividness and emotionality persist at a 24 h follow up and whether the magnitude of these effects is related to the duration of the intervention.
*Methods:* Seventy-three undergraduates recalled two negative autobiographical memories, one with EM ("recall with EM") and one without ("recall only"). Half of participants recalled each memory for four periods of 24 s, the other half for eight periods of 24 s. Memory vividness/emotionality were self-rated at a pre-test, an immediate post-test, and a 24 h follow-up test.
*Results:* In both duration groups, recall with EM, but not recall only, caused an immediate decrease in memory vividness. There were no immediate reductions in memory emotionality. Furthermore, only the 'eight periods' group showed that recall with EM, but not recall only, caused a decrease in both memory emotionality and memory vividness from the pre-test to the follow-up.
*Limitations:* Only self-report measures were used.
*Conclusions:* The findings suggest that recall with EM causes 24-h changes in memory vividness/emotionality, which may explain part of the EMDR treatment effect, and these effects are related to intervention duration.



## 1. Introduction

Eye movement desensitization and reprocessing (EMDR) is a treatment for posttraumatic stress disorder (PTSD; APA, 2004; NICE, 2005), and an element unique to EMDR is that patients are instructed to make eye movements (EM) while recalling traumatic memories. Meta-analyses have shown that EMDR for PTSD is effective (e.g., Bisson et al., 2007; Seidler & Wagner, 2006), and that the EM component adds to its effects (Lee & Cuijpers, 2013). Until recently, however, there was little consensus on *how* EM might contribute to the effectiveness of EMDR (for an overview and critical testing of the competing theories, see Gunter & Bodner, 2008). This is relevant because theory on how EM work may inform how to best apply the EM in EMDR therapy.

Recent research has focused on the mechanism that underlies the EM effect and there is now much experimental data that support a working memory (WM) account (e.g., Gunter & Bodner, 2008; Van den Hout & Engelhard, 2012; Maxfield, Melnyk, & Hayman, 2008). WM theory emphasizes the limited capacity of WM and the finding that when two demanding tasks are performed simultaneously performance degrades (e.g., Baddeley & Andrade, 2000). Accordingly, when both EM and mental imagery are performed simultaneously, short-term storage capacity and rehearsal processes are divided and the memory comes to mind in a degraded form. Early evidence for WM theory came from experimental studies that showed that EM during recall of negative autobiographical memories renders imagery less vivid and emotional *while* EM are made compared to recall without EM (Andrade, Kavanagh, & Baddeley, 1997, exp. 4; Kavanagh, Freese, Andrade, & May, 2001).

These results, however, cannot account for the clinical observation that EMDR affects the vividness/emotionality of memory recall *after* a treatment session. Therefore, other studies have

* Corresponding author. Tel.: +31 302531470; fax: +31 302534718.
*E-mail addresses:* a.leer@uu.nl, A.Leer@uu.nl (A. Leer).

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included a test in which memory vividness/emotionality were assessed before and shortly after the intervention phase. These studies consistently demonstrated that the effects of EM extended beyond the intervention (e.g., Engelhard, van den Hout, Janssen, & van der Beek, 2010; Gunter & Bodner, 2008; van den Hout, Engelhard, Beetsma, et al., 2011; van den Hout, Muris, Salemink, & Kindt, 2001; Kemps & Tiggemann, 2007). Thus, the experimental data corroborate clinical observations, but it is unclear how the effects shortly after the intervention might be explained. Van den Hout et al. (2001) offered two competing accounts. First, because the post-test takes place *immediately* after the intervention, the memory vividness/emotionality ratings at the post-test may become confused with what was experienced during the intervention. Accordingly, reductions in memory vividness/emotionality from the pre-test to the post-test may *not* reflect changes in the phenomenological quality of memory. If this is true, one would not expect any reductions caused by EM from pre-test to a substantially delayed post-test. Second, the observed reductions from the pre-test to the post-test may reflect actual *changes* in memory. Several authors have suggested that the EM procedure changes the experience of the memory and that this changed memory is (re)consolidated in long-term memory (e.g., van den Hout & Engelhard, 2012; van den Hout et al., 2010; Maxfield et al., 2008). If this explanation is correct, then one would expect reductions in memory vividness/emotionality from the pre-test to a delayed post-test. Thus, to get a better understanding of how EM work, it is relevant to investigate (relatively) long-term effects.

To the best of our knowledge, five studies have been conducted so far that (1) compared "recall with EM" to a "recall only" condition and (2) employed a pre-test and a delayed post-test (i.e., a 1-week follow-up) (Gunter & Bodner, 2008, exp. 2; Kavanagh et al., 2001; Lee & Drummond, 2008; Lilley, Andrade, Turpin, Sarbin-Farrell & Holmes, 2009; Schubert, Lee, & Drummond, 2011), and one of them used a clinical sample (Lilley et al., 2009). To determine whether these studies provide evidence that EM change memory, we examined the differences between ratings at pre-test and ratings at follow-up (cf. Gunter & Bodner, 2008, exp. 2). The alternative method, to compare ratings at immediate post-test to ratings at follow-up, is subordinate, because, as noted before, it is unclear what the ratings at immediate post-test reflect (van den Hout et al., 2001). All five studies assessed memory vividness. One did not find long-term decreases, neither in recall with EM nor in recall only (Lilley et al., 2009), and one only reported that changes over time did not differ between the two interventions (but not whether there was a main effect of time; Lee & Drummond, 2008). Two studies showed that vividness ratings were lower at follow-up than at pre-test in both recall with EM and recall only (Kavanagh et al., 2001; Schubert et al., 2011). Only Gunter and Bodner (2008) demonstrated that reductions were larger in recall with EM than in recall only, which means that the decreases in memory vividness could be attributed to the EM procedure rather than imaginal exposure. Thus, only one out of five studies showed that EM caused long-term decreases in memory vividness. Three of the five studies also assessed memory emotionality (Gunter & Bodner, 2008; Kavanagh et al., 2001; Lilley et al., 2009). One reported that memory emotionality ratings were lower at follow-up than at pre-test in both recall with EM and recall only (Kavanagh et al., 2001; there was only a marginal effect in Lilley et al., 2009). Again, only in Gunter and Bodner (2008) reductions were larger in recall with EM than in recall only. Thus, only one out of three studies showed that EM caused long-term decreases in memory emotionally.

Overall, it may be concluded that the findings are mixed and there is yet little evidence that EM change memory vividness/emotionality. The inconclusiveness of the data may not be surprising considering the diversity in experimental designs. Kavanagh et al. (2001) speculated that the absence of long-term effects in their study may have been affected by their short recall duration (64 s), which may also account for the null results reported in Lilley et al. (2009) who used an identical recall period (also note that Lilley et al. tested a clinical sample that may not benefit from such a brief intervention). For EM effects to be detected after one week, perhaps a longer intervention is needed. In line with this suggestion, the only study that demonstrated long-term changes employed a recall period of 96 s (Gunter & Bodner, 2008). In addition, both Lee and Drummond (2008) and Schubert et al. (2011) used recall periods up to 45 min but did not assess memory emotionality. It is thus unclear whether changes in memory emotionality persist or disappear when the intervention duration exceeds 96 s.

The goal of the current experiment was (1) to replicate Gunter and Bodner's (2008) reductions in memory vividness and emotionality at a delayed post-test and (2) to test whether intervention duration is involved in the magnitude and/or detection such effects. Whereas the studies discussed earlier scheduled their follow-up test seven days after the intervention, we tested 24 h later. Note that the previous studies aimed to test 'long-term' effects of the EM procedure. In contrast, the objective of the current study was to critically test an explanation of the well-documented 'immediate' effects of the EM procedure. As extending the period in between intervention and follow-up likely increases drop-out rates, and thereby reduces power, the current design seems to provide a better test of our hypothesis. All participants recalled one aversive autobiographical memory with EM and one without. To investigate the effect of intervention duration half of participants recalled each memory for four periods of 24 s (cf. Gunter & Bodner, 2008), the other half for eight periods of 24 s. Memory vividness and emotionality were self-rated at a pre-test, a post-test, and a 24 h follow-up. We predicted that (1) reductions from the pre-test to the follow-up would be larger for recall with EM than for recall only and (2) that intervention duration would be positively related to the magnitude of these effects.

## 2. Material and methods

### 2.1. Participants

Seventy-three undergraduates with a mean age of 21.52 years (range = 18–28; $SD = 2.30$; 44 women) participated in exchange for a financial reward or course credits. They were randomly assigned to one of two groups: 'four periods', $n = 36$; 'eight periods', $n = 37$. Exclusion criteria were knowledge about EMDR, prior participation in an experiment that required participants to recall memories, or recent intake of tranquilizers. Sixty-nine participants (response rate: 95%; four periods, $n = 34$; eight periods, $n = 35$) returned for the follow-up assessment.

### 2.2. Materials and procedure

Participants were seated in a dim room about 45 cm in front of a computer screen. After receiving oral and written instructions, they provided written informed consent. By order of appearance they were assigned to the four periods or eight periods group. On day 1, all participants recalled one memory with eye movements ("EM") and another memory without (recall only: "RO") following the procedure used by van den Hout et al. (2001). They provided ratings for memory vividness and emotionality before and shortly after the intervention, and 24 h later.

On day 1, the experiment started with a memory selection phase. Participants were instructed: 'Try to recall two autobiographical events that make you fearful or sad and still have

emotional impact on you, for example 'going unprepared into an examination' or 'witnessing an accident'. Form an image of each memory and write down some keywords on a label that easily remind you of the memory'. They were left alone for a few minutes and then reported their memories to the experimenter, rated unpleasantness of each memory (0 = not unpleasant at all, 10 = very unpleasant), and recalled another event when their rating was lower than 6. Based on these ratings, memories were ranked and balanced over the EM and RO conditions.

Next, there was a pre-test, a recall phase, and a post-test for each condition. These phases directly followed each other up and order of conditions was balanced. First, participants were provided one of the two memory labels and received instructions: 'Form an image of this memory and keep your eyes open. Remember where it happened, who was present, and anything else you can think of. Bring it to mind as if it were happening right now and please indicate when the image is vivid'. After 10 s of recall, participants rated their memory on 100 mm computerized visual analogue scales (VASs) for vividness, emotionality, and difficult recalling (0 = not vivid/unpleasant/difficult at all, 100 = very vivid/unpleasant/difficult). Then, participants recalled their memory four or eight times for 24 s and simultaneously followed a grey dot (Ø 1 cm) that horizontally moved 21.5 cm across a black computer screen at 1 cycle per second (EM), or looked at a black computer screen (RO). Recall periods were separated by 10 s breaks during which participants were instructed to stop recalling the memory and to focus on something else. At the post-test, they recalled their memory again for 10 s and rated it for vividness and emotionality. When both conditions were finished, participants rated for each condition to what extent they actually recalled their memory during the 24 s recall periods (0 = not at all; 100 = all the time). Finally, they were asked to return to the lab 24 h later.

After a 24 h break ($M$ = 24 h 22 min, $SD$ = 37 min, range = 23 h 55 min–27 h 10 min) participants recalled each memory again for 10 s, in balanced order, and rated its vividness and emotionality. They were then debriefed and given compensation.

### 2.3. Data analyses

There were 3 outliers in the four periods group and 1 in the eight periods group that were replaced[1] by $M \pm 2.5$ $SD$. Immediate changes in memory ratings were analysed by repeated measures ANOVAs with Time (pre-test vs. post-test) and Condition (EM vs. RO) as within-subjects factors and Duration (four periods vs. eight periods) as between-subjects factor. Twenty-four-hour changes were investigated with similar analyses that compared the ratings at pre-test and follow-up. To control for Type I error rates for multiple comparisons, the Bonferroni correction was applied to post-hoc comparisons, which resulted in testing at a .005 (.05/10) alpha level. Tests that were crucial to the hypothesis were one-tailed.

## 3. Results

### 3.1. Randomization check and a priori differences

No differences were found between the two duration groups in age, $t(71) = 1.45$, $p = .15$, or gender ratio, $\chi^2(1, N = 73) = 1.67$, $p = .20$. Furthermore, Duration × Condition ANOVAs on pre-test ratings showed no main effects or interactions for memory vividness, largest $F(1, 71) = 1.02$, $p = .32$, memory emotionality, $F$s < 1, or difficulty recalling the memories, $F$s < 1, meaning that randomization of memories to conditions and duration groups was successful. As expected, during EM ($M$ = 38.59, $SD$ = 25.14) participants were less able to recall their memory than during RO ($M$ = 75.37, $SD$ = 18.34), $F(1, 71) = 141.02$, $p < .001$, $\eta\rho^2 = .67$, which did not differ between duration groups, $F < 1$.

### 3.2. Immediate effects

First, we tested whether the widely reported immediate effects of EM were replicated.

#### 3.2.1. Vividness

The ANOVA showed no main effects for Time, $F(1, 71) = 2.73$, $p = .10$, Condition, $F(1, 71) = 3.36$, $p = .07$, or Duration, $F(1, 71) = 1.58$, $p = .21$. There were interaction effects for Time × Condition, $F(1, 71) = 15.95$, $p < .001$, $\eta\rho^2 = .18$, and Time × Duration, $F(1, 71) = 4.39$, $p < .05$, $\eta\rho^2 = .06$, but not for Condition × Duration, $F < 1$. The three-way interaction was not significant, $F < 1$, meaning that changes over time differed between EM and RO, irrespective of intervention duration. $T$-tests revealed that vividness ratings decreased in EM, $t(72) = 3.30$, $p = .002$, $d = .40$, but did not change in RO, $t(72) = 1.39$, $p = .17$. Thus, irrespective of the intervention duration, EM, but not RO, caused an immediate decrease in memory vividness (see Fig. 1).

#### 3.2.2. Emotionality

The analysis on emotionality ratings did not yield main effects or two-way interactions, largest $F(1, 71) = 1.77$, $p = .19$. There was,

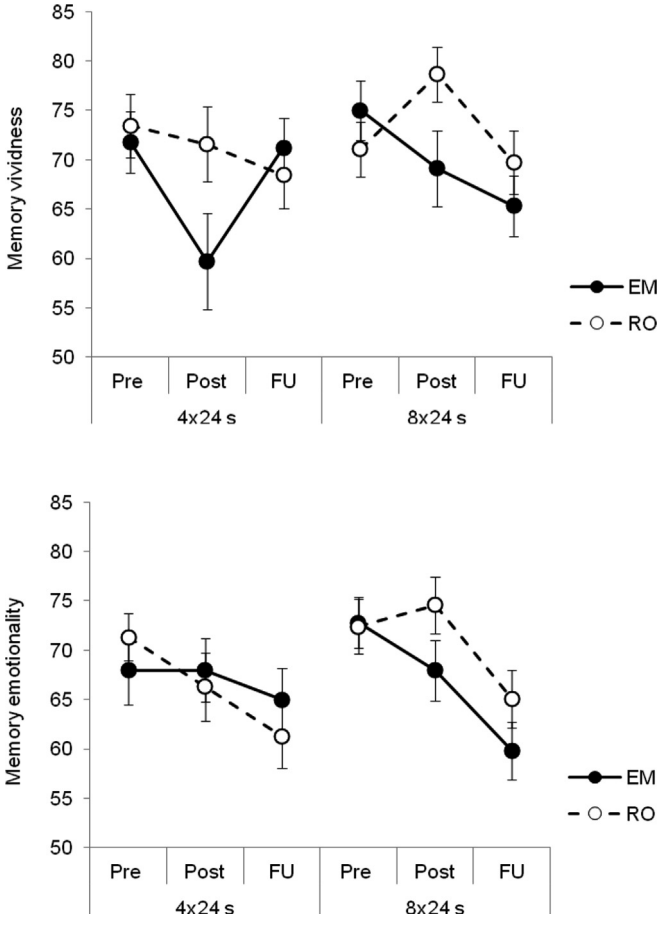


**Fig. 1.** Mean memory vividness (upper panel) and memory emotionality ratings (lower panel) before (Pre) and immediately after the intervention (Post), and at 24 h follow-up (FU). Error bars indicate SEM.

[1] The reduction of outliers did not influence the absence or presence of effects.

however, a three-way interaction, $F(1, 71) = 6.65$, $p < .05$, $\eta\rho^2 = .09$. Follow up 2 × 2 ANOVAs for each duration group showed no effects after four periods, largest $F(1, 35) = 1.73$, $p = .20$, and only a Time × Condition interaction effect after eight periods, $F(1, 36) = 6.70$, $p < .05$, $\eta\rho^2 = .16$. *T*-tests revealed that emotionality ratings did not decrease in either EM, $t(36) = 2.03$, $p = .05$, or RO, $t(36) = 1.04$, $p = .31$. Thus, no immediate reductions in memory emotionality were found.

### 3.3. Twenty-four-hour effects

#### 3.3.1. Vividness

A comparison between pre-test and follow-up ratings showed a main effect for Time, $F(1, 67) = 5.82$, $p < .05$, $\eta\rho^2 = .08$, but not for Condition or Duration, $Fs < 1$. There were no two-way interactions, largest $F(1, 67) = 1.09$, $p = .30$, but the three-way interaction was significant, $F(1, 67) = 4.36$, $p < .05$, $\eta\rho^2 = .06$. To understand this interaction, Time × Condition ANOVAs were performed for each duration group. In the four periods group there were no main effects, $Fs < 1$, or interaction effect, $F(1, 33) = 1.05$, $p = .31$. In the eight periods group there was a main effect for Time, $F(1, 34) = 5.85$, $p < .05$, but not for Condition, $F < 1$. Crucial to our hypothesis, the Time × Condition interaction was significant, $F(1, 34) = 3.73$, $p = .031$ (one-tailed), $\eta\rho^2 = .10$. *T*-tests revealed that in EM vividness ratings were lower at follow up than at pre-test, $t(34) = 3.07$, $p = .004$, $d = .59$, but not in RO, $t < 1$.

#### 3.3.2. Emotionality

A similar analysis on emotionality ratings showed only a main effect of Time, $F(1, 67) = 28.30$, $p < .001$, $\eta\rho^2 = .30$, and a three-way interaction, $F(1, 67) = 7.30$, $p < .01$, $\eta\rho^2 = .10$, all other $Fs < 1$. To break down the interaction effect, Time × Condition ANOVAs were performed for each duration group. In the four periods group there was no main effect for Condition, $F < 1$, but there was a main effect for Time, $F(1, 33) = 8.30$, $p < .01$, $\eta\rho^2 = .20$, and a significant interaction effect, $F(1, 33) = 4.42$, $p < .05$, $\eta\rho^2 = .12$. *T*-tests showed that, in contrast to expectations, emotionality ratings decreased in RO, $t(33) = 3.99$, $p < .001$, $d = .67$, but not in EM, $t(33) = 1.05$, $p = .30$. In the eight periods group there was no main effect for Condition, $F < 1$, but there was a main effect for Time, $F(1, 34) = 23.68$, $p < .001$, $\eta\rho^2 = .41$, which was, as hypothesized, qualified by a Condition × Time interaction, $F(1, 34) = 2.98$, $p = .047$ (one-tailed), $\eta\rho^2 = .08$. *T*-tests showed that emotionality ratings dropped in EM, $t(34) = 4.77$, $p < .001$, $d = .79$, but not in RO, $t(34) = 2.53$, $p = .02$ (note that $\alpha = .005$).

In sum, four periods of recall only caused a decrease in memory emotionality at the 24-h follow-up and eight periods of recall with EM caused decreases in both memory vividness and memory emotionality at the 24-h follow-up.

## 4. Discussion

This aim of this investigation was to replicate Gunter and Bodner's (2008) finding of EM effects at a delayed post-test and to test whether the magnitude of these effects is related to intervention duration. On the one hand, we did not replicate Gunter and Bodner (2008): our four periods group (cf. Gunter & Bodner, 2008) did not show changes in memory vividness/emotionality from the pre-test to the follow-up. This may relate to the immediate reductions that were smaller in our study. By comparing the two duration groups in the present study (Fig. 1), it may be hypothesized that direct drops in scores are predictive of reductions 24 h later for memory emotionality, but not for memory vividness. Indeed, correlation analyses showed that immediate reductions caused by EM were related to reductions 24 h later for memory emotionality, $r = .55$, $p < .001$, but not for memory vividness, $r = .22$, $p = .064$. On the other hand, our eight periods group did provide the first replication of Gunter and Bodner (2008) that recall with EM produces changes in memory vividness/emotionality 24 h later compared to recall only. Hence, the hypothesis that intervention duration is positively related to the magnitude of these effects was confirmed.

In our four periods group we did not find effects of EM at the follow-up test, which agrees with previous investigations that employed a relatively short intervention duration (64 s; Kavanagh et al., 2001; Lilley et al., 2009). The authors of these studies speculated that EM do not directly affect desensitization (i.e., reduce emotional reactivity to the memory) but may rather serve an aid that facilitates exposure to highly emotive memory. This explanation, however, contradicts our findings in the eight periods group as well as Gunter and Bodner's (2008) follow-up effects. Gunter and Bodner (2008) found that immediate reductions in memory emotionality persisted at the follow-up and that immediate reductions in memory vividness were significantly smaller at the follow-up. They speculated that EM may not permanently change memory vividness, but may rather facilitate imaginal exposure (Kavanagh et al., 2001) and thereby foster desensitization. Alternatively, they also speculated that their intervention duration (96 s) may have been too short to produce persisting effects in memory vividness. The present findings support the latter hypothesis. The eight periods group employed a recall period that was twice as long as Gunter and Bodner (2008), and produced reductions in memory vividness shortly after the intervention that persisted one day later. In addition, compared to the immediate post-test memory emotionality ratings were even lower at the follow-up. Together, these findings suggest that EM during recall may have long-term effects on emotional memories. Moreover, and in line with our hypothesis, these effects were related to intervention duration.

The findings have several implications. First, they provide corroborating evidence that EM change memory vividness and emotionality, which may explain part of the EMDR treatment effect. They are consistent with prior research suggesting that EM reduce memory accessibility (van den Hout, Bartelski, & Engelhard, 2013) and with other work demonstrating that EM attenuate fear potentiated startle responses during recall of the memory (Engelhard, van Uijen, & van den Hout, 2010). The 24-h changes further correspond with recent suggestions that the reductions in vividness/emotionality during the intervention retrievals are reconsolidated in long-term memory and therefore recall of the 'updated' memory elicits less distress (e.g., van den Hout, Engelhard, Beetsma, et al., 2011; van den Hout et al., 2010; Maxfield et al., 2008). Note, however, that the mere observation of lasting effects does not proof the reconsolidation account of EM. Reconsolidation, by definition, implies that the original memory trace is changed (Nader & Hardt, 2009). There are at least two alternative explanations. First, it may be the case that EM cause the formation of a *new* memory trace, like exposure to a feared stimulus leads to the formation of a new memory (i.e., that the feared stimulus is not predictive of a catastrophic outcome) rather than erasing or updating the original 'fear memory' (Vervliet, Craske, & Hermans, 2013). Fear conditioning experiments have shown that retrieval/expression of the new extinction memory is context-specific, i.e. extinction memory is typically activated in the context where it was created (e.g., Bouton, 2002; Hermans, Craske, Mineka, & Lovibond, 2006; Vervliet et al., 2013). Notably, this (at least partially) explains the return of fear after extinction. Future research may test the hypothesis that EM affect updating of the original memory and that EM effects generalize across contexts. Second, the observed changes in ratings may reflect shifts in how participants *relate* to their memory rather than phenomenological

changes. As Gunter and Bodner (2008) put it: "By experiencing the memory in a weakened form (…) people may change some of their beliefs about how dangerous their memories are, as well as their beliefs about their ability to cope with remembering them". Changes in memory emotionality may thus reflect changes in memory *appraisal*. In contrast, the (often) observed changes in memory vividness point towards changes in the phenomenological quality of the memory. One way to gain more insight into effects of EM on memory is to use a more comprehensive assessment of memory features (e.g., including multiple perceptual and contextual details), such as the Memory Characteristics Questionnaire (Johnson, Foley, Suengas, & Raye, 1988).

The findings further encourage future studies that investigate (relatively) long-term effects of EM to use an intervention duration of eight periods of 24 s or longer. Note, however, that two studies using healthy student samples and sessions of up to 45 min of imaginal exposure with or without EM did not find direct or long-term differential reductions in memory vividness (Lee & Drummond, 2008; Schubert et al., 2011). These studies suggest that, in nonclinical samples, prolonged imaginal exposure with EM may be equally effective as prolonged imaginal exposure only. As the current hypothesis was tested using a student sample and required the presence of immediate effects, we employed an intervention that lasted only a few minutes. Future studies using clinical samples or investigating different hypotheses (e.g., about the optimal intervention duration) may be advised to employ a greater number of trials.

Several other issues deserve further attention. First, the results regarding immediate reductions corroborate earlier findings that EM during recall of aversive memory, relative to recall only, cause a *direct* decrease in memory vividness (e.g., Engelhard, van den Hout et al., 2010; Gunter & Bodner, 2008; van den Hout et al., 2001; van den Hout, Engelhard, Beetsma, et al., 2011; Kemps & Tiggemann, 2007; Kristjánsdóttir & Lee, 2011; Smeets, Dijs, Pervan, Engelhard, & van den Hout, 2011). Yet, in contrast to most earlier investigations (but see Maxfield et al., 2008, exp. 1; van den Hout, Engelhard, Rijkeboer, et al., 2011), EM did not cause direct reductions in memory emotionality. Note, however, for the eight periods group, that both Fig. 1 and the medium effect size of drops in scores ($r = .32$) suggest that the lack of statistical evidence for an effect resulted from the rather conservative testing procedure. Next, we found that four periods of mere recall caused a drop in memory emotionality at the delayed post-test. As this finding is inconsistent with both our expectations and previous findings (Gunter & Bodner, 2008; Kavanagh et al., 2001; Lilley et al., 2009), we believe that at present any conclusions regarding this effect are premature. Finally, previous research suggests there is an optimal degree of taxing WM, i.e. that the dose–response relationship with beneficial effects is inverted U-shaped rather than linear (Engelhard, van den Hout, & Smeets, 2011). Future studies may investigate whether there is an optimal intervention duration.

There were several limitations of this study. First, only self-report measures were used and demand effects cannot be ruled out. However, such effects seem unlikely. It has been shown that EM benefits occur when EM are made *during* recall but not when made *before* recall, while participants' expectancies about their effectiveness should not differ (Gunter & Bodner, 2008, exp. 1). Furthermore, EM effects have been replicated with measures that are less prone to demand effects, like the fear potentiated startle response (Engelhard et al., 2010) and reaction times (van den Hout et al., 2013). Second, a nonclinical sample was tested. Kavanagh et al. (2001) pointed out that student and clinical samples may differ in the degree of intrusiveness and emotionality of the memories involved. These groups may also differ in working memory capacity, which correlates with the effectiveness of EM (Gunter & Bodner, 2008; van den Hout & Engelhard, 2012). It is therefore unclear whether the present findings may be generalized to clinical populations.

In sum, this study provides corroborating evidence that EM during recall causes reductions in memory vividness and emotionality at a delayed post-test and that the magnitude of these effects is related to intervention duration. Future investigations may focus on the optimal intervention duration.

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