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# Intrusive images and intrusive thoughts as different phenomena: Two experimental studies

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According to the dual representation theory of PTSD, intrusive trauma images and intrusive verbal thoughts are produced by separate memory systems. In a previous article it was shown that after watching an aversive film, participants in non-movement conditions reported more intrusive images than participants in a free-to-move control condition (Hagedaars, Van Minnen, Holmes, Brewin, & Hoogduin, 2008). The present study investigates whether the experimental conditions of the Hagedaars et al. study had a different effect on intrusive images and intrusive thoughts. Experiment 2 further investigated the image-thoughts distinction by manipulating stimulus valence (trauma film versus neutral film) on the subsequent development of intrusive images and thoughts. In addition, both experiments studied the impact of peri-traumatic emotions on subsequent intrusive images and thoughts frequency across conditions. Results showed that experimental manipulations (non-movement and trauma film) caused higher levels of intrusive images relative to control conditions (free movement and neutral film) but did not affect intrusive thoughts. Peri-traumatic anxiety and horror were associated with subsequent higher levels of intrusive images, but not intrusive thoughts. Correlations were inconclusive for anger and sadness. The results suggest intrusive images and thoughts can be manipulated independently and as such can be considered different phenomena.

**Keywords:** Intrusions; PTSD; memory.

The dual representation theory of post-traumatic stress disorder (PTSD) proposes that two separate memory systems regulate information processing

after trauma (Brewin, 2001; Brewin, Dalgleish, & Joseph, 1996). One memory system (VAM) handles verbally accessible trauma information.

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We would like to thank Anke Ehlers for her loan of the video.

To be stored in this system, information requires sufficient conscious processing. In VAM information is placed into context, provided with higher-level meaning, and made available for narration and deliberate cognitive appraisal. VAM is thought to be associated with experiencing memories as belonging to the past, and includes both “primary” and with “secondary” emotions. Primary emotions are considered to occur at the time of the event, whereas secondary emotions, like anger and sadness, would be generated during and after the event, by retrospective cognitive appraisal and reflection of consequences and implications (Brewin & Holmes, 2003). The second memory system (SAM) results from lower-level perceptual processing of both the traumatic scene and the person’s bodily response to it. Trauma memories that are processed this way are therefore difficult to retrieve intentionally and full of sensory impressions. Intrusive images involving reliving originate in this latter memory system, and are thought to be inhibited by corresponding representations in the VAM system. SAM is thought to be associated predominantly with primary emotions, like fear and horror, although secondary emotions may be included if the trauma leaves time for more complex evaluations. Similar distinctions in perceptual and conceptual processing are also found in other models of PTSD (Ehlers & Clark, 2000) and autobiographical memory models (Conway & Pleydell-Pearce, 2000; see also Holmes & Bourne, 2008).

Although the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV, American Psychiatric Association, 1994) states that in PTSD re-experiencing can take the form of “distressing recollections of the event, including images, thoughts or perceptions” (p. 428), there is some uncertainty about what causes these different types of recollection. Some studies indicate that visual intrusions are quite common and intrusive thoughts are relatively rare (Ehlers et al., 2002; Mellman & Davis, 1985), whereas others have found thoughts to be more prominent (Reynolds & Brewin, 1998). However, some people in the latter study experienced intrusions as a combination of thoughts, images, and flashbacks. Assessing the occurrence of intrusive thoughts is complicated, because they are not always distinguished from rumination, worry, and deliberate evaluative thoughts about the trauma. Moreover, images are sometimes included in the assessment of intrusive thoughts. In the present study “intrusive thoughts” refers to

intrusive verbal thoughts without images. The distinction between intrusive images and intrusive thoughts is theoretically interesting. That is, although named intrusions, the language-based nature of intrusive thoughts may indicate conscious appraisal at some point and may thus implicate dominant processing in verbally accessible memory.

Lang’s bio-informational theory suggested a special link between mental images and emotion, especially fear (Lang, 1979), and subsequent studies did indeed show that imagining emotional sentences or scripts was related to greater physiological activity (Miller et al., 1987; Vrana, Cuthbert, & Lang, 1986). Unfortunately, however, imagery was not compared to linguistic processing, leaving open whether mental imagery is uniquely linked to emotion. Holmes and Mathews (2005) therefore compared imagining several verbal descriptions with thinking about their meaning. Descriptions in the imagery condition were associated with more anxiety than those in the verbal condition. Convergent evidence for the powerful impact of imagery on emotion has been found using pictorial stimuli (Holmes, Mathews, Mackintosh, & Dalgleish, 2008). However, to our knowledge, the reverse relationship (between emotion and subsequent development of mental images) has not been studied yet.

Recent research exposing non-clinical samples to trauma films (see Holmes & Bourne, 2008, for a review) has shown that increased verbal reports of dissociation and reduced heart rate during the film are associated with an increase in later intrusive memories (Holmes, Brewin, & Hennessy, 2004). These responses may reflect the tendency for some species to freeze in response to danger. Freezing is suggested to enhance attentional orienting towards threat, and is indeed associated with bradycardia (Lang, Bradley, & Cuthbert, 1997). Witnessing a traumatic film under the instruction not to move may be a useful analogue to a dangerous encounter with a predator in which escape is not possible. Despite the advantages from an evolutionary perspective, freezing may become maladaptive, for example by provoking feelings of unpredictability and uncontrollability (important factors in the development of PTSD; Foa, Zinbarg, & Rothbaum, 1992), or by becoming a conditioned response to non-threatening stimuli. Non-movement may thus cause a shift from VAM towards SAM processing because of enhanced perceptual processing. Consistent with this, a

non-movement condition was followed by increased intrusive images compared to a control condition (Hagenaars et al., 2008).

In conclusion, it has been suggested that intrusions may develop as a result of memory disturbing reactions during the trauma, like peri-traumatic dissociation (Ozer, Best, Lipsey, & Weiss, 2003), or non-movement (Elbert & Schauer, 2002). Thus far, peri-traumatic reactions have not been related to intrusion type, like being image based or thought based. In the following two experiments we investigated whether intrusive images and intrusive thoughts are indeed two distinctive types of intrusions that function relatively independently.

In a previous article we reported that participants who did not move while watching a traumatic film experienced more intrusive images in the subsequent week than participants who were allowed to move freely (Hagenaars et al., 2008). That article focused on the effect of non-movement on intrusive *images*, analogous to re-experiencing in PTSD. We now investigate whether peri-traumatic non-movement in the previous study had a different effect on the development of intrusive images than on intrusive thoughts. Peri-traumatic non-movement (being related to traumatic events and threat) may enhance storage in the sensory-rich SAM, which could explain the increased frequency of intrusive images (Hagenaars et al., 2008). If non-movement does indeed cause a shift from verbal towards perceptual processing, an imbalance between intrusive images and intrusive thoughts should characterise the non-movement groups. A second experiment was set up to investigate whether intrusive images and intrusive thoughts are also differentially affected by the intensity of the event. In addition, we tested the prediction from the dual representation theory and bio-informational theory that higher levels of SAM-associated peri-traumatic emotions, especially anxiety and horror, would be associated with an increased frequency of intrusive images but not intrusive thoughts.

## EXPERIMENT 1

### Method

The data are derived from an experiment (described elsewhere; Hagenaars et al., 2008), set up to investigate the effect of dissociative paralysis on intrusion development, with a deliberate

non-movement and free movement as control groups. As non-movement per se, and not the dissociative component, was responsible for the effect, we compared the combined (dissociative + deliberate) non-movement group with the free-to-move group in the present study. For a detailed description of the methodology we therefore refer the reader to that article. In the present article we will describe the methodology only briefly for reasons of clarity.

*Participants.* A total of 79 healthy students participated, after 10 students were excluded for meeting criteria of a DSM-IV (blood phobia, depressive disorder and drug abuse;  $n=9$ ) or failure to comply with the instructions during the experiment ( $n=1$ ). Students were randomly assigned to one of three experimental conditions: deliberate non-movement ( $n=25$ ), dissociative non-movement ( $n=27$ ), and a free-to-move control condition ( $n=27$ ). A total of 11 participants (13.9%) were male and 68 (86.1%) were female. The age range was from 18 to 29 years ( $M=21$  years,  $SD=2.2$ ).

*Material.* A 10-minute film depicting four traumatic scenes of real-life footage of the horrible aftermath of road traffic accidents was used to model a traumatic experience (see also Hagenaars et al., 2008; Holmes et al., 2004). A brief commentary introduced each scene, providing background information about the accident and people involved. To prevent fatigue from sitting still too long, one scene (having the lowest distress ratings as judged by independent raters) was removed from the original five scenes compiled by Steil (1996). A DVD recorder was used, and a projector (3M, type MP8745) to project the film onto a  $113 \times 88$  cm screen.

*Measures.* For exclusion purposes, psychiatric symptoms were assessed by the Structured Clinical Interview for DSM-III-R (SCID-I; Spitzer, Williams, Gibbon, & First, 1992). The SCID-I is a standardised, semi-structured, diagnostic interview for diagnosing DSM-IV psychiatric disorders, which has good reliability (overall kappas were .61 for current and .68 for lifetime diagnosis). The 12 screening questions of the SCID-I were used initially. Diagnoses were established using the relevant SCID-I sections if participants endorsed symptoms. SCID-I interviews were conducted by licensed clinical psychologists.

At pretest, participants rated anxiety, horror, anger, and sadness on an 11-point scale from

AQ4

AQ5

0 (*not at all*) to 10 (*extremely*) to show the film's impact on their emotional state. "Peri-traumatic" mood (anxiety, horror, anger, and sadness during and immediately after the film) was rated post-film in the same way.

For 7 days after the film, participants recorded every intrusion of the film using a tabular diary (see also Brewin & Saunders, 2001; Davies & Clark, 1998; Holmes et al., 2004). To check the intrusive character, participants had to describe the content of each intrusion, the degree of distress it caused, whether it was image or thought based (or both), and how spontaneous it was. Verbal and written instructions were given about the nature of involuntary intrusions and how to keep the diary. As in previous studies, intrusions were described as unintended, "spontaneously occurring" rather than deliberate memories of the film; they were to interfere with ongoing activity and easily capture attentional resources (Clark & Rhyno, 2005). Participants were also asked to discriminate between evaluative thoughts and rumination versus intrusive thoughts, and to record the latter only. The importance of recording every intrusion was emphasised. They were instructed to carry the diary with them and check whether they had completed their diary at regular times each day.

The total number of intrusive images and the total number of intrusive thoughts were calculated by the experimenter (blind to group membership), by adding up all intrusive images and thoughts respectively. Intrusions that contained images as well as thoughts were scored as image-based intrusions, because we wanted to compare intrusions with a sensory component with intrusions without a sensory component (i.e., intrusive thoughts alone). Following Davies and Clark (1998), to check diary compliance at follow up, participants rated how often they forgot or were unable to record intrusions from 0 (*not at all true*) to 10 (*extremely true*).

*Procedure.* Participants who passed screening gave written informed consent, completed the pre-film questionnaires, and were instructed about the manipulation. Participants in the dissociative non-movement condition were told a special technique would make them unable to move (catalepsy);<sup>1</sup> participants in the deliberate non-movement condition were told they were not allowed to move and should sit as still as possible; and participants in the control condition were told they could sit however they wanted to and move as much as they wished. All participants were given standardised instructions on how to watch the film. A video camera recorded the participants discreetly to check for adherence to the instructions. After the film had ended, participants in the dissociative non-movement condition were instructed to shake their arms and legs to get out of their cataleptic state. The deliberate non-movement participants were told they were allowed to move again, and the control group was told the film had ended. All participants then completed "peri-traumatic" mood ratings.<sup>2</sup> They were debriefed using a standardised debriefing form, which explained that they might or might not experience intrusions. It was explained what is considered an intrusion, and the difference between intrusive images and intrusive thoughts was defined. The distinction between intrusive thoughts and rumination or evaluative thoughts was thoroughly clarified.

## Results

As reported elsewhere (Hagenaars et al., 2008), mood ratings significantly increased from pre to post,  $t(78) > 5.3$  and  $p < .001$  in all cases. In particular horror (PTSD criterion A2 in the DSM-IV) showed a large increase from pre ( $M = .57$ ,  $SD = 1.37$ ) to post ( $M = 5.80$ ,  $SD = 2.26$ ), indicating that the film was distressing, and quite horrifying. These scores seem somewhat higher than those in other studies using the trauma-film paradigm (e.g., Holmes et al., 2004).

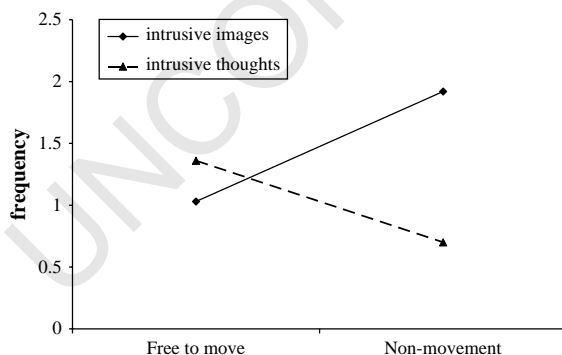
<sup>1</sup> Catalepsy was induced following the standardised procedure described in Hagenaars, Roelofs, Hoogduin, and Van Minnen (2006). That is, the participant's forearm is pushed slowly up and down by the experimenter, who alternatively supports and releases this forearm (initiating and blocking the movement at the same time). The same procedure was used for the other arm, the upper part of the body, and the head. Feet were firmly placed on the ground, under the knees.

<sup>2</sup> An adapted version of the Catalepsy Questionnaire (CQ; Hagenaars et al., 2006) was used to assess catalepsy and co-occurring sensorimotor dissociative symptoms in the entire body (instead of the original arm version). The CQ was significantly higher in the dissociative non-movement group, showing that the manipulation was successful.

Group differences in intrusion types. ANOVA analyses were conducted to study the frequency of intrusive images and thoughts in the combined non-movement groups versus the control group. These revealed a significant condition  $\times$  intrusion type interaction effect,  $F(1, 73) = 9.33$ ;  $p = .003$  (see Figure 1). That is, participants who did not move during the film reported more intrusive images and tended to have fewer intrusive thoughts than participants who could move freely. Tests of simple main effects showed an effect for images,  $F(1, 73) = 5.23$ ;  $p = .02$ , and a trend for thoughts,  $F(1, 73) = 2.93$ ;  $p = .09$ , confirming this difference in intrusion frequency between free-to-move and non-movement groups.

In addition, paired  $t$ -tests showed that the number of intrusive images was significantly higher than the number of intrusive thoughts in the non-movement groups,  $t(48) = -4.11$ ,  $p = .001$ . However, the frequency of intrusive images and intrusive thoughts did not differ for participants in the control group,  $t(25) = 0.82$ ,  $p = .42$ .

Intrusion types and emotion. To investigate the relation between intrusion type and emotion, partial correlations were conducted, controlling for the effect of experimental condition (i.e., movement versus non-movement). These revealed that greater peri-traumatic anxiety, horror, and anger were positively related to the frequency of intrusive images ( $r = .31$ ,  $p = .008$ ;  $r = .28$ ,  $p = .01$ ; and  $r = .24$ ,  $p = .03$  respectively). Sadness was not significantly related to the frequency of intrusive images ( $r = .18$ ,  $p = .12$ ). With respect to intrusive thoughts, there was a non-significant trend towards a negative association with peri-traumatic horror ( $r = -.21$ ,  $p = .06$ ). Peri-traumatic anxiety, anger, and sadness



**Figure 1.** Intrusive thoughts and images in the free-to-move and non-movement conditions.

were unrelated to the frequency of intrusive thoughts (all  $r$ s  $< -.06$  and all  $p$ s  $> .61$ ).

## Discussion

Our previous study (Hagenaars et al., 2008) showed that non-movement, an experimental condition designed to interfere with the processing of traumatic information, led to an increase in intrusive images. Our further analyses have shown non-movement also tended to lead to a decrease in intrusive thoughts. A closer inspection of the data showed that in the non-movement groups the frequency of intrusive images was significantly higher than the frequency of intrusive thoughts, whereas the frequency of the two types of intrusions was not different in the free-to-move control group.

Our second hypothesis was partly confirmed. That is, peri-traumatic anxiety, horror, and anger were related to an increased frequency of intrusive images. Peri-traumatic sadness was not, although this could be a power problem given that the correlation was moderate and almost reached a trend level in significance. In contrast, none of the emotions was related to the frequency of intrusive thoughts. Moreover, peri-traumatic horror tended to be associated with a decreased frequency of intrusive thoughts.

## EXPERIMENT 2

Experiment 2 was set up to replicate these findings under different circumstances. That is, we now aimed to investigate how stimulus content (traumatic versus neutral) would differentially affect the development of intrusive images and thoughts. In Experiment 2 the film itself and not the manner of watching the film was manipulated. That is, we studied whether a trauma film affected intrusive images and intrusive thoughts differently from a neutral film. As a trauma can cause a shift from verbal towards perceptual processing we hypothesised that, in general, a trauma film would lead to higher levels of intrusive images, but not thoughts, while a neutral film would not provoke either images or thoughts. As in Experiment 1, it was tested whether peri-traumatic emotions were associated with the frequency of intrusive images and thoughts.

## Method

**Participants.** A total of 52 healthy students participated in the second study. Students were randomly assigned to one of two experimental conditions: Neutral film ( $n = 23$ ), or Trauma film ( $n = 29$ ). A total of 9 participants (17.3%) were male and 43 (82.7%) were female. The age range was from 18 to 32 years ( $M = 20.6$  years,  $SD = 2.3$ ).

**Material.** The film described in Experiment 1, depicting traumatic scenes of real-life footage of the horrible aftermath of road traffic accidents, was used to model a traumatic experience. Another film depicting neutral traffic situations was composed to model a neutral event. The neutral film matched the trauma film in content (traffic-related scenes), number of scenes, duration of scenes, and overall duration. This neutral film consisted of scenes like cars driving by, and traffic crossing a junction. Like the trauma film, a brief commentary introduced each scene, providing background information about the traffic scene. As in Experiment 1 a DVD recorder was used, and a projector (3M, type MP8745) to project the film onto a  $113 \times 88$  cm screen.

**Measures.** As in Experiment 1, psychiatric symptoms were assessed by the Structured Clinical Interview for DSM-III-R (SCID-I; Spitzer et al., 1992).

Pre-film and peri-traumatic mood were assessed by an 11-point scale as in Experiment 1. Intrusions were recorded for 7 days in a tabular diary, as in Experiment 1. Instructions were also similar to Experiment 1.

**Procedure.** The procedure, including assessments and instructions, was similar to Experiment 1 except for the stimuli (trauma film and neutral film). Because non-movement was associated with higher intrusion frequency, participants in both the trauma and the neutral condition were instructed to sit still during the film.

## Results

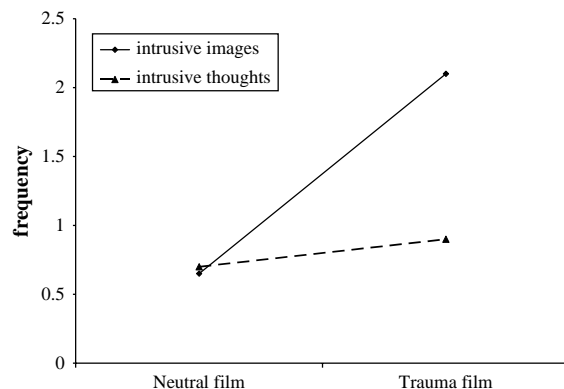
Mood ratings significantly increased from pre to post,  $t(51) > 2.7$  and  $p < .01$  in all cases. In particular, horror (PTSD criterion A2 in the DSM-IV) showed a large increase from pre ( $M = .69$ ,  $SD = 1.14$ ) to post ( $M = 5.59$ ,  $SD = 2.13$ ), indicating that, as in Experiment 1, the

trauma film was perceived as distressing, and quite horrifying. ANOVA analyses confirmed the neutral film was followed by fewer emotional reactions than the trauma film,  $F(1, 52) > 15.40$  and  $p < .001$  for all emotions.

**Group differences in intrusion types.** ANOVA analyses were conducted to study the frequency of intrusive images and thoughts in the trauma condition versus the neutral condition. These revealed a significant condition  $\times$  intrusion type interaction effect,  $F(1, 50) = 5.98$ ;  $p = .02$  (see Figure 2), and a main effect for intrusion type,  $F(1, 50) = 5.18$ ;  $p = .03$ . Tests of simple main effects showed an effect for intrusive images,  $F(1, 50) = 5.20$ ;  $p = .02$ , but not for intrusive thoughts,  $F(1, 50) = .21$ ;  $p = .65$ , showing that groups differed in intrusive images but not thoughts.

In addition, paired  $t$ -tests showed that the number of intrusive images was significantly higher than the number of intrusive thoughts in the trauma-film group,  $t(28) = 3.08$ ,  $p = .005$ . Participants who watched the neutral film, on the other hand, did not experience more intrusive images than intrusive thoughts,  $t(22) = -0.15$ ,  $p = .88$ .

**Intrusion types and emotion.** To investigate the relation between intrusion type and emotion, partial correlations were conducted, controlling for the effect of experimental condition (i.e., trauma film versus neutral film). These revealed that greater peri-traumatic anxiety, horror, and sadness were positively related to the frequency of intrusive images ( $r = .26$ ,  $p = .06$ ;  $r = .33$ ,  $p = .02$ ; and  $r = .34$ ,  $p = .01$  respectively). Anger was not significantly related to the frequency of intrusive images ( $r = .13$ ,  $p = .36$ ). With respect



**Figure 2.** Intrusive thoughts and images in the trauma film and neutral film conditions.

265 to intrusive thoughts, peri-traumatic anxiety, hor-  
ror, sadness, and anger were all unrelated to the  
frequency of intrusive thoughts (all  $r_s < .18$  and  
all  $p_s > .18$ ).

## Discussion

270 Using a different manipulation in Experiment 2  
we found a similar pattern of findings to Experi-  
ment 1 in that stimulus type had a differential  
effect on the development of intrusive images and  
intrusive thoughts. Intrusive images were higher  
275 in the trauma condition relative to the neutral  
condition, whereas the frequency of intrusive  
thoughts did not differ between conditions.  
As in Experiment 1, heightened levels of peri-  
traumatic mood were related to the later devel-  
280 opment of intrusive images and not thoughts.  
However, this was now the case for anxiety,  
horror, and sadness, but not for anger.

## GENERAL DISCUSSION

285 Both experiments reported here found that in-  
trusive images and intrusive thoughts are devel-  
oped under different circumstances. That is, non-  
movement (versus free movement) provoked  
intrusive images but not thoughts, and the same  
was true for a trauma (compared to a neutral)  
290 film.

According to the dual representation theory of  
PTSD, verbal thoughts arise from a verbally  
accessible memory system that is distinct from a  
situationally accessible memory system support-  
295 ing intrusive images (Brewin, 2001; Brewin et al.,  
1996). Despite their intrusive character, our data  
suggest that intrusive thoughts and intrusive  
images do indeed arise from independent mem-  
ory systems. A similar distinction at the level of  
300 processing, proposing that images reflect more  
data-driven and appraisals more conceptual  
processing, forms an important part of the cognitive  
model of PTSD (Ehlers & Clark, 2000) as well as  
non-clinical models of autobiographical memory  
(Holmes & Bourne, 2008). These new data  
305 further suggest the presence of two independent,  
although not necessarily competing, memory (or  
processing) systems. Under normal conditions,  
here free movement or a neutral event, both  
310 systems appear to be operative. However, condi-  
tions that favour one system or process do not  
necessarily affect the operation of the other,

resulting in either a dominant encoding of sensory  
components (hence higher frequency of intrusive  
images) or a hampered dominance of verbal  
encoding (hence no increase in the frequency of  
intrusive thoughts). Our data therefore indicate  
that imagery-based and verbally based intrusions  
can be generated independently, and may develop  
under different circumstances.

The second goal of both experiments was to  
study the effect of several peri-traumatic emo-  
tions on the development of intrusive images and  
intrusive thoughts. Peri-traumatic anxiety and  
horror proved to be associated with a subsequent  
higher frequency of intrusive images, but not  
intrusive thoughts. The results were inconclusive  
for peri-traumatic anger and sadness in that these  
were related to intrusive images in only one of the  
experiments although, like anxiety and horror,  
neither was related to intrusive thoughts. Peri-  
traumatic horror tended to be associated with a  
decreased frequency of intrusive thoughts, but  
this was not replicated in Experiment 2. The  
inconsistency in anger and sadness leaves us with  
two possibilities: (1) all emotions, including anger  
and sadness (although possibly not as strongly as  
anxiety and horror), are associated with mental  
imagery and this was not consistently found  
because of a lack of power or differences in  
emotional intensity, or (2) anxiety and horror, but  
not anger and sadness, are associated with the  
formation of intrusive images, which is why the  
anger and sadness correlations were not repli-  
cated.

In considering the first option, it has indeed  
been suggested that imagery can provoke strong  
emotions (Holmes & Mathews, 2005). The finding  
of peri-traumatic emotions being associated with  
a higher frequency of intrusive images could be an  
expression of a more general two-way relationship  
between mental imagery and emotion. It has been  
suggested that mental imagery is effective in  
eliciting emotion (Holmes & Mathews, 2005).  
Our data imply that this relation may also work  
the other way around: namely, that peri-traumatic  
emotions have an impact on the subsequent  
*development* of intrusive images (and not intrusive  
thoughts). Any differences between the various  
emotions in the emotion-intrusive image associa-  
tion could be due to different levels of physiological  
arousal or to their neural basis. Appropriate  
studies that would allow these possibilities to be  
tested have not yet been conducted.

The second option suggests a special link  
between anxiety and horror and subsequent higher

315 levels of intrusive images. Brewin et al. (1996) indeed suggested such a link, in that intrusive  
320 images contain emotional reactions produced immediately by the traumatic situation but not emotions that are the result of subsequent reflection and appraisal, like sadness. Previous research with clinical samples also suggested that there might be a specific relationship between the emotion of fear and re-experiencing (Hellawell & Brewin, 2004; Reynolds & Brewin, 1999), although other studies indicate that flashbacks in patients with PTSD can contain moments of intense sadness or guilt which appear to be congruent with the peri-traumatic experience (Grey & Holmes, 2008). Our results, then, do support previous research suggesting that emotions in PTSD show marked variation in their association with the direct experience of trauma and in their stability over time (Hellawell & Brewin, 2004; Speckens, Ehlers, Hackmann, Ruths, & Clark, 2007). It may thus be that more fundamental properties of emotions—like evoking arousal and indicating self-relevance and action and motivational tendencies—dictate whether they lead to intrusive images, although further research is needed.

340 Interestingly, only emotions that appear most relevant in dangerous situations (anxiety and horror) were associated with intrusive images. Lang (1979) suggested that mental images include action functions and proposed a special link between mental imagery and fear (relevant to the flight response). Evolutionarily, it may have been relevant for survival to have vivid visual memories of dangerous situations. It has been suggested that emotional systems may be more strongly associated with imagery than language systems because the latter evolved later than basic emotions (Holmes & Matthews, 2005). The fact that anger and sadness were associated with higher levels of intrusive images in only one of the experiments could be due to these not being flight emotions relevant to survival, or may simply be due to the intensity of the emotional experience. An explanation for the absence of a relation between VAM-related emotions (anger, sadness) and intrusive thoughts may be that the participants did not appraise or reflect on the film because of its lack of self-relevance. That is, events seem to be associated with later distress especially if perceived as central to one's life (Berntsen & Rubin, 2007). As the results on anger and sadness were not consistent across

experiments, however, future research should address whether flight-emotions only or emotionality in general causes a shift from conceptual towards perceptual information processing.

Our study was limited by a number of factors, including the assessment of the specific emotions (using Likert scales), and the relative frequency of intrusive images and thoughts recorded. Also, the design was adequate for establishing the effects of condition on intrusion frequencies, but does not allow statements about the mutual influence of intrusive images and intrusive thoughts. For example, the presence of intrusive images could have hindered the development of intrusive thoughts. This seems unlikely however, as intrusive images did not occur during encoding or shortly after the film, but during the entire week afterwards, and they did not occur so frequently that they would have hindered reflection or appraisal processes. However, future research should address this issue.

The results are in need of replication in this and in related paradigms. Nevertheless, the data are supportive of the theoretical proposal that intrusive images and intrusive thoughts are dissociable after an analogue traumatic experience and, importantly, are also differentially associated with emotion. The present study indicates that more intense peri-traumatic emotions are more likely to generate intrusive images than thoughts, but of course the design does not allow statements on exactly how information was processed during the film. It would be interesting to explore related issues like emotion-regulation strategies and viewer perspective with respect to the development of intrusive images and thoughts. Understanding these basic processes is likely to be valuable in formulating more effective and more scientifically based treatments for PTSD.

Manuscript received 9 April 2009  
Manuscript accepted 4 November 2009  
First published online/day/month/year

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