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To cite this article: Suzy J.M.A. Matthijssen, Thomas Brouwers, Celeste van Roozendaal, Tessa Vuister & Ad de Jongh (2021) The effect of EMDR versus EMDR 2.0 on emotionality and vividness of aversive memories in a non-clinical sample, *European Journal of Psychotraumatology*, 12:1, 1956793, DOI: [10.1080/20008198.2021.1956793](https://doi.org/10.1080/20008198.2021.1956793)

To link to this article: <https://doi.org/10.1080/20008198.2021.1956793>



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Published online: 22 Sep 2021.



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## The effect of EMDR versus EMDR 2.0 on emotionality and vividness of aversive memories in a non-clinical sample

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### ABSTRACT

**Background:** Eye movement desensitization and reprocessing (EMDR) therapy is a treatment meant to reduce vividness and emotionality of distressing memories. There is accumulating evidence that working memory taxation is the core of the working mechanism of EMDR therapy and that EMDR derives its effect by taxing the working memory (WM) with a dual task while actively keeping a disturbing memory in mind. From a theoretical stance, based upon assumptions derived from the WM theory, the effectiveness of EMDR therapy could be improved by several adaptations.

**Objectives:** To test the assumption that integrating these elements into the standard EMDR protocol would enhance EMDR therapy, this adapted version of EMDR (i.e. EMDR 2.0), was compared to standard EMDR in a laboratory setting. It was hypothesized that EMDR 2.0 would be more efficacious than standard EMDR, and show a greater decrease in emotionality and vividness than standard EMDR therapy. Our second hypothesis was that EMDR 2.0 would be more efficient than standard EMDR in that this variant needs less session time and a smaller number of sets (i.e. approximately 30 seconds of WM taxation).

**Method:** Non-clinical participants ( $N = 62$ , 79% female, mean age = 35.21) with a disturbing autobiographical memory were randomly allocated to receive either EMDR or EMDR 2.0. Emotionality and vividness of the memory were measured pre- and post-intervention, and at 1- and 4-week follow-up.

**Results:** The results showed no difference between EMDR and EMDR 2.0 in decreasing emotionality and vividness, and no difference in session time. However, participants in the EMDR 2.0 condition needed fewer sets than those in the standard EMDR condition.

**Conclusion:** The notion that EMDR 2.0 is more efficient is partially supported by the results showing participants needed less sets than in standard EMDR to reach the same results. Future research with clinical samples is warranted.

### ARTICLE HISTORY

Received 19 November 2020

Revised 8 June 2021

Accepted 27 June 2021

### KEYWORDS

PTSD; EMDR; EMDR 2.0; emotional memories

### PALABRAS CLAVE

TEPT; EMDR; EMDR 2.0; memorias emocionales

### 关键词

PTSD; EMDR; EMDR 2.0; 情绪记忆

### HIGHLIGHTS

- EMDR 2.0 requires fewer desensitization sets than EMDR to reach the same effect, suggesting more efficiency.

## El efecto de EMDR versus EMDR 2.0 en la emocionalidad y la vivacidad de las memorias aversivas en una muestra no clínica

**Introducción:** La terapia de desensibilización y reprocesamiento por movimientos oculares (EMDR en su sigla en inglés) es un tratamiento pensado para reducir la vivacidad y emocionalidad de las memorias angustiantes. Existe un cúmulo de evidencia que muestra que la tasa de la memoria de trabajo es el centro del mecanismo de trabajo de la terapia EMDR y que el EMDR deriva su efecto desde las tasas de memoria de trabajo (MT) con una tarea dual mientras mantiene activamente una memoria perturbadora en mente. Desde una postura teórica, basada en las asunciones derivadas de la teoría de la MT, la efectividad de la terapia EMDR podría mejorarse por medio de varias adaptaciones.

**Objetivos:** Para probar la asunción que integrando estos elementos en el protocolo estándar EMDR para potenciar la terapia EMDR, esta versión adaptada de EMDR (es decir, EMDR 2.0), fue comparada con el EMDR estándar en un contexto de laboratorio. Fue hipotetizado que EMDR 2.0 sería más eficaz que el EMDR estándar, y mostraría una mayor disminución en la emocionalidad y vivacidad de la terapia EMDR estándar. Nuestra segunda hipótesis fue que EMDR 2.0 sería más eficiente que EMDR en que esta variante necesita menos tiempo de sesión, un número menor de sets (es decir, aproximadamente 30 segundos de tasas de MT).

**Método:** Participantes no clínicos ( $N = 62$ , 79% mujeres, edad promedio = 35.21) con una memoria autobiográfica perturbadora fueron asignadas aleatoriamente a recibir ya sea EMDR o EMDR 2.0. La emocionalidad y la vivacidad de la memoria fueron medidos antes y después de la intervención, y seguimiento a 1 y a 4 semanas.

**Resultados:** Los resultados mostraron no diferencias entre EMDR y EMDR 2.0 en disminuir la emocionalidad y la vivacidad, y no diferencia en el tiempo de la sesión. Sin embargo, los

participantes en la condición de EMDR 2.0 necesitaron menos sets que aquellos en la condición EMDR estándar.

**Conclusión:** La noción de que EMDR 2.0 es más eficiente es parcialmente apoyada por los resultados mostrando que los participantes necesitaron menos sets que en EMDR estándar para alcanzar los mismos resultados. Se justifican investigaciones futuras con muestras clínicas.

### 非临床样本中EMDR 对比 EMDR 2.0对厌恶记忆的情绪性和生动性的影响

**引言:** 眼动脱敏和再加工(EMDR) 疗法是一种旨在减少痛苦记忆的生动性和情绪性的疗法。越来越多的证据表明, 工作记忆征税是 EMDR 疗法工作机制的核心, 并且 EMDR 通过在活跃记住令人不安记忆的时候使用双重任务对工作记忆 (WM) 进行征税, 从而发挥其作用。从理论立场来看, 基于源自 WM 理论的假设, EMDR 治疗的有效性可以通过几种调整来提高。

**目的:** 为了检验将这些元素整合到标准 EMDR 方案中将增强 EMDR 治疗的假设, 在实验室环境中对比了此改编版 EMDR (即 EMDR 2.0) 与标准 EMDR。假设 EMDR 2.0 将比标准 EMDR 更有效, 并且比标准 EMDR 疗法可更大程度降低情绪性和生动性。我们的第二个假设是 EMDR 2.0 比标准 EMDR 更有效, 因为此变体需要更少的疗程时间、更少的次数 (即约 30 秒的 WM 征税)。

**方法:** 具有令人不安自传性记忆的非临床参与者 ( $N = 62$ , 79% 女性, 平均年龄 = 35.21) 被随机分配接受 EMDR 或 EMDR 2.0。在干预前、后以及在第 1 周和第 4 周的随访中, 测量记忆的情绪性和生动性。

**结果:** 结果表明, EMDR 和 EMDR 2.0 在降低情绪性和生动性方面没有差异, 疗程时间也没有差异。但是, EMDR 2.0 条件下的参与者需要的次数少于标准 EMDR 条件下的参与者。

**结论:** EMDR 2.0 更有效的观点由达到相同效果需要比标准 EMDR 更少次数的结果得到了部分支持。未来需要对临床样本进行研究。

Establishing the effectiveness of treating post-traumatic stress disorder (PTSD) is one thing, enhancing treatment by unravelling the underlying working mechanisms is another. Experimental research provides the opportunity to study the mechanisms of action of therapeutic procedures and, as a consequence, not only to generate a better understanding of the therapy, but also to acquire knowledge as to how to enhance its effectiveness. For example, one of the first-choice treatments for PTSD is eye movement desensitization and reprocessing (EMDR) therapy (De Jongh, Amann, Hofmann, Farrell, & Lee, 2019; Matthijssen et al., 2020; Shapiro, 2018). This treatment procedure has proven to be both effective and efficient (International Society for Traumatic Stress Studies, 2018; Lewis, Roberts, Andrew, Starling, & Bisson, 2020; Mavranezouli et al., 2020; National Institute for Clinical Excellence, 2018).

However, both clinicians and researchers are always striving for enhancing treatment because not all patients respond equally well. An adapted version of EMDR therapy has been developed specifically for those individuals who do not respond. Possible enhancements for the effectiveness or efficiency of EMDR therapy are largely generated by experimental research into the mechanisms and have focused on the working memory theory (WMT) which presumes that the effects of EMDR therapy can be attributed to taxation of one's limited working memory (WM) capacity while recalling an aversive memory. The WMT predicts that as a consequence of this dual tasking, the aversive memory becomes less emotional and less vivid (Gunter & Bodner, 2008; Van den Hout & Engelhard, 2012), while based upon the work on memory reconsolidation it could be assumed that the

memory reconsolidates as such in the long-term memory (e.g. De Quervain & Margraf, 2008).

Research into WMT and the degradation of aversive memories shows there is potential into making EMDR therapy more effective and efficient. Also clinically, potential elements have been used in patient samples already and showing large treatment effects in an intensive treatment setting when combined with sports, psycho-education and prolonged exposure (e.g. Voorendonk, De Jongh, Roozendaal, & Van Minnen, 2020). From both clinical observations in the intensive treatments and experimental studies an important finding is that providing more dual working memory taxation seems more effective in reducing emotionality and vividness than less dual taxation (Littel & Van Schie, 2019; Maxfield, Melnyk, & Hayman, 2008; Van Veen et al., 2015), which underlines the importance of increasing working memory load. Another important finding from experimental research is the support for the importance of keeping the memory in mind while performing dual taxation (Van Veen, Engelhard, & Van den Hout, 2016). This is in line with WMT, which assumes that competition between two tasks is essential; that is, participants need to be engaged in both tasks (recalling a memory and another WM taxing task) simultaneously. Further, Cuperus, Laken, Van Schie, Engelhard, and Van den Hout (2019) showed that combining short exposure to a screenshot representing a negative memory and performing a dual task resulted in larger decreases in emotionality of the memory than just recalling the memory while performing a dual task. These results suggest improvements in EMDR therapy can be made by maximizing working memory load and effectively

activating the trauma memory while taxing and reprocessing it.

There are more suggestions to improve the effect of EMDR therapy. This psychotherapy aims to reduce PTSD symptoms by decreasing the emotionality of intrusive memories that are mainly conceptualized as being visual. Intrusions, however, appear in different sensory modalities (Ehlers et al., 2002; Hackmann, Ehlers, Speckens, & Clark, 2004). Matthijssen, Verhoeven, van den Hout, and Heitland (2017) and Matthijssen, Heitland, Verhoeven, and van den Hout (2019) showed that auditory memories are mouldable. Furthermore, there is some evidence that a larger impact on working memory is found when both the dual task performed and the (dominant) sensory modality of the memory are in the same modality (Baddeley & Hitch, 1974; Matthijssen, Van Schie, & Van den Hout, 2018). Hence, findings show anecdotal evidence for another possible treatment enhancing effect in that, albeit the general effect of WM taxation is large, adding modality-specific taxation might enhance the effectiveness of EMDR therapy somewhat more.

Not only the WMT is of importance when considering mechanisms that could enhance the effectiveness of EMDR therapy. Also other lines of research are relevant in the search for optimizing treatment outcome. To this end, one could theoretically argue the possible clinical relevance of unexpected (surprise) effects. There is evidence to suggest that the element of surprise makes complex memories mouldable by destabilizing them (Sinclair & Barens, 2018). In this respect Visual Schema Displacement Therapy (VSDT), a relative novel and promising therapeutic procedure which uses an element of surprise has proven to be capable of reducing the emotionality and vividness of aversive memories (Matthijssen, Brouwers, van den Hout, Klugkist, & de Jongh, 2021; Matthijssen, Van Beerschoten, De Jongh, Klugkist, & Van den Hout, 2019).

Linked to this is another potentially interesting mechanism and potential active therapeutic ingredient that may be capable of enhancing trauma-focused therapy, and that is the addition of arousal (Foa, Riggs, & Gershuny, 1995; Jaycox, Foa, & Morral, 1998). There is evidence to suggest that arousal could boost memory updating during reconsolidation (e.g. Anderson, Yamaguchi, Grabski, & Lacka, 2006; Stein, Rohde, & Henke, 2015; Van den Hout, Eidhof, Verboom, Littel, & Engelhard, 2013, Littel et al., 2017b). In the same vein, a placebo-controlled study showed that reducing arousal by administering beta blockers reduced the effects of eye movements on vividness of emotional memories (Littel et al., 2017a). Thus, it is conceivable that, besides the aforementioned ingredients, increasing arousal might also

give a boosting effect to the efficacy of trauma-focused therapies, such as EMDR therapy.

Based upon the work and the standard EMDR protocol developed by Francine Shapiro (2018), and inferred from the WMT and other research findings as well as clinical observations, it could be assumed that integrating the aforementioned elements into the standard EMDR protocol would enhance EMDR therapy, making treatment potentially more effective and efficient. Therefore, the purpose of the present study was to compare the effects of using the standard EMDR protocol with an adapted version of EMDR therapy, a procedure referred to as 'EMDR 2.0', using a non-clinical sample. The latter method is standard practice when investigating a new treatment protocol within a randomized controlled trial (Spieth et al., 2016). It was hypothesized that EMDR 2.0 would be more efficacious than standard EMDR, and show a greater decrease in emotionality and vividness than standard EMDR therapy.

A central element of EMDR therapy is that the therapist performs 'sets' (approximately 30 seconds) of dual WM taxation while the patient simultaneously recalls the trauma memory. It is conceivable that by taxing working memory more in EMDR 2.0 compared to EMDR, this would result in a more efficient therapy with less session time and fewer number of sets needed as in standard EMDR. Therefore, our second hypothesis was that EMDR 2.0 would be more efficient than standard EMDR in that this variant needs less treatment time, and a smaller number of sets.

## 1. Method

### 1.1. Participants

A total of 130 participants were recruited via posters at the Utrecht University campus and through social media posts. Thirty-four declined participation after receiving additional study information, and 14 participants could not be reached to schedule an appointment. After completing a screening questionnaire at the start of the experiment, 13 persons were excluded based on exclusion criteria. More specifically, four persons rated the subjective unit of disturbance (SUD) of their negative emotional memory below the threshold, and nine persons had knowledge of EMDR treatment or the current study goals. Thus, 69 participants took part in the present study. An additional seven persons were excluded during or following the experiment. Four persons were excluded because the therapist deviated from treatment protocol, and three were excluded because the SUD related to the selected memory was rated lower than threshold upon starting the experiment. Therefore, the final sample included in the analyses consisted of 62 participants, with

a mean age of 35.21 years ( $SD = 13.49$ ) and 79.0% being female.

An a priori power analysis and statistical procedures were preregistered on OSF (<https://osf.io/zrvp9>). We deviated from the preregistered statistical method due to a preference for the use of Bayesian statistics compared to Null Hypothesis Significance Testing (NHST), though the same type of analyses were run. Albeit Bayesian statistics are less dependent on strict power analyses, the current  $N$  of >30 participants per group is considered sufficient to detect the hypothesized differences using Bayesian statistics.

## 1.2. Procedure

Study procedures were approved by the Faculty Ethics Review Board (FERB) of the Faculty of Social and Behavioural Sciences, Utrecht University (UU; Registration ID: 19-127). The experiment was conducted by two graduate students of the Clinical Psychology Master's programme of Utrecht University. Potential participants applied by emailing the student researchers, upon which they were called to elucidate study procedures, screen for exclusion criteria and schedule an appointment. Afterwards, they received an email containing appointment details and the information letter. The letter informed them about study procedures, informed consent, potential risks and benefits of participation, reimbursement, confidentiality and anonymity of data, and contact information of all researchers involved. At the start of the experiment, participants were taken to a lab appointed for informed consent and screening procedures. The student researchers checked whether all procedures were fully understood. Participants then signed an informed consent form. Next, they were screened for the exclusion criteria using a questionnaire. Exclusion criteria were that participants were not able to recall a disturbing memory of a specific event with a minimum SUD rating of six on a scale from zero to ten, insufficient command of the Dutch language, current use of benzodiazepines, antidepressants, antipsychotics or mood stabilizers, a current psychiatric diagnosis of bipolar disorder, major depression, PTSD, psychosis or autism spectrum disorder, current treatment for psychiatric problems, prior EMDR treatment less than three years ago and/or more than ten sessions, uncorrected visual or auditory impairment, and lastly, the use of alcohol or drugs 12 hours prior to participation. Upon inclusion, they were escorted to a second lab where the EMDR therapist was present for the treatment procedures. Next, treatment procedures were explained and thereafter executed following protocolled procedures. A student researcher (out of sight for the participant, but visible for the therapist) was present during all treatment sessions to evaluate protocol adherence

and was able to give a signal to the therapist with flashcards if they were not adhering. They also recorded study data. After finishing the treatment procedure, the student researcher planned two follow-up appointments by phone after one and four weeks. Both appointments consisted of the collection of SUD and vividness ratings of the selected aversive memory. At the end of the second follow-up appointment, participants were thanked, debriefed and reimbursed by electronic payment or course credits.

## 1.3. Materials

### 1.3.1. Emotionality

The SUD-scale is used as an index of perceived intensity of disturbance or distress induced by recalling a negative emotional memory or image (Wolpe, 1969). The score is measured on a 11-point Likert scale ranging from 0 (*no distress at all*) to 10 (*maximum distress*). The SUD-scale is integrated within the standard EMDR protocol and is frequently used in EMDR-related research (Shapiro, 2018) and shows good psychometric properties to measure emotionality of memories (Kim, Bae, & Park, 2008). In the current study, SUD scores of the selected disturbing memory were assessed verbally by the experimenter during the screening, at the start and end of the experiment, and via telephone at one and four-week follow-up. Participants were excluded if the SUD score was rated lower than six at the start of the experiment.

### 1.3.2. Vividness

Participants rated the vividness of the recalled disturbing memory on a 11-point Likert scale ranging from 0 (*not vivid at all*) to 10 (*very vivid*). Vividness is a measure often used in experimental EMDR research (e.g. Van den Hout & Engelhard, 2012). In the current study, vividness scores of the selected disturbing memory were assessed verbally by the experimenter at the start and end of the experiment, and via telephone at one and four-week follow-up.

### 1.3.3. Session time and number of sets

The researcher measured the duration of the session, the total number of 'sets' (i.e. every set being approximately 30 seconds dual WM taxation during memory recall) and sets per 'round' (i.e. all sets from back to target to back to target moment).

## 1.4. Treatment

The treatment was carried out by eleven therapists who attended an accredited course of EMDR therapy. The therapists were also trained in 'EMDR 2.0' and were supervised by the principal investigator, an EMDR Europe consultant and last author, an EMDR Europe accredited trainer in EMDR therapy. To

ensure protocol adherence, fidelity checks were performed by supervising video recordings of trial sessions. Depending on the condition, the standard Dutch EMDR protocol (Ten Broeke, De Jongh, & Hornsveld, 2019), or EMDR 2.0 protocol (De Jongh & Matthijssen, 2019) was used.

#### 1.4.1. EMDR

EMDR uses a manualized standard EMDR, eight-phase protocol (De Jongh & Ten Broeke, 2019; Shapiro, 2018, for a description, see <https://www.emdria.org/about-emdr-therapy/experiencing-emdr-therapy/>). An essential part of the EMDR procedure consists of the activation and reprocessing of the traumatic memory by asking the patient to bring up the memory and to concentrate on the most disturbing image of the memory, a self-referencing dysfunctional belief, and its emotional and somatic components. Next, the clinician instructs the patient to concentrate on these elements of the memory while simultaneously performing another task, most commonly following the hand of the therapist with their eyes. In the present study, participants were asked to report their upcoming associations after each set ( $\pm 30$  sec) of working memory taxation. These sets were repeated until the participant reported similar associations two subsequent times, thereby completing one desensitization round, after which the therapist returned back to target to evaluate treatment progress by evaluating the disturbance and after that, to proceed with a new series of sets (i.e. a new round). These desensitization rounds were repeated until the maximum session time of 20 minutes was reached or sooner when the SUD rating decreased to zero. During the assessment and prior to the positive closing (last phase of the session) SUD and vividness of the selected memory were rated.

#### 1.4.2. EMDR 2.0

The EMDR 2.0 treatment protocol is also based on the standard EMDR eight-phase protocol (see above), but is supplemented by text parts aimed at motivating the participant to explicitly place the memory in his or her working memory, thoroughly activating the disturbing memory while a variety of specific WM taxation techniques are added in the desensitization phase of the

procedure. More specifically, EMDR 2.0 covers three core elements. Firstly, informing and motivating the patient to place the traumatic memory in all its detail in the working memory with the purpose to engage in the treatment and to provide a rationale as to what the core and working mechanism of the therapy is. Secondly, helping the person to activate the memory and to optimize the arousal of the memory network and the body. The therapist increases activation of the target memory by stimulating the person to focus on all sensory aspects of the memory, and not only the visual content (i.e. auditory, olfactory, gustatory and tactile aspects). Thirdly, to reprocess the memory with the use of a diversity of new memory-taxing tasks and techniques covering different sensory modalities (desensitization techniques; see Table 1). Therapists are encouraged to expand and adapt these as is appropriate for the participant. In the desensitization phase four aspects were taken into account.

**1.4.2.1. Maximizing WM taxation.** WM taxation is maximized by combining different tasks. The participant starts with complicated tapping patterns and very fast eye-movements. Subsequent sets combined fast eye-movements with one or several of six different tasks: 1. Varying eye-movement patterns instead of horizontal (e.g. diagonal, circles), 2. Counting or spelling tasks, 3. Repeating tongue twisting word combinations like 'tick-tock' 4. Performing the V-step: standing up and making diagonal steps, 5. Tapping tasks, 6. Introducing (strong) distracting smells and tastes.

**1.4.2.2. Adding surprise effects.** Surprising the participant by making unrelated comments, asking unrelated questions (e.g. 'What do you think of the weather?') or making unexpected movements.

**1.4.2.3. Inducing arousal.** The therapist induces arousal by unexpectedly clapping the hands or loudly saying words or making sudden sounds or very sudden gestures.

**1.4.2.4. Modality specific taxation.** The therapist matches the WM taxation to the modality of the target

**Table 1.** Desensitization tasks and interruptions part of the EMDR 2.0 protocol.

Task/Interruption	Modality
Superfast eye-movements, around 10 cm away from the nose	Visual
Tapping a sequence on the legs	Kinaesthetic
Diagonal, up/down, circle (or other shape) eye-movements	Visual
Counting, spelling words, reciting alphabet, singing a song *	Auditory
Repeating 'tick, tock' or 'left, right' *	Auditory
Clapping, saying 'whoosh', other arousal inducing tasks	Auditory/Visual
Surprise effect by therapist by strange remarks/questions/movements	Auditory/Visual
V-step movement	Kinaesthetic
Strong smells (perfume, tea, ammonia, etc.)	Olfactory
Strong tastes (sweets, mints, lemon, etc.)	Gustatory

Note. \* = Therapist can provide additional interference by speaking simultaneously during performance of these tasks

memory. For example, when the target memory has a strong aversive auditory component (e.g. deep sighing), an auditory taxation method is used as an add-on task (e.g. counting and spelling). Besides the visual, auditory and kinaesthetic tasks described under *Maximizing WM taxation*, several objects were available in the lab to induce modality-specific taxation (e.g. gustatory: sweets).

### 1.5. Design

The study employed a two (Condition: EMDR and EMDR 2.0) by four (Time: pre, post, follow-up 1, follow-up 2) mixed design. Participants were randomly assigned to one of the conditions by order of inclusion. The within-subjects variable time consisted of SUD and vividness assessments at the start of the experiment (pre), after completion (post), at one-week follow-up (follow-up 1) and at four-week follow-up (follow-up 2). The between-subject variable was the condition, being either EMDR or EMDR 2.0. For efficiency, dependent variables were measurements of total session time and number of sets performed. Sets were measured both in total and as an average per round.

### 1.6. Data analysis

All data were analysed using a Bayesian approach in the statistical software JASP (v0.12.2; JASP Team, 2020). This method uses the Bayes factor (BF) to evaluate relative support for one hypothesis or model compared to one or multiple others. If  $BF > 1$ , there is support for the tested model, with larger values indicating more support. If  $BF < 1$ , there is support for the null or alternative model(s), with smaller values indicating more support. If BF values approximate one there is equal support for the models. The strength of Bayesian hypothesis testing compared to NHST lies in the absence of stringent cut-off values (e.g.  $p < .05$ ) and resultant arbitrary dichotomous decisions. However, indication on how to interpret BF values is considered pragmatic. Generally, BF values of 1–3 are considered anecdotal evidence for the tested hypothesis, a BF of 3–10 is interpreted as moderate support, and BFs  $>10$  indicate strong support.

Overall group differences in efficacy were analysed using Bayesian repeated measures analyses of variance (ANOVAs) with condition (EMDR, EMDR 2.0) as between-subjects variable and SUD and Vividness ratings representing the within-subjects variable time (pre, post, follow-up 1, follow-up 2). To interpret slope differences between the relevant time points, subsequent Bayesian Independent Samples T-Tests (ISTTs) were conducted with condition as independent variable and SUD and Vividness difference scores (pre-post, pre-follow-up 1, pre-follow-up 2) as dependent variable.

Efficiency was analysed using Bayesian ISTTs with condition as independent variable and total session time, number of sets per round and number of sets as dependent variables.

When reporting results, the notation  $BF_m$  quantifies the support, the data shows for one model when compared to all other tested models.  $BF_m$  is computed by dividing the posterior odds of the specific model by the average posterior odds of all other tested models. For the ANOVAs, these models include main effects for Condition and Time, the interaction effect, and a combination of these effects. For the other tests in general, the notation  $BF_{10}$  is used to express the support for a single hypothesis (e.g. ISTT: mean group scores are different) versus the null hypothesis.  $BF_{01}$  expresses support for the null hypothesis compared to the tested hypothesis. Default priors were used for all analyses (Rouder, Morey, Speckman, & Province, 2012). JASP automatically corrects for multiple testing by fixing to 0.5 the prior probability that the null hypothesis holds across all comparisons (Westfall, Johnson, & Utts, 1997).

## 2. Results

### 2.1. Descriptive statistics

Data of 62 participants were analysed. One follow-up SUD measurement was removed from the analyses because at the second follow-up it appeared the participant misinterpreted the question rating the current emotionality in relation to the whole traumatic period, instead of the emotionality induced by retrieving the memory of the traumatic event. At the second follow-up, one participant could not be reached resulting in missing values for that participant for both SUD and vividness.

The number of participants treated per therapist ranged from four to eight. At baseline, participants rated the emotionality of their selected target memory with an average SUD of 8.01 ( $SD = 1.03$ ). The mean score of the vividness of the memory was 7.99 ( $SD = 1.25$ ). Treatment in both conditions was conducted for a maximum of 20 minutes, albeit 25 participants (40.32%) reported a SUD-rating of zero before the session time was over. This resulted in a mean session time of 16.92 minutes ( $SD = 4.54$ ). Approximately four desensitization rounds were performed on average ( $M = 4.24$ ,  $SD = 1.58$ ). A round was concluded when a participant did not report any new associations, which happened at an average of 2.76 ( $SD = 1.42$ ) sets.

### 2.2. Randomization check

The null model with no differences in SUD and vividness ratings between groups at baseline was supported by Bayesian ISTTs (SUD:  $BF_{01} = 3.58$ ; Vividness:  $BF_{01} = 3.85$ ). The null models for randomization of age

(Bayesian ISTT;  $BF_{01} = 3.73$ ) and gender (Bayesian contingency table;  $BF_{01} = 1.78$ ) were supported as well. A Bayesian univariate ANOVA comparing pre to post SUD and vividness decreases between the therapists showed support for the null model with no differences between therapists (SUD:  $BF_m = 2.93$ ; Vividness:  $BF_m = 1.58$ ). Also, no difference between therapists for session time was found ( $BF_m = 1.56$ ).

## 2.3. Efficacy

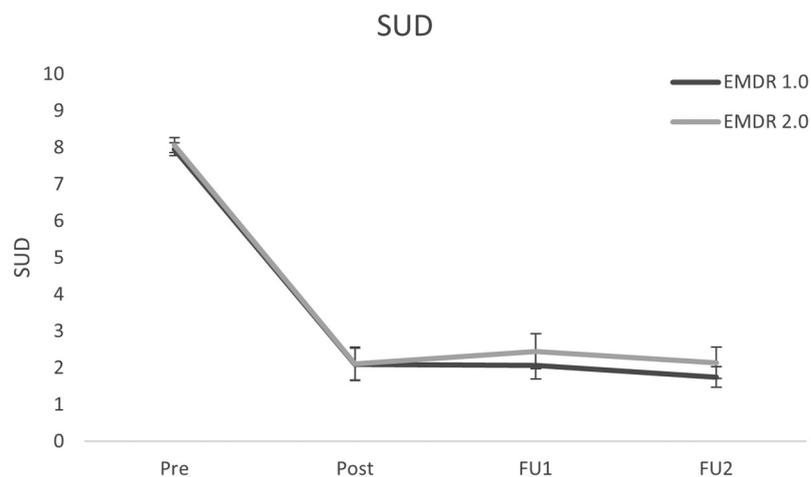
### 2.3.1. Emotionality

The Bayesian repeated measures ANOVA with Condition (EMDR, EMDR 2.0) as between subjects variable and SUD ratings representing the within subjects variable Time (pre, post, follow-up 1, follow-up 2) shows the most support for a model with only a main effect of Time ( $BF_m = 11.52$ ). Post-hoc tests show strong support for SUD decrease ratings from pre to post ( $BF_{10} = 1.34 \times 10^{22}$ ; Cohen's  $d = 2.27$ ), pre to follow-up 1 ( $BF_{10} = 3.87 \times 10^{23}$ ; Cohen's  $d = 2.44$ ),

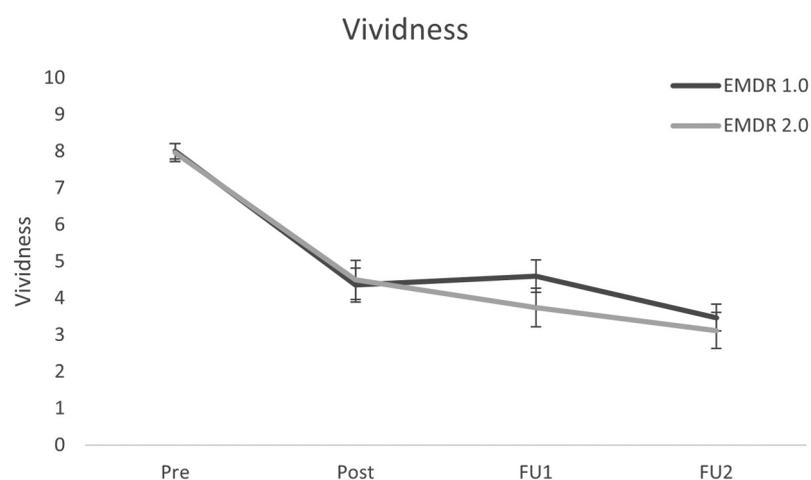
and pre to follow-up 2 ( $BF_{10} = 4.84 \times 10^{26}$ ; Cohen's  $d = 2.90$ ). SUD ratings did not decrease further following the post test, meaning that support was found for the model without mutual decreases between post, follow-up 1 and follow-up 2 ratings ( $BF_{s01} > 4.24$ ). The model with a main effect for Time and Condition is not convincingly supported ( $BF_m = 1.29$ ). There is strong evidence against the model including the interaction effect ( $BF_m = 0.06$ ). The planned post hoc Bayesian ISTTs comparing decreases in SUD ratings from pre to post, follow-up 1 and follow-up 2 show support for the lack of differences between conditions (pre-post:  $BF_{01} = 3.83$ ; pre-follow-up 1:  $BF_{01} = 3.53$ ; pre-follow-up 2:  $BF_{01} = 3.41$ ). For a graphical overview of all SUD ratings, see Figure 1.

### 2.3.2. Vividness

The Bayesian repeated measures ANOVA comparing vividness scores over time between groups shows most support for the model including only a main effect of Time,  $BF_m = 10.65$ . This main effect is further



**Figure 1.** Mean (SE) SUD scores for all time points specified per condition. EMDR = Eye Movement Desensitization and Reprocessing; SUD = subjective unit of disturbance; FU1 = follow-up after 1 week; FU2 = follow-up after 4 weeks.



**Figure 2.** Mean (SE) vividness scores for all time points specified per condition. EMDR = Eye Movement Desensitization and Reprocessing; FU1 = follow-up after 1 week; FU2 = follow-up after 4 weeks.

specified by post-hoc tests yielding a strongly supported decrease in vividness ratings from pre to post ( $BF_{10} = 2.43 \times 10^{11}$ ; Cohen's  $d = 1.30$ ), pre to follow-up 1 ( $BF_{10} = 7.42 \times 10^{12}$ ; Cohen's  $d = 1.41$ ), and pre to follow-up 2 ( $BF_{10} = 9.64 \times 10^{17}$ ; Cohen's  $d = 1.87$ ). Also, decreases from post to follow-up 2 ( $BF_{10} = 35.45$ ; Cohen's  $d = 0.46$ ) and follow-up 1 to follow-up 2 ( $BF_{10} = 58.74$ ; Cohen's  $d = 0.48$ ) were supported by post hoc tests. The null model with no decrease from post to follow-up 1 was supported ( $BF_{01} = 4.99$ ). The model including both the main effect of Time and Condition was not convincingly supported,  $BF_m = 1.23$ . The analysis shows evidence against the model including the interaction effect,  $BF_m = 0.16$ . Separate ISTTs showed support for the models including equal decreases in vividness ratings between conditions and the specific time points (pre-post:  $BF_{01} = 3.76$ ; pre-follow-up 1:  $BF_{01} = 2.11$ ; pre-follow-up 2:  $BF_{01} = 3.37$ ). For a graphical overview of all vividness ratings, see Figure 2.

## 2.4. Efficiency

### 2.4.1. Session time

A Bayesian ISTT showed anecdotal support for the null model with no differences in session time between groups,  $BF_{01} = 1.35$ . The standard EMDR sessions lasted an average of 16.02 minutes ( $SD = 4.91$ ), the EMDR 2.0 sessions an average of 17.82 minutes ( $SD = 4.01$ ).

### 2.4.2. Number of sets

A Bayesian ISTT showed support for the model with differences between groups for the number of sets,  $BF_{10} = 6.53$ . Participants in the EMDR 2.0 condition conducted fewer sets within the session ( $M = 9.03$ ;  $SD = 4.36$ ) than participants in the standard EMDR condition ( $M = 12.90$ ;  $SD = 6.30$ ). Likewise, the number of average sets per round differed between groups ( $BF_{10} = 72.23$ ). Participants in the EMDR 2.0 condition also needed fewer sets per round ( $M = 2.15$ ;  $SD = 0.95$ ) and thus went back to target faster than participants in the standard EMDR condition ( $M = 3.38$ ;  $SD = 1.55$ ).

## 3. Discussion

The purpose of the present study was to compare the efficacy and efficiency of the EMDR 2.0 therapy protocol with the standard EMDR protocol in affecting emotionality and vividness of distressing autobiographical memories in a non-patient sample. The results of the present study did not support the hypothesis that EMDR 2.0 would be more effective than traditional EMDR therapy in reducing emotionality and vividness of distressing memories, both directly post-intervention and at follow-up after one and four

weeks. Individuals in both treatment conditions showed equal effects. There was only partial support for the hypothesis that EMDR 2.0 would be more efficient than EMDR. Participants in the EMDR 2.0 condition needed fewer sets than in the EMDR condition to induce the same emotionality and vividness decreasing effect as EMDR. Conversely, the two interventions did not differ in session-duration-time.

If fewer sets were needed in EMDR 2.0 to get similar effects, why were effects not observed in difference in session time or lower emotionality or vividness scores? One could argue that the enhanced WM loading used in EMDR 2.0 could have resulted in overloading the WM and thereby making it impossible for some participants to keep the aversive memory in mind. Recent research has repeatedly shown that WM taxation in EMDR follows a dose-response relationship (Littel & Van Schie, 2019; Maxfield et al., 2008; Van Schie, Van Veen, Engelhard, Klugkist, & Van den Hout, 2016; Van Veen et al., 2015), but participants also need to hold the memory in mind for it to be processed (Van Veen et al., 2016). To what extent participants were able to keep the disturbing memory in mind while executing the dual tasks was not monitored. Reports from several participants in the EMDR 2.0 condition after completing the study – admitting they were happy to engage in the dual tasks so they didn't have to think about the distress-evoking memory – add to the likelihood of this possibility. On the other hand, had there been no WM capacity left, and had participants not been able to keep the memory in mind, no effect of EMDR 2.0 would have been observed. Future research should monitor whether participants are keeping the memory in mind while performing the dual tasks, and dual tasks should be adjusted to their capacities if they are unable to do so.

Another, quite logical explanation for the lack of differences in time and effect is the time that is used for other elements in the intervention. The active desensitization in EMDR 2.0 therapy, if one takes into account that the duration of a set is approximately 30 seconds, was more or less 4.5 minutes, while in conventional EMDR this was 6.5 minutes. This suggests that the bulk of the intervention time is filled with other elements of the therapy. Going back to target and explaining the dual tasks are examples of that. Even more so, since participants went back to target more quickly in EMDR 2.0, it is clear the back to target procedure also takes up more time. Another explanation for the absence of difference in session time and effect might be due to the sample used and the memories resulting therefrom. It seems plausible that in patients suffering from PTSD, more time is spent to process the memory and therefore its desensitization to SUD zero requires more sets. It is likely that due to the sample of non-clinical participants, the aversive memories

are easier to mould. Furthermore, one could argue that for easy to manipulate memories there might be, by all means, less difference in the effects of EMDR and EMDR 2.0 since there might be less need for added motivation, activation and/or desensitization. Data was collected amongst a non-patient sample who were motivated to participate in this study, in contrast to the avoidance of the distressing memory that is typically observed in patients suffering from PTSD (American Psychiatric Association, 2013). EMDR 2.0 is developed specifically for individuals who do not respond to EMDR because of avoidance to fully activate a memory – an effect witnessed in clinical practice, and because regular dosages of working memory taxation seem insufficient to elicit effect.

Although not resulting in difference in session time, the finding that in EMDR 2.0 fewer sets are needed to reach the same effect in desensitization and reduction of vividness brings up the question on the usefulness of monitoring associations or the need to inquire about associations. Although positive effects on EMDR effectiveness have been observed by allowing the internal association process (Rogers & Silver, 2002), the added effect of associations has not been studied empirically (Van den Hout & Engelhard, 2012), and it is debatable whether associations, or verbalizing these is an effective and thus essential ingredient of EMDR therapy.

This study has several limitations. The first is the use of a fixed time-limit of maximum 20 minutes. This rendered us unable to detect whether there were any differences in session duration when one would proceed to resolve emotionality of all memories. Comparing total amount of time would have resulted in a more straight comparison in session durations. Furthermore, in the sample 25 out of 62 participants reached a SUD score of zero, which reflects on the mean session time, but also indicates that some of the easier to mould memories compile a large part in the means, thereby maybe not reflecting the variance in effort of desensitizing. Also, no process measure was included to determine the velocity of the decline of emotionality ratings during the session. Therefore, it is difficult to have a more refined view on the slope of emotionality or vividness decrease. In future research, longer sessions could be used to obtain better understanding of the decline in emotionality scores during the session, and process measures could be taken into account. Furthermore, although the use of non-clinical sample sheds light on defining mechanisms, a limitation of the use of such a sample is the generalizability of the findings. More research must be conducted in patient groups to determine whether EMDR 2.0 can be a better-working alternative to standard EMDR for a specific groups of patients or not.

In conclusion, since EMDR 2.0 is found to be as effective as standard EMDR in desensitizing aversive memories in non-clinical participants, but results suggest it might be somewhat more efficient, it is worthwhile investigating the efficacy and efficiency in a target group of patients suffering from a clinically relevant trauma-related symptom level. Also, future research needs to focus on further dismantling working mechanisms. Since EMDR 2.0 is composed of several possible enhancing mechanisms, research needs to answer the question what mechanisms are in the end responsible for improving clinical treatment results.

## Acknowledgments

We want to thank the EMDR therapists who participated in this study.

## An ethical statement if one is necessary

### *Institutional Review Board Statement:*

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences, Utrecht University (Registration ID: 19-127; approval date: 21 October 2019).

### *Informed Consent Statement*

Informed consent was obtained from all subjects involved in the study.

## Author statement

SM, TB and AdJ designed the research and methodology. CvR and TV collected the data. SM and TB supervised data collection. SM and AdJ trained the EMDR therapists and supervised treatment fidelity. TB analysed the data. SM, TB and AdJ wrote the original draft paper, SM, TB, CvR, TV, and AdJ reviewed and edited. SM, TB, CvR, TV, and AdJ approved the final manuscript.

## Disclosure statement

Ad de Jongh receives income from published books on EMDR therapy and for training postdoctoral professionals in this method. Ad de Jongh and Suzy Matthijssen received income from webinars on EMDR 2.0. We have no other known conflict of interest to disclose.

## Data availability statement

Data available on request due to privacy/ethical restrictions. The data that support the findings of this study are available from the corresponding author, SM, upon reasonable request. The data are not publicly available due to their containing information that could compromise the privacy of research participants. Furthermore, participants were not asked to give consent to save their data in a public data repository.

## Funding

This research was supported by a grant from the Dutch EMDR association (in Dutch: ‘Vereniging EMDR Nederland’)

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