"I see what you're saying": Intrusive images from listening to a traumatic verbal report

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Abstract

We tested the hypothesis that intrusive visual images could develop from listening to a traumatic verbal report. Eighty-six participants listened to a traumatic verbal report under one of three conditions: while shaping plasticine (visuospatial condition), while performing articulatory suppression (verbal condition), or with no extra task (control condition). Results showed that intrusive visual images developed from listening to the traumatic report. In line with the idea that central executive processes guide encoding of information, intrusion frequency was reduced in both the visuospatial and the verbal condition compared to the no task control condition. Overall, this pattern is similar to intrusive images from a traumatic film as found in earlier studies. This study provides a valuable addition to models of posttraumatic stress disorder and autobiographical memory. Additionally, the results have potential implications for therapists working with traumatized individuals.

1. Intrusive images from listening to a traumatic verbal report

The experience of a traumatic event can lead to development of intrusive memories: uncontrollable and distressing images of the traumatic event that repeatedly come into consciousness unbidden, such as the sights and sounds of a terrifying car crash (Grey & Holmes, 2008). Intrusive memories in posttraumatic stress disorder (PTSD) are mostly visual in nature, although images from other senses and verbal intrusions are also reported (Speckens, Ehlers, Hackmann, Ruths, & Clark, 2007). The content of intrusive images, however, is not necessarily restricted to actual memories or even the diagnosis of PTSD (Hackmann & Holmes, 2004). Intrusive images can also display fantasies of alternative outcomes, future events (flashforwards; Holmes, Crane, Fennell, & Williams, 2007), or reflect a story told by another (Pearlman & Mac Ian, 1995; McCann & Pearlman, 1990; Figley, 1995). In the last two decades it has been acknowledged that learning about a traumatic event without being personally involved (i.e., secondary traumatization) can induce posttraumatic stress symptoms. In a classic paper, Terr et al. (1999) found that children who heard about the explosion of the *Challenger* space shuttle in 1986 afterwards developed posttraumatic stress symptoms, such as nightmares, *Challenger*-specific fears and negative expectations of the future. Furthermore, it has been shown that therapists and other helpers are at risk of developing intrusive images of their client's traumatic experience (Pearlman & Mac Ian, 1995; McCann & Pearlman, 1990; Figley, 1995). Secondary traumatic stress in people dealing with trauma survivors has been distinguished from burnout and seems to be specifically related to treating trauma survivors (McCann & Pearlman, 1990; Arvay 2001). Studies have mainly used survey methods to explore broad clusters of secondary stress symptoms (Arvay, 2001).

Although these studies give important information on secondary stress, they lack the benefits of an experimental design and are too broad in focus to assess basic processes underlying specific symptoms like intrusive images or how these might arise.

The goal of our study was to investigate whether intrusive *visual* images could develop from *verbal* information by evoking mental imagery when listening to traumatic material. That is, whether people would develop flashback-like images to a trauma they had never seen, but only imagined. Furthermore, we explored whether the frequency of these "imagined" intrusions could be modulated by interfering with the encoding of analogue traumatic information.

Two influential models that aim to explain intrusion development in PTSD are the dual representation theory (Brewin, Dalgleish, & Joseph, 1996) and the cognitive model of PTSD by Ehlers and Clark (2000). As proposed in a pragmatic model by Holmes and Bourne (2008), these models converge on the idea that the balance between peri-traumatic visuospatial and verbal processing predicts intrusion development. During high stress, information processing shifts in favor of visuospatial processing with a relative lack of verbal conceptual processing. Resulting memory representations are rich in sensory detail but are not conceptually integrated within autobiographical memory (Holmes & Bourne, 2008). Accordingly, interference of visuospatial processing during encoding should reduce intrusion development whereas interference of verbal processing should increase intrusion development.

Alternatively, the self-memory-system (SMS) model (Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagini, 2004) is a more general model of autobiographical memory that, importantly, also aims to explain intrusive memories. The "working self" consists of active goals and serves to allocate attention and motivates behavior in the broadest sense. The working self guides encoding of information through control processes such as the central executive in working memory. As with more “ordinary” events, episodic memories with highly sensory detail are initially formed of the traumatic event. In contrast to non-traumatic memories, the episodic trauma memories are not easily integrated within the autobiographical knowledge base and thus direct activation of trauma memories by internal or external cues can therefore not be inhibited and intrusive images persist (Conway & Pleydell-Pearce, 2000; Conway et al., 2004). One hypothesis that can be derived from the SMS model is that interfering with central executive capacity during encoding should reduce intrusion development regardless of the modality of the interference (i.e., visuospatial, verbal) because less traumatic information is encoded.

Generally speaking, there are two views on intrusion development: PTSD-specific models propose modality-specific effects of encoding interference in relation to intrusion development, whereas more general autobiographical models suggest that modulation of intrusive memories is dependent on the encoding capacity guided by the central executive. While the PTSD-specific view provides an often used framework for research on intrusion development, more general models of autobiographical memory, like the SMS model, have been less associated with the subject of intrusion development.

Many studies testing hypotheses from information processing models of PTSD have adopted the trauma film paradigm (Holmes & Bourne, 2008). Typically, healthy participants view an aversive film while performing a concurrent task that relies on visuospatial or verbal resources. During the week after film viewing, participants report their intrusive images in a diary. A general finding is that performing a visuospatial task during encoding of an aversive film reduces intrusion development compared to a no task control condition or other movement condition (e.g., Brewin & Saunders, 2001; Holmes et al., 2004; Stuart, Holmes, & Brewin, 2006; Krans, Näring, Holmes, & Becker, in press). This finding has been extended to a visuospatial task given in the post-film period (Holmes, James, Coode-Bate & Deeprose, 2009). Verbal processing has been studied to a lesser extent, and results are more mixed. Some studies (e.g., Holmes et al., 2004; Bourne, Frasquilho, Roth, & Holmes, submitted) have found an *increase* in intrusion frequency from verbal interference, as would be predicted from dual process models (Holmes & Bourne, 2008). In contrast, others have found a *decrease* in intrusion frequency as a result of verbal interference (e.g., Krans, Näring, & Becker, 2009; Pearson, Sawyer, & Holmes, 2008), which is in line with the SMS model (Conway & Pleydell-Pearce, 2000; Conway et al., 2004).

Clinical models of PTSD (Brewin & Holmes, 2003) focus on intrusive memories from direct sensory experience. However, stressful intrusive images can also develop from listening to an aversive story, as studies of secondary traumatic stress have shown (Pearlman & Mac Ian, 1995; McCann & Pearlman, 1990; Figley, 1995). Because listening to trauma narratives is an important part of a therapist's job in effective cognitive behavioral treatment (National Institute for Health and Clinical Excellence, 2005), more knowledge about how to modulate this kind of intrusion may aid in preventing intrusion development in clinicians, and thus also to therapist "burn out".

The main goal of our study was to investigate the development of intrusive *visual* images as a result of *verbal* input. As a variation to the trauma film paradigm, we presented participants with an aversive verbal report of a traumatic situation and asked them to imagine the story. Our main research questions were: (a) to ascertain whether intrusive images would develop from a verbal report and (b), if so, could their frequency be modulated by interfering with encoding of the provoking verbal stimulus? We predicted (1) that intrusive images would develop, and (2) that visuospatial interference during encoding would reduce intrusion development compared to no extra task. Verbal interference was added as a concurrent-task control condition. An increase in intrusive images in this verbal condition compared to no-task would be in line with dual-process models of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000) as suggested by Holmes and Bourne (2008), whereas a reduction would be in line with a hierarchical model of autobiographical memory such as the SMS model (Conway & Pleydell-Pearce, 2000). To control for individual differences that could be related to intrusion development, we assessed spontaneous use of imagery, trait dissociation, and trait anxiety.

2. Method

Questionnaires and instructions were presented on a PC using Perseus® Software (Version 6).

2.1 *Participants*

Participants were invited by e-mail to participate in exchange for course credit. As required by the ethical committee (CMO approval number 2005/063), the invitation contained information about the graphic nature of the film/report. In total, 90 participants completed the study. Exclusion criteria were: panic attacks, panic disorder (current and lifetime), PTSD (current and lifetime), major depressive episode (current and lifetime), psychotic episode (current and lifetime), blood phobia, history of fainting, and history of road traffic accidents. Four participants failed to complete the intrusion diary and were excluded from the dataset. The final dataset contained 60 women and 26 men with an age of $M = 22.01$ years ($SD = 3.14$). Seventy participants were students, and 16 participants were either working or seeking employment. The non-student participants were comparable on age, $F(2, 83) = 0.42$, $p = .66$, and trait imagery, $F(2, 83) = 0.08$, $p = .92$, but showed higher levels of trait dissociation, $F(2,82) = 4.07$, $f = 0.33$, $p = .02$; and trait anxiety, $F(2, 82) = 4.71$, $f = 0.34$, $p = .01$, compared to the student participants. Running the analyses in the student sample only yielded the same result pattern; since level of education was equally distributed between the three conditions, $\chi^2(4) = 4.17$, $p = .38$, the non-student participants were included in the analyses reported below.

2.2 *Materials*

2.2.1 *Verbal report.* The verbal report (11 min 42 sec) was based on an often used ‘trauma film’ depicting the aftermath of real-life road traffic accidents (Steil, 1996) for studying the development of traumatic intrusions (Holmes & Bourne, 2008). The cover story was that a traffic journalist was describing the events into a dictaphone for later use. The background noise of the original film was audible in the recording. Each scene was preceded with a short auditory introduction about the people involved in the accident and the outcome. Participants listened to the report through headphones.

2.2.2 *Experimental task.* All participants were instructed to focus on the report while imagining everything that the journalist described using field perspective, that is, as if looking through one’s own eyes (Holmes, Coughtrey, & Connor, 2008). In the visuospatial interference condition, participants shaped plasticine into small cubes and pyramids alternately as fast and accurate as possible (Stuart et al., 2006). Hands were covered with a wooden inverse U-shaped box. In the practice trial, participants were shown an example of each plasticine figure and were asked to copy this. In the verbal interference condition, participants counted from 1 to 6 continuously at a speed of three digits per second (Larsen & Baddeley, 2003). They were instructed to whisper so that utterances could be recorded but did not interfere with listening to the traumatic report. In the practice trial, participants performed the task paced by a metronome for one minute. Imagery of the report (vividness and distress) was rated on a 4 – point scale (1 = totally disagree, 4 = totally agree).

2.3 *Control measures*

2.3.1 *Individual differences.* Trait imagery was measured with the Spontaneous Use of Imagery Scale (SUIS). The SUIS has high internal consistency with α = .98 and has a significant relationship with other imagery measures (i.e., VVIQ; Marks, 1973) supporting its validity (Reisberg, Pearson, & Kosslyn, 2003). The scale contains 12 items that are rated on a 1 – 5 point scale (1 = never appropriate, 5 = completely appropriate). Trait dissociation was measured with the Dissociative Experiences Scale, revised (DES-II; Bernstein & Putnam, 1986). The DES-II contains 28 items and answers are rated on an 11-point scale from 0 % (never) to 100 % (always). The DES-II has a test-retest reliability of .84 and a median coefficient for construct validity of .64 (Bernstein & Putnam). Trait anxiety was measured with the Dutch version of the State-Trait Anxiety Inventory (STAI-T; Van der Ploeg, 1980). The STAI-T contains 20 items about general anxiety level, with ratings from 1 (almost never) to 4 (almost always). The STAI-T showed a test-retest reliability of .75 and an internal consistency of α = .85 (Van der Ploeg, 1980).

2.3.2 *Impact of the report.* A mood questionnaire (Holmes et al., 2004) measured current happiness, fear, horror, depressed mood, and anger on a 0 - 10 point scale (0 = not at all, 10 = extremely). The state version of the State-Trait Anxiety Inventory was used to assess state anxiety (STAI-S; Van der Ploeg, 1980). This questionnaire contains 20 items about current anxiety level, with ratings from 1 (almost never) to 4 (almost always). Test-retest reliability has been reported at .25 and up, and the internal consistency at $\alpha = .88$. State dissociation was measured with the self-report version of the Dissociative States Scale (DSS; Bremner et al., 1998). The questionnaire contains 19 items and answers are rated on a 5-point scale from 0 (not at all) to 4 (very much). Reliability has been shown at $\alpha = .94$. The DSS discriminates between PTSD patients and non-patients, supporting its validity (Bremner et al., 1998).

2.4 *Experimental measures*

2.4.1 *Intrusion frequency.* Intrusive images were reported in an event-related diary (Holmes et al., 2004). For every entry, participants reported intrusion frequency, nature (sensory or verbal), and content. An intrusion provocation task (Lang, Holmes, & Moulds, 2009) was included as an alternative measure of intrusion frequency. Participants were presented with ten 4-second neutral fragments from the report and then were required to think freely for two minutes while pressing a key whenever an intrusion occurred.

The Impact of Event Scale (IES; Horowitz, Wilner, & Alvarez, 1979; Dutch version by TZP Psychotrauma, 2006) contains an Intrusion subscale (8 items), an Avoidance subscale (8 items) and a Hyperarousal subscale (6 items). Answers are rated on a 5-point scale from 0 (not at all) to 4 (very much). Internal consistency has been reported at 0.97 for the Total score, 0.86 for the Intrusion subscale, 0.82 for Avoidance, and 0.85 for Hyperarousal. Test-retest reliability has been reported at 0.87 for the Total score, 0.89 for the Intrusion scale, 0.79 for Avoidance, and 0.82 for Hyperarousal (Sundin & Horowitz, 2002).

2.4.2 *Other PTSD symptoms*. Avoidance was measured with the avoidance subscale of the IES (Horowitz et al., 1979) and with a single-item on an 11-point scale (0 = not at all, 10 = very strongly). Participants rated the fragmentation of their memory of the report on an 11-point scale (0 = not at all, 10 = very strongly).

Posttraumatic cognitions in relation to the report were measured with the Posttraumatic Cognitions Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999; Dutch version by Van Minnen, 2001). The PTCI consists of three subscales: Negative cognitions about self (21 items), Negative cognitions about the world (7 items) and Self-blame (5 items). Statements are rated on a 7-point scale from 1 (totally disagree) to 7 (totally agree). Internal consistency has been reported at $\alpha = .97$ for the Self scale, .88 for World, and .86 for Self blame. Test-retest reliability has been reported at .75 and higher (Foa et al., 1999).

2.4.3 *Attention and memory.* Attention for the report was rated on an 11-point scale from 0 (not at all) to 10 (completely). Cued-recall memory was assessed with 12 open ended questions about the journalist report. Recognition memory was assessed with 12 statements of the report with a yes/no response (Holmes et al., 2004).

2.4.4 *Compliance and demand.* Participants rated the appropriateness of the statement "I have often been unable (or have forgotten) to report my intrusions in the diary" on an 11-point scale from 0 (not at all) to 10 (very much), as in Holmes et al.

(2004). Participants were asked about the perceived goal of the study with an open-ended question. In the visuospatial and verbal interference conditions participants indicated if they thought their task had increased, decreased or had no effect on intrusion frequency.

2.5 *Procedure*

Participants signed an informed consent and filled in the SUIS, STAI-T, DES-II, STAI-S, DSS, and the mood questionnaire. All participants received short imagery training in field perspective (Holmes et al., 2008). Participants were instructed according to experimental condition and the recording of the journalist report was started. After the report, participants filled in the imagery compliance check, the mood questionnaire, STAI-S, DSS, the attention rating, and received the diary. After one week, participants returned for follow-up. The intrusion provocation task was performed and participants filled in the diary compliance rating, cognitive avoidance item, cued-recall and recognition memory test, the IES, PTCI, and ratings about the perceived goal of the study. Finally, participants were debriefed and thanked for their involvement.

2.5.1 *Statistical approach*

Analysis of variance (ANOVA) was the main statistical method used. In cases where Levene's statistic was significant, indicating a violation of the homogeneity of variance, corrected t-tests or non-parametric tests are reported. A priori hypotheses were tested directionally. Spearman correlations were calculated for intrusion frequency because of non-normal distribution. An α of 0.05 was regarded as the level of significance. Effect sizes reported are Cohen's d for t-tests and Cohen's f for ANOVAs. Descriptive statistics are presented in Table 1 and 2.

3. Results

3.1 *Compliance, demand, and outliers*

The mean diary compliance rating was $M = 1.56$ ($SD = 1.50$), indicating high compliance. Participants in the verbal interference condition repeated the "123456" string $M = 291.80$ times ($SD = 46.13$), with $M = 9.30$ errors ($SD = 7.15$) and $M = 2.70$ pauses ($SD = 2.47$). In the visuospatial interference condition, participants produced $M = 20.33$ plasticine objects ($SD = 5.22$). Eighteen participants mentioned intrusion modulation as the goal of the experiment but there was no difference in intrusion frequency compared to those who did not ($p > .05$).

All variables were checked on multivariate and univariate outliers across and within conditions as advised by Tabachnick and Fidell (1996). One multivariate outlier was identified and removed from the dataset. Nine univariate outliers were detected and were adjusted appropriately. Unfortunately, the IES-hyperarousal scale yielded many univariate outliers and it was decided to exclude this scale from analyses (Tabachnick & Fidell, 1996).

3.2 *Control measures*

3.2.1 *Randomization check.* One-way ANOVAs with condition (control, visuospatial interference, verbal interference) as the between-subject factor indicated no significant difference between conditions in trait imagery, $F(2, 83) = 1.08$, $p = .35$, or trait anxiety (STAI-T), $F(2, 83) = 0.21$, $p = .81$. A Kruskal-Wallis test with condition (control, visuospatial interference, verbal interference) as the between-subject factor and indicated no significant difference in trait dissociation (DES-II) between the three conditions, $\chi^2(2) = 5.11$, $p = .08$.

3.2.2 *Manipulation check.* The ratings on the mood questionnaire were summed into a single score (happiness reversed; Mackintosh et al., submitted). A 3 condition (control, visuospatial interference, verbal interference) x 2 mood (pre-report, post-report) mixed model ANOVA with condition as the between-subject factor and mood ratings as the within-subject factor showed a significant increase in negative mood from pre- to post-report, $F(1, 83) = 30.56, f = 0.61, p < .001$. There was no significant main effect of condition or a significant interaction (both $p > .05$). The same pattern emerged for state anxiety (STAI-S), with a significant increase pre- to post report, $F(1, 83) = 40.59, f = 0.70, p < .001$.

A 3 condition (control, visuospatial interference, verbal interference) x 2 DSS (pre-report, post-report) mixed model ANOVA was performed with condition as the between-subject factor and state dissociation (DSS) as the within-subject factor. There was no significant main effect (both $p > .05$) but a significant condition x DSS interaction emerged, $F(2, 83) = 3.09, f = 0.27, p = .05$. Repeated measures ANOVAs within conditions with state dissociation (DSS) as the within-subject factor indicated that there was a significant *decrease* in state dissociation in the visuospatial interference condition, $F(1, 26) = 6.03, f = 0.48, p = .02$, but no significant change in the control or the verbal interference condition (both $p > .05$).

3.3 *Experimental measures*

3.3.1 *Intrusion frequency.* The à priori hypotheses were tested with directional tests. As predicted, the number of intrusive images reported in the diary was lower in the visuospatial condition than in the no task control condition, $t(53) = 2.53, d = 0.71, p < .001$ (one-tailed). Intrusion frequency was also lower in the verbal interference condition compared to no task, $t(57) = 2.51$, $d = 0.66$, $p = .02$ (two-tailed). There was no significant difference between the visuospatial and the verbal interference condition, $t(56) = 0.06$, $p = .96$ (two-tailed).

The same pattern emerged for intrusions in the provocation task. Intrusion frequency was significantly lower in the visuospatial interference condition compared to the no-task control condition, corrected $t(39.74) = 2.83$, $d = 0.80$, $p < .01$ (one-tailed), but not significantly different from the verbal interference condition, $t(56) = 1.44$, $p = .15$ (two-tailed). Intrusion frequency was not significantly different in the verbal interference condition compared to the no-task control condition, corrected $t(45.05) = 1.72$, $p = .09$ (two-tailed), although the direction was similar to the diary measure.

Both the intrusion diary and the provocation task were significantly correlated with the IES-intrusion scale, and with each other, as reported in Table 3.

3.3.2 *Other PTSD symptoms.* One-way ANOVAs with condition (control, visuospatial interference, verbal interference) as the between subject factor showed no significant differences between conditions on the avoidance single-item, IES-avoidance subscale, fragmentation rating, or the PTCI subscales, all $p > .05$. Correlation coefficients are reported in Table 3.

Intrusion frequency in the diary was significantly related to the IES-intrusion scale, single-item measure of avoidance, the IES-avoidance scale, and the PTCI-self blame scale. The diary measure was not significantly related to the other PTCI scales or the fragmentation rating, all $p > .05$. Intrusion frequency in the provocation task was significantly related to the IES-intrusion scale, the single-item measure of avoidance and the fragmentation rating, but not with the IES-avoidance scale or the PTCI scales, all $p >$

.05. Furthermore, there was a significant correlation between the single-item measure of avoidance and the IES-avoidance scale.

3.3.3 *Attention and memory.* A one-way ANOVA with condition (control, visuospatial interference, verbal interference) as the between subject factor and the attention rating as the dependent variable was significant, $F(2, 83) = 5.88$, $f = 0.38$, $p < .01$. Post hoc tests with Bonferroni correction showed a significantly higher attention rating in the control condition compared to both interference conditions, both $p < .05$. The interference conditions did not differ significantly from each other, $p > .05$. The three conditions were comparable on cued-recall and recognition memory performance, $F(2, 83) = 0.15$, $p = .86$, respectively, $F(2, 83) = 2.60$, $p = .11$. The attention rating was significantly correlated with recognition memory, $r_s = .32$, $p < .02$, but not cued-recall memory.

4. Discussion

The main goal of this study was to explore whether intrusive *visual* images could develop from aversive *verbal* information when participants imagined the described scenarios. Our results clearly showed that participants developed intrusive visual images from imagining the traumatic journalist report. Furthermore, the participants reported a significant emotional impact from listening to the report, with mean scores even higher than the emotional impact reported by participants who viewed the original road-traffic accident trauma film on which the journalist report was based (Näring, Krans, Speckens, & Becker, submitted). Thus, our findings suggest that *intrusive* visual images can indeed develop not only from direct visual input, but also from verbal descriptions of events. This indicates that, as earlier survey research and anecdotal reports have suggested, clinicians working with traumatized individuals may be at risk of developing intrusive images of their patients' trauma narratives. Our study has, for the first time to our knowledge, brought the investigation of intrusions of imagery into the laboratory.

We know that intrusions to directly perceived trauma (a film) can be selectively modulated by competing tasks (Holmes & Bourne, 2008). Thus, our second goal was to explore whether intrusive visual images from verbal information could be modulated by interfering with the encoding of the verbal narrative. Our results showed that intrusion frequency was reduced in both the visuospatial and verbal interference condition, compared to the no task control condition. This finding has implications for the field of secondary traumatization and those at risk of developing symptoms. For example, clinicians working with traumatized individuals could benefit from performing a dual task when listening to the trauma narrative. Speculatively, writing therapy notes while listening to a trauma narrative in exposure therapy may help in this regard. From a theoretical point of view the results are more complex. Since this is, to our knowledge, the first study experimentally examining intrusive visual images from an aversive verbal report, our interpretation of the findings is still speculative.

Mental imagery research has shown that visuospatial competition reduces the vividness and emotionality of visual imagery whereas verbal competition does not (Baddeley & Andrade, 2000; Van den Hout, Muris, Salemink, & Kindt, 2001). This modality-specific effect does not appear in our results: first, there was no significant difference between conditions on the vividness and distress ratings of their imagery, indicating that the dual-tasks did not affect the imagery itself. Of course, it is possible that our imagery compliance check suffered from a lack of power to pick up any group differences. However, power-analyses (GPower 3.0.10) indicated that with the current results, a sample size of 495 would be required for imagery vividness and 1,854 for distress to show a significant difference between conditions. Another explanation is that imagery is especially vulnerable for modality-specific interference during encoding from a direct percept, or during memory retrieval, but not so much during imagery generated by incoming verbal information. In contrast to earlier imagery studies in which participants applied mental imagery during *retrieval* of for example a personal memory (Van den Hout et al., 2001), our participants were given specific *generation* instructions to use the incoming verbal information to generate experiences using mental imagery.

Interestingly, the competing resources tasks led to a difference in intrusion frequency. Participants in both the visuospatial and verbal interference condition reported lower intrusion frequency compared to those in the no task control condition. This indicates that the encoding of the imagery of the report was interfered by cognitive load, independent of modality. As discussed in the introduction, this is in line with predictions made by the SMS model of Conway and Pleydell-Pearce (2000) and does not support modality specific predictions made by the dual representation theory (Brewin et al., 1996). These models were not developed to explain intrusions of imagery and this interpretation is merely speculative. However, a similar pattern has been found in studies using a trauma film (Krans, Näring, & Becker, 2009) and IAPS pictures (Pearson et al., 2008) and is thus not unique to intrusions of imagery.

Our study has several limitations. The large majority of our participants was comprised of students. Given that they differed from the non-student participants on several measures (e.g., trait dissociation and trait anxiety), replication in a community sample is warranted. We focused on visual intrusions specifically, and therefore our results cannot be generalized to intrusive images from other modalities. Further, all participants were instructed to generate mental imagery when listening to the verbal report, but it is difficult to ascertain (as in other mental imagery studies; e.g., Baddeley & Andrade, 2000) how well participants were able to comply with this task. Methodological innovations such as fMRI may help in future studies. Future research should explore the role of mental imagery in more detail. For example, exploring variations of modality in input, intrusions, and mental imagery will be a very valuable enterprise.

In sum, our study showed that *intrusive* visual images can develop from *verbal* traumatic information and the frequency of these intrusions can be modulated. Our findings have practical implications. Clinicians working with PTSD patients may opt for employing a dual task during reliving sessions to prevent intrusion development, which may be useful in helping to reduce therapist "burnout" or at least the reluctance by some clinicians to conduct the exposure component of therapy for PTSD. Theoretically, our current results are more in line with a hierarchical model of autobiographical memory (e.g., Conway & Pleydell-Pearce, 2000) and not with dual-processing theories of PTSD (Holmes & Bourne, 2008).

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Table 1.

Means and standard deviations of control measures within and across conditions.

Measure		*Control condition* M	SD	*Visuospatial interference* M	SD	*Verbal interference* M	SD	*Total* M	SD
SUIS		40.11	6.23	38.26	7.31	37.81	5.32	38.70	6.30
STAI-T		36.32	8.13	36.81	8.26	35.42	8.69	36.15	8.30
DES-II		9.99	7.09	14.06	9.67	8.49	6.06	10.73	7.95
Mood Q	Pre	7.43	3.67	7.89	5.92	8.16	5.68	7.84	5.15
	Post	11.39	5.55	11.26	7.43	11.71	7.49	11.47	6.82
STAI-S	Pre	32.50	7.10	33.59	8.28	33.45	8.56	33.19	7.94
	Post	37.07	8.64	37.11	8.20	40.19	6.40	38.21	7.81
DSS	Pre	1.86	2.81	2.33	2.04	2.19	2.52	2.13	2.46
	Post	2.32	3.17	1.63	1.69	3.00	2.91	2.35	2.72

Table 2.

Means and standard deviations of experimental measures within and across conditions.

	Control condition		*Visuospatial interference*		*Verbal interference*		*Total*	
Measure	M	SD	M	SD	M	SD	M	SD
Number of intrusive images in diary	4.57	3.69	2.48	2.23	2.52	2.55	3.17	3.01
Number of intrusive images in provocation task	3.54	2.94	1.78	1.45	2.42	1.88	2.58	2.27
IES – intrusion	5.11	2.53	3.70	3.58	4.16	3.23	4.33	3.16
IES – avoidance	4.07	2.18	2.81	2.88	3.65	3.28	3.52	2.85
Single-item avoidance	1.57	2.04	0.78	0.97	1.52	2.05	1.30	1.80
Fragmentation	6.11	2.77	6.30	2.96	5.77	2.62	6.05	2.75
PTCI – negative	1.64	0.51	1.62	0.64	1.54	0.55	1.60	0.56

cognitions about self								
PTCI – negative cognitions about the world	2.94	1.09	2.68	1.20	2.62	1.33	2.74	1.21
PTCI – self blame	1.98	0.76	1.86	0.74	1.87	0.87	1.90	0.79
Attention	7.46	0.96	6.44	1.45	6.23	1.80	6.70	1.54
Cued-recall	5.86	2.10	5.56	2.29	5.61	2.23	5.67	2.19
Recognition	8.00	1.63	7.07	1.77	7.56	1.43	7.55	1.64

Table 3

Correlation coefficients (Spearman's Rho) between the frequency of intrusive images in and other PTSD symptoms.

	Intrusive visual images in diary	*Intrusive visual images in provocation task*
Intrusive images in provocation task	.36**	-
IES intrusion	.60**	.24*
IES avoidance	.36**	.10
Single-item avoidance	.33**	.21*
Memory fragmentation	.14	.22*
PTCI negative cognitions about self	.14	.03
PTCI negative cognitions about the world	.03	-.0.3
PTCI self blame	.25*	.10

* Significant at the .05 level, ** Significant at the .01 level