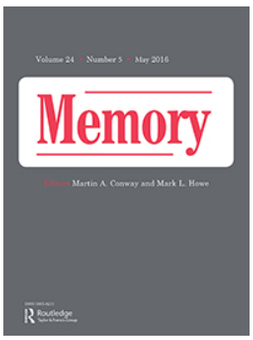
Imagery rescripting



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Imagery rescripting: Is incorporation of the most aversive scenes necessary?

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During imagery rescripting (ImRs) an aversive memory is relived and transformed to have a more positive outcome. ImRs is frequently applied in psychological treatment and is known to reduce intrusions and distress of the memory. However, little is known about the necessity to incorporate the central aversive parts of the memory in ImRs. To examine this necessity one hundred participants watched an aversive film and were subsequently randomly assigned to one of four experimental conditions: ImRs including the aversive scenes (Late ImRs), ImRs without the aversive scenes (Early ImRs), imaginal exposure (IE) or a control condition (Cont). Participants in the IE intervention reported the highest distress levels during the intervention; Cont resulted in the lowest levels of self-reported distress. For the intrusion frequency, only the late ImRs resulted in fewer intrusions compared to the Cont condition; Early ImRs produced significantly more intrusions than the Late ImRs or IE condition. Finally, the intrusions of the Late ImRs condition were reported as less vivid compared to the other conditions. To conclude, it seems beneficial including aversive scenes in ImRs after an analogue trauma induction.

Keywords: Imagery rescripting; Imaginal exposure; Intrusions; Trauma induction; Post-traumatic stress disorder.

Although imagery rescripting (IMRs) is a treatment technique that was already being used in the late nineteenth century, it started to attract considerable attention only recently. Today, imagery-based techniques have been integrated in cognitive therapies and can be used to transform negative emotional memories (Edwards, 2007). During ImRs a person is instructed to mentally relive a memory or fantasy of an aversive experience and, next, to change the course of events in a more desired direction. For example, a person is asked to recall a memory of sexual abuse. Subsequently, the person is encouraged to change the course of events of this memory by letting an adult entering the scene and stopping the abuse. As ImRs taps on negative memories or fantasies, it has been mostly studied in the context of post-traumatic stress disorder (PTSD). Several clinical studies have indicated that incorporating ImRs during treatment can help to reduce PTSD symptoms such as feelings of anger, guilt and hostility (Arntz, Tiesema, & Kindt, 2007), fear and nightmares

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(Long et al., 2011) and the vividness and frequency of involuntary intrusions (Hackmann, 2011). Additionally, other psychopathological problems involving negative affect also seem to benefit from ImRs such as depression, social phobia, simple phobia, borderline personality disorder and other personality disorders (see for a review Arntz, 2012). Furthermore, adding ImRs to imaginal exposure (IE)—in which the aversive memories are (repeatedly) relived, but the course of events is not changed—seems to make the treatment more acceptable for both patients and therapists, resulting in lower drop-out rates. Also, adding ImRs to IE has more beneficial effects regarding non-fearful emotions such as guilt and anger compared to IE alone (Arntz et al., 2007).

Though the body of evidence that ImRs is an effective and powerful tool increases, the underlying mechanisms remain relatively unexplored. A possible explanation for the effectiveness of ImRs is that it re-evaluates the mental representation of the aversive stimulus or event [Unconditioned Stimulus (US)]. That is, the aversive memory and accompanying fear network are activated and during ImRs (emotional) aspects and the meaning of the mental representation are changed and reconsolidated (Long & Quevillon, 2009). As such, subsequent activation of the aversive memory will result in a diminished fear response (see for a review Arntz, 2012), and, compared to extinction or exposure, less return of fear as the US-representation itself is changed in meaning (Dibbets, Poort, & Arntz, 2012).

An alternative account for intrusions is retrieval competition (Brewin, 2006; Brewin, Gregory, Lipton, & Burgess, 2010). According to the revised dual representation theory two different types of memory representations can be distinguished: abstract, flexible, contextualised representations (C-reps) and inflexible, sensory-bound representations (S-reps). In comparison to C-reps, S-reps are poorly integrated with previous knowledge, easily triggered and accessed involuntarily. In case of PTSD-related intrusive memories, the S-rep is more readily activated as this representation is relatively stronger compared to the C-rep, and therefore retrieval competition may be in favour of the S-rep. During ImRs, the C-rep corresponding with the aversive event is deliberately activated and, as a consequence, the content of the associated S-rep is activated. By adding new information, a novel and more elaborated and accessible C-rep is formed which might be able to win the retrieval competition over the S-rep (see Brewin et al., 2010).

A different explanation is that the traumatic memory lacks context and is not well-integrated with other long-term autobiographical information. As a result, the traumatic memory is easily triggered. ImRs elaborates and integrates the memory into a proper context, resulting in better contextualisation and less fear generalisation (Hackmann, 2011). Still another mechanism is that it is helpful to express inhibited responses that were activated (but not expressed, for instance, because of survival reasons) during the trauma. Relatedly, a sense of control over life might be restored (Arntz, 2012). Based on these notions, ImRs seems to be a more promising treatment for alleviating PTSD-symptoms than mere (imaginal) exposure (see also Hagenaars & Arntz, 2012).

Fundamental research on ImRs mechanisms has just started (Arntz, 2012). For a controlled study of ImRs effects, it is necessary that the content and temporal aspects of the traumatic experience are equal across conditions. As patients do vary on these aspects, such comparison can only be made by inducing a trauma in a controlled setting. Such trauma induction allows control over the traumatic experience and, at the same time, can provide more insight into the mechanisms underlying the development and treatment of PTSD (Holmes & Bourne, 2008). Only a few studies have assessed ImRs using a trauma analogue (e.g., Hagenaars & Arntz, 2012; Seebauer, Froß, Dubaschny, Schönberger, & Jacob, 2014). In these studies a trauma was induced by aversive film fragments. These film fragments or scenes are known to induce PTSD-like symptoms such as increased stress levels and film-related intrusions (see for reviews Holmes & Bourne, 2008; Weidmann, Conradi, Gröger, Fehm, & Fydrich, 2009). In the study of Hagenaars and Arntz (2012), participants were allocated to one of three early interventions: IMRs, imagery re-experiencing (cf. IE) or positive imagery. During the intervention, the positive imagery group reported the lowest level of distress; no difference was observed between the re-experience and ImRs group. However, the ImRs group developed fewer intrusions the days following the trauma induction compared to the other conditions and less negative cognitions compared to the re-experience group. These results seem to indicate that ImRs might be an adequate intervention technique to diminish or prevent PTSD-like symptoms. The study of Seebauer et al. (2014) examined whether it is dangerous to incorporate violent revenge strategies during ImRs. The results indicated that

such strategy does not necessarily increase aggressive emotions, but does not seem to have added value over non-violent ImRs or ImRs in which a safe place is offered. For purpose of emotion regulation, the latter strategy seems to do best. The results regarding the efficacy of ImRs are difficult to interpret as ImRs was part of all experimental conditions and all interventions resulted in a decrease in negative emotions and an increase in positive emotions.

The two abovementioned studies indicate that ImRs can be beneficial as an intervention technique for such PTSD-like symptoms as involuntary intrusions. A topic that is still in debate in the context of ImRs of traumatic memories is when the actual rescripting should start, that is when the sequence of events should be changed by an imagined intervention. One obvious point would be to start when the expectation of the upcoming trauma is high (and emotional arousal is clearly increased) so that the disconfirmatory effect of the rescripting is maximal (in other words, the surprise effect is large, so that the disconfirmatory information has maximum impact). This would fit with the view that "warning signals" of the trauma are very central in traumatic memory, and that intrusions usually reflect such warning signals (Ehlers et al., 2002). On the other hand, one could reason that first the whole trauma memory should have been activated for corrective information to have maximal impact, and especially the aversive scenes or images that cause the greatest distress in the trauma memory should have been activated (see also literature on hotspots, Foa & Rothbaum, 1998). Both in the theory of PTSD and in its treatment the importance of these aversive scenes have been stressed (Ehlers & Clark, 2000; Grey & Holmes, 2008) as it is these aversive scenes or images that are associated with intrusive images of the event (Holmes, Grey, & Young, 2005). IMRs aims to change these scenes into a more realistic and/or less toxic appraisal (Hackmann, 2011). Indeed, experimental studies indicate that these highly aversive scenes become less aversive and the intrusion frequency diminishes after ImRs (Hagenaars & Arntz, 2012).

The question rises whether it is necessary to include the most aversive scenes in the to be rescripted scenario. For example, Arntz and Weertman (1999) suggest that in some cases it is better to relive and rescript only a part of the traumatic memory, for example, when the patient refuses to relive the whole trauma. In such cases the most aversive scenes might not be incorporated (unless they are identical to the warning signals that are part of the sequence of events happening before the trauma proper). Likewise, Krakow and Zadra (2006) encouraged persons who suffered from severe nightmares after a traumatic experience not to rescript their most severe nightmare. They also explicitly state that it is not necessary to relive the entire nightmare; persons are allowed skipping the mental exposure and to directly start with the rescripting part.

However, in light of changing or contextualisation of the aversive memory, one could argue that it is necessary to activate the entire mental representation, involving the accompanying fear network, including the most aversive scenes (see also for a review Long & Quevillon, 2009). Accordingly, omitting these scenes should result in diminished efficacy of ImRs as only part of the mental representation/fear network is activated and changed or put into context. As such, the remaining, highly aversive component is still intact, resulting in PTSD symptoms (see for rebound effects on thought suppression, Davies & Clark, 1998). Similarly, according to the cue competition view, ImRs is most effective when all relevant material is contextualised, as a more elaborated comprehensive image will favour retrieval of later rescripted representation (Brewin et al., 2010). In contrast, one could argue that elaborating on the most aversive scenes is not necessary. For example, previous research has indicated that even without elaborating on all aversive scenes ImRs can be beneficial (e.g., Krakow & Zadra, 2006). In addition, living through these aversive scenes can be highly distressing and may affect participants' compliance with ImRs instructions. Therefore, the present research wants to examine the necessity of incorporating the most aversive scenes in ImRs, and to compare the efficacy of ImRs with and without inclusion of these scenes.

In line with the previous analogue experimental studies, a trauma film paradigm was used to induce PTSD-like symptoms. To investigate the effectiveness of incorporation of the most aversive scenes in ImRs participants were assigned to one of four conditions: Late ImRs in which ImRs took place after the most aversive parts of the scene were relived; Early ImRs in which ImRs started before reliving the most aversive parts of the scene; IE to the aversive scenes of the film (IE); or a control condition (Cont) that did not involve active trauma reprocessing.

Based on the theoretical models and previous research, a number of hypotheses were posed.

First, it was expected that both ImRs interventions are less stressful than the IE intervention. Second, it was expected that ImRs should result in fewer and less vivid intrusions than the IE and the Cont conditions. Third, ImRs should result in stronger diminishment of non-fear-related emotions compared to the IE and Cont conditions. Fourth, inclusion of the most aversive scenes during rescripting should result in higher levels of distress during the intervention. Note that no directional hypotheses were posed regarding the inclusion or exclusion of the most aversive scenes during rescripting as the present, explorative, study is the first that examines this topic and related studies are inconclusive.

METHODS

Participants

A total of 102 participants was recruited. The study population consisted of 78 women and 24 men, in the age range 18–31 years. The participants were recruited using social media, the online research participation programme Sona, advertisements on the university billboards and by asking persons to participate. Participants with prior experience of sexual or physical abuse or current PTSD symptoms were excluded using the Jellinek-PTSD Screening Questionnaire (van Dam, Ehring, Vedel, & Emmelkamp, 2010, 2013). Based on these criteria, two female respondents were excluded leaving a total of 100 included participants. Participation was rewarded by either course credit or a voucher of 15 €. The study was approved by the local ethical committee (ECP 10-05-2011).

Measures

Jellinek-PTSD Screening Questionnaire (JPSQ)

The JPSQ is a short self-report questionnaire and serves as a first screening instrument to identify participants which might suffer from PTSD (van Dam et al., 2013). The instrument consists of four questions that can be answered with either yes or no. The score is the total sum of positive answers (range 0–4). Only participants with a score of 0 were allowed to participate in the current study. The JPSQ has shown to have high sensitivity (.87) and specificity (.75; van Dam et al., 2013).

Mood and control ratings

Mood ratings were obtained to measure the current level of four different emotions: fear, disgust, sadness and anger. Additionally, the level of control was assessed. Ratings were made on Likert scales with answer possibilities ranging from 0 (not at all) to 10 (extremely).

Self-Assessment Manikin (SAM)

SAMs were used to assess the valence and arousal elicited by the film. The scale has a range of 9 units, recoded to the range −4 to +4, with 0 presenting neutral. In case of valence the scale ranges from highly positive (score −4) to highly negative (score +4). For arousal the range represents decreasing levels of arousal. For each scale levels −4, −2, 0, 2 and 4 were represented by a Manikin depicting the corresponding level (Bradley & Lang, 1994).

Subjective Units of Distress (SUD)

The level of distress during the intervention was measured by asking participants to report distress verbally using SUDs with 0 representing completely relaxed, no fear at all and 10 indicating extreme levels of distress. This SUD measure has been frequently used in PTSD intervention research (Bluett, Zoellner, & Feeny, 2014; Fairbank & Keane, 1982).

Trauma film

The film used to induce PTSD symptoms is a 15-minute long compilation of scenes from the film *Salò or the 120 days of Sodom* by Pasolini. The compilation contains extreme violence, sadism, sexual and mental torture scenes and is known to induce negative mood changes and intrusions (Weidmann et al., 2009).

Intrusion diary

For seven days after the film, the participant recorded film-related intrusions on a paper tabular diary (cf. Brewin & Saunders, 2001; Hagenaars & Arntz, 2012; Holmes, Brewin, & Hennessy, 2004). The diary consisted of rows (part of the day, reporting all information of a particular intrusion on one line) and columns (information about the characteristics of the intrusion). They noted the content of each intrusion (what was the intrusion about?), the situation that triggered the intrusion, the emotion accompanying the intrusion and the level of distress, vividness and control on a scale

from 0 to 100 (with 0 representing low levels and 100 high levels). Furthermore, they noted whether the intrusion was a thought, an image or a combination. The usage of the diary was explained verbally and written information was provided on the top of each page of the diary. Participants were instructed to carry their paper diary with them and, in case of an intrusion, immediately note down information about that intrusion. An intrusion was defined as an unintended "spontaneously occurring" memory.

Procedure

The experiment consisted of two sessions: the experimental session and the follow-up session. The sessions were spaced one week apart and scheduled on the same part of the day. Before onset the participant received the Jellinek-PTSD Screening Questionnaire and additional questions about experience with sexual or physical abuse by email. Two experimenters ran the experiment to ensure that foreknowledge about the intervention did not contaminate the experimental results.

Experimental session

The participant was welcomed by Experimenter 1 and received written information about the general experimental set-up stating that the experiment consisted of two sessions, watching an aversive film and keeping a diary. The participants were not informed about the interventions or the nature of the diary. After signing the informed consent, the participant filled out the Mood and control ratings (Ratings#1). Next, the participant received background information about the setting of the film and was encouraged to engage in the film as if he or she was present at the scene. The participant was seated in a comfortable armchair, headphones were placed, the light was dimmed and after starting the film, Experimenter 1 left the participant alone in the room.

After watching the film Experimenter 1 re-entered the room and the participant filled out the Mood and control ratings again (Ratings#2) and the SAM (SAM#1). Subsequently, participants took a break of 30 minutes. After the break the participant returned and Experimenter 2 took over. The participant was randomly assigned to one of four conditions (n = 25 per condition; experimenter learned the condition just before entering the room by opening a sealed envelope, with condition determined by an independent researcher), with the restriction of an equal gender distribution across conditions: IE, IMRs before the most aversive part of the scene (Early ImRs), IMRs including the most aversive scenes (Late ImRs) or Cont.

During all conditions, the participant was repeatedly asked how much distress he or she experienced. The ratings took place before onset of the intervention (SUD#1), after closing the eyes for the intervention conditions or after five seconds for the Cont (SUD#2), after three minutes (SUD#3), six minutes (SUD#4) and nine minutes (SUD#5). Additionally, the participants in the intervention conditions (IE, Early ImRs and Late ImRs) were asked several times to indicate where they were in the scene imagined.

Experimental conditions

All interventions (IE, Early ImRs and Late ImRs) started with Experimenter 2 exemplifying mental imagery. The experimenter closed her eyes and described in detail making breakfast using present tense (e.g., "I open the refrigerator to get something for on my sandwich. The refrigerator feels cold and is humming a bit. I am seeing a bit of cheese in the refrigerator. I want this cheese on my sandwich, so I grab the cheese …"). Next, the participant was encouraged to select the scene that affected him or her most (i.e., the scene that caused the strongest negative emotion) and to report the experienced level of distress (SUD#1). The participant then closed his or her eyes, reported the level of distress (SUD#2) and was instructed to shortly relive the scene in their mind as vividly as possible, as if it was happening at that moment, with as much detail and emotion as possible (cf. Hagenaars & Arntz, 2012). The participant raised his/her hand after finishing this scene while keeping the eyes closed. From this point, the intervention conditions differed in the following way.

Imaginal exposure. The participant was instructed to mentally relive the selected scene for a second time. Subsequently, the participant was encouraged to relive other aversive scenes. After 10 and a half minutes, the participant was asked to finish the current scene and to open his/her eyes.

Early imagery rescripting (Early ImRs). The participant was instructed to mentally rescript the aversive scene in their mind in such way that

the tortures and humiliations were prevented (early intervention by the participant). The participant was allowed to alter the new script in case the script was not satisfying. All types of scripts were allowed as long as the solution was applicable to other scenes and satisfactory for the participant (e.g., the police or superman intervening). After reliving the rescripted scene the participant was encouraged to apply the solution to rescript other aversive scenes. After ten and a half minutes, the experimenter asked the participant to finish the scene and open the eyes.

Late imagery rescripting late (Late ImRs). The Late ImRs condition was similar to the Early ImRs condition with the exception that the participant was asked to relive the entire scene, including the most aversive moment, and was encouraged to change the end of the scene in a more preferable way (e.g., the children overpower the perpetrators after the tortures and humiliations; late intervention by the participant).

Control condition. The participants in the Cont condition did not receive an intervention. They were instructed to select one of the neutral magazines and to read for about 11 minutes.

After the intervention, a short interview was conducted in which the participant was asked which scenes were relived (IE, Late and Early ImRs) and if more than one script was used (Early and Late ImRs). The content the script(s) used was shortly discussed. In case of multiple scripts, the effectiveness of previous versions of the script on the relived scene was rated (range 0–10, with 10 representing a completely satisfying solution). Furthermore, the effectiveness of the final script used on all rescripted scenes was rated (similarly on a scale from 1 to 10).

Next, the use of the intrusion diary was explained by going through the instructions and terms used together with the participant. The telephone number of the psychological therapist was provided in case the participant needed help.

Follow-up session

Experimenter 1 guided the follow-up session. The experimenter discussed the diary and, if necessary, asked for clarification. Subsequently, the participant filled in the SAM (SAM#2) and received course credit or a voucher of 15 €.

Statistical analyses

The scores of the Mood and control rating, SAMs, SUDs, scenes relived, scripts used and the frequency and characteristics of the intrusions served as dependent variables; experimental condition served as independent variable. One person omitted the second SAM and was therefore, excluded for the SAM analyses (Late ImRs condition). Only intrusions that contained at least a visual image were included in the data analyses. Data were analysed with SPSS version 21 using parametric tests, Pearson and Partial correlations, General Linear Models, analyses of variance (ANOVAs), Chi-square tests and, in the case of intrusion frequency, Gamma regression with a loglink using generalised linear mixed models, given the skewed distribution of this variable. As Gamma regression cannot handle zero's, +.5 was added to the reported frequencies (with estimated means and 95% CI's based on a back-transformation to the original scale). In case of violations of sphericity in repeated measures ANOVA, Greenhouse-Geisser corrections were made. Possible differences between conditions regarding gender or presence/absence of intrusions were analysed non-parametrically. The rejection criterion was set at $p < .05$ throughout.

RESULTS

Pre-film measurements

Table 1 displays the demographic information per condition. No differences between the conditions were observed regarding the age ($F < 1$) or gender distribution ($\chi^2 = 0$). Neither did the conditions differ on any of the five Mood and control ratings, Fs(3, 96) < 1.66, ps > .18.

Film effects

To assess the influence of the aversive film on the Mood and control ratings a GLM-repeated measures was carried out with time (before and after the film) as within-subject factor and fear, disgust, sadness, anger and control as measures. The experimental condition functioned as between-subjects factor (for mean scores per condition see Table 1). This analysis revealed a main effect of time for each mood with an increase in fear, disgust, sadness and anger, Fs(1, 96) > 65.54,

TABLE 1
Demographic information, mood ratings, interview and intrusion information

Condition	*IE*	*Early ImRs*	*Late ImRs*	*Cont*
Male/female	6/19	6/19	6/19	6/19
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age	21.72 (2.49)	21.64 (2.34)	21.36 (1.50)	21.68 (2.19)
Mood ratings before				
Fear	.84 (1.40)	.56 (.87)	.96 (.93)	.68 (1.03)
Disgust	.48 (.96)	.20 (.58)	.52 (.71)	.44 (.82)
Control	7.52 (2.12)	7.88 (1.51)	6.68 (1.93)	7.28 (2.21)
Sadness	1.52 (2.26)	1.12 (1.33)	1.36 (1.50)	1.16 (1.49)
Anger	.32 (.74)	.44 (.87)	.68 (1.23)	.64 (1.35)
Mood ratings after				
Fear	2.60 (2.61)	1.88 (1.92)	2.12 (1.59)	2.36 (1.98)
Disgust	7.12 (2.09)	7.72 (2.42)	7.44 (1.78)	7.24 (2.39)
Control	6.36 (2.60)	7.00 (2.14)	6.48 (1.87)	6.64 (1.87)
Sadness	4.36 (2.66)	4.04 (2.64)	3.84 (2.15)	3.88 (2.49)
Anger	4.88 (2.74)	4.68 (3.53)	4.88 (2.35)	4.68 (3.31)
SAM session 1				
Valence	2.56 (1.53)	2.84 (1.57)	3.12 (1.27)	2.92 (1.04)
Arousal	–.96 (2.09)	–.48 (2.47)	–1.24 (1.79)	–.84 (1.84)
SAM session 2				
Valence	1.20 (2.20)	2.00 (2.09)	1.71 (2.24)	1.84 (1.80)
Arousal	1.28 (2.23)	1.79 (1.84)	1.29 (1.94)	0.72 (2.17)
Interview				
Number of scenes	4.64 (1.73)	4.16 (1.46)	3.76 (1.27)	–
Number of scripts	–	1.63 (.71)	1.48 (.73)	–
Success script	–	7.36 (1.38)	7.31 (1.27)	–
Intrusions				
Number (Median)[a]	2.00	4	1	4
(Minimum – Maximum)	0 13	0 23	0 10	0 20
Distress	28.23 (23.19)	23.50 (18.92)	17.86 (19.40)	28.21 (17.85)
Vividness	35.64 (24.19)	33.89 (22.80)	20.86 (18.13)	38.88 (17.88)
Control	75.55 (19.61)	80.59 (20.68)	78.17 (20.88)	69.83 (25.04)
Proportion emotion intrusions				
Fear	.23 (.31)	.092 (.15)	.054 (.14)	.16 (.31)
Disgust	.32 (.35)	.58 (.38)	.47 (.44)	.40 (.36)
Anger	.17 (.28)	.19 (.31)	.25 (.40)	.20 (.28)
Confusion	.016 (.067)	.013 (.053)	.044 (.15)	.026 (.11)
Powerless	.00 (.00)	.0069 (.029)	.042 (.11)	.011 (.038)
Empathy	.092 (.20)	.0080 (.024)	.024 (.089)	.021 (.092)
Other	.17 (.33)	.11 (.21)	.11 (.23)	.18 (.33)

[a]Because of skewed distributions, here medians, minimum and maximum number of intrusions are given. For means and SE's of the number of intrusions based on Gamma regression, see Table 2 and Figure 2.

$ps < .001$, $\eta_p^2 > .40$. The amount of feelings of control decreased over time, $F(1, 96) = 10.33$, $p < .005$, $\eta_p^2 = .097$. No main effects of condition or interactions were observed, $Fs < 1.06$, $ps > .37$, $\eta_p^2 < .032$. This indicates that the film did result in an increase of negative emotions and a decrease in experienced control.

Intervention-related measures

Levels of distress

The levels of distress during the session were analysed using a GLM-repeated measures with time as within-subject factor (SUD#1 through SUD#5) and condition as between-subject factor (see Figure 1). This analysis revealed a main effect of time, $F(4, 384) = 9.01$, $p < .001$, $\eta_p^2 = .086$, a main effect of condition, $F(3, 96) = 7.15$, $p < .001$, $\eta_p^2 = .18$, and a time × condition interaction, $F(12, 384) = 13.87$, $p < .001$, $\eta_p^2 = .30$.

The interaction was analysed further using Univariate ANOVA with each of the five SUD scores as dependent variable and experimental condition as factor. These analyses showed no condition differences on SUD#1 and SUD#2, $Fs < 1$, but did reveal differential responding on SUD#3, SUD#4

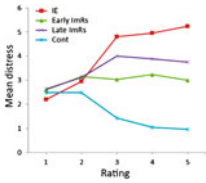

Figure 1. Mean SUD ratings per condition during the intervention.

and SUD#5, $Fs(3, 99) > 11.79$, $ps < .001$, $\eta_p^2 > .26$. Post hoc comparisons indicated that for SUD#3, SUD#4 and SUD#5, the Cont condition reported lower distress levels than did the intervention conditions, $ps < .005$. Furthermore, the IE condition reported more distress than did the Early ImRs condition during SUD#3, SUD#4 and SUD#5, $ps < .01$, and more distress than the Late ImRs condition during SUD#5, $p = .018$. No differences were observed between Early ImRs and Late ImRs, $ps > .11$. To summarise, the IE condition resulted in the highest level of self-reported distress; no intervention (Cont) resulted in the lowest level of distress.

Interview

The data obtained from the interview were analysed using Univariate ANOVA (see Table 1). The total number of relived scenes served as dependent variable and experimental condition (IE, Early ImRs and Late ImRs) as factor. This analysis revealed no differences between the three conditions, $F(2, 72) = 2.16$, $p = .12$, $\eta_p^2 = .057$.

Likewise, for the Early ImRs and Late ImRs condition the total number of used scripts and the successfulness of each script were analysed. These analyses indicated no differences regarding the number of scripts used or the efficacy, $Fs < 1$.

Intrusions

Frequency of intrusions

Because male participants tended to report less intrusions than female, Mann-Whitney test $U = 709.5$, $p = .097$, we controlled the analysis of intrusion frequency for gender. As the distributions of frequencies were skewed, and had a natural minimum of zero, we used Gamma regression with a loglink on the intrusion frequency + .5 as dependent variable, as available in the generalised linear mixed models module of SPSS.[1] The SPSS module can also produce pairwise contrasts between conditions.

Table 2 shows the estimated means, SE, and 95% CI of transformed and back-transformed frequencies. Figure 2 shows the estimated means and 95% CI on the original scale. The Gamma regression showed significant effect of condition, $F(3, 95) = 3.29$, $p < .05$. Pairwise comparisons indicated that only the Late ImRs condition reported significantly fewer intrusions than the Cont condition, $t(95) = -2.15$, $p < .05$, while the difference between the latter and the two remaining intervention conditions (IE and Early ImRs) was not significant ($ps > .20$). In addition, the Early ImRs condition produced significantly more intrusions than participants in the Late ImRs or the IE condition, $ts(95) > 2.00$, $ps < .05$, which did not differ from each other, $t(95) = .87$, $p = .39$.

A total of 31 participants did not report any intrusion (containing at least a visual image) at all (Cont $n = 3$; IE $n = 9$; Early ImRs $n = 7$; Late ImRs $n = 12$). The number of persons with and without intrusions varied across conditions, $\chi^2(3) = 7.91$, $p = .048$. Pairwise comparisons indicated that the number of persons with intrusions was higher in the Cont condition compared to the IE, $\chi^2(1) = 3.87$, $p = .049$, and Late ImRs condition, $\chi^2(1) = 7.56$, $p = .006$. No other differences were observed, $\chi^2(1) < 1.95$, $ps > .16$.

Characteristics of intrusions

Univariate ANOVA was used to assess the mean level of distress, vividness and control of the intrusions. These analyses revealed no difference between the conditions for the amount of experienced distress and control, $Fs(3, 85) < 1.34$, $ps > .26$, $\eta_p^2 < .045$. The mean level of vividness did vary across conditions, $F(3, 85) = 3.11$, $p < .05$, $\eta_p^2 = .099$. In particular, participants in the Late ImRs condition reported overall a lower level of vividness compared to the other three conditions, $ps < .05$, no other significant effects were observed, $ps > .42$.

The reported emotions that accompanied the intrusions are listed in Table 1. The proportion of each emotion was calculated as each intrusion could result in multiple reported emotions. A GLM-repeated measures was carried out with type of emotion as within-subject factor and condition as between-subjects factor. This analysis revealed a main effect of type of emotion, $F(5, 320) = 28.98$, $p < .001$, $\eta_p^2 = .31$, but no effect

[1] We used a gamma regression as this analysis is recommended for distributions that are intrinsically skewed and are by nature non-negative.

TABLE 2
Estimated means, SE and 95% CI of frequency of intrusions from the mixed Gamma regression analyses (controlled for gender)

	Loglink transformed (frequency + 0.5)				*Back-transformed frequency*			
			95% CI				*95% CI*	
Condition	*Mean*	*SE*	*Lower*	*Upper*	*Mean*	*SE*	*Lower*	*Upper*
IE	1.27	0.22	0.83	1.70	3.05	0.78	1.79	4.99
Early ImRs	1.85	0.21	1.43	2.26	5.83	1.33	3.67	9.12
Late ImRs	1.02	0.21	0.59	1.44	2.26	0.59	1.30	3.73
Control	1.64	0.21	1.22	2.05	4.64	1.07	2.90	7.28

Raw frequencies were analysed with Gamma regression with a loglink after 0.5 was added (as Gamma regression cannot handle zero's). Back-transformed statistics were corrected by subtracting 0.5.

of condition, $F < 1$, or interaction, $F(15, 320) = 1.12$, $p = .34$, $\eta_p^2 = .050$. Disgust was significantly more often reported than all other emotions, ps $< .005$, anger and fear were reported more often than confusion, powerless and empathy, ps $< .05$. No other differences were observed, ps $> .20$.

Intervention and intrusions

Partial correlations were carried out between the mean level of distress (SUD) during the intervention and the number of intrusions, mean level of distress, vividness and control accompanying the intrusions. In these analyses, we controlled for experimental condition. The analyses revealed that higher levels of distress during the session (all conditions) were linked with more vivid intrusions, $r(86) = .31$, $p < .005$, more distressing intrusions, $r(86) = .51$, $p < .001$ and less feelings of control over the intrusions, $r(86) = –.32$, $p < .005$. However, the mean level of distress (SUD) did not significantly correlate with the number of intrusions, $r(86) = .16$, $p = .15$.

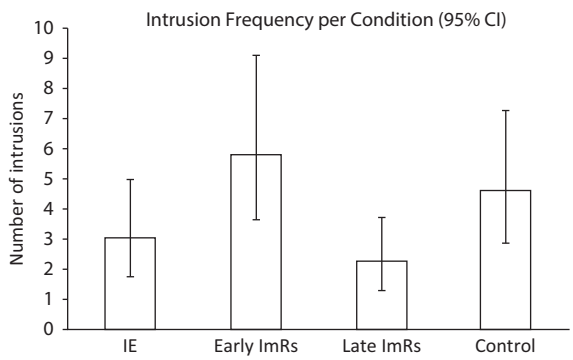

Figure 2. Mean intrusion frequencies per condition with 95% CI's (estimates from mixed Gamma regression controlled for gender transformed back to original scale).

A similar analysis was carried out between the number of scenes relived (IE, Early ImRs and Late ImRs), the amount of scripts used (Early and Late ImRs conditions), the effectiveness of the scripts used (Early and Late ImRs conditions) and the frequency, vividness, distress and perceived control of the intrusions. The only significant correlation observed was between the effectiveness of the script used (Late and Early ImRs) and the vividness of the intrusions, $r(38) = –.35$, $p < .05$, with more effective scripts resulting in less vivid intrusions. More effective scripts also tended to result in less intrusions, $r(38) = –.28$, $p = .079$ and less distressing intrusions, $r(38) = –.27$, $p = .090$. No other (marginally) significant correlations were observed $|r$s$| < .21$, ps $> .10$.

Follow-up measures

A GLM-repeated measures with the SAM score after film and at follow-up as within-subject factors and condition as between-subjects factor was carried out. The analysis yielded a main effect of time for both the level of valence and arousal, Fs$(1, 95) > 30.81$, ps $< .001$, $\eta_p^2 > .24$, but no interaction or condition effect, Fs < 1. Overall, the level of arousal regarding the film decreased and the valence became more positive across the sessions (see Table 1).

DISCUSSION

The main aim of the present study was to compare ImRs to IE, to further explore mechanisms underlying ImRs and to assess the necessity of including the most aversive scenes in ImRs. To this end, participants viewed a highly aversive film, a compilation of scenes of *Salò or the 120*

days of Sodom by Pasolini, in order to induce PTSD-like symptoms. Next, the participants were assigned to one of four conditions: IE, ImRs including the most aversive part of the scenes (Late ImRs), ImRs without the most aversive part (Early ImRs) or a Cont condition (reading a magazine, Cont). The week following the trauma induction the frequency and characteristics of the intrusions were recorded using an intrusion diary (cf. Brewin & Saunders, 2001; Hagenaars & Arntz, 2012; Holmes et al., 2004).

Watching the aversive compilation did result in PTSD-like symptoms, a prerequisite for comparing the interventions. That is, after the film the levels of fear, disgust, sadness and anger increased and perceived control decreased. In the week after the trauma induction participants experienced on average about four intrusions. As such the trauma induction was successful.

In line with our first prediction, the results showed that participants in the IE condition reported higher levels of distress during the intervention than participants in either Late- or Early-ImRs conditions. Somewhat surprisingly, the distress levels in the two ImRs conditions did not differ from each other.

The second prediction was that ImRs conditions should result in fewer and less vivid intrusions than IE. The results were somewhat mixed, but appear to support the idea that only Late ImRs is more beneficial than IE. Indeed, although Late ImRs and IE did not differ in the number of reported intrusions, only Late ImRs reported significantly fewer intrusions than the control. In addition, concerning the vividness of the intrusions, participants in the Late ImRs condition reported less vivid intrusions than the IE, Early ImRs and Cont condition. In contrast, and somewhat unexpectedly, Early ImRs produced significantly more intrusions than either the Late ImRs or the IE condition. Furthermore, the proportion of persons reporting at least one (visual) intrusion did also vary between conditions. In the Cont condition more persons reported having had intrusions than in the Late ImR and IE condition.

The third hypothesis concerned the emotions accompanying the intrusions and film-related content. It was expected that ImRs would be more successful in reducing non-fear-related emotions than IE. Though there was a discrepancy between the emotions reported in the diaries, with disgust being the most-reported emotion, no differences were observed between the conditions. This is not surprising as scenes depicting eating human faeces with a spoon, scalping and cutting off a tongue were displayed (see for clincial digust reactions, Dalgleish & Power, 2004) and the film is known to specifically induce feelings of disgust (Weidmann et al., 2009). A final observation is that the level of distress during the intervention was positively linked to the vividness of intrusions, to the level of distress caused by the intrusions and negatively linked to the perceived control. This indicates that the level of distress during the intervention relates to the characteristics of the intrusions afterwards.

Our data are in line with the results of Hagenaars and Arntz (2012). In their experimental set-up the most aversive scenes were included during rescripting, as such this resembles our Late ImRs intervention. In their study, ImRs resulted in fewer intrusions compared to mentally reliving the scenes and positive imagery. Our data are also partially in line with the study of Davies and Clark (1998). In their study, suppression of thoughts about a traumatic film resulted in a rebound effect for analogue traumatic intrusions. Like in the study of Davies and Clark, no active processing took place of the most aversive scenes during Early ImRs. This resulted in more intrusions than reliving all parts during rescripting (Late ImRs and IE). However, one can also reason that during rescripting, the information is not actively suppressed, but that the limited focus of awareness is occupied by alternative information to substitute a thought or memory (Benoit & Anderson, 2012).

Regarding the clinical studies on ImRs, the present data are in line with the results of Arntz and colleagues (2007) in which IE plus rescripting resulted in less drop out compared to IE alone. Though we did not have any drop outs, rescripting did result in less self-reported distress during the intervention compared to IE. As such, the ImRs conditions seem to be more acceptable for the participants than the IE condition.

Not all data are in line with previous studies or our expectations. First of all, the Cont condition (reading a magazine) did not significantly display more intrusions than two of the intervention conditions. Only the Late ImRs condition led to significantly fewer intrusions than the Cont condition. A possible explanation is that the persons in the Cont condition used a coping strategy, for example, emotionally processing scenes of the film, while they were reading a magazine. This

seems a plausible explanation, however, the distress scores during their reading period remained low, making this a less likely explanation. An alternative explanation is that some kind of coping strategy was used during the break or after session 1. Unfortunately, no data were obtained regarding possible coping strategies used in these time frames.

An observation that also deserves attention is that the Late ImRs and IE condition did not differ regarding intrusion frequency and the number of participants reporting intrusions. This lack of a difference might be caused by the level of IE as in both conditions, prior to the intervention manipulation, participants relived the entire scene. Though this seems to suggest that both conditions are equally effective, we did observe differences between the conditions concerning the vividness of the intrusions and experienced distress during the intervention. That is, participants in the Late ImRs condition reported less vivid intrusions and less distress at the end of the intervention compared to participants in the IE condition.

Based on the study of Arntz and colleagues (2007), it was expected that ImRs should result in a stronger reduction of non-fearful emotions compared to IE. However, no such observation was made. In the study of Arntz et al., IE + ImRs resulted in a decrease in anger control, externalisation of anger, hostility and guilt, especially at follow-up compared to IE alone. However, this observation was made in a clinical sample with established PTSD-symptoms, using specific questionnaires. It is quite possible that the film used for the present study was not suitable for inducing more permanent feelings of anger, hostility and guilt. Even more, it is doubtful whether any trauma induction using a film will enable such kind of feelings as the participants only observe the scenes and do not take part in them. Another difference is the time gap between traumatic experience and intervention. In the present study only 30 minutes separated these events, in a clinical setting the time between traumatic experience and intervention is often more than a year. These time differences have of course consequences for the (re)consolidation of the traumatic memory (e.g., Alberini & LeDoux, 2013) making it difficult to compare the present study with clinical studies.

The theoretical frameworks pose that only in case of activation of the mental representation of the aversive event the memory can be more easily retrieved, altered or placed into context and reconsolidated. The observations of the present study support this notion. Activating and rescripting only part of the mental representation resulted in more frequent and vivid intrusions compared to activation of the complete aversive representation. Rescripting added to mere IE in that it more effectively reduced the vividness of the intrusions.

The present study does have several drawbacks. First of all, a non-clinical sample was used, making it difficult to extrapolate the results to a clinical population. Second, the most frequently reported emotion accompanying the intrusions was disgust, making it more difficult to generalise the results to films that elicit different emotional profiles. Third, the film consisted of a compilation of several scenes making the rescripting more difficult as the script should fit all aversive scenes. Fourth, we did not check if the participants in the Cont condition used some kind of coping strategy. Fifth, the Early ImRs condition might have failed to include essential "warning signals" and expectation and associated arousal might not have been high enough to have an optimal effect of "Early ImRs". This would match clinical observations that just fantasising that the trauma did not happen is not effective—a clear and upsetting expectation in the reliving that the trauma is going to happen seems necessary. More research is needed to clarify this. Sixth, the trauma induction does not allow immersing and interacting in the traumatic event; as such it is hard to measure feelings of guilt or powerlessness. For future studies we would recommend using a trauma induction displaying one scene in which the participant feels present, for example, exposing a participant to a deadly train accident in virtual reality (see for emerging virtual reality Riva et al., 2007). Seventh, the sample size (n = 25 per condition) only allowed to detect large effects (Cohen's $d > .8$) with 80% power and alpha = .05, which means that smaller effects might have remained undetected. Eighth, all participants in the experimental conditions briefly imagined the most aversive scene before the experimental procedure started. This potentially reduced the differences between the Early and the Late ImRs conditions. Nevertheless, the two ImRs conditions turned out to differ, probably because in the Early ImRs condition the Rescripting was not linked enough to the memory representation of the most aversive part of the film.

A final and highly important point is that the time between the traumatic experience and

intervention was rather short. Though the 30-minute gap is in line with other experimental studies on rescripting, it is not in line with clinical observations, making it hard to generalise the results to a clinical setting. As such one can argue that the current study is more in line with PTSD prevention research (see for reviews Feldner, Monson, & Friedman, 2007; Roberts, Kitchiner, Kenardy, & Bisson, 2009). Like in the experimental study of Hagenaars and Arntz (2012), the intervention rather aimed at preventing PTSD-like symptoms than treating them. For future studies it would be highly interesting to further unravel trauma memory mechanisms by comparing ImRs with other techniques that are known to reduce or prevent PTSD-like symptoms in an experimental setting, such as Eye Movement Desensitisation and Reprocessing (e.g., Holmes, James, Coode-Bate, & Deeprose, 2009).

To conclude, the trauma induction in the present study did result in PTSD-like symptoms. The IE intervention was experienced as more stressful compared to ImRs interventions. More distress during the intervention resulted in more vivid and distressing intrusions and less feelings of control over the intrusions. Including the most aversive scenes during rescripting resulted in a diminishment of the frequency and vividness of film-related intrusions. Thus, Late ImRs seems to be the most promising for reducing PTSD-like symptoms after an analogue trauma induction.

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Pauline Dibbets and Arnoud Arntz have contributed and consent to this paper and certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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