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Inducing and modulating intrusive emotional memories: A review of the trauma film paradigm

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Abstract

Highly affect-laden memory intrusions are a feature of several psychological disorders with intrusive images of trauma especially associated with post-traumatic stress disorder (PTSD). The trauma film paradigm provides a prospective experimental tool for investigating analogue peri-traumatic cognitive mechanisms underlying intrusion development. We review several historical papers and some more recent key studies that have used the trauma film paradigm. A heuristic diagram is presented, designed to simplify predictions about analogue peri-traumatic processing and intrusion development, which can also be related to the processing elements of recent cognitive models of PTSD. Results show intrusions can be induced in the laboratory and their frequency amplified/attenuated in line with predictions. Successful manipulations include competing task type (visuospatial vs. verbal) and use of a cognitive coping strategy. Studies show that spontaneous peri-traumatic dissociation also affects intrusion frequency although attempts to manipulate dissociation have failed. It is hoped that further use of this paradigm may lead to prophylactic training for at risk groups and an improved understanding of intrusions across psychopathologies.

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1. Introduction

Intrusive memories, or intrusions, are involuntary recollections relating to events that appear, apparently spontaneously, in consciousness (e.g. Brewin & Saunders, 2001; Davies & Clark, 1998b; Halligan, Clark, & Ehlers, 2002; Holmes, Brewin, & Hennessy, 2004; Schlagman, Kvavilashvili, & Schulz, 2006). Intrusions can be contrasted with the deliberate recollection of events or repeated verbal rumination over such events. Whilst intrusions can take the form of either sensory mental images or verbal thoughts our main interest is to understand mental imagery based intrusions (i.e. those which have a sensory compo-

nent such as mental picture or sounds). This focus mirrors both clinical phenomenology and also healthy autobiographical memories for emotional events. Several studies have suggested that emotional memories typically take the form of mental images irrespective of whether such memories are intrusive or deliberately recalled (Arntz, de Groot, & Kindt, 2005; Conway, 2001) and, conversely, imagery seems to have a special impact on emotion (Holmes & Mathews, 2005).

Intrusive memories occur often in everyday life with studies in non-clinical populations suggesting that their frequency is approximately 2–4 a day (Berntsen, 1996) or 1–5 a day (Mace, 2005), although they occur less frequently than verbal thoughts (Brewin, Christodoulides J., & Hutchinson, 1996). However, these common, unsolicited recollections typically present no concern for the experiencer and can give rise to positive as well as negative affect. In

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contrast, the vivid re-experiencing of excerpts from a traumatic event can be extremely distressing and form one of the three key symptoms for diagnosis of post-traumatic stress disorder (PTSD; American Psychological Association [APA], 1994). There is also considerable evidence implicating intrusive image-based memories in other psychological disorders than PTSD such as: social phobia (Hackmann, Clark, & McManus, 2000; Hirsch, Clark, Mathews, & Williams, 2003); depression (Kuyken & Brewin, 1994, 1999; Reynolds & Brewin, 1999); psychosis (Morrison et al., 2002); agoraphobia (Day, Holmes, & Hackmann, 2004); and cravings in substance misuse (Kavanagh, Andrade, & May, 2005). See Holmes and Hackmann (2004) for further examples. Steel, Fowler, and Holmes (2005) suggested that similar cognitive information-processing mechanisms may be involved in the creation of intrusive memories irrespective of disorder. Psychopathological intrusions can be viewed as an extension of a continuum from our common, everyday intrusions (see Holmes, 2004).

The factors that determine whether a memory becomes intrusive need to be understood. The clinical literature indicates that peri-traumatic factors (i.e. processes during encoding of trauma), such as dissociation, are the best predictors of later PTSD symptoms compared to other factors such as demographics or trauma type (see the meta-analysis by Ozer, Best, Lipsey, & Weiss, 2003). However, as argued by Candel and Merckelbach (2004) a limitation of many "peri-traumatic" clinical studies is heavy reliance on retrospective reports of reactions during trauma. Such methodology has important limitations since people in general, and PTSD patients in particular, find it difficult to give accurate descriptions of past emotional states. Prospective designs are therefore warranted, however it is clearly unethical to deliberately expose research participants to real trauma. To circumvent this, some studies have adopted ingenious paradigms such as testing trainee firefighters prior to their exposure to a real fire (Bryant & Guthrie, 2005), or using analogues of high anxiety situations such as volunteer sky divers (Sterlini & Bryant, 2002). Another analogue approach, the trauma film paradigm, offering laboratory control, has emerged in the quest for prospective methodologies.

The trauma film paradigm involves showing non-clinical participants short films which contain scenes depicting stressful or traumatic events. In this context, a traumatic event is defined as actual or threatened death or serious injury to the body or self (APA, 1994). Strictly speaking, these films might best be referred to as "films with traumatic content" since they do not necessarily induce an "intense emotional reaction" as required by the diagnostic criteria for trauma. However, for brevity we use the term "trauma films".

1.1. Historical perspective

The use of the trauma film paradigm was pioneered by Lazarus and colleagues in the 1960s (e.g. Lazarus & Alfert,

1964; Lazarus & Opton, 1964; Lazarus, Opton, Nomikos, & Rankin, 1965; Speisman, Lazarus, Mordkoff, & Davison, 1964). These predominantly focussed on physiological stress responses (heart rate and skin conductance) produced by viewing the film and clearly demonstrated that marked stress responses were inducible in the laboratory by a variety of film stimuli. More crucially, these studies also showed that stress response severity could be experimentally altered by various manipulations such as: prior "cognitive orientation", i.e. perceiving events as fictional or being emotionally detached from events (Lazarus et al., 1965); assuming an involved or detached viewing stance (Koriat, Melkman, Averill, & Lazarus, 1972); or by utilising relaxation, desensitisation, and cognitive rehearsal techniques (Folkins, Lawson, Opton, & Lazarus, 1968).

A psychophysiological finding of Folkins et al. (1968) seems particularly intriguing. Relative to a control condition, use of either relaxation or cognitive rehearsal (desensitisation without the relaxation component) during the film reduced self-reported anxiety scores and skin conductance. However, such manipulations did not reduce heart rate response during film viewing as hypothesised by a traditional 'fight or flight' arousal response to stress. As the authors note, a closer inspection of the data suggests that the lack of a significant group difference in heart rate may be due to heart rate reductions in the control group immediately around the traumatic scenes contained in the film. A finding of reduced heart rate, or bradycardia, coincident with peaks in trauma content is also found in Holmes et al. (2004), see Section 3.2.

The trauma film paradigm was further developed by Horowitz and colleagues in the 1970s (e.g. Horowitz, 1969, 1975; Horowitz & Becker, 1971a, 1971b, 1971c, 1973; Horowitz, Becker, Moskowitz, & Rashid, 1972; Horowitz & Wildner, 1976). A major development was to consider the impact of films (with content depicting blood and injury, bereavement and separation, or erotic scenes) on the frequency of intrusive thoughts generated. Typically intrusive thoughts were measured over short periods (within 5-min of the film ending) rather than the week-long diary methods typically used today (see Section 2). This considerable body of work (for a review see Horowitz, 1975) systematically considered how intrusion frequency was affected by variables such as: nature of stimuli (film type and film repetition); sample populations (including psychiatric patients and servicemen with prior exposure to trauma); and cognitive processing instructions (to vary use of imagery, attention, or modify interpretation of the meaning of intrusions). In summary, Horowitz (1975) suggested that the tendency to experience intrusive memories following a stressful event was a general one, present in the population at large and expected to occur following mild as well as severe stress events.

Butler, Wells, and Dewick (1995) extended the paradigm by monitoring film-related intrusions for a week after film viewing. They also provided verbal instructions requesting

participants to modify their cognitive processing. This instructional manipulation occurred in the 4 min after watching the film and thus reflects post-trauma rather than peri-traumatic processing. A “worry” group was instructed to worry in verbal form about the film’s contents, whilst an “imagery” group was asked to imagine in pictorial form the distressing elements of the film. If just the first three days’ intrusion data were examined then, as predicted, the worry group reported more intrusions than the imagery and control (no-task) groups. However, over the full seven day diary period there were no group differences in number of intrusions.

Davies and Clark (1998a) investigated how post-trauma thought suppression might affect intrusive memories. Using a Horowitz-type methodology, the study measured intrusive memories for only 4 min post-film. During the first 2 min, participants were either asked to deliberately suppress thoughts pertaining to the film, or to think freely. Meanwhile, they recorded their film related intrusions by pressing a ‘clicker’. In a second 2-min period, participants continued to record their intrusions but both groups were instructed to think freely. Relative to the control group, the suppression group reported a reduced number of film related intrusions in the initial period but an increased number in the second period.

1.2. Cognitive theories of PTSD and intrusive memories

Although intrusive memories appear to be commonplace and not necessarily indicative of psychopathology, in their more extreme form they are associated with several psychological disorders. One example is the “flashbacks” seen in PTSD, historically the “hallmark” intrusive image disorder. In PTSD, intrusions can be extremely vivid, experienced as if the events are occurring again in the present. (e.g. Ehlers, Hackmann, & Michael, 2004; Hackmann, Ehlers, Speckens, & Clark, 2004). Holmes, Grey, and Young (2005) provide several examples of PTSD related intrusions including a patient caught in a railway carriage fire: “[I am] sitting with X trying to move his clothing so he can breathe easily and his skin [is] coming away.” (p. 8).

Contemporary theories of PTSD conceptualise intrusive memories as instances of ‘faulty information processing’ (Brewin & Holmes, 2003) and thus place memory processes and encoding mechanisms at the centre of PTSD aetiology and treatment (see also Conway, Meares, & Standart, 2004; Conway & Pleydell-Pearce, 2000). Specific clinical models of this ‘faulty processing’ include Ehlers and Clark’s (2000) cognitive theory of PTSD and the dual representation theory of PTSD (DRT; Brewin, 2001, 2003; Brewin, Dalgleish, & Joseph, 1996). While these theories differ in other respects, in relation to intrusion formation they appear to make similar predictions, as outlined by Holmes et al. (2004) and Mathews and Macleod (2005).

Ehlers and Clark (2000) suggest that during trauma our everyday balance of processing style is shifted away from conceptual processing of events (focussing on the meaning

of the situation, organising information, and placing it in context) and towards data-driven or perceptual processing (focussing on sensory impressions). It is this shift in processing balance towards a relative increase in perceptual processing that can be considered to be ‘faulty’. Similarly, the most recent version of DRT (Brewin, 2003) proposes that trauma can cause a neurophysiological shift in processing balance away from standard, conscious, verbal processing of information (“verbally accessible memory”) in favour of a relative increase in sensory processing and storage (“situationally accessible memory”). Both theories propose that the ‘faulty’ trauma related processing leads to a lack of the context for a coherent time code, so that intrusions can be perceived as being ‘relived’ or ‘happening again’. Broadly speaking, both models suggest that the shift in processing balance occurs due to an extreme emotional response to the traumatic event itself. Emotion is specifically thought to promote perceptual memory encoding, as found in experimental results using slide stimuli with non-clinical participants (Arntz et al., 2005). Arntz et al. also argue this might be related to the prominence of perceptual memories in traumatic memory, such as intrusions and nightmares.

We suggest that a simplified way to understand this ‘faulty information processing’ shift may be to consider the nature of a typical traumatic event: trauma events (or other very emotional events) can unfold very rapidly reducing time available for sufficient verbal or conceptual processing (i.e. for the individual to make sense of the events). Simultaneously, the individual may focus more intently than usual on sensory or visuospatial information as it may be especially valuable in the current survival context (i.e. identifying potential escape routes) as well as providing a key learning experience for future dangerous occasions. The trauma film paradigm allows investigation of the variables that may trigger ‘faulty’ processing contemporaneously with encoding. This type of controlled analogue of clinical trauma can be used to test specific theory-driven predictions.

2. Methodology

2.1. Method

The basic methodology involved in recent trauma film studies is depicted in Fig. 1. Participants typically complete a raft of baseline measurements (“pre-film measures”) to check for pre-existing vulnerabilities or trait biases, as well as state levels of certain variables, before viewing a short (8–12-min) film depicting traumatic events (e.g. scenes of

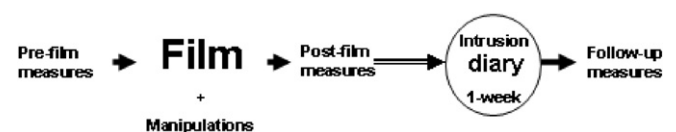


Fig. 1. Basic procedure for trauma film paradigm.

267	injury or death). The films used include industrial accidents	322
268	(Butler et al., 1995), Steil's (1996) video of real-life road	323
269	traffic accidents (Brewin & Saunders, 2001; Hagensars,	324
270	van Minnen, Holmes, Brewin, & Hoogduin, submitted	325
271	for publication; Halligan et al., 2002; Holmes & Steel,	326
272	2004; Holmes et al., 2004, Holmes, Oakley, Stuart, & Bre-	327
273	win, 2007; Stuart, Holmes, & Brewin, 2006), a fire safety	
274	film depicting an office fire (Davies & Clark, 1998a,	2.3. Manipulations of peri-traumatic processing: an overview
275	1998b), and real-life footage of a patient with severe inju-	of predictions
276	ries dying after treatment in a hospital emergency room	328
277	(Laposa & Alden, 2006). During the film participants can	329
278	either be asked to view the film as they would naturally	
279	("no task") or be given a "task". Such "tasks" will be	Peri-traumatic processing refers to processing that
280	described in more detail later, but include concurrent cog-	occurs during a traumatic event, for which the trauma film
281	nitive tasks and instructions about the mode of processing	acts as an experimental analogue. As discussed, the two
282	to adopt. After the film, state measures are repeated to	main cognitive models of PTSD (Brewin et al., 1996; Ehlers
283	assess the impact of film viewing and measures given to	& Clark, 2000) make similar predictions about peri-trau-
284	check compliance with any experimental manipulations	matic processing and intrusion development.
285	("post-film measures"). Some studies include additional	
286	variables, such as physiological measures, during the film.	2.3.1. Peri-traumatic processing in normal or control
287	Before leaving session one, participants are instructed on	conditions
288	use of the intrusion diary and asked to record any intrusive	336
289	memories of scenes from the trauma film spontaneously	337
290	occurring over the coming week. Participants return a week	A central tenet of both the clinical models of PTSD
291	later to submit their diaries and complete further tests	(Brewin et al., 1996; Ehlers & Clark, 2000) is that there
292	("follow up measures") such as recall for the film's content	are two forms of peri-traumatic cognitive processing that
293	and estimation of compliance with completing the diary.	occur simultaneously for any given event: a verbal or con-
294	To provide a check for demand characteristics, participants	ceptual form and a sensory visuospatial or perceptual
295	may be asked to rate their predictions about the results in	form. The latter type of processing can include sensory
296	relationship to the experimental hypotheses. Prediction	information in any sensory modality (visuospatial, audi-
297	ratings can then be compared with participants' actual	tory, olfactory, etc.) though the focus with visual traumatic
298	performance.	film stimuli is on visuospatial processing. For the sake of
299	The diary methodology is crucial to the paradigm. In	clarity, the terms verbal (meaning verbal and conceptual)
300	our studies, the weekly pen-and-paper intrusion diary pro-	and visuospatial (meaning perceptual and sensory) will typ-
301	vides a reminder for participants as to what constitutes an	ically be used for the remainder of the paper without imply-
302	intrusive memory (i.e. spontaneous not deliberately	ing any preference for either cognitive model. This division
303	recalled, image based, etc.). Each day is separated into time	also reflects that used in cognitive models of working mem-
304	periods (e.g. morning, afternoon, evening, night). The par-	ory i.e. the visuospatial scratch pad and phonological loop
305	ticipant is asked to enter the number of intrusions exper-	(e.g. Andrade, Kavanagh, & Baddeley, 1997; Baddeley,
306	enced for each period together with a description of the	1986; Kemps, Tiggemann, Woods, & Soekov, 2004).
307	content of each intrusion. This provides a check that	Clinical models of PTSD propose that the relative bal-
308	recorded intrusions indeed relate to the trauma film. It also	ance of verbal and visuospatial processing at encoding is
309	allows intrusions to be matched to the corresponding film	a major factor determining whether an event subsequently
310	section which is useful for peri-traumatic heart rate analy-	becomes intrusive.
311	ses or when using a within-subjects design (Holmes et al.,	Figs. 2a-c provide an overview of such clinical models
312	2004, 2007; Stuart et al., 2006). Information is also col-	of intrusion development and a heuristic for considering
313	lected on the nature of the intrusion (image based, thought	how dual tasks/mode of processing manipulations might
314	based, or both; typically only intrusions including imagery	influence intrusion frequency. Fig. 2a depicts a scenario
315	are used in analyses).	where information from the film enters the cognitive sys-
		tem and is processed simultaneously both verbally and
		visuospatially. If there is a sufficient balance of verbal rel-
		ative to visuospatial processing then the encoded events
		are unlikely to intrude. However, when emotionally trau-
		matic events cause a relative increase in visuospatial com-
		pared to verbal processing, the likelihood that the
		memory will intrude is increased. Fig. 2a thus illustrates
		a control condition in which "viewing the film as normal"
		produces a baseline number of intrusions. In comparison
		to this (no task) control condition, the subsequent dia-
		grams (Figs. 2b and c) illustrate the impact of various
		manipulations of peri-traumatic processing.
316	2.2. Designs	370
317	Some trauma film studies are correlational in design,	371
318	considering the relationship between pre-existing trait lev-	372
319	els and subsequent frequency of intrusive memories. Other	373
320	studies attempt to deliberately manipulate cognitive	374
321	processes to investigate effects on intrusive memory pro-	375

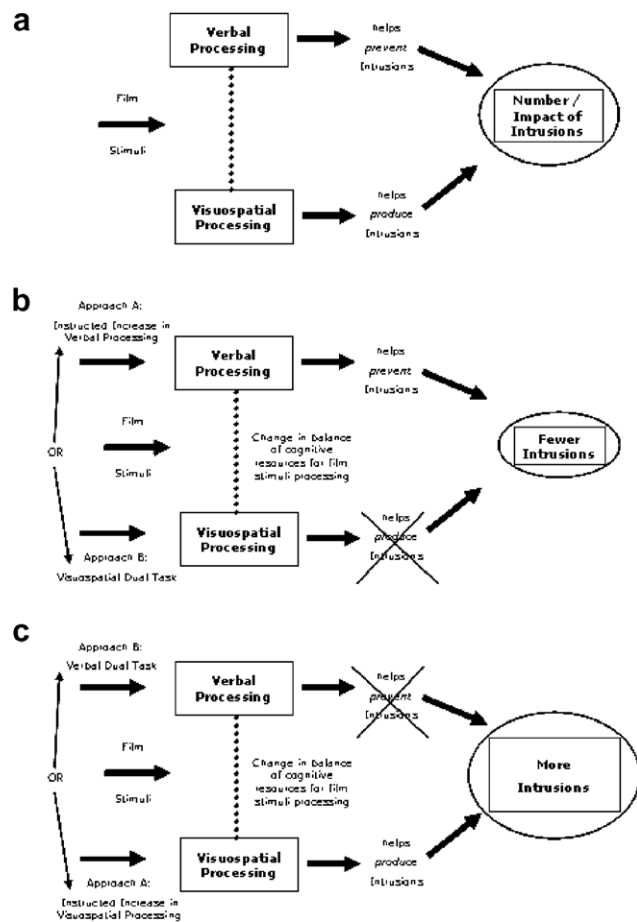


Fig. 2. (a) Control condition: intrusion frequency is determined by the relative balance of verbal and visuospatial processing. (b) Attenuation condition: intrusions decreased by relative increase in Verbal processing. (c) Amplification condition: intrusions increased by relative increase in Visuospatial processing. (a–c) Heuristic diagram for experimental manipulation of intrusive memories in the trauma film paradigm.

2.3.2. Peri-traumatic processing in “intrusion attenuation” conditions

Given that cognitive models of PTSD suggest that intrusive memories are generated by a relative shift towards visuospatial processing, it is hypothesised that if a processing shift can be generated in the *opposite* direction (i.e. in favour of verbal processing) then this may protect against intrusions. This leads to the prediction that if the film is viewed under conditions which create a “pro-verbal” processing shift then a reduced number of intrusions (relative to the control condition) would be experienced. This scenario is illustrated in Fig. 2b, with the “pro-verbal” shift being generated by either of two possible methods: Approach A (top arrow) requires participants via an explicit instruction to increase the amount of verbal processing they are undertaking. Alternatively, Approach B (bottom arrow) exploits a competition for resources rationale, and uses a concurrent dual task to compete for visuospatial resources (e.g. a spatial tapping task). Approach B reduces the visuospatial processing resources allocated to the

trauma film without affecting the amount of verbal processing, leaving the level of verbal processing now relatively high. Overall, Fig. 2b represents an “attenuation of intrusions” condition which can be achieved via two alternative approaches (increasing verbal-conceptual or decreasing visuospatial processing).

It is noted that the competition for specific types of cognitive resources approach aligns with the working memory rationale forwarded by Baddeley and Andrade (2000) to reduce the emotionality of non-clinical mental images. This approach is also being used in other contexts such as the role of EMDR in trauma therapy (Kavanagh, Freese, Andrade, & May, 2001; Van den Hout, Muris, Salemink, & Kindt, 2001), and the role of imagery and visuospatial tasks in both substance misuse cravings (Kavanagh et al., 2005; May, Andrade, Pannaboke, & Kavanagh, 2004) and food cravings (Kemps et al., 2004).

2.3.3. Peri-traumatic processing in “intrusion amplification” conditions

Fig. 2c represents an “amplification of intrusions” condition where the balance between the two forms of processing is shifted in the opposite direction to that illustrated in Fig. 2b (i.e. in the relative favour of visuospatial processing) thereby leading to more intrusions than under control conditions (Fig. 2a). Again, this shift can be generated via two alternative methods: (1) by a relative increase in visuospatial processing, depicted as Approach A (top arrow) in Fig. 2c; or (2) by decreasing verbal processing resources allocated to the trauma film via a competition for resources rationale (depicted as Approach B, bottom arrow, in Fig. 2c). Again, irrespective of whether Approach A or B is employed, our simplified model of PTSD predicts that a shift in favour of visuospatial processing will lead to a greater number of intrusions, as depicted in Fig. 2c, relative to control conditions (Fig. 2a).

While not all studies employ all three experimental conditions depicted in Figs. 2a–c, these diagrams aim to provide a heuristic representation of the peri-traumatic mechanisms proposed to lie behind intrusion development and how these mechanisms may be manipulated. An interesting feature of the overarching model is that we can derive predictions that would lead either an increase or a decrease in intrusions. Such bi-directional predictions provide ways to experimentally test the counterargument that any peri-trauma film task that might helpfully reduce intrusions is ‘merely’ working due to distraction from the film.

3. Findings

3.1. Types of study

The 10 recent trauma film studies reviewed in this section can be separated into three groups. The first group of studies comprise correlational analyses. These studies have considered the relationship between a range of individual differences (personality factors and cognitive traits)

and film intrusions. The second group has used experimental manipulations of cognitive processing during trauma film viewing, thereby testing predictions from cognitive theories of PTSD (as illustrated in Figs. 2a–c). A third group of studies has specifically considered the role of dissociation in intrusive memory production. Many studies incorporate elements from more than one of these classifications but each study has been categorized based on the nature of its principle hypothesis.

3.1.1. Correlational studies

Davies and Clark (1998b) used a correlational design to examine the relationship between frequency of intrusive memories following a traumatic fire safety film and a variety of personality traits, cognitive processing styles and mood measures. Pre-film measures included neuroticism and extraversion (Eysenck Personality Questionnaire; Eysenck & Eysenck, 1975), trait anxiety (State Trait Anxiety Inventory – STAI-T; Spielberger, Gorsuch, & Lushene, 1970), depression (Beck Depression Inventory – BDI; Beck, Rush, Shaw, & Emery, 1979), and specifically designed self-report scales concerning mental imagery, vulnerability to harm by fire, use of thought suppression, and intrusion proneness. Pre- and post-film mood ratings were also taken (happy, anxious, depressed and angry). Results showed that the number of intrusive memories experienced in the week following the trauma film was predicted by: (i) increase in anger across the film; (ii) self-rating for vulnerability to harm by fire; and (iii) the interaction between these two. These three variables accounted for 30% of the variance in intrusive memories frequency and no other variable reached significance.

Interested in intrusions in psychosis as well as PTSD, Holmes and Steel (2004) used a correlational design to investigate intrusions in relation to schizotypy (Oxford-Liverpool Inventory of Feelings and Experiences – O-LIFE; Mason, Claridge, & Jackson, 1995), trait dissociation (Dissociative Experiences Scale – DES-II; Carlson & Putnam, 1993) and peri-traumatic dissociation (Peritraumatic Dissociative Experiences Questionnaire – PDEQ; Marmar, Weiss, & Metzler, 1997). Results showed a significant positive relationship between positive symptom schizotypy (Unusual Experiences subscale of O-LIFE) and number of trauma-related intrusions. Trait dissociation was a univariate predictor of intrusions but became non-significant with the inclusion of schizotypy. PDEQ correlated with the Cognitive Disorganisation subscale of O-LIFE but did not predict intrusions. These findings indicate that trait dissociation may be a mediating mechanism by which high schizotypes are vulnerable to traumatic intrusions.

3.2. Experimental manipulation of peri-traumatic cognitive processing

Brewin and Saunders (2001) attempted to investigate the effect of peri-traumatic dissociation on intrusions. They compared a no task condition with a concurrent tapping

task hypothesised to mimic the divided attention aspect of dissociation. Contrary to predictions, the dual task led to significantly fewer intrusions than the control group. However, as no measure of dissociation was taken it is unclear whether the dual-task manipulation stimulated dissociation as intended. Holmes (2000) argued that the tapping task, rather than mimicking dissociation, instead competed for visuospatial resources involved in intrusion formation (see Fig. 2b) thereby reducing the number of intrusions. This suggestion thus lead Holmes et al. (2004) to consider thoroughly the effect of dual tasks on intrusive memory formation, as described later.

Halligan et al. (2002) investigated the effect of cognitive processing style (following Ehlers & Clark, 2000) on intrusion development, in Experiment 1 via an instructional manipulation and in Experiment 2 via groups divided by naturally occurring individual differences in information processing style. In Experiment 1, two groups were given either “Conceptual” or “Perceptual” instructions for viewing the film. Pre-film measures included the State Anxiety Inventory (STAI-S; Spielberger et al., 1970) and a cognitive processing questionnaire to assess perceptual and conceptual style processing (CPQ; developed by the authors). Post-film measures included the STAI-S and a retrospective state version of the CPQ. The Conceptual group was instructed to watch the film whilst focusing on the story, following what was happening to the people and why, and thinking about what might happen next. This group was thus encouraged to increase the relative amount of verbal processing of the film as illustrated in Fig. 2b, Approach A. The Perceptual group was instructed to watch the film whilst being absorbed in the images and sounds, viewing the scenes as unconnected snapshots. They were therefore requested to increase the relative amount of visuospatial processing of the film (Fig. 2c, Approach A). Both groups experienced significant increases in state anxiety from pre- to post-film and the experimental manipulation of processing style appeared successful. Contrary to predictions there was no significant difference in intrusions between the groups. The authors noted a potential confound in the processing style manipulation; individual’s innate processing bias may not have been adequately countermanded by the task instructions. Indeed, with data collapsed across groups, intrusion frequency showed a positive correlation with perceptual processing and a negative correlation with conceptual processing.

In Halligan et al. (2002) Experiment 2, a pre-film trait version of the CPQ was used to divide participants into “conceptual” or “perceptual” information processing style groups (selecting upper quartile scores). Other pre-film measures included the STAI-T, STAI-S and trait dissociation (TDQ; Murray, Ehlers, & Mayou, 2002) with the STAT-S repeated post-film. Follow-up measures, in addition to intrusions, included other analogue PTSD symptoms (fear, avoidance and arousal) using a purpose-designed questionnaire. As predicted, the Perceptual group experienced significantly more intrusions than the Concep-

tual group. The Perceptual group also found their intrusions more distressing and reported more fear, avoidance and arousal symptoms. Interestingly, the perceptual group had significantly higher scores of pre-film state anxiety, trait anxiety, and trait dissociation although these confounds were controlled for in the analysis. Although Experiment 2 did not use an experimental manipulation, the study can still be interpreted within Figs. 2b and c as the pre-selection of individuals with naturally extreme processing styles represents an alternative approach to generating shifts in processing balance. This study also supports the external validity of trauma films as an analogue of PTSD since, in addition to intrusions, other analogue symptoms of PTSD were induced.

In a series of experiments, Holmes et al. (2004) examined the effect of various dual tasks (during a trauma film) on intrusive memory formation. Cognitive tasks were used to actively modify processing style rather than instructing participants to deliberately shift their processing style. In Holmes et al. Experiment 1, two experimental manipulation groups were contrasted with a no-task control condition. A “Visuospatial” group was required to tap repeatedly a specified sequence of five keys on a 5 × 5 keypad without looking (after only 1-min of practice) throughout the film (see Fig. 2b, Approach B). This task was the same as that used by Brewin and Saunders (2001) but in this study was hypothesised to utilise visuospatial resources via recalling and repeating the spatial pattern. A “Dissociation” group was required to stare at a small dot on the film screen during the film (Leonard, Telch, & Harrington, 1999). Measures given pre- and post-film included state dissociation (sub-scale of the Clinician Administered Dissociative States Scale – DSS; Bremner et al., 1998). The key result was that, as predicted, the Visuospatial group reported significantly fewer intrusive memories than other groups (see Fig. 2b, Approach B). Although the dissociation manipulation gave the highest change in DSS scores, contrary to prediction this led to no more intrusions than the control condition. However, across all groups combined, spontaneous increases in state dissociation over the film were positively correlated with intrusions (even when controlling for experimental condition and trait dissociation). It is possible that such artificial dissociation tasks do not provide an adequate analogue of natural, spontaneous dissociative episodes.

Holmes et al. (2004) Experiment 2 investigated the potential active ingredients in the visuospatial dual task. Three forms of tapping task were compared with no task: standard Visuospatial tapping (as in Experiment 1); Overpracticed visuospatial tapping (increasing pattern practice to 6-min); and Single key tapping i.e. repeatedly pressing one key. The “Overpracticed” condition was used to reduce the general cognitive load required by task performance relative to the Visuospatial group, while still using visuospatial resources. The “Single Key” condition reduced visuospatial load, checking that any effect of the visuospatial task was not due to simple tapping per se.

As predicted (see Fig. 2b, Approach B), compared to the control group, there were fewer intrusions in both the Visuospatial and the Overpracticed group, but not in the Single Key group. There was a significant linear trend between visuospatial task demand and intrusive memory frequency. Again, spontaneous increases in state dissociation across groups were associated with intrusions. These results support the hypothesis that it is the visuospatial nature of the task that may be effective in reducing intrusions and that the effectiveness of that attenuation is proportional to the cognitive load of the visuospatial task.

Experiment 3 in Holmes et al. (2004) compared two verbal dual tasks with a no task condition. A “Verbal Interference” group was required to count backwards in threes whilst viewing the film. This task utilises verbal components of working memory (Vallar & Baddeley, 1982). Following clinical theories, verbal processing is needed to helpfully process trauma conceptually. The verbal disruption/interference task was therefore predicted to increase intrusions (see Fig. 2c, Approach B). In contrast, a “Verbal Enhancement” group was required to describe aloud details of the scenes whilst they viewed the film with the expectation that such helpful verbal description would enhance verbal processing of the traumatic scenes rather than divert verbal processing resources. “Verbal Enhancement” was predicted to reduce intrusions (see Fig. 2b, Approach A). As predicted, the Verbal Interference group reported significantly more intrusions than the Control group. Crucially, this result also indicates that the previous results using the visuospatial task cannot merely be due to “distraction” away from the film – as this counting task is also “distracting” but led to increased rather than reduced intrusion levels. However, the Verbal Enhancement group did not experience the predicted reduction in intrusions. Transcripts of the verbalisations indicated that they predominantly consisted of surface level descriptions of the scenes rather than the emotional meaning of the film. Perhaps this task was unable to recruit the verbal conceptual processing of the type needed to counteract intrusions (however, see Lapsa and Allen, 2005, for an alternative methodology).

All experiments in Holmes et al. (2004) measured heart rate using a blood flow optical sensor. Baseline heart rate was calculated over a 6-min rest period pre-film. Peri-traumatic heart rate was calculated over the 12.5-min film duration, yielding an index of film-induced heart rate change. As discussed, participants described the content of each intrusion in their diaries. The experimenter later matched diary intrusion descriptions to actual sequences in the film (e.g. a scene of a fireman carrying a baby). Heart rate recordings were synchronised with the film, allowing a mean ‘intrusion-sequence’ heart rate to be calculated per participant and compared to non-intruding sections. Experiments 1 and 2 found that peri-traumatic heart rate decrease was significantly correlated to increased number of intrusions. Additionally, both Experiments 1 and 2 found that intrusion-sequence heart rate was significantly

lower (by 1.6 and 1.9 bpm, respectively) compared to non-intruding film sequences. However, any differences in Experiment 3 did not reach significance. The significant findings appear to be in conflict with a stress-arousal view of the trauma film (see Van Stegeren, this issue; Wolf, this issue) but may be consistent with a 'freeze and surrender' or orientating response to threat stimuli and trauma (e.g. Nijenhuis, Vanderlinden, & Spinhoven, 1998; see also Campbell, Wood, & McBride, 1997; Lang, Bradley, & Cuthbert, 1997). Interestingly, the results are comparable to Folkins et al. (1968) which found evidence of bradycardia in the control group immediately around the traumatic scenes contained in the film (see Section 1.1). Further investigation is warranted.

Q4 Stuart et al. (2005) modified the trauma paradigm to use within-subjects rather than between-subjects conditions. A within-subjects design is made possible by again linking intrusion descriptions in the diary to particular segments of the film (as described in Section 2.1). The experimenter can thus retrospectively determine the number of intrusions associated with each condition (marked by portion of the film). The experiment sought to test the impact of an alternative, clinically relevant, visuospatial task (see Fig. 2b, Approach B) – clay modeling (of pyramids and cubes) – compared to a no-task control condition (see Fig. 2a). Clay modeling is sometimes used to 'ground' traumatised clients to reduce dissociation during psychological therapy. Results showed that participants experienced significantly fewer intrusions from the section of the film during which they were modeling than during the no-task sections (the two sections of film were matched for intrusion production potential using data from Holmes et al. (2004) and were counterbalanced between participants). Interestingly, the reduction in intrusions was not accounted for by post-film distress or peri-traumatic dissociation (PDEQ; Marmar et al., 1997).

A further use of the trauma film paradigm is provided by Loposa and Alden (2005, Study 2). In Study 1, Loposa and Alden undertook structured interviews of acute care health workers to provide an analysis of cognitive coping strategies used in traumatic situations. The most effective strategies were used in Study 2, the trauma film study, to experimentally test their effectiveness in reducing intrusion relative to a no-strategy control group. Such strategies included: directing attention to mechanical steps of medical treatment; focusing on events and processes occurring in the 'here and now'; and recalling prior training and applying it to solve medical problems.

In Study 2, the no-strategy Control group was told simply to watch the video of real events in a hospital emergency room, whilst the Coping group was given instructions such as: to focus on the medical procedures being used by the medical staff; and analyse what the staff are trying to accomplish. The groups did not differ on pre-film measures of trait anxiety (STAI-T; Spielberger et al., 1970), depression (BDI-II; Beck, Steer, & Brown, 1996), trait dissociation (DES-II; Carlson & Putnam, 1993), prior

traumatic experience (PDS; Foa, 1995), or intelligence (WPT; Wonderlic, 1999). A manipulation check confirmed that the Coping group reported using the required coping strategy more than Controls. As predicted, the Coping group experienced significantly fewer intrusions than Controls. Whilst this study did not set out especially to manipulate the balance of processing as proposed by cognitive theories of PTSD (Brewin et al., 1996; Ehlers & Clark 2000), the authors note that this manipulation "echoes" the conceptual processing results of Halligan et al. (2002). We assert that the cognitive coping strategies adopted may have specifically worked by boosting verbal/conceptual processing of the film (i.e. Approach A in Fig. 2b). This suggestion is supported by the finding that scores on Halligan's et al. (2002) Conceptual Processing Questionnaire (CPQ) were strongly associated with effective use of the coping strategy. That experimental support was provided for the effectiveness for coping strategies derived from real-life trauma situations (see Study 1) also lends further support for the external validity of the trauma film paradigm. Finally, it highlights the potential for the trauma film paradigm to test experimentally prophylactic treatments to prevent PTSD in at risk groups such as emergency services personnel.

3.3. Experimental studies of peri-traumatic dissociation

Much of the evidence for peri-traumatic dissociation being a predictor of later PTSD diagnosis is based upon retrospective self-report data for the traumatic event, even if the period between event experience and self-report is becoming increasingly short (e.g. Engelhard, van den Hout, Kindt, Arntz, & Schouten, 2003; Koopman, Classen, & Spiegel, 1994; Murray et al., 2000; Shalev, Peri, Canetti, & Schreiber, 1996; Ursano et al., 1999). Indeed, Ozer et al. (2003) showed in a meta-analysis that one of the strongest predictors for a subsequent PTSD diagnosis following a traumatic event was retrospective, self-reported peri-traumatic dissociation. However, as argued by Candell and Merckelbach (2004) we also need prospective evidence. The trauma film paradigm has been used to prospectively investigate the role of dissociation in intrusion development, though attempts to date appear to be frustratingly inconclusive.

Holmes et al. (2004, Expt. 1) found no effect of an active manipulation of dissociation task (dot staring) on intrusions, yet found intrusions to be associated with spontaneous increases in film-induced state dissociation. This was replicated in Experiment 2 but not Experiment 3. One possibility is that dissociation is a complex construction requiring a more detailed and precise definition. Holmes et al. (2005) therefore suggested that there are two distinct types of dissociation: detachment (i.e. being detached from everyday experience e.g. feeling 'spaced-out'); and compartmentalisation (i.e. deficit in control of processes or actions via a division or compartmentalisation of functions).

Holmes et al. (2007) used a within-subjects design (similar to Stuart et al., 2005) to contrast active manipulations of detachment dissociation via hypnosis. All participants were pre-screened for hypnotic susceptibility (using the Harvard Group Scale of Hypnotic Susceptibility; Shor & Orne, 1962) and viewed the entire film whilst hypnotised. For the “control” condition section of the film participants were instructed, under hypnosis, to view the film normally and from their own perspective. In the “Dissociation” condition section, participants were given suggestions to view the film as if they were disconnected from, or outside of, their bodies. The trauma film significantly increased state dissociation (DSS; Bremner et al., 1998) and this increase was greater for the Dissociation condition. However, contrary to prediction, there were no more intrusions in the Dissociation condition than the control condition. It is possible that detachment dissociation per se is not involved in intrusive memory formation. However, perhaps spontaneous detachment dissociation has some qualities not captured by the hypnotically suggested detachment manipulation.

In contrast, Hagenaaars et al. (submitted for publication) considered compartmentalisation dissociation and its role in intrusive memory formation. Again, hypnotic suggestion was used to induce the desired form of dissociation, in this case full body catalepsy (Dissociative Non-Movement or DNM group). Two other groups were used, a non-hypnotic group that was instructed not to move intentionally (NM group) and a non-hypnotic, non-restricted group (Controls). The groups did not differ in trait dissociation (DES-II; Carlson & Putnam, 1993), pre-film state dissociation (DSS; Bremner et al., 1998), or peri-traumatic dissociation (PDEQ; Marmar et al., 1997). The effectiveness of the compartmentalisation manipulation was supported by a significantly higher score for the DNM group, relative to the other groups, on the Catalepsy Questionnaire (CQ; Hagenaaars, Roelofs, Hoogduin, & van Minnen, 2006) and the Somatiform Dissociation Questionnaire – Peri-traumatic (SDQ-P; Nijenhuis, van Engen, Kusters, & van der Hart, 2001). The two non-movement groups combined reported significantly more intrusions than Controls. However, there was no significant difference between the DNM group relative to the other two groups combined. These results suggest that somatiform compartmentalisation per se may not be involved in intrusive memory formation but that non-movement may increase intrusion frequency. This later finding may relate to “freezing” during trauma (e.g. Nijenhuis et al., 1998).

A further use of the trauma film paradigm is provided by Kindt, van den Hout, and Buck (2005). Memory fragmentation and disturbances for trauma film scenes, as well as self-rated frequency of intrusions, was examined over a 4-h period following film viewing. Memory disturbances were assessed via a sequential test, where five scenes from the film were shown in random order and had to be placed in sequential order; and a perceptual memory test, where participants responded to scene descriptions with detailed

recollections of perceptual aspects of the identified scene. Memory fragmentation was assessed via visual analogue scales ratings for how fragmented or “snap-shot” like memories were. Participants completed the PDEQ (Marmar et al., 1997). Scores on the memory disturbance tests were not predicted by peri-traumatic dissociation (PDQ). However, memory fragmentation and short-term intrusion frequency correlated with PDEQ score but not to a trait measure of dissociation (DES; Bernstein & Putnam, 1986). This study not only provides further evidence for the role of spontaneous dissociation in intrusion formation but extends the effect of dissociation to problems of memory coherence – another key phenomenon of PTSD.

4. Discussion

Taken together, the studies discussed above show that the trauma film paradigm can induce negative mood, distress, dissociation, and intrusive memories for film content. In addition to looking at intrusions, some studies (e.g. Brewin & Saunders, 2001; Halligan et al., 2002; Laposa & Alden, 2006) have shown that the trauma film paradigm can induce other analogue PTSD-like symptoms (e.g. fear, avoidance, and arousal). These findings support the assumption that the trauma film paradigm provides a useful analogue to real life trauma. Interestingly, there is still some debate as to whether PTSD can actually be produced from viewing traumatic events via television or video rather than first person experience, especially if there is no direct relationship between viewer and some of the victims (e.g. Holmes, Creswell, O'Connor, & Saunders, 2003; Pfefferbaum, Pfefferbaum, North, & Neas, 2002). Further, Mol et al. (2005) note that many individuals meet diagnostic levels for PTSD like symptoms without having experienced an event that meets current diagnostic criteria for being “traumatic” (Criterion A; APA, 1994). It seems possible that intrusions may develop on a continuum of stressfulness. Such a continuum may range from, say, viewing fictitious stressful films, through viewing films of real and self-related trauma, to the spectrum of “true” traumatic events (Holmes, 2004). Accordingly, it is clear that ethical considerations are especially important when using this paradigm. Such ethical safeguards include: non-inclusion of participants with mental health difficulties; clear information to participants about film content prior to their participation; use of precautionary measures to deal with potentially distressed participants (most studies have been conducted under the guidance of clinical psychologists); and provision of contact details to participants in the event of any concerns even after the study has ended.

The findings of the reviewed studies, taken as a whole, appear consistent with the heuristic diagram we presented in Figs. 2a–c. This figure illustrates a simplified account of the cognitive processes proposed to underlie intrusive memory formation common to recent cognitive models of PTSD (Brewin et al., 1996, 2001; Ehlers & Clark, 2000). We suggest that in using the Trauma film paradigm, intrusive mem-

ory formation has been shown to be modified by all of the four alternative analogue peri-traumatic approaches shown in Figs. 2b and c: (1) Fig. 2b, Approach A; Both Laposa and Alden (2006, Study 2) and Halligan et al. (2002, Expt. 2) provide evidence that a relative increase in helpful verbal processing, either via coping strategies or high trait conceptual processing, is associated with a relative reduction in intrusions; (2) Fig. 2b, Approach B;

Holmes et al. (2004, Expts. 1 and 2) and Stuart et al. (2006) provide evidence that a visuospatial dual task reduces intrusions, in line with a competition of visuospatial cognitive resources rationale; (3) Fig. 2c, Approach A; Halligan et al. (2002, Expt. 2) provides evidence that high trait visuospatial/perceptual processing may be related to increased intrusions; and (4) Fig. 2c, Approach B; Holmes et al. (2004, Expt. 3) provide evidence that use of a verbal dual task (competing with 'helpful' conceptual processing) rather than being distracting actually increases intrusive memory formation. This latter finding has been recently replicated in our lab, although current work by Krans, Holmes, Näring, and Becker (2006), with some methodological differences, failed to re-replicate the bi-directional effect, and further work is clearly needed.

It is noted that whilst the data appears to be consistent with the heuristic (derived from contemporary clinical models) presented in Figs. 2a–c, this may not rule out alternative explanations of the data. Work by Pearson, Sawyer, and Holmes (in press) suggests that the modulation of intrusions using dual tasks may be more strongly associated with general attentional load than task modality per se. In two experiments, Pearson et al. (in press) examined the impact of verbal, visuospatial, and executive concurrent tasks on the occurrence of memory intrusions for positive and negative stimuli selected from the International Affective Picture System (IAPS; Lang, Öhmann, & Vaitl, 1988). This material involves static slide images rather than film presentation. Results indicate that a significant reduction in the occurrence of intrusions during a one-week period following initial exposure was more strongly associated with the general attentional load of concurrent tasks than their modality (either verbal or visuospatial). However, a pure attentional load approach may have difficulty explaining the bi-directional impact of verbal and visuospatial task shown in Holmes et al. (2004). Clearly, further empirical work is required to resolve this intriguing debate and to explore the interface between clinical and experimental accounts of intrusions.

Even if the theoretical assumptions in Figs. 2a–c prove to be correct, there is still a methodological concern over the ability for a balance of processing style to be altered via explicit instructions (rather than a task). Halligan et al. (2002, Expt. 1) and Holmes et al. (2004, Expt. 3) found that instructions intended to facilitate deliberate attempts by participants to consciously control their processing style did not have an effect on intrusions. However, following a systematic analysis of strategies used by emergency personnel, Laposa and Alden (2006) carefully

extracted specific methods for experimental participants to employ. These more precise instructions successfully had the predicted impact on intrusions. This well executed study may indicate the benefit to future work of thoroughly delineating variables of clinical interest in target clinical populations before testing them in the laboratory.

However, one peri-traumatic factor whose role in intrusion formation remains relatively unclear is that of dissociation. Ozer's et al. (2003) meta-analysis of 68 clinical trauma studies suggested that the strongest predictor for a subsequent PTSD diagnosis is level of peri-traumatic dissociation. Despite this persuasive clinical link, no trauma film study has yet been able to manipulate successfully intrusions by experimentally altering level of dissociation and findings seem rather mixed. For example, Holmes et al. (2004) found that film-induced *spontaneous* increases in dissociation were correlated with intrusions in Experiments 1 and 2 (although not Experiment 3) as did Kindt et al. (2005). However, Holmes and Steel (2004) found that a correlation between trait dissociation and intrusions became non-significant when controlling for schizotypy. Halligan et al. (2002) found that whilst trait dissociation was associated with intrusions, this relationship was not significant when controlling for cognitive processing style. Hagenaaers, van Minnen et al.'s (submitted for publication) results indicate that compartmentalisation dissociation may be mediating intrusion development via non-movement rather than dissociation per se. A further alternative is that peri-traumatic dissociation is a correlate of, or marker for, a further psychological or physiological process (such as non-movement) which itself is the cause of intrusion formation. This would leave peri-traumatic dissociation being highly correlated with intrusions, as is found clinically, but without a causal role. This would explain the null findings of studies attempting to manipulate intrusions via inducing dissociation. Clearly work is still required to tease apart the role of peri-traumatic dissociation.

Other areas of interest raised by the reviewed studies include the psychophysiological investigation of intrusions and use of the paradigm to study memory related phenomenology of PTSD other than intrusions. Folkins et al. (1968) and Holmes et al. (2004) point to trauma-induced instances of bradycardia. Further work is required to investigate if this spontaneous bradycardia may be related to an orienting or freezing response to intense trauma (e.g. Nijenhuis et al., 1998), or could be a physiological correlate of some other change such as balance of cognitive processing styles. It will be interesting to employ the paradigm to investigate neural substrates of PTSD using neuroimaging techniques (c.f. Elzinga & Bremner, 2002). While some studies (e.g. Halligan et al., 2002; Kindt et al., 2005; Laposa & Alden, 2006) have used the trauma film paradigm to investigate memory disorganisation and fragmentation, further work is needed in this area. Another area for refinement might involve diary methodology – we rely on explicit recognition of an intrusion as related to the film, which

may be difficult in some cases (e.g. in re-experiencing without explicit awareness or where there are source monitoring errors, Steel et al., 2005). Other methods to access other types of trauma memories (which may not always be recognized) will be valuable.

The trauma film paradigm also offers a smörgåsbord of possibilities for investigating non-peri-traumatic factors involved in intrusive memories. For example, ongoing work by Wessel (2006) is investigating the role of deficient cognitive control in intrusive memory production. Nixon (2006) is currently using trauma films depicting physical and sexual violence to investigate the role of post-event processing in intrusions. Early findings suggest that factors such as a participant's interpretations of experiencing intrusions may modulate intrusion frequency. We suggest this finding may echo work by Orne (1962) which showed that if participants are told that intrusions are evidence of psychopathology, then intrusion frequency increases.

Nevertheless, the trauma film paradigm points to at least one clear and valuable finding: namely, that intrusions can be reduced by peri-traumatic interventions. The results of Laposa and Alden (2004), Holmes et al. (2004), and Stuart et al. (2005) among others, suggest clear potential for prophylactic measures for at risk groups. Laposa and Alden show that pre-training individuals with coping strategies appropriate for members of the emergency services could well reduce trauma induced symptoms. Additionally, following Holmes et al., it may prove that contemporaneous visuospatial tasks (provided such activity did not interfere with emergency personnel's principle function), may also be protective, (see, for example, on line article by Hirschon, 2004). As many traumas can not be anticipated, it is also important to test any effectiveness of such intervention not only "peri-traumatically" but in the aftermath of traumatic events, beginning to be explored in our lab's current studies (Holmes, 2007). In the context of one of the evidence-based treatments for PTSD known as "EMDR" (eye movement desensitisation and reprocessing") it has been argued that the eye movement component may indeed act as a visuospatial task aiding desensitisation to emotive visual memories (Andrade et al., 1997; Kavanagh et al., 2001; Van den Hout et al., 2001). Within a clinically traumatised sample, Lillie, Andrade, Turpin, Sabin-Farrell, and Holmes (submitted for publication) have found support for this proposal using a side-to-side eye movement task while reliving traumatic 'hotspots' (Holmes et al., 2005). However, other visuospatial tasks than eye movements (including our pattern tapping and moulding tasks) may also have benefits. Further, such tasks might be used as an adjunct to exposure therapy or other therapeutic techniques where images are evoked (rather than just part of EMDR per se). Such an approach may have application for intrusive images across other psychological disorders other PTSD such as substance misuse cravings (Kavanagh et al., 2005) and food cravings (Kemps et al., 2004).

We believe that the trauma film paradigm provides an invaluable tool for insight into the factors and mechanisms

that may be relevant at memory encoding in order for intrusive memories to be formed. Considerable further work using the paradigm is required to advance the understanding, prevention, and treatment of post-traumatic symptoms. As we have argued elsewhere (Holmes & Hackmann, 2004) affect laden intrusions are a feature not only of PTSD but also of many other disorders such as social phobia (Hackmann et al., 2000; Hirsch et al., 2003), depression (Kuyken & Brewin, 1994, 1999; Reynolds & Brewin, 1999); psychosis (Morrison et al., 2002); and agoraphobia (Day et al., 2004). Given the proposed role of intrusions in the maintenance of these disorders, then the trauma film paradigm could perhaps be adapted for the concerns and features of a given disorder. This should provide another tool in experimental psychopathology by which to understand distressing intrusive imagery across psychological disorders.

5. Uncited references

Bremner et al. (1992), Bryant and Harvey (1995), Bywaters et al. (2004).

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