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Count out your intrusions: Effects of verbal encoding on intrusive memories

Julie Krans MS [a], Gérard Näring [a] & Eni S. Becker [a]

[a] Radboud University, Nijmegen, The Netherlands

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Count out your intrusions: Effects of verbal encoding on intrusive memories

Julie Krans, Gérard Näring, and Eni S. Becker
Radboud University Nijmegen, The Netherlands

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Peri-traumatic information processing is thought to affect the development of intrusive trauma memories. This study aimed to replicate and improve the study by Holmes, Brewin, and Hennessy (2004, Exp. 3) on the role of peri-traumatic verbal processing in analogue traumatic intrusion development. Participants viewed an aversive film under one of three conditions: counting backwards in 3s (''verbal interference''), verbalising emotions and thoughts (''verbal enhancement''), or without an extra task. A dual-process account of PTSD would predict that verbal interference would increase intrusion frequency compared to no task, whereas verbal enhancement would lead to a decrease. In contrast, mainstream memory theory predicts a decrease in intrusion frequency from any concurrent task that diverts attention away from the trauma film. The main finding was that the verbal interference task led to a *decrease* in intrusive memories of the film compared to the other two conditions. This finding does not support a dual-process account of PTSD, but is in line with general theories of memory and attention.

Keywords: Intrusive memories; Post-traumatic stress; Information processing; Autobiographical memory.

A hallmark feature of post-traumatic stress disorder (PTSD) is re-experiencing the trauma through distressing intrusive memories (DSM-IV-TR; American Psychiatric Association, 2000). Distortions in peri-traumatic information processing have been suggested as an important factor in intrusion development (Holmes & Bourne, 2008). The present study aimed to test the effect of interference versus enhancement of verbal processing during encoding of an aversive film on the frequency of subsequent intrusive memories.

The dual representation theory of PTSD (DRT; Brewin, Dalgleish, & Joseph, 1996) distinguishes between (a) trauma memory representations from conscious processing that can be deliberately retrieved (VAMs), and (b) image-based trauma memories (SAMs) that are automatically activated by perceptually similar cues and give rise to intrusive memories. According to DRT, conscious processing is impaired during high stress, leading to more SAMs than VAMs, which finally leads to intrusive trauma memories. Peri-traumatic verbal processing has been suggested to underlie the formation of VAMs (Holmes & Bourne, 2008; Holmes et al., 2004). Interfering with peri-traumatic verbal processing, then, should *increase* intrusion frequency, whereas enhancing verbal processing should *decrease* intrusion frequency by modulating VAM information. Additionally, verbal interference should *decrease* deliberate recall whereas verbal enhancement should *increase* deliberate recall compared to a no-task control condition.

More general theories of memory and attention (e.g., Baddeley & Hitch, 1994; Cowan, 1995; Conway & Pleydell-Pearce, 2000; Rubin, 2006;

Address correspondence to: Julie Krans MS, Radboud University Nijmegen, Department of Clinical Psychology, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands. E-mail: J.Krans@psych.ru.nl

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Kirkegaard Thomsen & Berntsen, 2009) suggest it depends on the retrieval process whether a memory will be intrusive or deliberately recalled (Rubin, Boals, & Berntsen, 2008). For example, the self-memory-system (SMS) model (Conway, Singer, & Tagini, 2004) suggests that (traumatic) information is stored in its raw near-sensory form in the episodic memory system. Because of its threatening nature, traumatic information is not readily integrated into the autobiographical memory knowledge base and therefore automatic activation of traumatic episodic memories (i.e., intrusions) is not inhibited. Traumatic information is not stored in separate systems (e.g., VAMs and SAMs) but it lacks the natural integration into the autobiographical knowledge base. In terms of encoding, additional cognitive load generally reduces encoding of the film (Baddeley & Hitch, 1994). Thus, verbal interference during film viewing should *decrease* both intrusion development and deliberate recall of the film.

The ''trauma film paradigm'' (see Holmes & Bourne, 2008, for a review) was developed to study peri-traumatic information processing. Typically, healthy participants are presented with an aversive film while performing a concurrent task. Participants report intrusive memories from the film in a 1-week diary. Studies have supported the role of visuospatial-perceptual information processing in intrusion development (e.g., Krans, Näring, Holmes, & Becker, in press) but the role of verbal-conceptual processing is less well studied. This is surprising because the study of peri-traumatic verbal processing is critical for the dual-processing account, for showing that intrusion frequency can *increase* through interference with peri-traumatic verbal processing would argue against a general distraction argument. In an important study, Holmes et al. (2004, Exp. 3) presented participants with an aversive film under one of three conditions: while counting backwards in 3s (''verbal interference'' task), while verbalising the impact of the film (''verbal enhancement''), or with no extra task. Predictions were based on DRT (Brewin et al., 1996) and, in line with this, participants in the counting backwards condition reported significantly more intrusive memories from the film compared to the control condition. The verbal enhancement condition showed a non-significant trend towards more intrusions. However, on closer inspection it appeared that participants in the latter condition were verbalising physical features of the film, which is not thought to promote verbal-conceptual processing. The Holmes et al. (2004) study is important since it suggests that mere distraction is not an explanation for the results obtained in other trauma film paradigm studies. However, the results need to be replicated and the dual-processing account needs to be contrasted with general memory and attention theory. Finally, participants did not perform the verbal enhancement task as intended and this task needs to be improved.

The present study aimed (a) to replicate the study by Holmes et al. (2004), Exp. 3) while contrasting dual-processing and mainstream memory views, and (b) to improve the verbal enhancement task using more extensive training. Participants viewed an aversive film under one of three conditions: counting backwards in 3s (verbal interference), verbalising the impact of the film (verbal enhancement), or no task. Participants reported intrusive memories of the film in a 1-week diary. Results in line with the DRT (Brewin et al., 1996) would be: (a) a *decrease* in intrusive memories and an *increase* in deliberate recall of the film in the verbal enhancement condition compared to the no-task control condition and the verbal interference condition; and (b) an *increase* in intrusive memories and a *decrease* of deliberate recall in the verbal interference condition compared to both other conditions. However, more general theories of autobiographical memory (e.g., Conway & Pleydell-Pearce, 2000) would predict a *decrease* in intrusive memories and deliberate recall in the verbal interference condition compared to the no-task-control condition and the verbal enhancement condition. No specific difference would be expected between the verbal enhancement and the no-task-control condition attention is film-related in both conditions.

METHOD

This study has been approved by the ethical committee (CMO 2005/063).

Participants

Participants, all psychology students, were recruited by flyers and posters that contained information about the violent content of the film. They received credit for participation. Data from 76 participants (11 men and 65 women) were collected (age $M = 21.84$ years, range 18–30).

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Participants were screened for panic attacks, panic disorder, PTSD, major depressive episode, psychotic episode, blood phobia, history of fainting, and a history of car accidents. No students had to be excluded.

Materials

Aversive film. The film consisted of three clips: (1) a female student in the aftermath of a traffic accident being medically attended to while crying out in pain (Steil, 1996; 2 minutes 6 seconds); (2) a mother in a WWII concentration camp forced to choose which one of her two children will be killed (from the film *Sophies's Choice*; 2 minutes 32 seconds); and (3) several short scenes showing mortally wounded children, faces burned with napalm, American soldiers talking about killing Iraqi citizens, and a woman crying out to Allah (from the film *Fahrenheit 911* by Michael Moore; 2 minutes 10 seconds). The film was projected onto a smooth white wall with sound presented through headphones.

Experimental tasks. All participants were instructed to pay full attention to the film as if being a witness. Participants in the verbal processing conditions received task training. For verbal enhancement, participants were instructed to verbalise their emotions, sensations, and thoughts during the film. An example was provided with a correct verbalisation (emotion, sensory experience, or thought) and an incorrect verbalisation (physical feature). Participants practised in the presence of the experimenter, who stopped and corrected the participant in a friendly way in the case of an incorrect verbalisation. When participants fell silent they were encouraged to continue verbalising. Practice continued until the participant was able to perform the task without error for 1 minute. Participants in the verbal interference condition were instructed to count backwards in 3s from 958 during the film. To practise, participants counted backwards in 3s from 100 in the presence of the experimenter. In the case of an error, the experimenter stopped and corrected the participant in a friendly way. Participants then restarted counting from 100 until they reached number 1 or 1 minute had passed. When participants fell silent they were encouraged to continue counting. During the film, an audio recording was made in all conditions with an unobtrusive microphone.

Measures

Emotion. The mood questionnaire (Holmes et al., 2004) was used to rate current happiness, anxiety, horror, depression, and anger on an 11-point scale (0 = not at all, 10 = extremely). The State-Trait Anxiety Inventory (STAI; Van der Ploeg, 1980) was used to assess state anxiety with 20 items (1 = almost never, 4 = almost always). It has satisfactory reliability and validity (Van der Ploeg, 1980).

Intrusive memories. Participants reported their intrusive memories in a 1-week diary (Holmes et al., 2004). ''Intrusions'' were defined as spontaneously occurring unwanted memories of the film clips. It was emphasised that deliberate thinking about the film did not count as an intrusion. Participants were instructed to write down every occurrence immediately and check the diary at the same time every day.

Control measures

Attention and memory. Attention for the film was rated on a single item (0 = not at all, 10 = completely focused). The recognition test contained nine statements with a true/false format. The cued-recall test contained nine open-ended questions (e.g., ''What was the student that was medically attended to wearing?'').

Diary compliance and demand characteristics. Diary compliance was rated on a scale from 0 (never forgot to write down the intrusion) to 10 (always forgot to write down the intrusion). The perceived goal of the study was asked for with an open-ended question.

Procedure

After screening, participants signed an informed consent form. Participants were randomly assigned to one of the three conditions and were tested individually. The STAI-S and mood questionnaire were administered before and after film viewing. Participants in the verbalisation conditions received their task training. Then participants viewed the film, after which the attention scale was administered. At 1 week follow-up, participants filled in the cued-recall memory test, the recognition memory test, and diary compliance rating.

Statistical approach

Analyses of variance were used to test between-participants effects. A priori hypotheses were examined with directional tests. The corrected *t*-value is reported in case of violation of Levene's statistic. The level of significance was an alpha level of .05.

RESULTS

Outliers were checked across and within conditions using boxplots. Four univariate outliers were identified on the number of intrusive memories. These were adjusted according to the procedure described by Tabachnick and Fidell (1996). Six univariate outliers (all scores 1 or 2) were identified for pre-film horror on the mood questionnaire. However, correction would lead to all scores being 0. To ensure variance it was decided not to adjust these scores. No multivariate outliers were detected with Mahalanobis distances (Tabachnick & Fidell, 1996). Descriptive statistics are presented in Table 1.

Randomisation and manipulation check

A multivariate ANOVA to test for pre-film differences on the mood questionnaire was not significant, $F(10, 140) = 0.75$, $p = .68$. There was no significant difference between conditions in pre-film STAI-S, $F(2, 73) = 0.76$, $p = .47$. Pre-film mood was comparable across conditions.

Audio recordings from 47 participants (88.68%) were suitable for analysis. The verbal interference condition showed $M = 5.40$ ($SD = 6.68$) errors. In the verbal enhancement condition, thoughts and emotions about the film were verbalised during 16.36% of the film, physical features during 1.95%, and participants were silent during 81.69% of the film. The number of pauses in this condition was similar to that in the verbal interference condition (see Table 1), corrected $t(41.05) = 1.22$, $p = .23$. The mean duration of the pauses was almost three times longer in the verbal enhancement condition than in the verbal interference condition, corrected $t(15.92) = 6.26$, $p < .001$, $d = 1.77$.

Control measures

Demand characteristics. Participants who recognised intrusion modulation as the perceived goal of the study were given a score of 1 on a demand variable, whereas other participants were given a score of 0. Within conditions, one-way ANOVAs were performed with demand as the independent factor and the number of intrusive memories as the dependent variable. There was no difference by demand on intrusion frequency in the no-task-control and the verbal interference condition ($p > .05$). Participants in the verbal enhancement condition who mentioned intrusion modulation ($n = 8$) reported significantly fewer intrusive memories compared to participants who did not ($n = 16$), $F(1, 22) = 6.56$, $p = .02$, $f = 0.55$.

Diary compliance. The overall diary compliance rating was $M = 1.97$, $SD = 1.38$, indicating high compliance. There was no significant difference between conditions ($p > .05$).

Intrusion frequency. The verbal enhancement condition was not significantly different from the no-task-control condition with regard to intrusion frequency, corrected $t(40.17) = 1.04$, $p = .30$ (two-tailed). Participants in the verbal interference condition showed a trend towards fewer intrusive memories compared to the no-task control condition, $t(50) = 1.80$, $p = .08$ (two-tailed), $d = 0.50$. There was no significant difference between the verbal interference and verbal enhancement condition, $t(51) = -0.85$, $p = .20$ (one-tailed). Because the number of intrusive memories in the verbal enhancement condition could be deflated due to demand characteristics, we reran the analyses for this condition with only participants who were unaware of the goal of the study. Now the verbal enhancement condition showed significantly more intrusive memories compared to the verbal interference condition, $t(28) = 2.05$, $p = .04$ (two-tailed), $d = .76$, but not compared to the no-task control condition, $t(31) = 0.22$, $p = .82$ (two-tailed).

Emotional impact. A 2 (mood questionnaire: pre- film, post-film) × 3 (condition: control, verbal interference, verbal enhancement) repeated-measures MANOVA was done to test the emotional impact of the film. The within-participants test was significant, $F(5, 69) = 70.37$, $p < .001$, $f = 2.26$, indicating significant emotional impact of the film. There was no significant main effect of

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TABLE 1
Descriptive statistics for the experimental variables

		No-task control		*Verbal interference*		*Verbal enhancement*	
		M	*SD*	*M*	*SD*	*M*	*SD*
Intrusive images*		3.53	3.26	2.07	2.02	3.75	2.41
Number of pauses		–	–	14.76	13.20	18.64	8.34
Pause duration (seconds)		–	–	6.85	4.74	18.88	9.77
Happiness	Pre-film	6.65	0.89	6.24	1.15	6.67	1.31
	Post-film	3.09	1.93	4.17	2.11	3.92	1.96
Anxiety	Pre-film	1.57	1.47	1.66	1.52	1.38	1.81
	Post-film	2.48	2.48	2.55	1.99	2.67	1.93
Horror	Pre-film	0.30	0.64	0.59	0.98	0.33	0.57
	Post-film	6.09	2.45	5.00	2.25	4.88	2.42
Depressed mood	Pre-film	1.65	1.70	1.52	1.50	1.04	1.40
	Post-film	4.57	2.27	3.83	2.51	3.42	2.04
Anger	Pre-film	0.39	0.72	0.45	0.78	0.38	0.82
	Post-film	4.43	2.91	3.62	2.71	4.67	2.75
STAI-S	Pre-film	30.26	5.75	32.14	7.35	30.25	5.91
	Post-film	39.43	8.94	39.31	12.37	43.42	9.53
Attention		9.09	0.73	5.97	2.24	8.71	1.20
Cued recall		5.48	1.59	2.97	2.15	4.38	1.86
Recognition		5.78	1.31	5.17	1.34	5.63	1.21

*Corrected for demand characteristics.

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condition, $F(2, 73) = 0.64$, $p = .53$. The interaction effect was only marginally significant, $F(10, 140) = 1.81$, $p = .06$, with a significant larger decrease in happiness in the control condition compared to the verbal interference condition ($p = .02$).

A 2 (anxiety: pre-film, post-film) × 3 (condition: control, verbal interference, verbal enhancement) repeated measures ANOVA with STAI-S scores as the within-participants factor and condition as the between-participants factor showed a significant increase in state anxiety, $F(1, 73) = 99.75$, $p < .001$, $f = 1.17$. There was no significant main effect of condition, $F(2, 73) = 0.40$, $p = .67$, but there was a significant interaction, $F(2, 73) = 3.29$, $p = .04$, $f = 0.30$. A one-way ANOVA was performed with the change scores on the STAI-S as the dependent variable and condition as the between-participants factor. Post hoc tests (Bonferroni correction) showed a significantly lower increase in anxiety in the verbal interference condition compared to the verbal enhancement condition, $p = .04$, but not compared to the no-task control condition, $p > .05$. The latter two conditions were not significantly different, $p = .34$.

Attention for the film. A one-way ANOVA with attention rating as the dependent variable and condition (control, verbal interference, verbal enhancement) as the between-participants factor was significant, $F(2, 73) = 30.55$, $p < .001$, $f = 0.92$. Post hoc analysis (Bonferroni correction) showed that attention rating was significantly lower in the verbal interference condition compared to the no-task control and the verbal enhancement condition, both $p < .001$. There was no significant difference between the latter two conditions, $p > .05$.

Memory for the film. A one-way ANOVA was performed with cued-recall as the dependent and condition as the independent variable, $F(2, 73) = 11.39$, $p < .001$, $f = 0.56$. Post hoc analyses (Bonferroni correction) showed a significantly lower performance in the verbal interference condition compared to the other two conditions, both $p < .05$. There was no significant difference between conditions with regard to recognition test performance, $F(2, 73) = 1.60$, $p = .21$.

DISCUSSION

The main goal of this study was to investigate the role of peri-traumatic verbal processing in the development of intrusive memories. We aimed to replicate research (Holmes et al., 2004, Exp. 3) that grounded predictions in a dual-processing account of PTSD (e.g., Brewin et al., 1996). From this view predictions were (a) *lower* intrusion frequency with *higher* deliberate recall performance in the verbal enhancement condition

compared to both the verbal interference and the no-task control condition; and (b) an *increase* in intrusion frequency with a *decrease* in deliberate recall in the verbal interference condition compared to the verbal enhancement and the no-task condition. Interestingly, we found *lower* intrusion frequency and deliberate recall (as well as attention rating) in the verbal interference condition compared to both other conditions. This pattern is in line with a general disruption of encoding of the film as predicted by mainstream models of attention and memory that do not assume separate memory systems for traumatic information (e.g., Baddeley & Hitch, 1994; Conway et al., 2004; Rubin, 2006).

Audio-recordings indicated that we taught participants to verbalise their emotions and thoughts instead of physical features of the film, thereby solving the problem that was reported in Holmes et al. (2004, Exp. 3). However, participants performed the task during only 20% of the film. If participants were verbalising their emotions and thoughts subvocally this would be supported by a reduced attention rating. However, attention for the film was not reduced in this condition compared to the no-task condition and was actually higher than in the verbal interference condition. It has been previously noted in the literature that enhancing processing style in participants is difficult. In addition to the problem reported in Holmes et al. (2004, Exp. 3), Halligan, Clark, and Ehlers (2002) also failed to have participants successfully apply data-driven or conceptual processing of an aversive film when this was not their natural processing style. We cannot rule out ''silent processing'' in our study but we suggest that low task performance is a more plausible interpretation of our results.

The finding that the verbal interference task *reduced* intrusion frequency as well as deliberate recall is in conflict with the DRT (Brewin et al., 1996). It is possible that counting backwards in 3s is not a purely verbal task as it involves more than verbalising numbers. However, the exact same task was used in Holmes et al. (2004, Exp. 3) and was defined as a verbal task there. Accepting a general cognitive load interpretation involving central executive resources would make *their* finding (an increase in intrusive memories in the verbal interference condition) problematic. A similar finding as ours was presented by Pearson, Sawyer, and Holmes (2008), and we echo their argumentation here. Several studies have shown that the central executive is involved in forming mental images from perceptual information in working memory and in keeping these images active (Pearson, 2001; Pearson, Logie, & Green, 1996; Rudkin, Pearson, & Logie, 2007). From this viewpoint, interfering with executive processes by a concurrent task disrupts the encoding of perceptual information.

A possible explanation for the incompatible findings of our study and the study by Holmes et al. (2004, Exp. 3) is a difference in the context given with the film material. The film clips in Holmes et al. were preceded by a short auditory introduction that informed participants about what had happened, the victims, and the outcome. In the present study and the studies by Pearson et al. (2008) participants were not given any introduction. It is possible that a film context affects verbal processing of the film because it may already activate conceptual processing. Also, our film material included different clips from those used in Holmes et al. (2004). Finally, participants in our study practised the counting backwards task before viewing, which is not reported in Holmes et al. (2004). Generally, the analogue trauma and healthy sample of limited size, common in trauma film studies, restrict generalisation to clinical populations. In this study we controlled for state and trait anxiety, but perhaps other moderators might be important as well (e.g., dissociation or schizotypy).

To conclude, our results do not support dual-process accounts of PTSD (e.g., Brewin et al., 1996) with regard to the development of intrusive memories. Rather, our findings are in line with non-PTSD models of memory and attention (e.g., Conway & Pleydell-Pearce, 2000; Rubin, 2006) and indicate that analogue traumatic information is not encoded into separate memory systems (i.e, VAMs and SAMs). Our results contradict earlier findings (Holmes et al., 2004) and we believe that they should be inspirational for future research.

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