

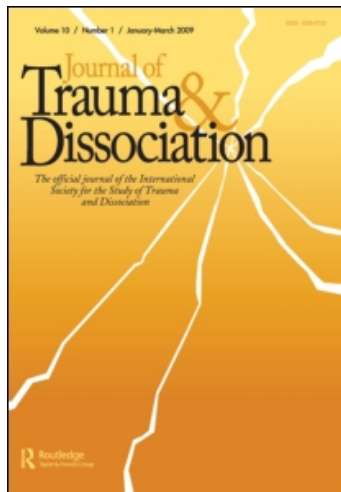
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Motion Effects on Intrusion Development

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Analogue studies on intrusion development have found that visuospatial tasks performed during the encoding of aversive information reduce subsequent intrusion development. However, these studies cannot rule out a physical explanation in terms of simple movement. In the current study we addressed this issue. Healthy participants viewed an aversive film while performing a visuospatial movement task, a configurational movement task, or no task. Intrusive images from the film were reported in a diary during the week following film viewing. In line with an information-processing account of posttraumatic stress disorder, intrusion frequency was significantly reduced by the visuospatial movement task but not the configurational movement task compared to no task. This finding supports the role of visuospatial processing specifically in intrusion development.

KEYWORDS *intrusions, information processing, motion, trauma film*

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Intrusive images can be defined as images of a traumatic event that come into mind uncontrollably. Intrusive images in posttraumatic stress disorder (PTSD) are mainly of a visual nature (Speckens, Ehlers, Hackmann, Ruths, & Clark, 2007), and visuospatial processing is thought to play a critical role in intrusion development. The dual representation theory (Brewin, Dalgleish, & Joseph, 1996) states that intrusion development depends on the balance between peritraumatic automatic and conscious processing. During extreme stress, information processing shifts toward more visuospatial processing, resulting in image-based trauma representations that are prone to automatic intrusive activation (Holmes & Bourne, 2008).

Experimental studies have shown that performing a visuospatial task (e.g., complex pattern tapping) during the encoding of an aversive film reduces subsequent intrusion frequency (Brewin & Saunders, 2001; Holmes, Brewin, & Hennessy, 2004; Stuart, Holmes, & Brewin, 2006). However, movement per se is confounded with the visuospatial aspect in these studies. Hagenaaers, Van Minnen, Holmes, Brewin, and Hoogduin (2008) found that participants who were instructed not to move during an aversive film reported more intrusive images after 1 week compared to participants who could move freely. This gives rise to the idea that movement per se could have the reverse effect. A critical test is needed of the effects of visuospatial versus non-visuospatial movement on intrusion development.

Configurational movements by definition rely on *propriospatial* information and *not* on visuospatial processing. Smyth, Pearson, and Pendleton (1988) found that performing a visuospatial tapping task interfered with visuospatial recall but not with movement recall. Conversely, configurational movement tasks (continuously tapping body parts with the hands, hand squeezing) interfered with configurational but not visuospatial recall (Smyth et al., 1988; Smyth & Pendleton, 1989).

In terms of suitability for the current study, the body-tapping task in Smyth et al. (1988) could have interfered with film viewing, and the squeezing task used by Smyth and Pendleton (1989) might have affected heart rate, which is related to intrusion development (Holmes et al., 2004). Therefore, we chose a complex gum-chewing task. This involved chewing the gum from the left jaw to the front teeth, the right jaw, the left jaw, and back again continuously. This task did not interfere with film viewing, was unlikely to have a significant effect on heart rate, and involved *propriospatial* but not visuospatial imagery. Research on infant imitation behavior supports the idea that tongue movements rely on a proprioceptive system and not on visuospatial processing (Meltzoff & Moore, 1983a, 1983b, 1989).

We also included measures of dissociation and cognitive avoidance in this study. *Dissociation* is described as “a disruption in the usually integrated functions of consciousness, memory, identity, or perception” (American Psychiatric Association, 2000, p. 519). Retrospective studies (e.g., Ozer, Best,

Lipsey, & Weiss, 2003) and prospective studies (Engelhard, Van Den Hout, Kindt, Arntz, & Schouten, 2003; Murray, Ehlers, & Mayou, 2002) have shown that dissociation is related to intrusion development and that dissociation can be induced by an aversive film (Brewin & Saunders, 2001; Holmes et al., 2004).

The main goals of the present study were (a) to replicate the finding of lower intrusion frequency from a concurrent visuospatial task (complex pattern tapping) during the encoding of an aversive film and (b) to distinguish between the effect of visuospatial versus non-visuospatial movement on intrusion development using a configurational task. Based on an information-processing account of PTSD (Brewin et al., 1996; Holmes & Bourne, 2008), we expected that the visuospatial task would result in lower intrusion frequency than either no task or the configurational task, which would not affect intrusion frequency compared to no task. If both movement tasks reduce intrusion frequency compared to no task, this would count against the special role of visuospatial processing in intrusion development (Holmes et al., 2004).

METHOD

Participants

Participants, all psychology students, were recruited on a university campus using flyers and posters. As required by the ethical committee (Commissie Mensgebonden Onderzoek (CMO) Approval No. 2005/063), flyers and posters contained information about the violent nature of the film. Participants received 24 Euros for participating. Exclusion criteria were panic attacks, panic disorder, PTSD, major depressive episode (current or lifetime), blood phobia, history of fainting, and history of road traffic accidents. No participants dropped out. Data were collected from 54 participants (34 women, 20 men). Participants' average age was 21 years, 9 months ($SD = 3$ years, 10 months). Age and gender were comparable across conditions.

The visuospatial tapping task, mood questionnaire, attention rating, cued recall and recognition memory tests, diary compliance rating, and intrusion diary were the same as in Holmes et al. (2004). All questionnaires were presented on a personal computer using Perseus[®] software (Version 6).

Materials

Aversive film. The film contained four scenes of the aftermath of real-life road traffic accidents showing car wrecks, bloody wounds, and dead bodies being moved (Hagenaars et al., 2008; Steil, 1996). The film was projected onto a smooth white wall, and sound was presented through headphones.

Experimental tasks. A 5×5 matrix keyboard with letters running from A to Y (“Moar box”) was used for the visuospatial tapping task. Participants continuously tapped the complex pattern *JYPVA* as fast and as accurately as possible during the film while the tapping hand was out of sight. For the configurational task, participants chewed sugar-free gum (peppermint flavor). Participants in the visuospatial and the configurational movement conditions practiced the task for 1 min before the film. All participants were instructed to view the film as if they were witnesses, not to look away, and to pay full attention to the film. To enhance task compliance we told participants that they were being videotaped (a recording was not actually made).

Measures

Emotional impact of the film. A mood questionnaire was used to rate current happiness, fear, horror, depression, and anger on a scale from 0 to 10 (0 = *not at all*, 10 = *extremely*). The Dutch version of the State-Trait Anxiety Inventory (STAI-S; Van der Ploeg, 1980) was used to assess state anxiety. It contains 20 items about the individual’s current level of anxiety, with ratings from 1 (*almost never*) to 4 (*almost always*). The STAI has satisfactory reliability and validity (Van der Ploeg, 1980).

Dissociation. Trait dissociation was measured with the Dutch version of the Dissociative Experiences Scale-Revised (DES-II; Bernstein & Putnam, 1986). The DES-II consists of 28 items and rates the frequency of dissociative phenomena on an 11-point scale with a 10% interval from 0% (*never*) to 100% (*always*). It has satisfactory reliability and validity (Bernstein & Putnam, 1986; Van IJzendoorn & Schuengel, 1996). State dissociation was measured with the Dutch version of the self-report Dissociative States Scale (DSS; Bremner et al., 1998). It contains 19 items rating current dissociative phenomena on a 5-point scale from 0 (*not at all*) to 4 (*very much*). Reliability and validity are sufficient (Bremner et al., 1998).

Attention and memory for the film. Attention was rated on an 11-point scale (0 = *not at all focused on the film*, 10 = *attention completely focused on the film*) as an indirect measure of task difficulty. The cued recall memory test contained two to four open-ended questions per scene (e.g., “What body parts were wounded and bleeding when the woman was freed from the minivan and was lying down on the stretcher?”). The recognition memory test contained three to five statements per scene (e.g., “The paramedics covered the students’ head with bandage” yes/no).

Compliance and demand. 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*). Participants were asked about the perceived goal of the study with an open-ended question.

Cognitive avoidance. A single-item question (“During the last week, how strongly have you tried to push away or suppress thoughts and images

of the film?”) was rated on a 7-point scale (1 = *not at all*, 7 = *very strongly*). The item correlates highly ($r = .62$, $p < .001$; Krans, Näring, Holmes, & Becker, 2009) with the avoidance subscale of the Impact of Event Scale (Horowitz, Wilner, & Alvarez, 1979), and similar single-item avoidance measures have been used in previous research (e.g., Becker, Rinck, Margraf, & Roth, 2001).

Intrusive images. Intrusive images were recorded in a 1-week diary. Participants indicated whether the intrusion was an image, a verbal thought, or both and provided a content description. Participants were required to check their entries at a fixed time every day.

Procedure

After signing informed consent, participants filled out a demographic questionnaire (age, gender, and education), the DES-II, the DSS, the STAI-S, and the mood questionnaire. Then participants received instructions according to their condition and practiced their task for 1 min. Participants were told that they could quit the experiment at any time. Participants viewed the film and then filled out the DSS, the mood questionnaire, the STAI-S, and the attention rating. During the week between the first session and follow-up, participants reported their intrusions of the film in the diary. At follow-up they filled out the cued recall and the recognition memory tests, the diary compliance rating, and an open-ended question about the goal of the study. The participants were debriefed, paid, and thanked for their participation.

Method of Analysis

For variables that showed a violation of homogeneity of variance according to Levene's statistic, the corrected t value is reported. A priori hypotheses were examined using directional tests. The number of intrusive images did not have a normal distribution, so Spearman correlations were used. For all analyses, an alpha of .05 was the level of significance. Descriptive statistics are reported in Table 1.

RESULTS

Outliers and Task Compliance

The diary data were checked for outliers (more than 3 SD from the mean) using boxplots. One multivariate outlier (in the visuospatial tapping condition) was removed from the data set. One univariate outlier was changed into 1 unit smaller than the next extreme score in that condition (Tabachnick & Fidell, 1996).

TABLE 1 Descriptive Statistics for Each Experimental Condition

Measure	No task		Visuospatial tapping		Configurational gum chewing	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total key presses			807.19	404.99		
Correct sequences			148.31	62.67		
Intrusion frequency	4.28	4.79	1.64	1.86	2.63	1.61
Happiness						
Pre-film	7.47	1.31	8.13	0.72	7.95	0.85
Post-film	5.47	1.87	6.38	1.75	5.89	2.21
Anxiety						
Pre-film	1.89	1.41	2.13	1.41	1.89	1.41
Post-film	2.11	1.60	3.38	2.36	2.58	2.01
Horror						
Pre-film	1.16	0.50	1.63	0.89	1.05	0.23
Post-film	2.89	2.18	4.63	2.78	4.00	2.94
Depressed mood						
Pre-film	1.58	0.61	1.88	1.03	2.00	1.53
Post-film	2.89	2.05	4.00	1.93	3.26	2.51
Anger						
Pre-film	1.16	0.38	1.69	1.01	1.21	0.54
Post-film	1.32	0.95	2.63	2.25	2.37	2.31
State anxiety (STAI-S)						
Pre-film	31.68	5.97	30.31	5.88	31.53	7.31
Post-film	36.63	6.92	37.50	8.85	36.11	9.67
State dissociation (DSS)						
Pre-film	21.00	1.83	21.44	3.24	21.95	3.01
Post-film	21.74	3.46	23.00	7.27	22.58	2.97
Trait dissociation (DES-II)	4.72	3.07	5.02	4.04	6.62	3.98
Attention	8.68	1.06	8.13	1.20	8.05	1.39
Cued recall	7.00	1.56	5.19	2.34	6.21	1.47
Cued recognition	11.47	1.90	10.81	1.60	11.00	1.86

Notes: STAI-S = State-Trait Anxiety Inventory; DSS = Dissociative States Scale; DES-II = Dissociative Experiences Scale-Revised.

The average numbers of tapped keys and correct sequences were compared to those reported in Holmes et al. (2004; Experiment 1) with two single-sample *t* tests. These showed comparable performance (both *ps* > .05).

Control Measures

Emotional impact. A mixed analysis of variance (ANOVA) was done with the mood questionnaire and STAI-S as the within-subject factors and condition (control, visuospatial tapping, configurational gum chewing) as the between-subjects factor. The overall within-subject effect was significant, $F(6, 46) = 13.53$, $p < .001$, $f = 1.33$, and all univariate within-subject effects were significant (all *ps* < .05), indicating a significant emotional

impact of the film. There was no significant effect of condition or a significant interaction effect (both $ps > .05$).

Dissociation. A 2 (pre-film vs. post-film) \times 3 (condition: control, visuospatial tapping, configurational gum chewing) mixed ANOVA with state dissociation as the dependent variable showed a significant increase from baseline to post-film, $F(1, 51) = 4.06$, $MSE = 6.31$, $p = .05$, $f = 0.27$. There was no significant effect of condition ($p < .05$) and no significant interaction effect ($p < .05$). Trait dissociation and state dissociation (pre-film, post-film, and change) were not significantly correlated with intrusion frequency (all $ps > .05$).

Attention and memory. A one-way ANOVA showed no significant difference between the conditions with regard to the attention rating for the film, $F(2, 51) = 1.48$, $MSE = 1.51$, $p = .24$, indicating that the tasks were comparable on required attention and task difficulty.

A one-way ANOVA showed a significant difference between the conditions on the cued recall memory test, $F(2, 51) = 4.40$, $MSE = 3.25$, $p = .02$, $f = 0.42$. Post hoc tests with Bonferroni correction showed a significantly better cued recall performance in the no-task control condition ($M = 7.00$, $SD = 1.56$) than the visuospatial tapping condition ($M = 5.19$, $SD = 2.34$; $SE = .61$, $p = .01$). There was no significant difference between the configurational gum-chewing condition ($M = 6.21$, $SD = 1.47$) and either other condition (both $ps > .05$). Across conditions, cued recall performance was positively related to intrusion frequency ($r_s = .35$, $p = .01$). A one-way ANOVA showed that recognition memory performance was comparable across conditions ($p > .05$).

Cognitive avoidance. A one-way ANOVA showed no significant difference between the conditions with regard to cognitive avoidance at follow-up ($p < .05$). There was no significant correlation with intrusion frequency, although there was a trend in the predicted direction ($r_s = .24$, $p = .08$), with more avoidance related to more intrusions.

Demand characteristics. None of the participants mentioned modulation of intrusion frequency by the two movement tasks when asked about the goal of the study.

Intrusion Modulation

As predicted, participants in the visuospatial tapping condition reported significantly fewer intrusive images of the film ($M = 1.64$, $SD = 1.86$) compared to participants in the no-task control condition ($M = 4.28$, $SD = 4.79$), corrected $t(24.09) = 2.21$, $p = .02$ (one-tailed), $d = 0.78$; and the configurational gum-chewing condition ($M = 2.63$, $SD = 1.61$), $t(33) = 1.70$, $p = .05$ (one-tailed), $d = 0.57$. The difference between the configurational gum-chewing condition and the no-task control condition was not significant, corrected $t(21.99) = 1.42$, $p = 0.17$ (two-tailed).

We performed a hierarchical regression analysis to determine whether cued recall contributed to the prediction of intrusive images independent of experimental condition. The first block contained two dummy variables representing experimental condition. The second block contained the cued recall memory test. The first block reached significance, $F_{\text{change}}(2, 51) = 3.13$, $p = .05$, $R^2_{\text{change}} = 0.11$. The second block did not increase the prediction significantly ($p < .05$). Thus, cued recall memory performance did not predict intrusive images after experimental condition was controlled for.

DISCUSSION

We aimed to replicate the finding that a visuospatial task performed during encoding protects against intrusion development after one views an aversive film. We investigated whether visuospatial movement specifically or movement in general reduces intrusion development. Our results show that the visuospatial tapping task reduced intrusion frequency compared to both the no-task control condition and the configurational gum-chewing condition, whereas the latter did not reduce intrusion frequency compared to no task. Attention or task difficulty did not seem to explain this difference. Our findings support an information-processing account of PTSD (Brewin et al., 1996; Holmes & Bourne, 2008). Although it has been found that non-movement is related to an increase in intrusion frequency (Hagenaars et al., 2008), our results do not support an opposite effect. It is interesting that performance on the cued recall memory test at 1 week was positively related to the number of intrusive images. This fits an explanation in which the visuospatial tapping condition reduces visuospatial encoding, affecting both intrusion frequency and deliberate recall.

With regard to dissociation, our results replicate the finding by Holmes et al. (2004) that an aversive film can induce spontaneous dissociation. However, our effect was modest at best. Neither state nor trait dissociation was related to the number of intrusive images in our study. Perhaps only higher levels of dissociation lead to intrusion development, and this was not induced in this analogue experiment.

The use of concurrent tasks in order to reduce intrusive images has also been endorsed by eye movement desensitization and reprocessing research. In a comprehensive series of experiments, Gunter and Bodner (2008) showed that vividness and emotionality of memory decreased according to the cognitive load of the task regardless of modality (visuospatial or verbal). This seems to contradict our present argument of a modality-specific effect of visuospatial processing. However, an important difference is that our study focused on *encoding* processes, whereas eye movement desensitization and reprocessing focuses on *recall* of traumatic memories. A systematic study of modality (a)specific effects on intrusive memories

directly comparing encoding and recall processes has not yet been done and would be an interesting future research direction.

The present study has some specific limitations. The gum-chewing task was created on the basis of the literature of configurational and proprioceptive movement, but we did not specifically test the assumption that it is not a visuospatial task. This leaves open the possibility that it may involve a visuospatial component after all, although our findings and previous research do not support this. Furthermore, we did not control for several measures that are thought to be related to intrusion development, such as repressive coping, neuroticism, and schizotypy. Avoidance was measured with a single item instead of a validated measure, for example the Impact of Event Scale (Horowitz et al., 1979).

In sum, our results suggest that it is not movement per se but visuospatial movement specifically that reduces intrusive images after one views an aversive film. This important finding confirms a central tenet of information-processing theories of PTSD (Brewin et al., 1996) that suggest that perceptual processing rather than movement per se underlies intrusion development.

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