

**The Effect of Viewpoint Dependence in Spatial Memory
Tasks on Intrusive Memories in Analogue Trauma**

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Overview

Part one of this thesis is a literature review on the use of Imagery Restructuring (IR) within anxiety disorders. Narrative methods were used to synthesise the findings of 18 studies. The review details the range of different IR methodology and revealed IR to be an effective short-term, long-term and preventative technique across different anxiety disorders, reducing anxiety, imagery and memory related symptomology. However, IR could not be established as an effective intervention in isolation with long-term therapeutic effects. Given the heterogeneity of the studies' methodology, of IR and anxiety pathology, a range of potential mechanisms underpinning IR are theorised. However, underlying mechanisms were not explicitly explored in the studies. Finally, the clinical implications of IR and the limitations of the review are reflected upon before research recommendations are made.

Part two is an empirical study which investigates the effect of egocentric and allocentric memory processing on intrusive memory (IM) frequency following exposure to analogue trauma films. Forty five healthy participants were allocated in turn, stratifying for gender to the egocentric or allocentric recognition memory task group or to the control group. Participants who undertook an egocentric memory task experienced significantly fewer intrusive images than the control group (who listened to music). This supports Dual Representation Theory (DRT) – that intrusive memories are underpinned by relatively stronger sensory-perceptual egocentric memory representations and relatively weaker contextualised, allocentric based memory representations. Allocentric memory tasks did not significantly increase or reduce the number of intrusive memories experienced. Theoretical, neurobiological and methodological explanations are offered for these findings.

Part three is a critical appraisal which addresses four issues. Firstly, the conceptualisation of intrusive imagery as being transdiagnostic and on a continuum. Secondly, how the project prompted the consideration of PTSD as a construct more broadly. Thirdly, the issue of measuring intrusive memory and considerations for measurement in future research. Finally, two key learning experiences around ethics of trauma designs and the dynamics of working with a research assistant.

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On a personal note I would like to thank my partner and family for their ongoing patience and support throughout the course.

Part 1: Literature Review

Imagery Restructuring in Anxiety Disorders

Abstract

Introduction

Anxiety is a common mental health diagnosis in which negative imagery is often present. The understanding of Imagery Restructuring (IR) interventions (rescripting and modification) is in its infancy. This review aimed to investigate IR methodology, its administration in the treatment of anxiety disorders, the effect of IR on anxiety symptoms and the theoretical implications of this.

Search Methods

Psychinfo, Medline and SCOPUS databases were searched and identified 1718 papers, 1504 of which were excluded after reading the title and abstract. Individual journals, reference and citation searches were also carried out, as well as contacting relevant authors. In total, the search process identified 18 which fulfilled the inclusion criteria.

Review methodology

Quality assessment was carried out using critical appraisal checklists. Due to methodological and clinical heterogeneity, narrative methods were used to synthesise the studies.

Results

IR proved to be diverse in methodology, but effective as a preventative, short-term and long-term intervention in reducing a range of anxiety, memory and imagery related symptomology. Given the heterogeneity of IR, anxiety disorders and study methodology, the effects of IR were discussed alongside a range of theoretical viewpoints.

Conclusions

IR was effective across different anxiety disorders. However, its effects within a wider range of anxiety disorders with long-term follow-ups are not yet established. In addition, the understanding of how it exerts its effects remains limited. A range of clinical and research implications are discussed.

Introduction

Anxiety disorders

Anxiety disorders are the most common mental health problem (Kessler, Chiu, Demler, & Walters, 2005). They can affect up to 15% of the public at any one time (Baxter, Scott, Vos, & Whiteford, 2013), are prevalent worldwide and are associated with comorbid depression, long-term disability and economic cost (Layard, Clark, Knapp, & Mayraz, 2007). Post Traumatic Stress Disorder (PTSD), which has an estimated lifetime risk of 6.8% (Kessler et al.), was moved from an anxiety to trauma and stressor-related disorders within the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM 5; American Psychiatric Association, 2013). However, recent literature has continued to classify it as an anxiety disorder and it will be considered as such within this review. Anxiety disorders often result, at least in part, from previous adverse experience. Such experiences are held in memory and can give rise to threat-focused cognitions, physiological arousal, negative imagery and avoidance behaviour. Anxiety may remain specific or become generalised and can have considerable impact on everyday functioning (Wells, 2002).

Imagery

Imagery is a part of normal experience. It has been defined as “contents of consciousness that possesses sensory qualities as opposed to those that are purely verbal or abstract” (Hackman, 1998, p. 301). Imagery arises in two main ways. One route is that sensory input is retained as a mental image over a very short period. The other is via activation of long-term memory (LTM; Kosslyn, Behrmann, & Jeannerod, 1995). The latter is particularly relevant to anxiety disorders where imagery is often associated with negative or traumatic memories (Hackmann & Holmes, 2004). Intrusive imagery can involve multiple sensory modalities and frequently enters our consciousness involuntarily (Holmes & Moulds, 2011). It is often considered in terms of frequency, intensity and vividness as well as associated memories, beliefs, distress and behavioural avoidance. The significance of imagery in psychopathology may be a result of its impact on emotional systems in the brain (LeDoux, 2000) which can

be greater than that of verbal representations for the same event (Holmes & Mathews, 2010). Negative imagery can also be representative of the idiosyncratic meaning given to memories. It is thus a means of accessing cognitions which may be fundamental to maintaining the anxiety disorder. Imagery is therefore an important phenomenon to understand and provides a potentially powerful therapeutic tool.

Theoretical Accounts of Mental Imagery in Psychopathology

Negative and intrusive imagery is common in anxiety disorders and different theoretical accounts have been offered to explain this. Links are often made between memory, meaning and imagery and increasingly the role of neurobiology is being incorporated.

Learning Theory

Anxiety often results as a consequence of a direct learning experience. Learning theory proposes a conditioning mechanism between a feared stimulus and an anxiety response (e.g. Lissek et al, 2005): If an initially neutral stimulus (which produces no emotional response) occurs concurrently with an aversive unconditioned stimulus (US) which produces an anxiety response, then the previously neutral stimulus can then become a conditioned stimulus (CS) which indicates or anticipates the US and then triggers anxiety, even in the absence of the US.

Negative mental imagery has been associated with anxiety and behavioural avoidance and may also play role within conditioning mechanisms (Dadds, Bovbjerg, Red & Cutmore, 1997). Negative imagery of the previously neutral stimulus can result from the association with an aversive US. Thereafter, the imagery, which often exaggerates the danger of the stimulus or is counterfactual (Arntz, Van den Berg & Rijsoort, 1993) may be evoked following a reminder of the feared stimulus and trigger an anxiety response. This therefore contributes to the maintenance of the conditioned response within anxiety. It has also been

suggested that imagery itself can substitute physical stimuli within classical conditioning and therefore play a role in the aetiology as well as the maintenance of anxiety (Dadds et al).

Emotional Processing Theory

Emotional processing theory (e.g. Foa & Kozak, 1986) posits that fear (often accompanied by imagery) is activated through networks which hold information about the feared stimulus, including the meaning of the fear and how to avoid it. Avoidance then prevents learning that the feared stimulus is not dangerous. This theory proposes that by activating the fear network, habituation is enabled and new information that is contrary to the fear network can be encoded, and this results in fear reduction.

Cognitive Theory

The main premise in cognitive theory of anxiety is the overestimation of threat and underestimation of coping ability (Beck & Emery, 1985). Imagery can contribute to this as well as the development of specific anxiety disorders (Hirsch, Mathews, Clark, Williams, & Morrison, 2006). Imagery in social anxiety often relates to an aversive event, which can be distorted but believed to be accurate (Stopa & Jenkins, 2007). This contributes to anxiety about current and future events, in turn leading to avoidance and maintenance of threat appraisals (Clark & Wells, 1995). In PTSD, Ehlers & Clark's (2000) cognitive model suggests that symptoms (including intrusive imagery) occur when traumatic information is insufficiently processed and contextualised. This therefore continues to evoke a current sense of threat. In addition, negative appraisals about an event, about its consequences and about intrusive memories are also thought to maintain anxiety.

Neurobiology and Cognitive Neuroscience

Research has revealed the importance of neural mechanisms in anxiety disorders (Mathew, Price, & Charney, 2008). The amygdala has been the most implicated brain region in fear processing. It shows increased reactivity to fear stimuli in anxiety disorders (Schneider et al.,

1997) and has reciprocal connections to the prefrontal cortex and medial temporal regions which are important in the development of fear within memory. Changes to the processing of body states by the anterior insula (Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004) and alterations in neurochemical symptoms have also been identified with anxiety disorders (Matthew et al). Neural systems underpinning fear also overlap with mental imagery and perception (Kreiman, Koch, & Fried, 2000) and imagery can be equivalent to real experience with visualisation engaging the motor system and affecting the body just as perception does (Kosslyn, Ganis, & Thompson, 2001).

Neurocognitive research has incorporated perception, memory and mental imagery; this has since been applied to understand imagery within anxiety disorders. The revised Dual Representation Theory (DRT; Brewin, Gregory, Lipton, & Burgess, 2010) proposes that there are two distinct but interactive memory systems which underpin healthy and intrusive imagery. The sensory-perceptual based memory system ('S-reps') is processed by the dorsal visual stream, insula and amygdala. The other memory system lays down corresponding C-reps, processed by the ventral visual stream and medial temporal lobe (the hippocampus and parahippocampus in particular). These representations support episodic memory with verbal accounts of an event. C-reps are better contextualised and more flexible than S-reps, and can be voluntarily retrieved. Physiological stress at the time of a traumatic event is suggested to have an impairing effect on the C-rep system and the connections to the S-rep system. This may result in the relatively stronger encoding of S-reps, which DRT suggests makes involuntary, vivid and intrusive image-based memories of the event more likely to occur.

More broadly within anxiety disorders, the retrieval competition account by Brewin (2006) suggests that multiple memory representations involving the self exist (positive and negative). Within anxiety it is thought that the negative threat focused self-representations are more accessible. These therefore win the retrieval competition in anxiety provoking situations and can underpin intrusive imagery.

Imagery Techniques

There has been increasing interest in the phenomenology of imagery and the use of imagery techniques within psychotherapeutic interventions (Edwards, 2007). *Imaginal Exposure* involves recalling and reliving the adverse event in memory. This is often done with eyes closed and guidance from the therapist to describe the event as if it is happening again with a focus on sensory experiences. Research has indicated its effect in reducing both fear and avoidance (Minnen & Foa, 2006). However, it has been criticised for not addressing negative cognitions deemed important to effectively treat anxiety (Wells, 2002).

Imaginal reliving builds on imaginal exposure by paying close attention to thoughts and emotions. In doing so, 'hot spots' of meaning from the event are drawn out whilst reliving. The meaning of 'hotspots' are then modified using cognitive restructuring. Finally, reliving is repeated with the modified meaning, for example, one which is less self-critical or threatening. However, such techniques can be lengthy and difficult for clients to engage with (e.g. Nijdam, Baas, Olf, & Gersons, 2013).

Imagery restructuring techniques (encompassing imagery rescripting and modification) have received growing attention as a transdiagnostic technique. This involves exploring and transforming existing negative imagery into neutral or positive imagery, or just forming a new positive image (Holmes, Arntz, & Smucker, 2007). Imagery rescripting (Arntz & Weertman, 1999; Smucker, Dancu, Foa & Niederee, 1995) involves restructuring intrusive imagery so that it represents an alternative meaning or preferred outcome. Arntz & Weertman do this in three stages: reliving, mastery and compassion. Firstly, the individual relives an event from the perspective of the younger self as if it is happening again. They then relive it at their current age, watching the previous self, intervening if they wish, to convey a different perspective and gain mastery. Finally, the memory is relived from the perspective of the younger self with the adult self in the room, intervening as before.

Previous Reviews

Mental imagery across psychopathology has been reviewed by Holmes & Matthews (2010) and Brewin et al (2010). Reviews of prolonged exposure in PTSD (Rauch, Eftekhari, & Ruzek, 2012; McLean & Foa, 2011; Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010) indicate its efficacy. However, such interventions are broad, including psychoeducation, emotional processing, imaginal and in vivo exposure. Imagery Rehearsal Therapy for post-traumatic and idiopathic nightmares (Hansen, Hö, Kröner-borowik, Stangier, & Steil, 2013; Thünker & Pietrowsky, 2012) has been subject to recent systematic and meta-analytic review. Nightmares are therefore not included in this review. There has been one review (Arntz, 2012) on imagery rescripting. Although recent, this review takes a broad brush approach to imagery rescripting across all kinds of psychopathological problems. Furthermore, many of the studies reviewed incorporated imagery rescripting into wider interventions which included cognitive and behavioural components. However, there are now an increasing number of studies exploring the effects of Imagery Restructuring (IR) on anxiety in isolation, and this research has yet to be reviewed.

Aims of the Review

The current review goes beyond Arntz (2012) by concentrating on IR within anxiety disorders using studies which better isolate the effects of IR. It makes explicit the differing IR methodology and explores the effects of IR on anxiety symptomology, imagery and memory. Understanding these effects may help to identify the most appropriate IR technique for different symptom clusters. This has the potential for improving clinical and economic outcomes which are increasingly important considerations in the current health-care climate (Bieling, McCabe, & Antony, 2006). Specifically, the current review aims to address the following questions:

1. What is the nature of IR procedures that are used in anxiety disorder treatment?
2. What is the impact of IR on general symptomology, imagery and memory?
3. What are the theoretical implications of IR in anxiety disorders?

Method

Search Strategy

In order to identify published literature on IR in anxiety disorders, searches were carried out on Psychinfo, Medline and SCOPUS databases. The search term *imagery* was used in combination with *rescripting*, *restructuring*, and *modification*. The search process is summarised in Figure 1 below.

Additional Searches

Hand searching was carried out to help identify recent publications not yet indexed by electronic databases. This was done by entering search terms in the journals that contained the largest number of relevant studies obtained from the above search (Journal of Behaviour Therapy and Experimental Psychiatry, Cognitive and Behavioural Practice, Behaviour Therapy & Research, Journal of Experimental Psychopathology). Reference lists of studies and citation searching of key papers identified in the database searches were also carried out. Finally, relevant researchers were contacted in order to help identify any unpublished or on-going research.

Inclusion Criteria

Studies which met the following inclusion criteria were included in the review (See Table 1 for study characteristics):

1. Adult populations who had a diagnosis or symptoms of an anxiety disorder, PTSD or who had been exposed to trauma (actual or analogue).
2. Where IR (with or without cognitive restructuring) was used as a standalone intervention, or the effects of adding it to an intervention were assessed.
3. Studies that employed randomised, non-randomised, pilot studies, case series, experimental/analogue designs.
4. Studies that used quantitative outcome measures to determine the effectiveness of IR.

5. Studies carried out in clinical or research settings.
6. Papers published in peer-reviewed journals and written in English

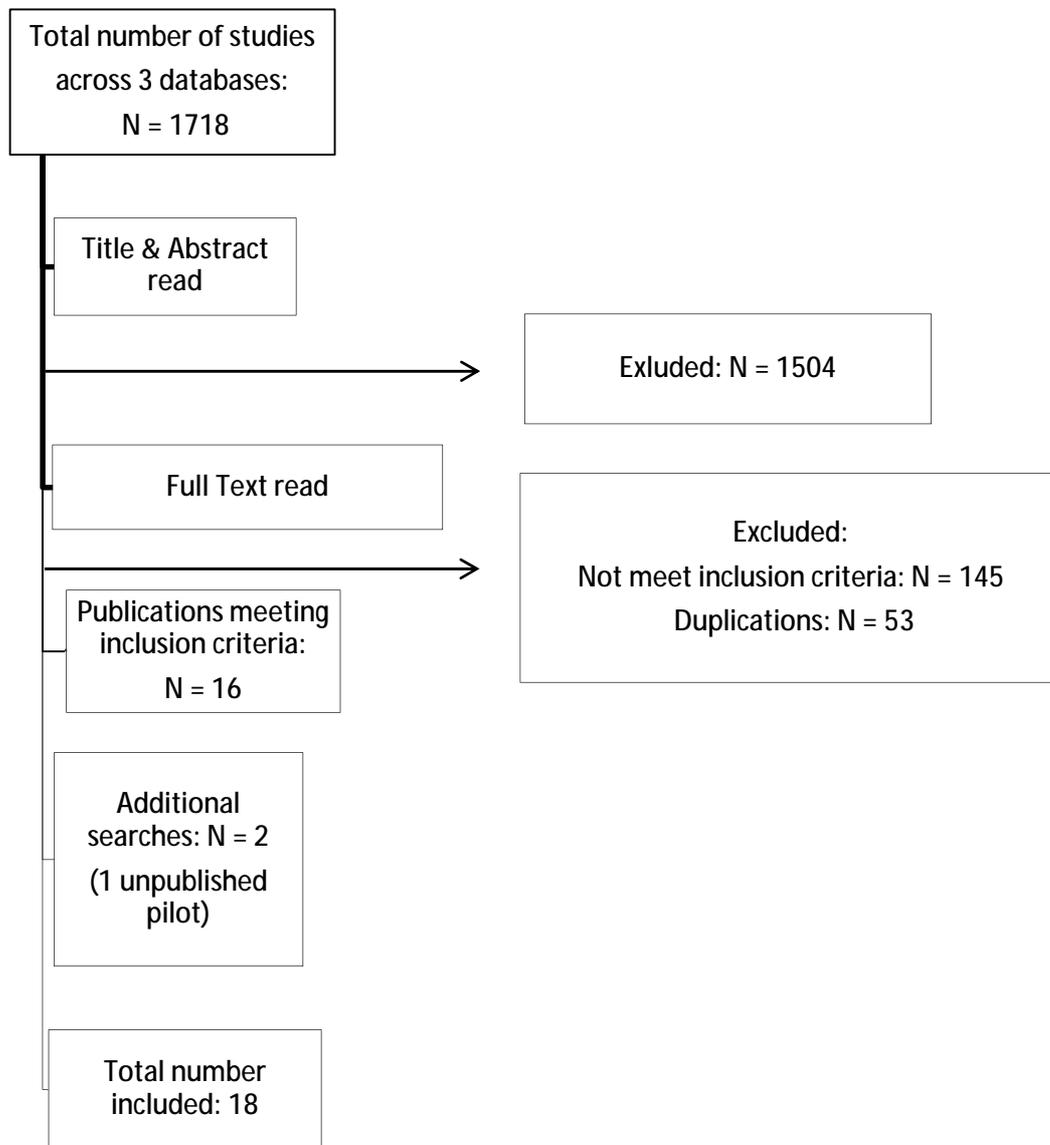


Figure 1. Flow Chart of Study Selection Process

Quality Assessment

Quality assessment was carried out using the Quality Assessment Tool for Quantitative Studies (Effective Public Health Practice Project, 1998). These tools were selected in order to assess studies with varying methodology. The quality assessment is summarised below and considered within the review findings.

Selection bias: all but two studies (Jung & Steil, 2013; Steil, Jung, & Stangier, 2011) used single methods of recruitment (from referrals or by study adverts) and several studies selected from non-clinical populations (Hagenaars & Arntz, 2012; Hagenaars, 2011; Hunt & Fenton, 2007; Hunt et al., 2006; Seebauer, Froß, Dubaschny, Schönberger, & Jacob, 2013). Only two studies (Frets, Kevenaer, & van der Heiden, 2013; Nilsson, Lundh, & Viborg, 2012) stated that participants had never received other psychological treatment.

Allocation bias: Randomised Control Trials (Jung & Steil, 2013; Lee & Kwon, 2013;) and randomised allocation methods (Arntz, So, & Breukelen, 2013; Hagenaars & Arntz, 2012; Hagenaars 2011; Hoffart, Oktedalen, Formo Langkaas, & Wampold, 2013; Hunt & Fenton 2007; Hunt et al, 2006; Nilsson et al 2013; Seebauer et al., 2013;) reduces allocation bias. However, some studies only used non-treatment control groups (Arntz, 2012); Jung & Steil, 2013) or were uncontrolled (Kindt, Buck, Arntz, & Soeter, 2007; Steil et al, 2011; Wild, Hackmann, & Clark, 2007). Three studies did not state whether there were baseline group differences or not (Grunert, Weis, Smucker, & Christianson, 2007; Hoffart et al, 2013; Raabe, Ehring, Marquenie, & Kindt, 2014). The others did so, or group differences were less relevant due to within participant designs.

Blind rating for some measures was used in several studies (Hagenaars & Arnzt 2012; Hagenaars, 2011; Hoffart et al; 2013; Hunt & Fenton, 2007; Hunt et al, 2006; Jung & Steil, 2013; Nilsson et al, 2013; Raabe et al., 2014).

Data collection methodology was limited by self-report outcome measures in the majority of studies, with only three studies (Hoffart et al, 2013; Jung & Steil, 2013; Raabe et al) also administering clinician interviews pre- and post-intervention.

Statistical analysis: Two studies did not use parametric tests (Frets et al, 2013; Steil et al, 2013), three did not report effect sizes (Frets et al, 2013; Seebauer et al, 2013; Wild, Hackmann, & Clark, 2008), two stated confidence intervals (Hoffart et al, 2013; Jung & Steil, 2013) and only Jung & Steil (2013) reported a power calculation (See Table 2).

Withdrawals and attrition rate was not reported as a major issue in the studies. However, the sample size was small in many studies.

Intervention Integrity was only formally assessed by Hoffart et al (2013).

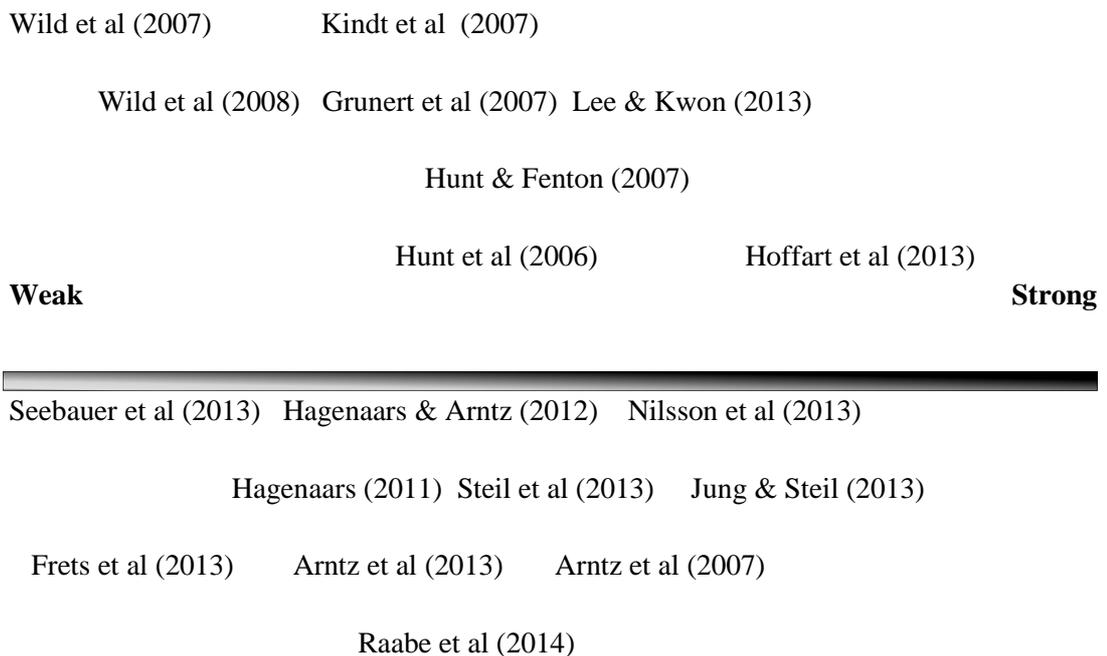


Figure 2. Diagram Summarising the Relative Quality of Studies

Review Outline

First, the specific methodology and administration of IR are reviewed, with similarities and differences between studies summarised. Secondly, the effect of IR on general symptomology, imagery and memory symptomology is described. Thirdly, the first and second sections are discussed in terms of theoretical implications and existing research. Finally, there is a general discussion of the review, outlining clinical and research implications. Tables and results sections are organised according to anxiety disorder and IR administration methodology.

Table 1. *Study Characteristics*

Study	Design	Primary Diagnosis (Assessment Tool)	Intervention (N) Duration Follow-up Length	Comparison Conditions (N)	Outcome Measures	Main Findings
Wild, Hackmann, & Clark, (2008).	Quasi-experimental Pilot Study Within participants	Social Anxiety (SCID) Trauma and anxiety disorder clinic patients	IR & CR (11) 2 sessions 1 week FU	CG - baseline Interview	FNE, LSAS-SR. anxiety of visualised situation) BDI, MD, ID, IV, IF, BR	Significant reductions in anxiety of visualised situation, BR, LSAS-R, FNE, IV, ID, MD in the IR group. Significant reduction in MD in the CG. No significant changes in IF.
Wild, Hackmann & Clark, (2007).	Naturalistic exploratory study Within participants	Social Anxiety (SCID) Trauma and anxiety disorder clinic patients	IR & CR (14) 1 session 1 week FU	None	SPWSS, SCOQ ID, IV, MD, MV, BR	Significant reduction in BR, ID, IV, MD, MV and SPWSS.
Lee, & Kwon, (2013).	RCT Computer-generalised random numbers in sealed envelopes opened by participants after assessment	Social Anxiety (SCID) Social anxiety clinic patients	IR & CR (13) 3 sessions 3 month FU	Supportive Therapy (10)	KSADS, FNE, ID, IV, MD, MV, BR, SQMI, TES	Significant effect of IR on KSADS, FNE, LSAS, IV, ID, MV, MD, EB. Significant change in CG on KSADS. Changes maintained at FU, with further decreases in KSADS and EB.
Frets, Kevenaar, & van der Heiden, (2013).	Case Series A-B design	Social Anxiety (SCID) Community mental health centre outpatients	IR (6) 5-17 sessions 3 and 6 month FU	CG – no treatment baseline of 3 weeks	SIAS, SPS, AVS, SPAI-N, BFNES, BAI	Lower scores for all participants on SPAI-N, BFNE, BAI post-intervention. At FU, three showed further reductions on SPAI-N and BFNE. Some scores deteriorated, but still improved compared to pre IR.

Study	Design	Primary Diagnosis (Assessment Tool)	Intervention (N) Duration Follow-up Length	Comparison Conditions (N)	Outcome Measures	Main Findings
Nilsson, Lundh, & Viborg, (2012).	Randomised single experimental intervention Pairwise randomised procedure	Social Anxiety (met DSM criteria) Student health centre patients	IR (7) 1 session 1 week FU	Reading introductory CBT text (7)	FNE, SIAS, BDI, MD, ID, IV, IF, MOI	Significantly greater reduction in the IR group on FNE and SIAS post-intervention. At FU there were greater reductions in MD in the IR group. ID reduced in both groups, significantly less in the CG. There were no significant effects for IV. There were significant changes in MOI following IR.
Hunt & Fenton, (2007).	Quasi-experimental Random assignment (MNS)	Snake Fear (ADIS Self-Report) Undergraduate students	IR & CR (12) 1 session	CG - MER (12) IVE (14) CBT (14)	TAI, BAT1, BAT2, SUD	All three treatment groups improved significantly more than CG on BAT and SUD. No significant differences between treatment groups. Imaginal ability unrelated to outcomes.
Hunt et al., (2006).	Quasi-experimental Randomised (MNS)	Snake Fear (Self-reported fear, SNAQ, BAT) Undergraduate students	IM & CR 1 session	CG-MER IVE (Total = 92)	Imagery & memory questionnaire SNAQ, BAT, ExitQ,	Active treatments were superior to the control group on all outcomes. Patients with higher fear benefited more from IR than in vivo work.
Steil, Jung, & Stangier, (2013).	Pilot Study Uncontrolled	PTSD & FBC CSA-related (SCID, IPDE) General population and PTSD clinic referrals	IM & CR (9) 2 sessions 6 week FU	None	PDS, FBC-I, FBC-V, FBC-U	Post intervention and at FU: significant reductions in PDS and FBC-I, FBC-V, FBC-U and distress.

Study	Design	Primary Diagnosis (Assessment Tool)	Intervention (N) Duration Follow-up Length	Comparison Conditions (N)	Outcome Measures	Main Findings
Jung, & Steil, (2013).	RCT 1:1 ratio assignment	PTSD & FBC CSA related (SCID, IPDE, CAPS) General population and PTSD clinic referrals	IM & CR (14) 2 sessions 5 week FU	CG - Waitlist (14)	PDS, CAPS, BDI-II, RSES, FBC-I, FBC-FBC-V, FBC-U	Significantly greater improvements in FBC, PDS, RSES, CAPS following IM & CR. Non - significant changes in BDI scores in either group.
Hoffart, Oktedalen, Formo Langkaas., & Wampold, 2013	Quasi-experimental Blocked randomisation procedure	PTSD (SCID, MINI, PSS) Inpatients	Modified prolonged exposure using IR (34) 10 weekly sessions No FU	Standard prolonged exposure using IE (31)	PSS I, PSS R, WAI-SR Alliance components (task, goal, and bond)	Significant reductions on the PSS in both IE and IR. No significant differences between groups. Task agreement was a predictor of IE but not IR outcomes.
Grunert, Weis, Smucker., & Christianson (2007).	Open Trial Naturalistic Clinic Setting	PTSD related to industrial injury ('DSM IV criteria') Clinic patients	PE & IRRT (23) (6-15 sessions of PE, 3 sessions IRRT) 6 month FU	PE	WAIS – DS IES-Avoidance IES-Intrusion BDI STAIT-State STAIT-Trait SUDS	Post IRRT and at FU (compared to pre to post PE/pre IRRT) there were significant changes in concentration, SUDS, IES-avoidance, IES-intrusions, BDI, state and trait anxiety.
Arntz, Sofi, & Breukelen, 2013	Multiple baseline concurrent design Randomised to baseline length.	PTSD (complex) (SCID, PSS) Mental health care patients	IR (10) 10 weekly sessions 5 week FU	Baseline waitlist 6-10 weeks (N = 2 per time length)	PSS, BDI	Post IR and at FU there were significant reductions on PSS and BDI. 9 patients remitted on the PSS and 6 fell into mild range on BDI.

Study	Design	Primary Diagnosis (Assessment Tool)	Intervention (N) Duration Follow-up Length	Comparison Condition (N)	Outcome Measures	Main Findings
Arntz, Tiesema, & Kindt, 2007	Randomised treatment trial Unstratified (MNS)	PTSD (SCID) Community mental health centre patients	IE + IR (28) 10 weekly sessions 1 month FU 6 month FU	IE (39)	PSS-SR; FQ; AEX; SCL-90; Expectancy of therapeutic outcome	PTSD and phobia ratings reduced significantly in both groups but no significant treatment effect. Superior effects of IR for anger ratings, guilt and shame.
Kindt, Buck, Arntz., & Soeter, (2007).	Open Trial Within participants	PTSD (SCID) Community mental health centre patients	IR (25) 10 weekly sessions 1 month FU	None	PSS-SR, SCL-90-R, STAI, TM, P/CM, MD, % TE, % SX	Post-intervention and FU: significant reductions on the PSS, SCL-90-R & STAIT. P/CM memory changes were non-significant. Narratives contained a significantly lower percentage of trauma memories. There was a trend towards narratives being more organised and containing less trauma symptoms.
Rabee et al. 2014 <i>Unpublished study.</i>	Open Trial Pilot Study	PTSD CSA related (CMIS) CAPS, SCID (I &II) Mental health institute outpatients	IR (8) 8 twice weekly sessions 3 month FU	2 Phase STAIR followed by IR (effects not yet reported)	CAPS, SCID I IES-R	Preliminary analysis shows significant reduction in PTSD symptoms.

Study	Design	Primary Diagnosis (Assessment Tool)	Intervention (N) Duration Follow-up Length	Comparison Conditions (N)	Outcome Measures	Main Findings
Seebauer, Froß, Dubaschny, Schönberger., & Jacob, (2013).	Experimental Analogue Study Randomised (order of imagery strategy pseudo-randomised)	Analogue Trauma Healthy student population (SCL-K9)	ImRS with or without revenge 1 session – 9 minutes Total (46)	Safe Place Imagery	SCL-K9, SUIS, STAXI, ER (sad/anxious, anger, and positive).	Sad/anxious emotions reduced in all groups. Rage reduced more in safe place imagery than ImRS without violence and aggression reduce more than both ImRS conditions. Positive emotions increased significantly more in safe place imagery.
Hagenaars & Arntz, (2012).	Experimental Analogue Study Randomised (MNS)	Analogue Trauma Healthy participants (SCID)	IRS (24) 1 session – 10 minutes FU after 1 week daily diary	PI (27) IRE (25)	MR (anxious, horrified, sad, anger). Distress IM Diary PTCI (self, world, self-blame) EM	Reduced negative emotions in PI group. Increased negative emotions in IRE group. No change in negative emotions in IRS. Participants in the IR and PI groups experienced less distress. Fewer IM and higher percentage experiencing no IM in IR group. Lower PTCI in IR and PI group.
Hagenaars (2011).	Experimental Analogue Study Randomised - stratified for anxiety	Analogue Trauma University population (SCID)	IR Anxious (16) Non-Anxious (18) 1 session - 9 minutes FU after 1 week daily diary	IRE Anxious (17) Non-Anxious (22)	TCQ, MR: anxious, horrified, Distress, IM Diary	Anxiety group had higher scores on TCQ-punishment & TCQ-worry and tended score lower on TCQ-distraction. Distress declined after IRS had started and ended significantly lower than IRE. IRS resulted in fewer intrusive thoughts and images than IRE. IRE had different effect on those that were anxious.

Study Design: MNS, Method not stated; RCT, Randomised Controlled Trial

Participants: PTSD, Post Traumatic Stress Disorder; CSA, Child Sexual Abuse

Assessment Tools: SCID, Structured Clinical Interview for DSM IV Criteria; CAPS; Clinician Administered PTSD Scale; SCL-K9, Symptom checklist-short

Interventions/Comparison Conditions: CG, Control Group; IR/IRS/ImRs Imagery Rescripting; IE, Imaginal Exposure; IRRT; Imagery Rescripting and Reprocessing Therapy, CR, Cognitive Restructuring; CRIM, Cognitive Restructuring and Imagery Modification; IRE, Imagery reexperiencing; PI, Positive Imagery; MER, Minimal exposure and relaxation; STAIR, Skills Training of Affective and Interpersonal Regulation.

Outcome Measures: PSS-SR/I; PTSD Symptom Scale-Self-rating/Interview; WAI-SR, Working Alliance Inventory; BDI, Beck Depression Inventory; FQ, Fear Questionnaire; AEX, Anger expression Scale; SCL-90 Hostility Subscale of Symptom Checklist; IES, Impact of Events Scale; WAIS-DS, Wechsler Adult Intelligence Scale-Digit Span; STAI, State-Trait Anxiety Inventory; SUDS, Subjective Units of Distress; SIAS, Social Interaction Anxiety Scale; SPS, Social Phobia Scale; AVS, Anxiety and Avoidance Scale; SPAI-N, Social phobia subscale of the Dutch Social Phobia Anxiety Inventory; SPWSS, Social Phobia Weekly Summary Scale; SCOQ, Social Cognitions Questionnaire; BFNES, Brief Fear of Negative Evaluation Scale; BAI, Beck Anxiety Inventory; ID, imagery distress, IV; imagery vividness; IF, Imagery Frequency, MD, memory distress; MV, memory vividness; BR, belief rating; MOI, Meaning of the Image; SQMI, Short Version of Questionnaire upon Mental Imagery; TES, Traumatic Experience Scale; TM, Trauma memory; P/CM, Perceptual/Conceptual; MDis, Memory disorganisation; % TE, % Traumatic Event; % SX, % Symptoms; CIS, Creative Imagination Scale (test of imaginal ability); ADIS, Anxiety Disorders Interview Schedule; BAT, Behavioural Approach Test; SUDS, Subjective Units of Distress; SCL-K9, SUIS, Spontaneous use of Imagery Scale; STAXI, State trait Anger Expression Inventory; ER, Emotion Ratings; MR, Mood ratings; PTCI, Posttraumatic Cognitions Inventory
FU, Follow-up; CG, Control Group

Anxiety Disorder: Social Anxiety, Snake Fear, PTSD & FBC, PTSD, Analogue Trauma

IR administration: Imagery Restructuring and Cognitive Restructuring (CR), Imagery Restructuring in isolation, Imagery Restructuring and Imaginal or Prolonged Exposure (PE), Preventative IR, 1 session 9-10 minutes

IR duration: 1-3 weekly sessions, 5 or more weekly sessions, 1 session lasting 9-10 minutes

Results

1. What is the nature of IR procedures that are used in anxiety disorder treatment?

The following section reviews specific IR methodology and administration for different anxiety symptomology. Results are organised by study design and anxiety disorder with a diagrammatic representation of specific IR administration/method. Methodological considerations are then summarised.

Imagery Rescripting or Modification with Cognitive Restructuring as a Short-Term Intervention:

*Interview/exploration of imagery, meaning and distress → Cognitive restructuring
→ Imagery Rescripting*

Social Phobia

The studies (Wild et al, 2008; Wild et al, 2007; Lee & Kwon, 2013) all carried out an initial semi-structured imagery interview (Hackmann, Clark & McManus 2000). This was used prior to IR, to identify a recurrent image, associated memory, encapsulated belief and meaning of the image/memory. All used the three phase method of IR (see introduction), sometimes terming it memory rescripting (focusing on a specific socially adverse experience). The cognitive restructuring stage focused on challenging the meaning and beliefs associated with the early memory using verbal strategies traditionally used with Cognitive Behavioural Therapy (CBT). The stage of the adult self-intervening then incorporates the alternative perspective developed during cognitive restructuring. The younger self was also asked what they might need to happen in order to feel better and the image then incorporates this (it was often nurture or compassion).

Verbal Cognitive Restructuring ↔ Imagery Rescripting

Specific Phobia

In the studies by Hunt & Fenton (2007) and Hunt et al (2006) the cognitive restructuring stage involved identifying frightening imagery and beliefs related to snakes, but not necessarily focusing on a specific memory. The cognitive restructuring and IR stages were not clearly defined, but used the following: corrective factual information, focusing on the size differences between the individual and the snake; counter-factual imagery; realistic somatic imagery; and the use of humour and fantastical imagery.

Interview/exploration of imagery, meaning and distress → Cognitive Restructuring

→ Imagery Modification

PTSD and Feeling of Being Contaminated (FBC)

Studies (Steil et al, 2011; Jung & Steil, 2013) involved an initial interview session to examine the FBC, but did not explicitly focus on the sexual abuse memories. The cognitive restructuring phase used research on skin renewal from the internet found by participants; this focused on challenging the beliefs around being contaminated. The IR stage then followed and involved developing an idiosyncratic image representing the process of skin renewal. The FBC and distress were then activated, eliciting detail from different sensory modalities and then rescripted using the new idiosyncratic imagery of skin renewal.

Short-Term Imagery Rescripting without Cognitive Restructuring

Interview/exploration of imagery, meaning and distress → Imagery Rescripting

Social Phobia

Both Nilsson et al (2013) and Frets et al (2013) excluded cognitive restructuring. Again, IR stage involved the three phase method. Following IR, Nilsson et al also asked participants to dwell upon an image that was secure and safe to them.

Long-Term Imagery Restructuring Intervention Studies

Imagery Restructuring ↔ *Prolonged Exposure/Imaginal Exposure*

PTSD

IR was adapted and administered over 9 to 10 weekly sessions and focused on specific trauma memories. All but one study (Arntz, 2013) stated that homework was provided (listening to audio-tapes of the IR sessions).

Hoffart et al (2013) added IR to a prolonged exposure intervention. The IR method developed by Smucker (2005) was used. First, reliving was carried out and used to identify 'hot spots' of the event. Reliving was then repeated but at the hotspots the patients were asked to imagine the current self bringing a solution. Finally patients were stimulated to imagine an interaction between the current self and traumatised self at the time of the traumatic event.

Grunert et al (2007) administered Imagery Rescripting and Reprocessing Therapy to patients who had not benefitted from prolonged exposure. The three phase method was followed by a reprocessing phase. This is similar to cognitive restructuring which aims to further the linguistic processing and reinforce the alternative representations.

Arntz et al (2013) used the interview phase to decide with the patient which traumas were to be addressed and in what order. The IR description lacked detail. However, it focused on intervening before the trauma took place 'early IR', (e.g. imagining the patient's tribe successfully defending an attack from another tribe).

Arntz et al (2007) added IR to an imaginal exposure intervention. Within the IR, the rescripting focused on acting as if they wished they had done at the most difficult moments.

Kindt et al (2007) did not provide detailed description of the IR method. However, each session started with imagery reliving, followed by three phase IR.

An unpublished pilot study (Raabe et al., 2014) administered IR in isolation, again using the three phase method to rescript specific memories of child sexual abuse. This was delivered for 8 weeks, twice weekly (90 minute sessions). Phases 2 and 3 were stopped when the adult and child self, respectively were satisfied with the interventions.

Short-Term Imagery Rescripting as a Prevention Technique

Video → *Reliving* → *Imagery Rescripting*

PTSD

In the studies that administered IR at the memory consolidation stage the precise method varied, but IR always lasted 9 to 10 minutes.

Hagenaars & Arntz (2012) compared IR to imagery re-experiencing and positive imagery. All participants watched trauma films, following which they closed their eyes, rated distress and wrote scripts. The IR condition involved recalling and re-experiencing a scene from the film for three minutes. They then had to change the event into something they wished had happened (realistic or unrealistic) and imagined this happening when reliving the scene.

Hagenaars (2011) looked at the effect of imaginal reliving and IR interventions with anxious compared to non-anxious participants. The IR intervention again involved reliving scenes, then changing the script to a satisfactory outcome. The new script was then imagined for six minutes.

Seebauer et al (2013) investigated the use of violent or non-violent actions in the IR intervention. Each strategy began with a relaxation instruction before reliving the worst scene from the film. In the 'violent' condition, the participants were asked to imagine

punishing the perpetrator violently, in the 'non-violent' condition, they were instructed to help the victim by any means except for the use of violence.

Summary

In sum, the majority of clinically-based studies used restructuring methods based on the three phase imagery rescripting techniques (Arntz & Weertman, 1999; Smucker et al 1995). However, there were considerable variations across the reviewed studies, especially in the following respects:

- Delivered in isolation or in addition to another technique.
- Delivered by psychologists, 'therapists' or students.
- Delivered as prevention or treatment.
- Frequency and length of imagery restructuring sessions.
- Inclusion/exclusion of cognitive restructuring.
- Inclusion of additional imagery or relaxation techniques.
- Whether or not they focused on specific memories.
- Creating written scripts
- Whether existing intrusive imagery was manipulated or negative imagery was brought into imagination and manipulated.
- The point in the memory in which IR was used to manipulate the imagery.
- The focus of the imagery restructuring (by the adult self, wishful actions, violence, hotspots, unrealistic/fantasy imagery, addition of safe place imagery).

2. The Effect of Imagery Restructuring Techniques on Anxiety Symptomology.

Due to methodological and clinical heterogeneity, a narrative synthesis was chosen to interpret the study findings. Results are grouped according to IR methodology and anxiety disorder. Effects on general symptomology, imagery and memory (where measured) are

described below, with consideration to study quality. The results are summarised with statistical outcomes in Table 2.

Short-Term Imagery Restructuring

Social Phobia

General symptoms

Post IR and at follow-up (ranging from one week to six months) there was a trend across studies for significantly reduced social anxiety symptomology with medium to large effect sizes (ES). Measures included cognitive and behavioural aspects of social anxiety. Several studies used the measure, Fear of Negative Evaluation (FNE) and indicated that IR helped to reduce cognitions about negative evaluation from others. In the study with stronger quality (Lee & Kwon, 2013), anxiety symptomology also reduced in the control group (supportive counselling) with medium ES.

Imagery and Memory

Across studies, baseline ratings of imagery (on subjective scales from 0-100) ranged from 50 to 85. Most studies found significant or larger reductions following IR compared to control groups in: imagery vividness, imagery distress, memory vividness, memory distress and encapsulated belief. Imaginal ability was not associated with changes in imagery (Lee & Kwon, 2013). There were also some significant reductions for distress in the study control groups. Studies that measured image frequency were limited (Nilsson et al, 2013; Wild et al, 2008), but did not show significant reductions. Findings were also inconsistent for imagery vividness (Nilsson et al 2013; Wild et al 2007). Nilsson et al revealed a change in meaning memory following IR alone.

PTSD and the Feeling of Being Contaminated

General Symptoms

The effects of cognitive restructuring and imagery modification on PTSD were consistent with social phobia studies. Jung & Steil's 2013 (relatively strong methodology) showed a significant reduction in PTSD symptomology compared to the control group (in both blind clinician and self-report ratings). However, this was a wait list control rather than an active treatment group. Significant reductions for self-esteem but not depression were identified.

Imagery

The IR intervention was superior to the control group in reducing the intensity, uncontrollability, distress and vividness (although to a lesser extent) of FBC at post-intervention and follow-up.

Specific Phobia

General Symptomology

Two studies showed IR (including cognitive restructuring) to be effective in reducing fear and behavioural avoidance, which were comparable but not superior to CBT or in vivo exposure. In one study (Hunt et al., 2006) those with high fear benefitted more from the IR intervention and those with low fear from in vivo exposure.

Imagery & Memory

Imagery was not used as an outcome measure of the intervention. However, there were significant and positive correlations revealed between ratings of imagery vividness and horror with fear and avoidance behaviour at baseline.

Long-Term Imagery Restructuring

PTSD

General Symptomology

An unpublished pilot study (Raabe et al., 2014) administered IR as an intensive isolated intervention. A significant reduction in PTSD symptoms with comparable ES to imaginal

exposure in other studies was reported. However, no significant differences were seen when IR was added to prolonged exposure (Hoffart et al., 2013) or to imaginal exposure (Arntz et al., 2007). In the former study there was no non-treatment control group and the interventions were part of a residential programme. Non-specific treatment effects were therefore possible. However, Grunert et al (2007) showed that adding Imagery Rescripting and Reprocessing Therapy to prolonged exposure was effective in reducing a range of symptomology. IR was also more effective than imaginal exposure alone (Arntz et al., 2007) in reducing PTSD-related emotions (anger, guilt and shame). In addition, IR was favourable compared to imaginal exposure in terms of attrition rates (Arntz et al., 2007), intervention agreement (Hoffart et al, 2013) and therapist preference. Arntz et al (2013) and Kindt et al (2007) also showed IR to be effective in significantly reducing PTSD symptomology, as well as anxiety and depressive symptoms. However, these studies had greater sources of bias.

Imagery and Memory

Pre- and post-intervention scores on PTSD measures and specifically on IES-intrusions indicated that IR was effective in reducing intrusive memories. Kindt et al (2007) showed that perceptual processing is followed by conceptual processing which significantly predicted symptom reduction. At follow-up the percentage of trauma related memories also significantly reduced. Memories were also more organised and less symptoms were described in the trauma narratives. However, these were non-significant trends.

Preventative Imagery Restructuring in Analogue Trauma Studies

General Symptomology

All of the film paradigms increased negative emotion ratings. Safe place imagery (Seebauer et al., 2013) and positive imagery (Hagenaars & Arntz, 2012) reduced negative emotions and increased positive emotions to a greater extent than the imagery techniques. The effect of using violent compared to non-violent imagery on emotions was not significant. However, this was in a non-clinical sample and no behavioural measures of aggression were used. In

the imagery reexperiencing groups, participants experienced an increase in negative emotions and greater distress compared to imagery rescripting and guided imagery techniques (Hagenaars & Arntz, 2012; Hagenaars, 2011).

Intrusive Memory

IR techniques resulted in fewer intrusive memories and in more participants who experienced no intrusions (Hagenaars, 2011; Hagenaars & Arntz, 2012). However, only the 'anxious' participants experienced significantly more intrusive images in the reexperiencing group compared to the rescripting group (Hagenaars & Arntz, 2012). Participants in the imagery rescripting group also had lower scores for trauma related cognitions compared to the imagery re-experiencing.

Summary

Overall, imagery rescripting and modification appeared to be an effective preventative and treatment intervention for anxiety, PTSD, imagery and memory symptomology. Effect sizes and *p* values indicated more consistent and larger changes with social phobia and PTSD than specific fear and prevention of intrusive memories. As a short-term or preventative intervention IR was more effective than other imagery techniques in reducing anxiety, imagery and memory symptomology. As a long-term intervention it was equally so, but there is evidence that IR is more effective in reducing non-fear based emotions.

Table 2.

The Effect of Imagery Restructuring on Symptomology

Study	IR compared to other intervention/control group for symptom reduction	Sample Size (No. groups)	Symptom Measures	Statistic	P values ranges for effect of IR	Effect Sizes for IR	Confidence Intervals
Wild, Hackmann & Clark (2008).	IR more effective than control group for social anxiety and imagery/memory	 11 (1)	FNE LSAS-SR, BDI, MD, ID, IV, IF, Liebowitz anxiety & picture	T-Tests	Social Anxiety $p < .0041 - p < .01$ Imagery/memory $p = .005 - p = .015$	X	X
Wild, Hackmann, & Clark, (2007).	Uncontrolled IR effective for social anxiety and imagery/memory	 14 (1)	SPWSS, SCOQ ID, IV, MD, MV, BR	T-tests	Social Anxiety $p = .009 - p = .025$ Imagery/Memory $p = .001 - p = .015$	Social Anxiety ● Imagery ●	X
Lee & Kwon (2013).	IR more effective than control group for social anxiety and imagery.	 23 (2)	SADS, FNE, ID, IV, MD, MV, BR, SQMI, TES	ANOVA T-Tests	Social Anxiety $p < .001 - p < .05$ Imagery/Memory $p < .001 - p < .05$	Social Anxiety ● Imagery ●	X
Frets, Kevenaar, & van der Heiden, (2013).	Effective on all measures compared to baseline controls.	 6 (1)	SIAS, SPS, AVS, SPAI-N, BFNES, BAI	% Changes	No statistical analysis Improved Social Anxiety	X % Changes only	X
Nilsson, Lundh, & Viborg, (2012).	IR more effective than control for social anxiety and for ID and MD.	 14 (2)	FNE, SIAS, BDI, MD, ID, IV, IF, MOI	ANCOVA	Social Anxiety $p = .03$ Imagery/Memory $p < .00 - p = .03$	Social Anxiety ●● Imagery ●●	X

Study	IR compared to other intervention/control group for symptom reduction	Sample Size (No. groups)	Symptom Measures	Statistic	P values ranges for effect of IR	Effect Sizes for IR	Confidence Intervals
Hunt & Fenton (2007).	IR more effective than control, equally effective to other interventions	 52 (4)	TAI, ADOS, BAT, SUDS	ANCOVA Correlation Chi-Squared	Distress $p < .01$ Avoidance $p < .001$	Distress ● Limited by measures used	X
Hunt et al., (2006).	IR more effective than control, equally effective to other interventions	 92 (3)	SNAQ, BAT, ExitQ, Imagery, fear & avoidance	ANCOVA T-test Sheffe Test	Snake Fear $p < .05$ Avoidance $p < .05$	Fear ●● Limited by measures	X
Jung & Steil (2013).	Effective compared to waiting list control on PTSD, self-esteem and imagery	 28 (2)	PDS, CAPS, BDI-II, RSES FBC-I, FBC FBC-V, FBC-U	MANOVA ITT	FBC $p < .001$ PTSD $p < .001$ Depression <i>ns</i> Self-Esteem $p = .009$	PTSD ● Imagery ●	✓
Steil, Jung, & Stangier (2011).	Uncontrolled Significant PTSD and imagery reduction	 9 (1)	PDS, FBC-I, FBC FBC-V, FBC-U	Friedman's tests	PTSD $p = .013$ FBC $p = < .001$	PTSD ● Imagery ●	X
Hoffart, Oktedalen, Formo Langkaas, & Wampold, 2013	Prolonged exposure alone and with IR were equally effective	 65 (2)	PSS I, PSS R	Mixed Models analysis Intention to Treat Analysis	PTSD $p < .001$	PTSD ● (both interventions)	✓
Grunert, Weis, Smucker & Christianson (2007).	IRRT effective compared to prior PE for PTSD, depression and anxiety	 23 (1)	IES-Avoidance IES-Intrusion BDI STAIT-State STAIT-Trait	ANOVA	PTSD $p < .001$ Depression $p < .001$ Anxiety $p < .001$	PTSD ●● Intrusions ●	X

Study	IR compared to other intervention/control group for symptom reduction	Sample Size (No. groups)	Symptom Measures	Statistic	P values ranges for effect of IR	Effect Sizes for IR	Confidence Intervals
Arntz, Sofi, & Breukelen, (2013)	Effective compared to baseline control	 10 (1)	PSS, BDI	Mixed Regression	PTSD $p < .001$ Depression $p < .001$	PTSD ● Depression ●	X
Arntz, Tiesema & Kindt (2007).	IR and IE both effective in reducing PTSD; IR more effective for some PTSD - related emotions	 67 (2)	SCID; PSS-SR; FQ; AEX; SCL-90;	ANOVA ITT	PTSD $p < .001$ Emotions $p = .028 - p = .043$	PTSD ● Emotions ● ●	X
Kindt, Buck, Arntz & Soeter (2007).	Uncontrolled IR effective for PTSD and anxiety symptoms.	 25 (1)	PSS-SR, SCL-90-R, STAI, TM, P/CM, MDis, % TE, % SX	ANOVA	PTSD $p < .001 - p < .01$ Anxiety $p < .01$ Memory ns - $p = .05$	PTSD ● ● Emotions ●	X
Rabee, Ehring, Marquenie & Kindt (2014;unpublished)	IR effective for PTSD symptoms. Comparison conditioned effects not yet described.	 10 (1)	CAPS, SCID II IES-R	ANOVA	PTSD $p = .001 - p = .027$	PTSD ● ●	X

Study	IR compared to other intervention/control group for symptom reduction	Sample Size (No. groups)	Symptom Measures	Statistic	P values ranges for effect of IR	Effect Sizes for IR	Confidence Intervals
Seebauer, Froß, Dubaschny, Schönberger, & Jacob, (2013).	IR not more effective for emotion reduction. Safe place imagery had superior effects	 46 (3)	SCL-K9, SUIS, STAXI, ER (positive & negative)	Multilevel analysis ANOVA	No significant effects of IR on emotion	X	X
Hagenaars & Arntz (2012).	IR not superior for emotion changes IR was more effective for intrusive memories and some scales on the PTCI	 76 (3)	MR (anxious, horrified, sad, angry) Distress, (IM) Diary PTCI	ANOVA T-tests Chi-Square	Mood ratings <i>ns</i> IM $p = 0.004$ PTCI $p = .005 - .04$ Some <i>ns</i> compared to positive imagery	Emotions (<i>ns</i>) IM ● ●	X
Hagenaars (2011).	IR showed larger effects for reduction in distress and intrusive memories	 73 (4)	MR (anxious, horrified), Distress, (IM) Diary	ANOVA T-tests Chi-Square	Distress $p = .001$ IM $p = .047 - p = .07$	Distress ● IM ●	X

● Small Effect Size

● Medium Effect Size

● Large Effect Size

X Not reported

Please see page 26 for definitions of abbreviated interventions and measures

3. Theoretical Implications of Imagery Restructuring in Anxiety Disorders.

The reviewed studies have revealed IR to be an effective technique in the treatment of anxiety disorders. However, the effects were variable. Theoretical implications of these effects and possible underlying mechanisms are discussed in the context of anxiety pathology, IR methodology, study design and existing research.

Imagery in Social Anxiety

Qualitative analysis was not carried out. However, imagery and memory were reported as having common themes which reflected that of other research (e.g. Wild & Clark, 2011), such as ridicule, humiliation and imagining the self being perceived more negatively than in reality. This can generalise to appraise current and future social situations as threatening and as in PTSD, related cues can trigger negative images and cognitions about the self, leading to anxiety and avoidance behaviour.

Social anxiety and imagery-related distress reduced following IR. However, imagery vividness and frequency change was limited in the studies. Both can be gradual in reduction (Speckens, Hackmann, Ehlers, & Cuthbert, 2007) and so may not have been identified in the studies with short-term follow ups and non-standardised measures. In addition, the interview/reliving itself may have made imagery more vivid and frequent in the short-term. Furthermore, frequency may not be the most important factor as intrusive imagery can still exist whilst the distress and impact of it reduce (Ison, Medoro, Keen, & Kuipers, 2013). However, vividness of negative imagery is associated with distress (Pearson, Deepro, Wallace-hadrill, Burnett, & Holmes, 2013) and strength of recollection (Rubin, 2005) making it an important treatment target.

Imagery Restructuring in Social Anxiety

The reviewed studies indicated that changes in imagery and memory following IR are important in reducing social anxiety. Small changes following reliving and control group

interviews/interventions may support the role of repeated memory evocation and symptom reduction via habituation (anxiety experienced during visualisation itself reduced; Wild et al, 2008) and weakening of the association between the social events and fear. However, consistent evidence for the importance of habituation is limited (Brewin & Holmes, 2003). There were also some cognitive changes and enhanced effects seen following IR. This indicated that IR is more effective and that spontaneous cognitive change does not necessarily occur following reliving. The explicit use of cognitive restructuring in three of the studies was used to enhance the belief change which links the memory, and imagery and anxiety. However, memory meaning (Nilsson et al., 2013) and encapsulated beliefs also changed in the IR interventions without cognitive restructuring. This suggests imagery is an effective means of incorporating alternative information leading to cognitive change.

Within social anxiety, negative representations of the self within memory may be retrieved over positive representations and underpin negative self-imagery. Retrieval competition accounts (Brewin, 2006) would state that memories are not abolished or directly modified by interventions. IR therefore, may help to develop a different memory representation with more realistic self appraisals (e.g. Zeigler-Hill, 2006) or increase the relative accessibility or activation of *existing* positive self-representations. This is particularly important in social phobia as it can help to reduce the threat appraisal of current social situations (often associated with negative imagery). This was indicated by the reduction of FNE, and social anxiety in the studies. However, negative memory representations are still likely to remain; vulnerable to being triggered along with negative imagery and anxiety. Therefore, in order to maintain anxiety reduction, positive self-representations may need to be rehearsed over time and remain salient in order to win the retrieval competition. It is not clear whether IR is sufficient to do this or indeed if this is how it works.

Given the changes seen in imagery, it may be a mediating factor between memories and social anxiety. Imagery can be elicited from long-term memory, be subject to interference

(Baddeley & Andrade, 2000) and transformation (Pearson, De Beni, & Cornoldi, 2001) which may take place within the rescripting phases. This may be particularly important in social phobia when information can be misinterpreted (Clark & Wells, 1995) and/or recalled inaccurately (Brewin, Huntley, & Whalley, 2012). Misrepresentations also exist within imagery, the experience of which reinforces them over time (Pearson et al., 2013). According to Self-Memory System framework (Conway & Pleydell-Pearce, 2000), changing negative imagery may help to reduce discrepancy between one's desired goal and the actual state. Changing imagery may then reduce anxiety, behavioural avoidance and negative self-beliefs. Consistent with this is research (e.g. Hirsch, Clark, Mathews, & Williams, 2003) showing that holding a neutral image rather than a negative image in mind whilst having a conversation resulted in less anxiety in individuals with social phobia.

The intervention by the adult self could also help change a dominant observer perspective to become more field orientated. Doing so may help to reduce related symptomology as observer perspective is more common in psychopathology (Kuyken & Howell, 2006) and is associated with avoidance (Williams & Moulds, 2008),

Imagery in Specific Phobia

Imagery of specific stimuli (e.g. a snake) often develops from an aversive event with the feared stimulus. Such imagery can be vivid, overestimate threat (Arntz et al., 1993), become fused with reality (Dadds et al., 1997) and can therefore maintain and enhance fear responses (Dadds, Hawes, Schaefer, & Vaka, 2004). In the study by Hunt et al (2006), both specific visual and somatic imagery were reported, with 78% of participants describing negative imagery in relation to their fear. This imagery was also correlated with avoidance behaviour. Low levels of reported fear were associated with little or no imagery and also little contact with a snake previously. Those participants also benefitted less from IR than those with high reported levels of fear and negative imagery. These findings are limited by being confined to non-clinical populations, and a higher level of negative imagery may be more

consistently present in clinically significant levels of phobia. In such cases IR may therefore be an appropriate technique which is less aversive than in vivo exposure, yet still effective.

Imagery Restructuring in Specific Phobia

IR was more effective than the minimal exposure control intervention, indicating a mechanism other than habituation alone. Although the IR technique did not directly address an aversive memory it may still work by stimulus revaluation (Arntz, 2012). By pairing the alternative imagery, (whether neutral, positive or fantasy) with the imagined feared stimulus, a new association could be formed which weakens the fear response, and can result in better generalisation than extinction alone (e.g. Dibbets, Poort, & Arntz, 2012).

The brain regions implicated within perception, imagery and fear overlap (Kreiman et al., 1996). Given the process of IR (in activating imagery and memory), it may implicate the same areas. Such activation could help to suppress fear conditioned responses processed in the amygdala (Milad & Quirk, 2002) and to develop alternative memory representations or strengthen existing positive ones (Brewin, 2006). However, cognitive restructuring was included in all of the active interventions which were equally effective. Therefore cognitive mechanisms are likely to have been fundamental to symptom change.

Imagery - the Feeling of Being Contaminated and PTSD

Intrusive memories in PTSD are most commonly visual, but can be multisensory (Pratt, Cooper, & Hackmann, 2004). This encompasses haptic imagery (Juttner & Rentschler, 2002) and the FBC. Amygdala activation during a traumatic event is thought to enhance the consolidation of such sensory memories which can be involuntarily triggered by reminders of the event. Reminders are therefore often avoided, which reduces the opportunity to weaken sensory memories (Brewin et al., 2010) and so the FBC remains.

Imagery Restructuring in FBC and PTSD

Whilst most research involves measuring visual imagery, studies have shown that haptic imagery can also be transformed (Miquée et al., 2008). This is consistent with the changes seen in FBC in the reviewed studies. Imagery modification may allow for the sensory bound FBC to become associated with the new, more elaborated, positive or realistic representations which become more accessible than the original FBC. However, the cognitive restructuring and imagery modification interventions were short and did not explicitly address memories from which the FBC originated. Nonetheless both FBC and PTSD symptomology improved. This perhaps questions whether PTSD symptoms change via memory manipulation at all. It may be that IR of FBC had an indirect effect on memory appraisals and thus associated symptomology. Alternatively, the behavioural component exploring the FBC and researching skin cell renewal may have led to habituation through exposure. However, this was largely a cognitive exercise used within the imagery manipulation. Cognitive change around the meaning and interpretation of the symptoms (FBC) was perhaps therefore key in reducing distress and negative self-beliefs which underpinned low self-esteem.

Long-Term Imagery Restructuring in PTSD

These studies indicated that nine to ten weekly sessions of IR in isolation are effective in reducing PTSD symptoms, but not necessarily more effective compared to, or in addition to, imaginal or prolonged exposure. However, IR was more effective in reducing non-fear emotions and intrusive memories. In addition, patient agreement with the intervention, which is a predictor of adherence (Keller, Zoellner, & Feeny, 2010), was less of an issue in IR than imaginal exposure. These findings suggest that IR may have better long-term outcomes and lower drop-out rates.

Both imaginal exposure and IR appeared to be effective in reducing PTSD that was fear driven. In such cases perceptual processing may lead to habituation of anxiety as an

individual is continually exposed to the imagery. However, symptom reduction is not always related to changes in fear activation (e.g. Kamphuis & Telch, 2000) and Grunert et al (2007) showed IR to be more effective compared to prolonged exposure in a sample where non-fear related emotions were present. Memories in which the self is evaluated negatively can promote feelings of shame, guilt and anger. These emotions are also common in PTSD and are associated with avoidance (Thompson & Waltz, 2008). IR may activate emotions, interact with the original memory and promote the development of alternative imagery and memory representations. This can stimulate mastery and self-compassion, important in counteracting non-fear related emotions and potentially comorbid conditions (Wheatley et al., 2007). Memory meaning and symptom change following IR in isolation, as well as the correlation between cognitive and symptom change within Imagery Rehearsal Therapy (Long et al., 2011) indicate that cognitive change appears to take place in IR and may be important in its therapeutic effect.

Memory organisation increased and negative content reduced following IR in the study by Kindt et al (2007). The findings were however limited by an uncontrolled design and use of non-standardised measures. Nonetheless, this study was novel and showed that whilst perceptual processing did not significantly explain symptom reduction, it was associated with conceptual processing which did. This is supported by Van Dantzig, Pecher, Zeelenberg, & Barsalou (2008) who showed that perceptual processing can activate conceptual processing. The sequence of perceptual and then conceptual processing within IR, followed by symptom change (Kindt et al, 2007) suggests that initial reliving may activate perceptual representations (S-reps) of the memory which possibly enter a modifiable state (Alberini, 2005) and/or allow for verbal representations (C-reps) to be developed or made more salient. Interestingly, in Arntz et al's study (2013), IR focused on events occurring before the worst part of the traumatic event. Imaginal reliving of entire events may therefore not be necessary. However, some perceptual activation combined with the rescripting phases may activate hippocampal processing alongside the sensory based

intrusive memory and promote conceptual processing. In turn, this may balance S-reps with stronger C-reps pathways within LTM (Brewin et al., 2010).

Short-Term Imagery Restructuring as Prevention

Compared to imaginal exposure, lower levels of distress and intrusive memories were seen following IR after exposure to trauma films. This supports the idea that IR is underpinned by a different mechanism to imaginal exposure. Imaginal exposure as a single session at the consolidation stage may be ‘retraumatising’ and therefore not appropriate. The superior effect of positive and safe place imagery on reducing negative emotions may be because they were a means of avoiding such emotions. However, they could also act as another form of IR if an individual manipulates the trauma imagery to form a safe or positive image. Perhaps this calls into question the necessity of the adult intervening in the three stage model of IR. However, in clinical cases an individual’s intervention and meaning change are likely to be important.

Preventing Intrusive Memories

Representations of newly learned material are thought to be malleable within a consolidation period of about six hours (Walker, Brakefield, & Hobson, 2003). This provides an opportunity for early intervention to reduce the degree of the developing sensory based trauma memories. IR of the trauma footage may have altered the encoding of the trauma information so that it became associated with different, more positive response information. Meaning appears to be an important mediator between memory and imagery, and therefore a different meaning supported by IR led to less intrusive memories. Following a cognitive neuroscience explanation, IR at the consolidation stage may act in a similar way to the effects of visuospatial tasks and interrupt the encoding of sensory based flashbacks (e.g. Deeprose, Zhang, Dejong, Dalgleish, & Holmes, 2012). Given the verbal component, IR may also promote hippocampal processing to develop stronger corresponding C-reps and result in fewer IM. The effects of IR were unlikely to be due to enhanced explicit memory as

both IR and reexperiencing groups showed superior explicit memory to the positive imagery intervention.

Anxiety appeared to be a vulnerability factor at the consolidation stage of memory, but only for imaginal reexperiencing, not for IR. Those in the anxiety group had higher levels of worry cognitions and use of self-blame as a coping strategy. These are associated with PTSD symptomology (Holeva, Tarrier, & Wells, 2001). IR therefore perhaps reduces these cognitive strategies (Hagenaars & Arntz, 2012) and the threat focused processing common in anxiety (Wells, 2002). Anxiety itself may also reduce the cognitive resources necessary for emotional processing and act similarly to other peritraumatic processes such as dissociation which are associated with avoidance, inadequate processing and severity of PTSD symptoms (Suliman, Troeman, Stein, & Seedat, 2013).

Evidence reviewing early interventions in PTSD suggests that their efficacy is limited (Rose, Bisson, Churchill, & Wessely, 2009). In this review, imagery rescripting has been identified as a potential intervention in the aftermath of the trauma with relatively large sample sizes. However, the clinical applicability of this is limited by analogue designs, use of healthy participants, and lack of a non-treatment control group.

Summary

The reviewed studies did not explicitly investigate the underlying mechanisms of IR and therefore the understanding of how IR works remains limited. However, collectively they indicate that IR involves a range of changes: to memory processing, content and meaning as well as emotions and imagery which do not take place within imaginal exposure and re-experiencing.

The initial reliving component may implicate habituation and perceptual processing, but the mechanisms of IR thereafter may differ. Within specific phobia, an associative learning and conditioning mechanism may be more relevant. The restructuring stages could then be a way of creating less aversive imagery or altering its dominant perspective, in turn reducing threat appraisals, anxiety and avoidance. In social phobia, the role of cognitive theory may be especially important given the negative self-appraisals and the misattributed meaning given to social memories. Where specific memories are rescripted, conceptual processing, dual representation and retrieval competition accounts may have particular relevance. Although rather speculative, neuroscience research supports the idea that memories are not abolished, but may be open to modification and then reconsolidation (Nadel, Hupbach, Gomez, & Newman-Smith, 2012). In sum, all of the aforementioned theoretical mechanisms could play a role in the different components of IR.

Discussion

The heterogeneity of the studies in this review widens the clinical application of IR and reflects the growing interest and research in IR techniques within anxiety disorders. In this paper three aspects of IR in anxiety were reviewed. IR was variable in its methodology and administration across different anxiety disorders. IR was effective as an isolated technique in reducing general anxiety symptomology as well as different aspects of imagery and memory. The variations in technique and application and the effects across anxiety disorders implicate several different theoretical viewpoints as well as providing insight into the potential adaptations of IR for different anxiety disorders and populations.

The Effect of Imagery Restructuring

This review indicated that IR is effective (and that the rescripting component specifically is important) as a short-term, long-term and preventative technique across mild to severe anxiety symptomology and when comorbid disorders exist. IR was more effective compared

to other imagery-based, short-term or preventative interventions. As a longer-term intervention it was equally effective and more so for reducing non-fear emotions. The effectiveness of IR was more consistent in studies of social phobia and PTSD than of specific phobia and prevention of intrusive memories. This may be owing to the different mechanisms of memory and imagery within these disorders (Rubin, 2005) and therefore the impact of IR is different. However, within this review it is also likely to be due to the greater number of social phobia and PTSD studies and their being of better quality.

In activating imagery, IR appeared to be a powerful way of accessing emotion and idiosyncratic memory meaning. This is consistent with research showing that evoking imagery can produce the same neurological activation as real life encounters (e.g. Ehrsson, Geyer, & Naito, 2003). IR appeared to impact on memory, related beliefs, different facets of negative, multimodal imagery as well as associated anxiety and distress. However, effects (where measured) were less consistent on frequency and vividness, the latter of which may be particularly important to reduce (Pearson, et al., 2013). The broad ranging effects of IR in a diverse group of studies makes it difficult to understand the mechanisms underpinning IR, as an impact on one aspect (i.e. memory, imagery or meaning) is likely to impact on others. It may be that imagery processing (perceptual and then conceptual) is a mediating factor between addressing aversive memories and anxiety reduction. Changes in beliefs and memory meaning in the studies also indicated the importance of cognitive mechanisms within symptom change following IR. Interestingly, cognitive change took place without an explicit stage of cognitive restructuring. However, a greater number of studies are needed to explore this. The effects of IR and underlying mechanisms are likely to vary according to its methodology and the nature of anxiety being addressed.

The review also showed that IR can be delivered by professionals with a range of experience after minimal training. Such findings are particularly important in current efforts to widen access to psychological interventions whilst also making financial savings. However, it

could not be ascertained from the review whether IR is an effective long-term intervention in insolation which has lasting effects.

Clinical Implications

Differences in Imagery

Consistent with previous reviews (e.g. Brewin et al., 2010), imagery existed across different anxiety disorders and appeared to play a role in both the aetiology and maintenance of anxiety disorders. Therefore, manipulating imagery as in IR is an important innovation and preliminary studies within this review attest to its effectiveness. This review also showed that multimodal imagery change has a role in reducing anxiety and PTSD symptomology. The nature of imagery and its meaning differs between disorders and individuals. Exploring this at an individual level may inform which IR methodology is most appropriate. Considerations within imagery may be the level of associated distress, intensity, controllability and vividness, whether the imagery relates to a specific memory, what perspective it is dominated by (e.g. observer or field), whether there is a prospective or retrospective focus, the content of the imagery and how close to reality it is (e.g. distorted imagery of a phobic stimulus compared to an actual event in PTSD).

Adapting Imagery Restructuring

This review showed IR to be a heterogeneous technique. However, this can be helpful in facilitating a person-centred approach. Where imagery is distorted or counter-factual, manipulating the imagery of the feared stimulus may be particularly important. In disorders where the self is evaluated negatively, manipulating one's own or others' actions, or an observer perspective may be necessary. Imagery restructuring could also be applied prospectively to help enter feared situations. In cases where anxiety is severe and the trauma too adverse to revisit, 'early' IR or preventative scripts could be used. Alternatively, very short IR sessions may be appropriate initially (which can still be effective). Such adaptations could reduce the time needed for the intervention and the distress associated with reliving

the whole trauma memory, potentially lowering the dropout rate. However, it should be ensured that adaptations such as early IR do not act as avoidance strategy, potentially having negative consequences in terms of memory processing and anxiety symptomology.

The meaning or self-representations that link imagery and memories are important in the maintenance of anxiety. However, IR may be insufficient in isolation to develop new, more positive self-representations that can compete with negative ones (Brewin, 2006) and this could limit its long-term effects. The intensity, vividness and controllability of imagery and the rigidity of encapsulated beliefs or lack of positive self-representations may inform whether additional techniques such as cognitive restructuring, behavioural interventions or schema therapy are also needed for long-term change. However, given the effect of imagery on emotions, IR may be important in reducing any rational-emotional dissonance (Stott, 2007) that can exist in following cognitive techniques alone. Severe anxiety may also call for relaxation techniques or safe place imagery alongside IR. This review has shown that there are many possible manipulations of IR methodology and application which could be adapted on an individual basis, in line with a transdiagnostic approach.

Different Anxiety Disorders

This review indicates that so far, IR studies have been limited to a small number of anxiety disorders. However, imagery is increasingly being recognised within anxiety disorders, suggesting a role for IR and related techniques. Obsessive Compulsive Disorder (OCD), like social phobia and PTSD can be associated with adverse events. In one study, 81% of patients reported mental imagery (Speckens et al., 2007), which were either memories of negative events or were associated with them. Imagery was also associated with more OCD symptoms, anxiety and beliefs about responsibility. Again in health anxiety, a high proportion report distressing, intrusive imagery of an adverse event (Muse, McManus, Hackmann, Williams, & Williams, 2010). Similar to phobic imagery, health anxiety imagery was often future oriented. Price, Veale, & Brewin, (2012) showed intrusive imagery within

vomit phobia to be multisensory, linked to childhood memories and prospective in nature. In light of the current review findings, IR could be effective in a wide range of anxiety presentations.

Beyond Anxiety

Research has investigated intrusive memories and IR within depression (Brewin et al., 2009). This is important given its prevalence and comorbidity with anxiety (Hirschfeld, 2001). Several of the reviewed studies used the BDI, with mixed outcomes. In the studies (Arntz et al, 2013; Jung & Steil, 2013) where PTSD presentations were complex and chronic there were non-significant effects of IR on depression. However, Nilsson et al (2013), Wild et al (2008) and Grunert et al (2007) showed that it did reduce following IR. Here, the depression may have been less severe and specifically related to the phobic and injury related imagery. It was therefore more amenable to change via IR. Imagery has also been implicated within psychosis (Ison et al., 2013), bipolar disorder (Gregory, Brewin, Mansell, & Donaldson, 2010), eating disorders (Tatham, 2011), cravings (Harvey, Kemps, & Tiggemann, 2005) and pain (Philips & Samson, 2012). IR therefore has the potential to be used beyond anxiety and depression.

Different Populations

All of the reviewed studies were with adult populations. However, frequent, vivid and distressing negative self imagery with an observer perspective has been identified in adolescents with social anxiety (Schreiber & Steil, 2013). IR techniques may therefore be applied in this population and could help to prevent the entrenchment of symptoms. Imagery can also still exist in those with visual impairments and blindness (Bridge, Harrold, Holmes, Stokes, & Kennard, 2012). Using IR with such populations could provide new insights in to the potential role of neuroscience in IR and also imagery more generally.

Limitations

The heterogeneity of IR methodology and clinical application limited this review to narrative methods. The statistical effectiveness of IR has therefore not been established. The review highlighted heterogeneity of IR methods themselves and although not part of wider psychological interventions (e.g. CBT, schema therapy) IR was still combined with other techniques (imaginal exposure, cognitive restructuring, prolonged exposure) in several of the studies and only one study formally assessed treatment integrity. Furthermore, many of the study participants were currently receiving, or had previously received psychological therapy. These factors therefore make it hard to attribute findings to a specific IR method. The number of papers also meant that conclusions drawn from subgroups of papers were restricted. The research on IR is in its infancy and the methodology of the papers also limits the review, the quality analysis of which was only carried out by one reviewer. Collectively, these factors restrict validity of the review findings and could potentially overestimate the effectiveness of IR. However, IR may prove more effective in studies with better methodology and greater power. The limitations pave the way for a number of recommendations regarding future research.

Research Implications

Causality is hard to determine in any psychological research. In order to better attribute symptom change to specific IR methodology and its different components, research studies need to do a number of things. Future research should develop and utilise more standardised imagery measures (see Pearson et al., 2013), have larger samples, longer follow-ups, utilise more consistent and comparable treatment conditions and non-treatment control groups. In order to better understand what is most effective about IR, further dismantling studies and component analyses are needed. For example, by comparing IR with reliving, imaginal exposure, cognitive restructuring and in vivo exposure. In addition, qualitative analyses of how IR strategies are used idiosyncratically and the associated outcomes could better inform the relationship between different IR techniques and their efficacy. Comparing different

methods of IR within Randomised Controlled Trials (RCTs) and comparing IR with cognitive interventions (e.g. cognitive bias modification) and complete psychological interventions (e.g. CBT) would also be valuable in understanding the extent of IR effectiveness.

Studies that better investigate the underlying mechanisms of IR are lacking. Studies could compare IR to interventions such as Mindfulness-based CBT or Acceptance and Commitment Therapy that do not directly manipulate imagery or engage with cognitions and memories. This may be helpful in understanding what is effective about IR and how it exerts its effects on different symptomology. Neuroimaging methods during IR could be used to investigate the potential role of neural mechanisms involved in IR. In addition, tracking imagery over time to explore if changes are maintained, continue (e.g. frequency which did not reduce in the short-term) or whether the effects are only short lived following IR. In addition, investigating the dominant perspective in the negative imagery before, during and after IR and whether it impacts on retrospective and prospective imagery may be relevant. Future research should also further investigate the relationship between different aspects of imagery and memory and their role in anxiety. Many of the reviewed studies were set up for research purposes. Clinical audits of IR methodology and the associated outcomes would therefore be beneficial.

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Part 2: Empirical Study

The Effect of Viewpoint Dependence in Spatial Memory Tasks on Intrusive Memories in Analogue Trauma

Abstract

Introduction: Intrusive Memories are a transdiagnostic symptom in psychological disorders, such as PTSD. A prominent model, the Dual Representation Theory (DRT), proposes two distinct but related memory systems which underpin the experience of normal and traumatic (intrusive) episodic memory. DRT views intrusive memory as the dominance of the sensory-perceptual egocentric memory system over contextualised, flexible allocentric memory representations.

Method: The trauma film paradigm was used as an experimental analogue for the development of intrusive memories in a non-clinical population. An independent group design was used. In each group, participants (N=45) watched the trauma film. They then either listened to music (control group), completed an egocentric (fixed-view condition) or an allocentric (shifted-view condition) spatial memory recognition task. Intrusive memories were then recorded by the participants for one week.

Results: Those engaging in the egocentric recognition memory task showed a reduced number of intrusive memories over the course of a week compared to the control group. Intrusive memory frequency in the allocentric recognition memory task group did not differ to a significant extent from the control group. Voluntary memory was unaffected by the experimental manipulation. Anxiety, depression, mentalization and task performance were unrelated to the intrusive memory frequency. The exception was a positive association between state anxiety and intrusive imagery in the allocentric group.

Conclusions: Engaging in an egocentric recognition memory task within the consolidation stage of memory reduced the development of intrusive imagery. This supports the notion by the revised DRT of relatively weakened hippocampally-dependent memory processes in the development of intrusive memories.

Introduction

Post Traumatic Stress Disorder and Intrusive Memories

Post Traumatic Stress Disorder (PTSD) develops in a small but clinically significant proportion of people who experience trauma (Kessler, Sonnega, Nelson, & Bromet, 1995). While Intrusive Memories (IM) are a transdiagnostic phenomenon, they are a defining symptom of PTSD. They are also part of normal autobiographical memory and can be recalled deliberately, but in PTSD occur recurrently and uncontrollably (Bourne, Mackay, & Holmes, 2013). IM are perceptual and involuntary memories of an event, and are most commonly visual, but can have multisensory qualities (Brewin, Gregory, Lipton, & Burgess, 2010). They range from momentary sensory impressions to distressing flashbacks (“a mental vision of past experience”; Stein, Seedat, Iversen, & Wessely, 2007 p.140) and are characterised by the involuntary reexperiencing of the traumatic event as if it were happening again. IM are often accompanied by distress and physiological arousal and are thought to be important in the maintenance of PTSD (Ehlers & Clark, 2000). Intrusive thoughts can also occur as part of IM. Intrusive *verbal thoughts* and *sensorial images* can be associated with different types of emotions, can be manipulated independently and may arise from independent memory systems (Hagenaars, Brewin, van Minnen, Holmes, & Hoogduin, 2010). However, images and thoughts can also be experienced together as well as in isolation (Reynolds & Brewin, 1998).

Interventions

A substantial proportion of individuals who meet criteria for PTSD in the aftermath of a traumatic event will recover naturally (Kessler et al., 1995). However, those who do not often require treatment. Pharmacological treatments such as the beta-blocker Propranolol can have the side effect of suppressing normal voluntary memories (Henry, Fishman, & Youngner, 2007) and concerns have been raised that talking therapies used directly after experiencing a trauma may actually exacerbate symptoms (Rose, Bisson, Churchill, & Wessely, 2009). Psychological treatment is therefore only delivered once PTSD has

persisted for at least one month (NICE, 2005). However, there may be peri or posttraumatic interventions that could interfere with the encoding and consolidation of PTSD symptomology. Specifically, analogue trauma designs have been used to investigate the effect of such interventions on the experience of IM after watching analogue trauma films. These initial research studies are important because they have implications for secondary prevention of psychological disorders after traumatic or stressful events.

Dual Representation Theory and Intrusive Memories

There are a number of theories applied to autobiographical memory and its role in PTSD. This study is grounded in the recently revised neurobiological-based Dual Representation Theory (DRT; Brewin et al, 2010). DRT posits that within normal autobiographical memory, episodic and perceptual memories are underpinned by two parallel but related memory representation systems. Normally, these systems act together to form memories of an event which are integrated into long-term memory (LTM) and are consciously accessible. However, within PTSD, DRT proposes that sensory-perceptual memories dominate and underpin the experience of IM. It suggests that this can be explained by an imbalance in the encoding of the two types of memory representation at the time of a trauma.

The sensory-perceptual memory representations (or 'S-reps') are inflexible and image-based. They can occur involuntarily and trigger emotional states. The other type are flexible, contextualised representations (or 'C-reps') which can be deliberately retrieved, manipulated and verbally expressed (Brewin et al, 2010). Cognitive neuroscience research proposes information within C-reps is encoded by the ventral stream and is supported by prefrontal and Medial Temporal Lobe (MTL) structures (notably the hippocampus). S-reps, however, are encoded by the dorsal stream and are supported by parietal areas and subcortical structures including the amygdala and insula. Normative memory involves communication between parietal and MTL regions underpinning S- and C-reps and involves visuospatial working memory processes. This information processing is suggested to supplement S-reps

with the appropriate spatiotemporal context in the form of C-reps, with the integrated representations incorporated into a coherent autobiographical memory (Nadel & Hardt, 2004).

High levels of glucocorticoid release associated with a highly stressful traumatic event is postulated to have a differential effect on the two memory systems supporting C- and S-reps. The release of these hormones impacts on a range of brain regions, but particularly on the hippocampus and amygdala (Henckens, van Wingen, Joëls, & Fernández, 2010; Joëls & Baram, 2009). According to DRT, the formation of hippocampal supported C-reps memories may then be relatively incomplete and appropriate spatiotemporal context compromised, whereas S-reps are selectively over-encoded. Later, when trauma-related cues are reencountered, areas of the brain supporting S-reps are activated by trauma-related cues and lead to the experience of IM.

Cognitive Behavioural techniques such as reliving are used in the treatment of PTSD. Reliving may permit hippocampal processing of a traumatic event which reduces the level of amygdala activation involved in the experience of IM. DRT might also suggest that this hippocampal processing allows S-reps to develop associated C-reps and for the sensory based memory to gain detail, coherence and appropriate temporal context. They can then be stored within long-term autobiographical memory and may be deliberately retrieved with verbal detail rather than as involuntary and sensory-perceptual reexperiencing of the traumatic event (Brewin et al., 2010).

Spatial Memory

Processing spatial information in memory utilises some of the same brain systems as in episodic memory (Nadel & Hardt, 2004). The spatial viewpoint of a memory can be egocentric or allocentric and in the absence of coherent, context based memory, IM are thought to be experienced from an egocentric viewpoint. Egocentric forms of spatial memory refer to viewpoint dependent information relative to the body and are thought to be part of S-reps, supported by parietal structures. Allocentric forms of spatial memory hold

viewpoint independent information, stored relative to the environment and form part of C-reps (Brewin et al., 2010). The allocentric viewpoint can be flexibly manipulated to allow multiple egocentric viewpoints in imagery, a process which is thought to be supported by the hippocampus (King, Burgess, Hartley, Vargha-Khadem, & O'Keefe, 2002).

Virtual environments have been used to investigate spatial memory. This includes the Town Square Task Paradigm (King et al., 2002), a virtual environment task which tests recognition memory from different spatial viewpoints. In the fixed-viewpoint condition of the task, egocentric processing is sufficient to perform the task. However, in the shifted-view, allocentric, hippocampal based processing is required. King et al found that a patient with focal bilateral hippocampal pathology had impaired performance in the shifted-viewpoint condition compared to the fixed-viewpoint condition. This supports the involvement of the hippocampus in allocentric memory and a specific role in recognising object location within a scene tested from a shifted-view.

Visuospatial Tasks and Intrusive Memories

A recent review (Brewin, 2013) has shown that visuospatial tasks administered concurrently or shortly after exposure to trauma films consistently leads to fewer intrusive images compared to no task control groups. Holmes, James, Kilford, & Deerprouse (2010) administered the visuospatial task Tetris within the six hour consolidation period of memory (Walker, Brakefield & Hobson, 2003) following analogue trauma films. They found that this led to fewer IM experienced over one week, compared to a no task control group, whilst leaving voluntary memory intact. A 'visuospatial hypothesis' would suggest that visuospatial tasks exert their effects on IM by disrupting the encoding and consolidation of visual, egocentric representations that underpin IM. Holmes et al also found that playing a verbal 'Pub Quiz' task led to an *increase* in IM. This suggests that such tasks compete for verbal-conceptual processing resources necessary to contextualise a trauma memory, thereby allowing for greater visuospatial processing which may underpin IM. However, this finding

was not significant when the verbal task was played four hours after the film. The review by Brewin (2013) also highlighted that there are mixed findings for the effects of verbal tasks on the number of IM; some leading to relatively more IM (e.g. Bourne, Frasquilho, Roth, & Holmes, 2010) and others to relatively less (Krans, Näring, Holmes, & Becker, 2010).

Inconsistent findings for the effects of verbal tasks may be owing to different study methodology. If verbal tasks are not continuous or cognitively demanding enough they may not compete sufficiently for verbal resources (Nixon, Cain, Nehmy, & Seymour, 2009). A similar limitation may apply to visuospatial tasks (Kamboj et al., 2014). Moreover, if there is a time gap between the film and task, sufficient hippocampal processing may have taken place to encode and contextualise the trauma memory. In addition, the neural basis to verbal processing is not the only system involved in encoding and consolidating appropriately contextualised episodic memories (Brewin et al., 2010). Therefore, a verbal task may not have sufficiently interfered with hippocampal processing and the C-rep system. However, tasks requiring allocentric memory known to require hippocampal processing (King et al., 2002) may do.

Deficits in allocentric memory have been associated with lower performance on allocentric tasks and a relative increase in the number of IM (Gilbertson et al., 2007). Bisby, King, Brewin, Burgess, & Curran (2010) also found that low doses of alcohol selectively impaired allocentric memory but not egocentric memory performance. Poorer allocentric memory performance was then associated with increased IM. A more recent study (Meyer et al., 2013) showed that better performance on a temporal lobe based spatial configuration predicted fewer IM. Differences in allocentric visuospatial processing could therefore be associated with the ability to form contextualised memories, which in turn are associated with reduced numbers of IM (Brewin et al., 2010). However, it is not clear post-traumatically whether an allocentric task would interfere with the consolidation of contextualised memory representations or promote hippocampal activity and reduce the development of IM.

Aims and Hypotheses

Differential effects of visuospatial and verbal tasks indicate the importance of identifying activities following real life trauma that may prevent or exacerbate IM. Reexperiencing symptoms in PTSD can have a significant impact on social, educational and occupational functioning (NICE, 2005). Preventing the build-up of IM could therefore reduce the demands of PTSD on health care. However, the theoretical understanding of such potential interventions is in its infancy and far from clinical application. Further research is therefore needed to better understand the consolidation of intrusive memories and the interaction with different cognitive processes.

This exploratory study investigates the effects of allocentric compared to egocentric recognition memory tasks on intrusive memories. In doing so, it explores DRT and the suggested potential for spatial memory processing to influence the consolidation of IM. The study employs the virtual environment town square task (VE) at the consolidation stage of trauma memory. This is a controlled way of investigating the effect of tasks requiring allocentric or egocentric memory (Burgess, Maguire, & O'Keefe, 2002) when carried out immediately after watching the trauma film on the number of IM for one week. In accordance with DRT and previous research, the following hypotheses were made.

1. Completing the VE from the fixed-viewpoint position (requiring egocentric processing) will lead to fewer IM of the traumatic footage over one week relative to the control condition.
2. Completing the VE from the shifted-viewpoint (requiring allocentric reviewing) could lead to either an increased or reduced number of IM compared to the control condition.
3. All conditions will leave voluntary memory intact and will therefore not have a differential effect on recognition memory of the traumatic footage one week post film.

Components of depression (Reynolds & Brewin, 1998) and anxiety (Brewin, Watson, McCarthy, Hyman, & Dayson, 1998) can be associated with the PTSD symptomology. More specifically in the context of memory and analogue trauma, performance on a task of mentalization was a predictor of IM in one study (Kamboj et al., 2014). The fragmentation of autobiographical memories of traumatic events (Brewin, 2007) may impair the ability to mentalize (Fonagy & Target, 2008), and a collapse in mentalization has been proposed within PTSD (Allen, Lemma, & Fonagy, 2012). This study therefore also controls for group differences in depression, anxiety and mentalization and explores the relationship between them and IM frequency.

Method

Setting

The study was carried out within the department of Clinical, Educational and Health Psychology at University College London (UCL) and has been approved by the UCL Ethics Committee.

Participants

Participants were recruited via an online study sign up system used by UCL researchers. Participants were screened via email and phone contact using the following criteria.

Inclusion Criteria

- First language or fluent in English
- Aged between 18 and 40 years old
- Regular and reliable access to a mobile phone and internet

Exclusion Criteria

- Any previous or current diagnosis of and/or treatment for a mental health problem (including Blood Phobia)
- Ever having witnessed or experienced any serious accident or injury associated with distress.

Design

An independent-group design was used. Participants were allocated in turn to the control group (n=15), the fixed-view group (n=15) and shifted-view group (n=15) and stratified for gender ^{*1} to reduce the risk of group differences at baseline.

Power Analysis

Power analysis was informed by previous studies (Deepröse, Zhang, Dejong, Dalgleish, & Holmes, 2012; Holmes et al, 2010). These studies compared the number of IM between groups randomised to three different tasks after watching a trauma film. The power calculation was carried out using GPower 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007), specifying a medium effect size and an alpha setting at 0.05 and power at 0.8. The required sample size was estimated at 78, or 26 per group.

Procedure

Participants signed up to the study via an online research study system where details of the study were described. They then completed the eligibility questionnaire via email. If eligible, participants were telephoned to ensure that they understood the study involved watching trauma films and to check if they still wanted to participate. If so, the trait anxiety measure was then completed via email before the testing session. At the testing session, participants were given the study information sheet and asked to give written informed consent (see Appendix A). The right to withdraw at any point was repeated verbally by the researcher. They then completed the baseline measures and mood ratings (outlined below) before completing an initial familiarisation trial of the VE (except for control participants). A familiarisation trial was administered in order to reduce the amount of verbal processing

¹Research indicates that females are at higher risk of experiencing PTSD (Breslau, 2009) depression (Nolen-Hoeksema, 2001) and anxiety (McLean, Asnaani, Litz, & Hofmann, 2011), and gender differences have been found in PTSD (Tolin & Foa, 2006). Gender differences have also been identified for REM-R (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), with females scoring higher.

(through reading instructions) between the film and VE, which could interfere with the effects of the experimental manipulation on the processing of trauma footage. A written brief about the trauma film was provided before watching the 20 minute trauma film footage. All participants watched on the same computer. Following the film, the mood ratings were repeated (see Appendix B). A rating of distress and self-relevance for the film was also obtained. Then, according to allocation to one of the three conditions, participants completed the fixed-viewpoint or shifted-viewpoint condition of the VE, or were in the no-task control condition (who listened to classical music). Each of these treatments lasted 10 minutes. Immediately following this, participants read an information sheet defining IM which in the study were called 'spontaneous memories' (see Appendix C). They then completed a question about whether they experienced any IM whilst completing the memory task or listening to music. Participants then read instructions (see Appendix D) for completing the diary. For seven consecutive days (including the testing day) they kept a daily IM diary. Participants were sent a daily SMS text message to remind them to complete the diary. Exactly one week later the participants completed a recognition memory and diary adherence questionnaire via email and returned their diaries via freepost. When received, participants were reimbursed either financially (£10) or through course credits. See Figure 1 for protocol outline.

Research Assistant

In light of needing a relatively large sample size a third year psychology undergraduate student seeking research experience was recruited to assist with data collection. The assistant was given an explanation of the theory underpinning the study, the study hypotheses as well as an explanation, demonstration and observation of the procedure. The assistant collected the data for the testing session (see procedure above) for eight participants. However, the timing of the data collection (which was later than planned due delays in research funding) clashed with demands of the assistant's own academic work and the time she could contribute to data collection was therefore less than planned. In turn, this contributed (as

well as the researcher having less time to collect data due to the delay in starting) to fewer participants being recruited than informed by the power calculation and therefore to the study being underpowered.

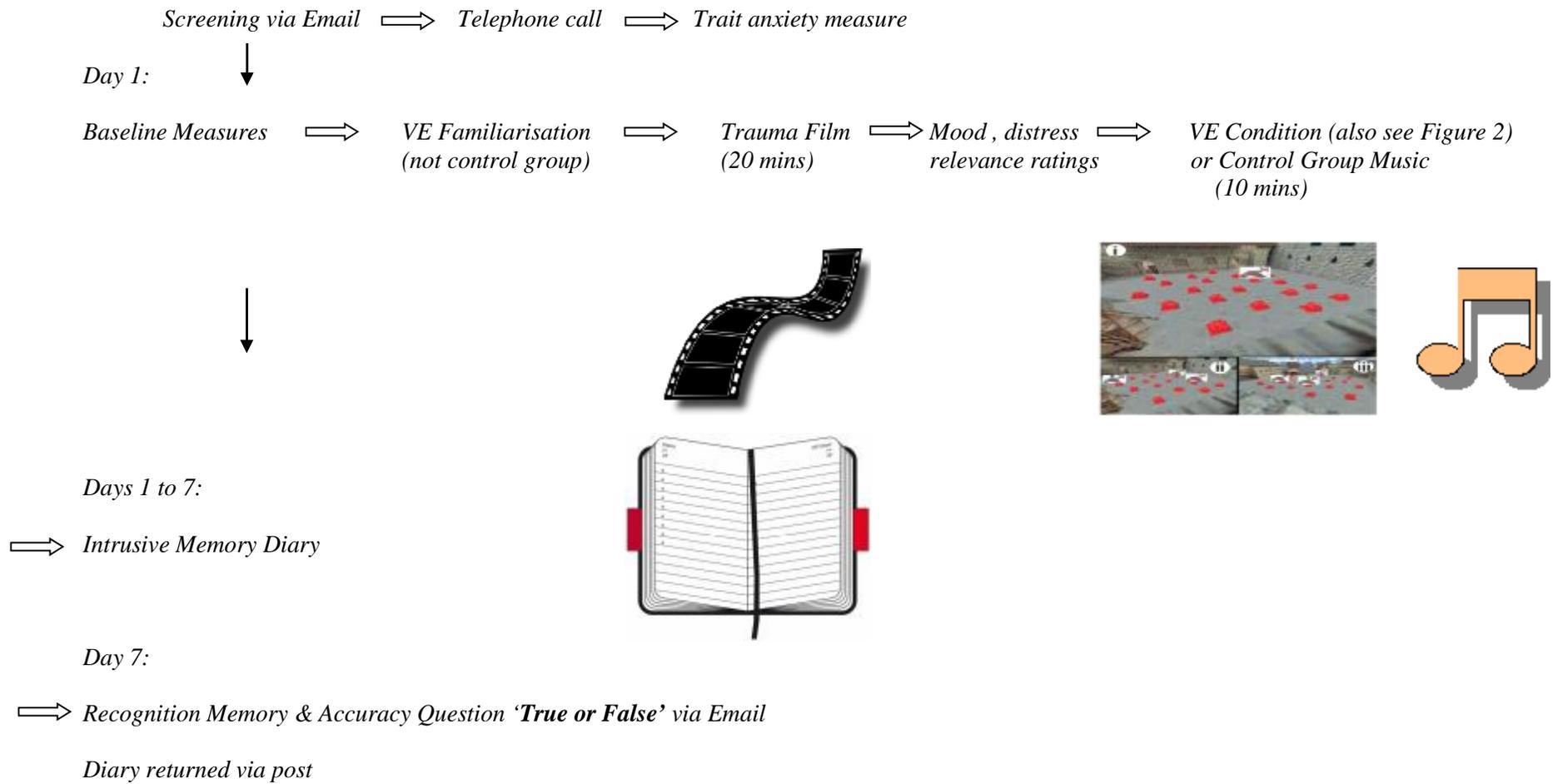


Figure 1. Diagram Outlining the Study Protocol

Measures

The Traumatic Events Questionnaire (Vrana & Lauterbach, 1994) was adapted to screen for any history of mental health problems, any experience or witness of trauma, and the impact of this.

The following baseline measures to assess anxiety, depression and mentalizing were used. The *Spielberger Trait Anxiety Inventory* (STAI-T; Spielberger, 1983) is a well-validated tool (Barnes, Harp, & Jung, 2002) and was administered to participants via email once assessed as being eligible for the study.

The Hospital and Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) is documented to be a validated screening tool (Bjelland, Dahl, Haug, & Neckelmann, 2002) for the presence and severity of anxiety and depression.

The Reading the Mind in the Eyes Test Revised Version (REM-R; Baron-Cohen et al., 2001) is a measure of adult mentalizing, showing good reliability.

Mood state was measured pre and post film using five Visual Analogue Scales (VAS) for ‘fearful’ ‘helpless’ ‘horrified’, based on Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition Text-Revision (DSM IV–TR; American Psychiatric Association; APA, 2000), ‘angry’ and ‘depressed’ (Davis & Clark, 1998). Scales anchored from 0 (‘not at all’) to 10 (‘extremely’) were rated individually and summed for a total score.

Distress ratings (0 ‘no distress’ to 5 ‘extreme distress’) adapted from the Impact of Events Scale-Revised (Weiss & Marmar, 1997) and *Self-relevance* ratings of the film (0 ‘not at all’ to 7 ‘extremely relevant’) were carried out. There was also a question on whether they had experienced any IM during the VE or music (see Appendix B).

Town Square Task performance was measured by counting the number and percentage of correct responses made by each participant.

Initial Intrusive Memory frequency was measured after having completed the VE task or having listened to the music (control group). Participants were asked to state if they had experienced any IM during the VE task or whilst listening to the music. If they had, they were asked to state how many were thoughts, images or both together.

Intrusive Memory frequency was measured for seven consecutive days using a paper diary based on previous studies (e.g. Bisby et al, 2010; Holmes et al, 2010). This included giving a brief description to check whether the IM was related to the trauma video, then stating whether it was a thought, image or both and whether there was any associated distress. This was rated from 0 (no distress) to 5 (extreme distress). Distress scores were averaged across all recorded IM. If the participants had not experienced any IM they were asked to record zero (see appendix F)

Diary compliance was measured by participants rating the extent to which they had accurately recorded their IM on a scale from 1 'not at all accurate' to 10 'extremely accurate'.

Recognition memory of the trauma film was also measured by responding 'true' or 'false' to 28 statements about the film.

The Trauma Film

The trauma film paradigm has successfully induced intrusive memories in a number of previous studies (e.g. Bisby et al 2010; Deeproose et al, 2012; Holmes et al, 2010), but no continued distress after the study. The films in this study were developed and used in previous studies (Soni, Curran, & Kamboj, 2013; Kamboj et al., 2014). The films are of graphic and real scenes of fatal accidents and human injury. Additional material of a motorbike accident and close-up footage of human surgery was also collated for this study.

Experimental Conditions

The VE paradigm (King et al., 2002) is a virtual environment task administered on a computer in which memory can be probed in fixed-viewpoint (egocentric memory) or shifted-viewpoint (allocentric memory) conditions (see Figure 2). The VE consists of a courtyard with 21 randomly distributed placeholders. The courtyard is surrounded by four walls at a rooftop level. Participants can navigate along two of these walls which are perpendicular to each other. The participant is prompted to navigate into a marker in one of two roof top wall corners. On contact with the marker a standard orientation viewpoint is given from which all placeholders can be seen. A series of images of different objects are then presented on randomly-selected placeholders. The number of images presented varies on each trial; between one, three, six and nine. Images are presented one at a time for three seconds each with a one second interval. Participants are then tested in a forced-choice recognition paradigm in which the images are presented alongside three randomly located placeholders. Each image has a colour code superimposed on it. Participants then select the corresponding coloured key on the keyboard to identify the placeholder they think that object was originally located. Depending on the condition, memory for the locations of the objects is tested from the original standard orientation (fixed-viewpoint) or from a changed viewpoint within the courtyard (shifted-viewpoint) which is the opposite corner of the courtyard to the original orientation. As performance on the egocentric condition was originally found to be higher, conditions have been matched for difficulty by manipulating the spacing of foil items at testing (King, Trinkler, Hartley, Vargha-Khadem, & Burgess, 2004).

Figure 2. The town square virtual environment task

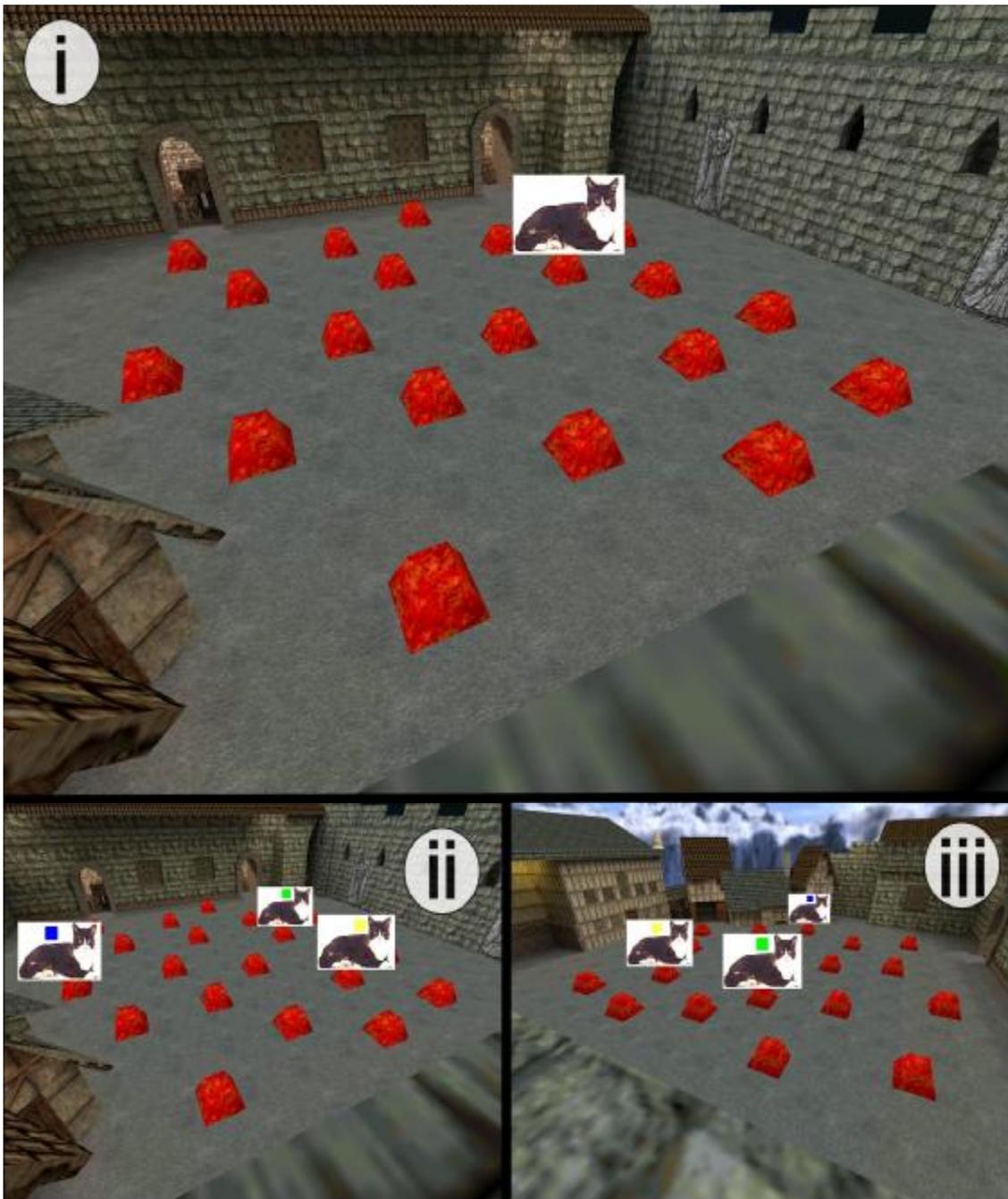


Figure 2. Views of (i) the VE during presentation of an image object from the standard view-point, (ii) the forced choice recognition tested from the fixed-view, and (iii) from the shifted viewpoint.

Ethics

Ethics approval (see appendix H) was obtained from UCL ethics committee (3223/001). No long-term distress has been caused to participants in previous research using the trauma paradigm. Recruitment material provided information about the nature of the film and written informed consent was obtained from all participants. The eligibility criteria were used to exclude potentially vulnerable participants. The study was also supervised by clinical psychologists and participants were informed that they could contact the researcher at any stage. All information provided by participants remained confidential and coded in order to protect anonymity.

One participant contacted the researcher two days after watching the film with concerns about experiencing anxiety in response to the footage. The supervisors were contacted immediately. Recruitment and testing were suspended and the incident was reported to the ethics committee. The participant was contacted by the researcher who provided reassurance and gathered information about the adverse reaction. The participant was offered a meeting with the supervisor (a practising clinical psychologist). The participant then met with the supervisor who provided reassurance and normalised the response. The participant reported this had alleviated her concerns and that the anxiety had already reduced. The participant had reported that they had not been entirely clear that the study would include the trauma films. This was detailed in the study information on the Sona study sign up site. However, following the incident and in agreement with the UCL ethics committee every potential participant (after completing the screening questionnaire) was phoned to check they had understood that the study involved watching the films and whether or not they wanted to proceed with participating in the study.

Results

Statistical Analysis

The data were checked for potential univariate outliers (3 standard deviations from the mean). Three outlier scores were identified and removed within the initial intrusive memory variables prior to analyses. Alpha was set at .05 (two-tailed) for all statistical analyses. If parametric assumptions were met, one-way analysis of variance and t-tests were used for single measures of comparison to check for any allocation, manipulation and adherence differences between groups and also for the effect of experimental conditions on the number of intrusive memories experienced. Spearman's Rank Order Correlation was used (due to violation of parametric assumptions) to investigate the relationship between baseline measures (anxiety, depression, mentalization) and intrusive memories.

Where histograms indicated non-normality and skewness/kurtosis were significant, appropriate transformations were applied. When this successfully normalised the distribution, parametric tests were used. If transformations were unsuccessful, non-parametric equivalents were used. Where multiple testing could have led to inflation of type 1 error, Bonferroni corrected p-thresholds were applied and any significant findings that survived such correction were identified. The untransformed means are reported in the text, tables and figures. Transformed data for intrusive memory variables are summarised in Table 3 in Appendix F.

Group Allocation, Manipulation and Adherence Checks

Demographics

Forty five participants (28 females and 17 males) with an age range from 18 to 39 ($M = 23.87$) completed the study. Thirty eight were from the student body and seven from the general population (7). One participant (in the fixed-view group) dropped out two days after the first part of the study. There were no significant group differences in age [$F(2, 42) = .54$, $p = 0.59$] or gender [$\chi^2(2) = .19$, $p = 0.91$]. See Table 1.

Baseline Measures

There were no significant group differences in STAI-T [$F(2,42) = .010$, $p = .99$], HADS anxiety [$F(2,42) = .37$, $p = .69$], HADS depression [$\chi^2(2) = 2.31$, $p = .31$] or REM-R (measure of mentalizing) [$F(2,42) = .75$, $p = .48$].

Mood Ratings

Pre-film mood ratings (see M and SD in Table 1) did not differ significantly between groups for fear, helplessness, horror, anger or depression (all $F_s < 2.87$, all $p_s > .07$). There were also no significant group differences for post-film mood ratings (all $F_s < 2.11$, all $p_s > .13$) apart from post-film depressed mood [$F(2,42) = 4.56$, $p = .02$]. Post-hoc multiple comparisons indicated a significant difference between the control group ($M = 2.47$, $SE = .32$) and fixed-view ($M = 3.80$, $SE = .37$) $d = 0.96$ (and survived Bonferroni correction). However, there was a non-significant relationship between post-film ratings of depressed mood and intrusive imagery $r(43) = .11$, $p = .47$.

Film Distress and Relevance Ratings

There were no significant group differences in distress ratings following the film [$F(2,42) = .33, p = .72$] or in ratings of film relevance [$F(2,42) = .32, p = .73$].

Task performance, recognition memory and diary accuracy

There were no significant differences between experimental groups on task performance, for either number of correct answers [$t(28) = -1.73, p = 0.95$] or percentage of correct answers [$t(28) = -1.16, p = 0.26$]. There were no significant group differences in diary accuracy ratings [$F(2,40) = 2.41, p = 0.10$] or for recognition memory one week after watching the films [$F(2,40) = 1.85, p = 0.17$].

Table 1.

Allocation, manipulation and adherence checks

Measure	Condition					
	Control Group		Fixed-View		Shifted-View	
	(n=15)		(n=15)		(n=15)	
	M	SD	M	SD	M	SD
Age (years)	25	6.52	23.73	5.6	22.87	4.72
STAI-T	36.53	9.8	36.93	9.38	36.47	9.58
HADS anxiety	4.67	2.97	4.73	3.69	3.87	2.42
HADS depression	1.67	2.29	2.67	3.29	2.8	2.29
REM-R	24.33	5.05	24.33	3.7	26	4.09
VAS Fear						
Pre-Film	1.93	1.16	1.6	0.83	1.4	0.74

Post Film	4.2	1.8	3.13	1.41	3.27	1.34
VAS Helplessness						
Pre-Film	1.93	1.53	1.53	0.92	1.33	0.72
Post Film	3	1.51	2.4	1.35	2.47	1.46
VAS Horrified						
Pre-Film	1.60	0.99	1.20	0.41	1.07	0.26
Post Film	4.00	1.85	3.60	2.10	4.00	1.85
VAS Anger						
Pre-Film	1.6	1.18	1.47	0.92	1.33	0.62
Post Film	2.53	1.06	2.47	1.72	2.27	1.71
VAS Depressed						
Pre-Film	1.8	1.37	1.53	0.74	1.4	0.63
Post Film	3.8	1.42	2.47	1.25	2.8	1.08
Film distress	2.6	1.06	2.4	0.99	2.67	0.72
Film relevance	1.93	2.09	2.47	1.85	2.33	1.8
Task number correct	-	-	43.4	11.27	35.6	13.33
Task percent correct	-	-	72.91	12.7	65.44	21.41
Recognition memory	19.87	2.45	17.86	4.24	19.29	1.64
Diary accuracy	7.6	1.77	8.71	1.07	7.67	1.65

Note STAI-T = State Trait Anxiety Inventory; HADS = Hospital Anxiety and Depression Scale; REM-R = Reading the Mind in the Eyes Test Revised Version; VAS = Visual Analogue Scale.

The Effect of Experimental Manipulation on Intrusive Memories

Initial Intrusive Memories

A Kruskal-Wallis Test revealed no significant group differences in *initial* (experienced during the VE task or control group music) intrusive thoughts, images or both experienced together (all $X^2 < 3.85$ and all $ps > .15$).

Intrusive Memories over One Week

One way ANOVAs revealed no significant group differences in the number of intrusive thoughts [$F(2,22) = .70, p = .51$] $n^2 = .06$ or the experience of both thoughts and images together [$F(2,31) = 2.51, p = .10$] $n^2 = .14$. However, there was a significant group difference for the number of intrusive images experienced [$F(2,42) = 6.46, p = .005$], $n^2 = .29$ (large). See Table 2.

Posthoc comparisons (Bonferroni adjusted) indicated that the mean number of intrusive images for the control group ($M = 5.53, SE = 1.3$), 95% CI [2.77, 8.30] was significantly higher than the fixed-view group ($M = 2.37, SE = .61$), 95 % CI [.75, 3.38]. The mean difference in intrusive images was 3.47 with 95% CI [-.11, 6.82], $p = 0.03, d = .89$ (large effect size). The shifted-view group ($M = 3.2, SE = .82$) did not differ from either the control group or the fixed-view group. See Figure 3.

Intrusive Thoughts and Images

A paired samples t-test revealed that on average, participants experienced more intrusive images ($M = 3.60, SD = 3.88$) than thoughts ($M = 1.47, SD = 1.98$), [$t(44) = -3.14, p = .003$]. This was the case for each of the conditions, but the difference was only significant for

participants in the control group, [$t(44) = -3.42, p = .004, d = 1.35$ (large effect size)]. The mean difference was 4.87, with 95% CI [1.81, 7.92]. The differences were not significant for participants in the shifted-view [$t(14) = -1.71, p = .11$] or in the fixed-view condition [$t(14) = -.20, p = .84$]. See Table 2 for means.

Intrusive Memory related Distress

A one way ANOVA revealed no significant group differences in the average distress related to IM [$F(2,42) = 1.99, p = .15$].

Table 2.

Effects of experimental condition on intrusive memories over one week

	Condition					
	Control Group (n=15)		Fixed-View (n=15)		Shifted-View (n=15)	
<i>Intrusive Memories</i>	M	SD	M	SD	M	SD
Intrusive images	5.53	4.99	2.07	2.37	3.2	3.17
Intrusive thoughts	0.67	0.98	1.87	2.77	1.67	1.68
Images/thoughts	1.4	2.03	3.13	3.46	3.4	3.36
Related distress	1.86	1.33	1.43	1.10	2.3	1.15

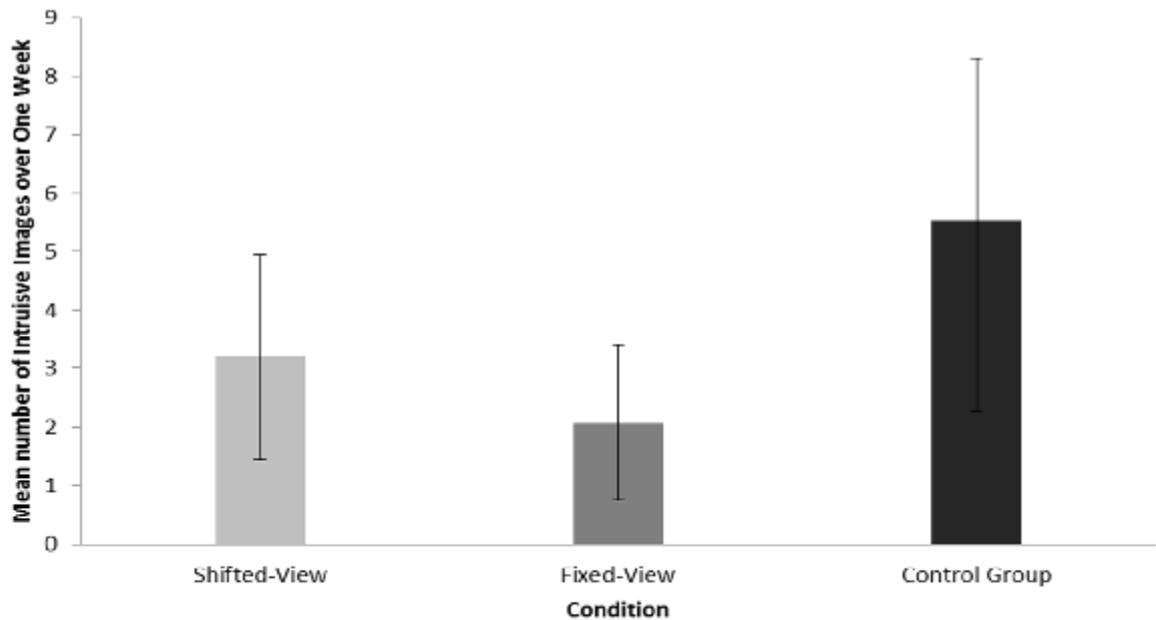


Figure 3. Error Bars represent 95% Confidence Intervals

Figure 3. Mean number of Intrusive Images in each Condition over One Week

Anxiety, Depression, Mentalizing and Intrusive Memories

Spearman's Rank Order Correlations indicated that the independent variables STAIT-T (trait anxiety), HADS anxiety, HADS depression or REM-R (mentalizing) were unrelated to the number of intrusive images, thoughts or both experienced together for the whole sample, in the fixed-view condition or control group (all $r_s < .34$ and all $p_s > .21$).

However, there was a strong, positive correlation between HADS anxiety and intrusive imagery in the shifted-view condition, $r_s(13) = .72, p = .002$ (large effect size). Higher levels of HADS anxiety were associated with more intrusive images. There was also a strong positive correlation between STAIT and intrusive images $r_s(13) = .56, p = .03$. However, this latter association did not survive Bonferroni Holme correction.

Task Performance and Intrusive Memories

Task performance was unrelated to intrusive images, thoughts or both together, in the whole sample or within groups ($r_s < .40$ and all $ps > .14$).

Discussion

Study Aims, Rationale and Hypotheses

Intrusive Memories (IM) are a common and distressing symptom which contribute to the maintenance of PTSD. Early interventions for PTSD are lacking. However, research indicates that carrying out a visuospatial task following trauma films consistently reduces the number of IM compared to a control task. The impact of spatial recognition memory tested from different viewpoints has had limited empirical investigation. More specifically, the role of hippocampal area based systems in the development of IM as hypothesised by DRT. This study therefore sought to investigate whether administering a visuospatial memory task that required either egocentric or allocentric memory processing had a differential effect (compared to a control group) on the number of IM for one week after watching analogue trauma films.

In line with previous research and the DRT, it was hypothesised that participants in the egocentric condition would experience fewer IM compared to the control condition. Previous research shows that lower performance on allocentric memory tasks is associated with more IM. According to DRT, this could indicate poorer allocentric memory and therefore ability to form contextualised memories of traumatic experiences, which would mean perceptual memories dominate and more IM ensue. However, unrelated to

performance it was not clear whether carrying out a hippocampal dependent task at the consolidation stage of trauma memory might increase or decrease the number of IM.

Intrusive Images and Thoughts

Significantly more intrusive images were experienced than thoughts. This is consistent with previous research (Hagenaars et al., 2010) and supports the view that images and thoughts may be produced by different memory systems and can therefore be differently affected at the stage of consolidation. However, visual information may just be more memorable than information within other modalities (Rubin, Burt, & Fifield, 2003) and if visual stimuli dominate as was the case in the films, IM are also likely to be visually based (Rubin, 2005). In line with this, the experience of both thoughts and images together may reflect that some of the films had verbal narration. Future studies could investigate the sensory experience of IM by reducing the visual content and increasing the salience of other sensory stimuli within trauma films.

Compared to intrusive images, both experimental groups experienced a greater number of intrusive thoughts and both thoughts and images together. These differences were non-significant. However, the experimental tasks may have had a common effect in reducing intrusive imagery, but within the process there was a shift towards thoughts alone or alongside images. In line with DRT, this could potentially be the early stages of the contextualisation process, or perhaps part of a temporary suppression mechanism. Therefore, if followed-up for a longer time frame, the differences between groups may not continue. Given that the significant findings were only with intrusive imagery, the discussion focuses on this phenomenon specifically.

Egocentric Memory

Engaging in an egocentric recognition memory task resulted in significantly fewer intrusive images than the control group. This is consistent with several studies (see Brewin, 2013 for a review) and shows that involuntary memories can be interfered specifically by an egocentric visuospatial task soon after watching trauma footage. This finding supports the notion that egocentric representations ('S-reps'), thought to be formed via the encoding of sensory and perceptual detail, may underpin the experience of IM when they are not appropriately translated and balanced by contextualised memories ('C-reps') of the same event (Brewin et al., 2010). The egocentric task may have tapped and competed for the same, but potentially limited, neural resources within the dorsal visual processing stream, in particular the parietal structures involved in visualisation and visuospatial working memory (Bohbot, Iaria, & Petrides, 2004). This could have selectively interfered with the consolidation of sensory-perceptual trauma memories and therefore intrusive images. This process has been termed the 'visuospatial hypothesis' (Deepröse et al., 2012).

Visuospatial Working Memory

The current findings contribute to the view that visuospatial working memory specifically is important in the consolidation of IM (Andrade, Kemps, Werniers, & May, 2002). Studies have indicated modality specific interference on the vividness and emotional impact of negative autobiographical memories (Kemps & Tiggemann, 2007). However, there is controversy over the specificity of the working memory model. Whilst there is some specificity to sensory modality, regions including the parietal cortex and dorsolateral prefrontal cortex are activated across several modalities and thus reflect a multimodal type

of activity (Linden, 2007). The effects of the egocentric task may therefore be due to interference with a general (rather than modality specific) processing system, which has been termed the central executive of working memory (Baddeley & Hitch, 1975).

Medial parietal areas are involved in the storage aspects of spatial working memory. The precuneus (medial parietal structure) is thought to be important in imagery based autobiographical memory as well as the storage and transformation of viewpoint within memory (Burgess et al., 2002). The proposed mechanism behind Eye Movement Desensitisation and Reprocessing therapy (EMDR) is that whilst the image is being held in the precuneus, simultaneous eye movements take up some of the resources maintaining the image which selectively interferes with the visuospatial sketchpad of working memory (Andrade, Kavanagh, & Baddeley, 1997). It is therefore possible that an egocentric task acts similarly, in turn perhaps reducing the salience of S-reps and allowing for corresponding C-reps and the links between them to develop. However, thus far EMDR has only been applied post-consolidation and therefore may not be directly comparable to the effects of visuospatial tasks at the consolidation stage.

Allocentric Memory

Several studies have implicated the hippocampus in allocentric processing and specifically in the allocentric condition of the VE task (King et al., 2002). According to DRT, engaging in an allocentric and hippocampal dependent task may interfere with the consolidation of C-reps and therefore the appropriate spatiotemporal context of the trauma stimuli. This could lead to an imbalance in S- and C-reps (Brewin et al., 2010), potentially resulting in an increase in IM. Alternatively, the allocentric task may promote hippocampal processing of

the trauma films, enhance the development of contextualised memories and lead to fewer IM. In the study, more intrusive images on average were experienced in the allocentric than the egocentric task and less than in the control group, but *neither* difference was statistically significant. An allocentric visuospatial memory recognition task does therefore not appear to impact on the consolidation and frequency of intrusive images. However, the study was underpowered and the differences between the allocentric and egocentric and/or control group may have been larger with a bigger sample. On the other hand it should be noted that the effects of verbal tasks which also tap MTL structures, notably the hippocampus have been variable (Brewin, 2013). A number of possible theoretical and methodological explanations for the non-significant findings are discussed below.

Overlapping Memory Systems

DRT proposes dissociable but related context-conceptual memory and sensory-perceptual systems which both operate (differently) within healthy memory and intrusive trauma memories. The non-significant findings suggest that different memory processes draw on the same brain regions. The neural processes supporting egocentric and allocentric memory are likely to overlap (King et al., 2002), with the allocentric task also having employed egocentric processing (e.g. Dhindsa, Drobinin, King, Hall, & Becker, 2014). In addition, viewpoint transformations (e.g. egocentric to allocentric coordinates) are complex and implicate a range of brain regions (Byrne, Becker, & Burgess, 2007).

Byrne et al (2007) propose that viewpoint translation takes place in the retrosplenial cortex (RSC) and also involves the intraparietal sulcus. The RSC is positioned well to do this because of reciprocal connections with parietal and MTL regions. Both the RSC and

intraparietal sulcus are also associated with visuospatial processing and cognitive control. Furthermore, the caudate has been activated during an allocentric task (Dhindsa et al., 2014) as well as having a role in egocentric, sensory and working memory representations. The precuneous/medial parietal cortex as previously mentioned is suggested to be responsible for maintaining egocentric representations. Parietal regions also have reciprocal connections with the frontal lobe areas involved in working memory. There are therefore a range of interconnected brain regions, potentially employed by both egocentric and allocentric conditions. According to DRT this may mean that these types of memory tasks are unlikely to have significantly different effects on the consolidation of IM.

Sensory-perceptual processing taking place within the allocentric task may have reduced the development of intrusive images. This could explain why there were less intrusive images experienced in the allocentric group than the control group. However, allocentric memory also places greater demands on the hippocampus than the egocentric memory (King et al., 2002). This could have impacted on the translation of sensory-perceptual S-reps and the development of contextualised C-rep based memories. In turn, this may have resulted in a small increase in intrusive images in the allocentric group compared to the egocentric group.

Insufficient Interference

The exact role of the hippocampus within spatial memory remains uncertain. However a review of hippocampal function (Burgess et al., 2002) suggested that the left hippocampus is involved in verbal or narrative memory and the right in allocentric memory processing. Therefore, perhaps allocentric processing (in this study) and verbal processing (other studies) alone are insufficient to interrupt hippocampal function and contextualisation of

memories. Insufficient interference may also be owing to the analogue trauma and thus low physiological arousal. Future studies could measure physiological arousal and explore the effect of a combined verbal and allocentric based memory task.

The Control Group

Participants in the control group listened to (subjectively) neutral pieces of classical music. The rationale for this was to minimise visuospatial processing which may confound the effects of the experimental manipulation. However, listening to music can have its own effect on mood (Zentner, Grandjean, & Scherer, 2008) and multiple brain regions, some of which overlap with those implicated in the human stress responses (Thoma et al., 2013) as well as visuospatial and episodic memory (Särkämö & Soto, 2012). Listening to music could therefore have had its own impact on the consolidation of intrusive imagery and therefore the effects seen may not have been entirely attributable to the egocentric task. This was perhaps indicated by slightly higher numbers of intrusive images experienced by this control group compared to similar studies where no task control groups were used (e.g. Holmes et al., 2010). It is also possible that in a no-task or in the music control group themselves, processes such as rumination take place resulting in an increase in IM (Ball & Brewin, 2012).

Intrusive Imagery Related Distress

Ratings of intrusive memory related distress were relatively low in this study and were unrelated to experimental manipulation, despite a higher frequency of intrusive images in the control group. This is consistent with previous research. Meyer et al (2012) found spatial configuration learning to be related to intrusive memory frequency, but unrelated to affective

responding of trauma. This suggests that visuospatial tasks have implications for the initial consolidation and frequency of IM, but less impact on the affect with which the trauma memory is experienced or on other PTSD symptomology. However, the hippocampus has a role in the encoding of appropriately contextualised memories, the existence of which are thought to help regulate emotional responses to reminders of a traumatic event (Davidson, Jackson, & Kalin, 2000). Furthermore, given that IM are experienced with distress, reducing their frequency may have an overall impact on PTSD related distress and its impact.

The Complexity and Heterogeneity of PTSD

Research increasingly shows PTSD to be a complex disorder with multifarious causes (Zoladz & Diamond, 2013). The psychological construction approach (Suvak & Barrett, 2011) highlights the limitations of neurobiological accounts in explaining the heterogeneity of PTSD symptomology, including the different experiences of IM (Kvavilashvili, 2014). It proposes that the neural circuitry underlying fear is transdiagnostic and non-specific to PTSD. It also emphasises the complexity of different peritraumatic responses and the range of factors involved in the development and experience of PTSD (Suvak & Barrett). DRT incorporates several such factors in relation to intrusive imagery. However, many (amongst others), for example the controllability of memory; the level of memory organisation; and the dominant perspective of the memory, were not accounted for by this study and may have played a role in imagery frequency.

Anxiety, Depression and Mentalization

There was a large (and significant) association between state anxiety and intrusive images in the shifted condition. Soon after a stressful event, an anxiety response in the body is

triggered: the hypothalamus activates the autonomic nervous system which responds by releasing hormones (such as adrenaline, noradrenaline and glucocorticoids) and neurotransmitters (Joëls & Baram, 2009), activating the amygdala and also, possibly owing to its high density of glucocorticoid receptors (McEwen, Weiss, & Schwartz, 1969), affects hippocampal functioning.

The impact of emotional stress on hippocampal functioning is thought to be time dependent (Diamond, Campbell, Park, Halonen, & Zoladz, 2007) according to the period of long-term potentiation (Schwabe & Wolf, 2013). Stress before a spatial memory task can impair memory performance (Wolf, 2009). However, unlike previous studies (e.g. Meyer et al., 2013) there were no group differences in task performance or associations between performance and IM in this study. The latter may be due to insufficient physiological arousal and hippocampal impairment within an analogue design. However it is possible, in light of hippocampal vulnerability (McEwen et al., 1969), that in addition to the impact of stress from the film, the allocentric task made further demands on the hippocampus which lowered the threshold for the effects of anxiety in comparison to the egocentric task. Therefore, state anxiety had greater impact, may have interfered with the consolidation of C-reps and thus been associated with a greater number of IM. However, stress can differentially effect multiple memory systems, not just those involving the hippocampus (Schwabe & Wolf, 2013). Therefore, without neuroimaging and physiological measures used over time, the impact of stress and the allocentric task, and the potential neural mechanisms underpinning the association between anxiety and imagery remain unclear.

There were higher levels of depressed ratings in the control group post-film. Depressed ratings did not significantly explain the variance in the intrusive imagery and is unlikely (as is any single factor) to be non-predictive in isolation (Bovin & Marx, 2011). However, it may have *contributed* to the higher levels of imagery in the control group.

Autobiographical memory, trauma memory, allocentric processing and mentalizing all involve the medial temporal lobes (including the hippocampus) and the mid prefrontal cortex (Perry, Hendler, & Shamay-Tsoory, 2011). Associations between these constructs have also been identified within PTSD (Allen, Lemma & Fonagy, 2012; Brewin, 2007; Fonagy & Target, 2006). In contrast to a previous study (Kamboj et al., 2014) performance on REM-R was not associated with IM. This may be due to methodological limitations of the study, but could also reflect that at present this is only a tentative association within a complex disorder. Future studies could further investigate the role of physical view point taking (i.e. allocentric processing) and different psychological constructs of viewpoint taking (e.g. mentalization, empathy, theory of mind) in the development of IM.

Memory Models

DRT is one of several models developed within the area of AM and PTSD. Some of these models overlap conceptually, for example in suggesting that IM are a result of normal autobiographical memory acting under stress (e.g. Rubin, 2005) and this can affect the appropriate integration of the event into an existing knowledge base (Ehlers & Clark, 2000). Some models incorporate neural mechanisms (Conway & Pleydell-pearce, 2000), but also emphasise the importance of factors such as personality, cognition, attachment, emotion and culture. Depending on their emphasis, other models or theories may question the relevance

of memory consolidation and appropriateness of interference. It is not within the scope of this discussion to review all of the relevant models. However, several are summarised briefly below.

Emotional processing theory (Foa & Kozak, 1986) emphasises the importance of successfully processing the traumatic memory in order to prevent PTSD symptoms such as IM. This theory may therefore question the appropriateness of interfering with the encoding or consolidation of trauma memories.

A cognitive model (Ehlers and Clarke, 2000) focuses on the importance of cognitive appraisal in memory symptoms within PTSD. The two main cognitive processes are individual differences in appraisal of threat and in how the trauma memory is incorporated into the existing autobiographical knowledge base. Within analogue studies therefore, the potential role of these processes within the consolidation of IM could be investigated.

Voluntary recognition memory of the trauma film did not differ between groups. This is consistent with previous studies (Brewin, 2013), supports the distinction between involuntary and voluntary memory (Conway & Pleydell-Pearce, 2000) and that only the former are modulated by visuospatial tasks. However, no such distinction is made by the basic systems approach to autobiographical memory (Rubin, 2005). This model suggests that autobiographical memories are made up of multiple sensory systems, that PTSD results from the alteration to one or more of these systems, but that no special mechanisms are involved. Accordingly, the involvement of two major visual processing pathways as proposed in DRT

would be unlikely and manipulating only spatial memory may not impact on the experience of IM.

Conway & Pleydell-Pearce (2000) place autobiographical memory within a self-memory system. This model proposes that a traumatic event presents a threat to the working self, one's plans and goals and this can impact on memory encoding: either the event cannot be encoded and amnesia ensues or the experience cannot be integrated into the knowledge base. Instead, the traumatic experience becomes associated with the self-system, its goals and overall psychological wellbeing. Within analogue studies, the encoding of trauma films in relation to the self and whether this is involved in the experience of IM could therefore be explored.

Strengths

This study was novel in investigating the effect of engaging with egocentric or allocentric memory tasks after exposure to analogue trauma on the number of IM experienced. A particular strength was the complete matching of the visuospatial tasks in all respects but viewpoint manipulation. Using the VE task and analogue trauma design provided a controlled way of investigating the effect of viewpoint dependence in spatial memory on IM and in doing so, this study contributed to the growing body of research in this area.

Limitations

Analogue Trauma Design

There are several limiting factors in this study, some of which have been offered above to explain the study findings. The analogue trauma film design is different to the experience of

real life trauma, thus limiting the external validity of the study. However, it has consistently induced symptoms in non-clinical participants (Holmes & Bourne, 2008) and, although debatable, the trauma films could be considered to meet DSM-5 criteria of ‘witnessing the traumatic event’ (APA, 2013).

Participants

The study sample was healthy participants, the majority of whom were students. Therefore, the range of factors present in the wider population which could influence the response to trauma may not have been represented in this sample. In addition, given that working memory is related to academic performance (Conway, Kane, & Engle, 2003) a largely student population may have performed better on the VE than some other demographic groups.

Design

Participants were allocated in turn to the experimental groups, whilst controlling for gender. Systematic bias was not expected given the independence of participants, and a priori randomisation was considered an unnecessary addition to the protocol. There were no significant group differences at baseline. However, this is not a truly randomised method and there were higher depressed mood ratings in the control group post-film, which may or may not have represented a systematic factor. This reduces the internal validity of the findings. In future computer generated number randomisation, which can also stratify for gender could be used ahead of recruitment to avoid this error.

Control Condition

The study did not include a no-task control group. The music chosen for the control group was not piloted and the potential effects of the music (as previously discussed) were not controlled for.

Town Square Task

There was greater variability in performance on the allocentric task than on the egocentric task, which may have influenced the consistency of any effects. The conditions have been matched for difficulty, but it is likely that allocentric memory ability is more variable given that egocentric processing is dominant in everyday life. The task was also delivered almost immediately after watching the video. However, those experiencing real life trauma are unlikely to access intervention until well after the stage of memory consolidation (Walker et al., 2003).

Measures

All measures used were self-report. In addition, factors measured in similar studies (e.g. Deerprouse et al., 2012; Holmes et al., 2010) were not included, such as attention, which is closely related to working memory, relying on parietal and prefrontal regions (Corbetta & Shulman, 2002). Differences in these measures may have contributed to the study findings. However, participants were generally observed to be engaged with the task and motivated to do well.

Fear, helplessness and horror are no longer considered to be predictive of PTSD symptoms and have been removed from DSM 5 (APA, 2013). Instead, measuring anxiety pre- and

post-film and task may have been helpful in understanding the association between anxiety and imagery within the allocentric group.

The intrusive memory diary was modelled on previous studies (e.g. Holmes et al., 2010) and is subject to variation in accuracy and compliance. In comparison to the online daily submission, the paper method is also at greater risk of being completed retrospectively at the end of the week. Alternative methodology could be considered (see Bolger et al, 2003). For example, participants could be asked to send text messages immediately after experiencing IM.

Analyses

Due to time restraints, fewer participants were recruited than outlined with the power calculation. The study is therefore likely to be underpowered. Type two errors were therefore more likely as were large effect sizes (Cohen, 1992). There were also relatively large standard deviations, issues with skew and wide confidence intervals. These factors reduce the validity of the finding that fewer IM were due to the effects of egocentric memory processing, particularly as significance value was only a little below .05.

Future Considerations

Exposure to analogue trauma via video could be likened to a field perspective in the image literature. However, observer perspective is more common in psychopathology (Kuyken & Howell, 2006). Therefore, using simulator technology it may be possible recreate trauma footage with a more observer dominant perspective and this may have more ecological validity. However, this would pose ethical questions. Alternatively, egocentric viewpoint within the trauma films could be frozen and rotated to gain an allocentric viewpoint. This

could be used to explore the suggestion by DRT that allocentric memory of a traumatic event is important in its appropriate integration within existing memory. To investigate the effects of spatial memory at the encoding stage and the potential time dependent effects of stress, the VE task could also be administered prior to, or interspersed at, different points during the films. With the aforementioned manipulations, future studies could also use neuroimaging (e.g. Bourne et al., 2013) and neurophysiological measures to better understand the processes involved.

Conclusion

This study was the first to administer a post-trauma task that matched egocentric and allocentric aspects of memory processes. Findings indicated that egocentric memory processing during memory consolidation may be a way of reducing intrusive imagery. This is consistent with a growing body of research showing that visuospatial tasks have this effect. It also supports DRT - that egocentric memory and visuospatial working memory processes are relatively stronger within trauma memory consolidation and that hippocampally-based memory processes are relatively weaker. Carrying out a hippocampally dependent allocentric memory task did not have significant influence on intrusive memory frequency. In line with DRT, this is likely to be due to the egocentric aspects of the shifted-view task reducing sensory-perceptual processing and the allocentric component acting in the opposite direction - interfering in the contextualisation of memory.

There are multiple brain regions, neural processes and psycho-social factors involved in PTSD which exist pre, peri and post trauma (Zoladz & Diamond, 2013). This is further complicated in cases of multiple trauma and complex PTSD. IM are only one symptom of

PTSD, but are nonetheless debilitating. Studies with clinical populations are needed to understand the risk factors for developing IM and for whom visuospatial tasks might be most effective. Accident and Emergency and military populations may present opportunities in which to move this research forward. However, this is not without ethical dilemmas, particularly given the rates of natural recovery (Kessler et al., 1995). In addition, given the reported ineffectiveness of early debriefing for trauma (Rose et al., 2009), interventions such as CBT delivered when symptoms have persisted past one month remain important. However, in populations with a PTSD diagnoses, egocentric memory tasks could be used within the structure of EMDR to see if there are similar effects on consolidated memory, which may be open to reconsolidation (Nadel, Hupbach, Gomez, & Newman-Smith, 2012).

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Part 3: Critical Appraisal

Introduction

This critical appraisal of the research process focuses on four main areas. First, how my initial way of thinking about mental health was shaped, and the role of this in project selection. In addition, how research for the empirical study and experience on clinical placement informed the direction of the literature review. Secondly, how the research process and clinical experience prompted interest and consideration of PTSD as a construct. Thirdly, on the conceptualisation of intrusive memories, the issue of intrusive memory measurement and considerations for future research. Fourthly, I reflect on two particular learning experiences during the research process before a final summary of the appraisal.

Project Selection

My undergraduate degree involved a number of neuropsychology, neuroscience and clinical disorder based modules. This had shaped a categorical view of mental health disorders, often as having some form of neurobiological basis, including Post Traumatic Stress Disorder (PTSD). A research assistant post carrying out diagnostic interviews based on The Diagnostic and Statistical Manual of Mental Disorders 4th Edition (DSM IV; American Psychiatric Association, 2000) criteria further reinforced this. Lectures on the doctorate course had also encouraged an interest in theories and potential neural mechanisms involved in the process of psychological difficulties and interventions (Makinson & Young, 2012). The retrieval competition theory (Brewin, 2006) initiated a curiosity in the idea of memory representations as a way of conceptualising some of the mechanisms involved in anxiety as well as interventions such as Cognitive Behaviour Therapy (CBT). In addition, the idea of brain changes within psychological therapy (Frewen, Dozois, & Lanius, 2010) led me to read around this and the bidirectional influences between biological/neurological and

psychological factors. A project investigating a neurobiological based theory to understand specific symptoms within PTSD was therefore of interest.

Imagery: Transdiagnostic and on a Continuum

Within clinical work the neurobiological based understanding of PTSD and intrusive memories (IM) has been useful; helping to normalise intrusive memories and engage clients in treatment. Experience on placement also developed a transdiagnostic view of mental health (Harvey, Watkins, Mansell, & Shafran, 2004). In particular, negative imagery appeared to be on a continuum and present across different anxiety presentations. Such imagery is often linked to memories of adverse events and research increasingly shows it as being present across a range of mental health problems (e.g Brewin et al., 2010). Imagery can be distressing and uncontrollable. It is therefore often avoided which makes it a maintaining factor (Harvey et al., 2004). Through clinical experience and exposure to relevant research, the appropriateness and value of transdiagnostic interventions (McEvoy, Nathan, & Norton, 2009), particularly those that utilise imagery, thus became apparent.

A range of imagery techniques are used within different mental health presentations (e.g. Brewin et al., 2009; Long et al., 2011; Tatham, 2011) and researchers emphasise the importance of transdiagnostic interventions: 'If it were feasible to develop transdiagnostic treatments, the public health implications would be startling' (Harvey, 2008 p. 299). An interest in imagery, its growing basis within research (Brewin, et al., 2010) and the importance of transdiagnostic techniques influenced the direction for the literature review.

Identifying transdiagnostic processes contrasts to the medical approach which focuses on researching specific disorders and placing them in categories. The latter approach has been criticised for neglecting the similarities across disorders (Harvey, 2008). However, diagnosis and categorising specific mental health disorders are considered useful for providing a framework within clinical practice, for facilitating communication between professionals and in identifying appropriate treatments and likely outcomes (Tyrer, 2013). Such categories also help form the basis of research, which in turn perhaps reinforces the compartmentalisation of disorders. In addition, within health services, funding can be dependent on specific diagnoses having been entered into service database systems. However, the transdiagnostic approach would suggest that specific diagnoses are not necessary. Experience of working in different services from primary care to inpatient units, in a range of demographically diverse areas has made me question the appropriateness of categorical diagnosis and instead take a continuum view. It has also reinforced and helped me to understand the significance of considering wider contexts when thinking about difficulties and individual responses. This is in contrast to the nature of the empirical study and my initial perspective which focused on specific disorders and their neuropsychological basis. Clinical experience alongside investigating the phenomenon of (IM) in the context of a neurobiological based theory has prompted the consideration of other mechanisms, perspectives, wider socio-political and cultural factors and also the construct of PTSD more generally.

The Construct of PTSD

There is ongoing debate over PTSD as a diagnosis (e.g. Rosen & Frueh, 2007), what constitutes a traumatic event (Rubin, Berntsen, & Bohni, 2008) and what peri and

posttraumatic responses may be most relevant (Bovin & Marx, 2011). This is perhaps partly reflected in the changes within the diagnostic criteria for PTSD in each edition of the DSM. This became particularly apparent with the release of DSM 5 (5th ed.; *DSM-5*; APA, 2013) during the research process, in which PTSD was also moved from being placed within anxiety to trauma and stressor-related disorders. The specific and individualistic focus on IM taken by the empirical study was more in line with the medical model which informs DSM. The ongoing debates and the release of DSM 5 however, reinforced the need to reflect on the validity of analogue trauma, measures used within the study and more widely the appropriateness of DSM criteria and the approach it takes.

The medical model defines PTSD as a mental disorder which results from damage to the structure and functioning of the brain (Tyrer, 2013). Its placement within DSM suggests that an individual either develops PTSD or they do not. There is a focus on identifying symptoms, for example IM and linking them to specific pathophysiological processes. This approach therefore prompts research to focus on differences in the brain within PTSD and on the prescription of specific treatment. This approach has been criticised for overemphasising the role of neurological processes (Bracken, Giller, & Summerfield, 1995). It also contrasts to clinical work as a psychologist where time is spent formulating and hypothesising about an individual client's presenting difficulties. These processes involve the consideration of multiple factors and levels of context, often with a focus on individual meaning (Johnston & Dallos, 2006). This contrast forced me to reflect on the body of research in which my study fell; to consider whether it reinforces an emphasis on the traumatic event itself and neural processes, and in doing so reducing the focus on other important factors relevant to individual context.

There are differing but also sometimes complementary perspectives on PTSD. For example, biological, cognitive, behavioural, spiritual and systems approaches (Jakovljevi, Brajkovi, Jakši, & Lon, 2012). The systems approach looks at different levels of context, for example: the role of the body, energy, familial, social, political, religious and mental systems within an individual's response to a traumatic event. There are also different views on the responses or symptoms that typically follow traumatic stress, and what treatment should look like.

PTSD as a diagnosis has been viewed as pathologising a normative response to traumatic stress (Summerfield, 2001). In a similar vein, PTSD is seen as a socially constructed diagnosis, bound in European-American, egocentric societies (Bracken et al., 1995). Within this view, PTSD is not a legitimate disorder and diagnosis can inhibit recovery by reducing the importance of individual meaning. Meaning is often a focus of systemic therapy and is seen as fundamental to understanding psychological difficulties (Boston, 2000). Within transdiagnostic phenomenon such as imagery, the idiosyncratic meaning given to a particular event and the experience of the traumatic memory is also thought to be important (Nilsson, Lundh, & Viborg, 2012; Ehlers & Clark, 2000).

Latent class analyses (LCA) have been used in studying the construct of PTSD (Steenkamp et al., 2012). Such analyses have shown PTSD to be dimensional and heterogeneous. This is at odds with the dichotomous concept of PTSD. Such an approach could be viewed at risk of failing to identify the significant distress and impact caused by subclinical levels of PTSD. However, studies using LCA also suggest that there may be homogenous subgroups within a

spectrum of responses to trauma. For example, in terms of: no disturbance, intermediate disturbance and pervasive disturbance. Differences in symptom severity and quality were highlighted between these groups, but not necessarily in the types of symptoms. For example, reexperiencing symptoms including IM, flashbacks and nightmares all occurred on a spectrum across these subgroups.

Intrusive memories have been incorporated into the normative response view to traumatic events, in which case it may be other factors rather than just exposure to an event which mean traumatic memories persist and are distressing (Bracken et al., 1995). With this view, peri or posttraumatic interventions to prevent IM may not be the most important area of consideration. Indeed the IM reported within analogue studies can be viewed as a normal response and may potentially be part of the contextualisation process (Brewin et al., 2010). In this view it might be asked whether it is actually useful to measure and prevent IM at this stage at all.

Understanding IM and the mechanisms at the consolidation stage does appear to be warranted. The nature of the memory itself has been considered more important than the details of the traumatic event itself (Rubin et al., 2008). It perhaps offers better insight into individual meaning and experience and is more predictive of PTSD symptomology than the nature of the event. This mnemonic model emphasises that it is the interaction between the person and the event that can predict whether PTSD will follow. It also still validates PTSD as a clinical disorder which other theories do not (e.g. Summerfield, 2001). A study by Bourne, Mackay, & Holmes (2013) indicated that the brain behaves differently during emotional events that will later become flashbacks. This therefore suggests that

understanding the neural basis of flashback memory consolidation within analogue studies is important and could contribute to the development of interventions for this symptom of PTSD.

If it is the nature of the memory rather than the specific event which is important, this would impact on whether DSM has to define what constitutes a traumatic event at all. The model does not however discount the importance of the event and its impact, for example loss of life or home. DSM criteria focus on the pathogenic nature of the event, whereas Rubin et al (2008) explore the implications of a PTSD diagnosis based on pathogenic memory. They also argue that peritraumatic emotions are more difficult to cluster than DSM suggests. A general memory model of PTSD is put forward by Rubin et al, which is in contrast to specific detailed theories and dimensional diagnoses. It is suggested that such a model has greater potential to facilitate research and understanding PTSD.

The focused empirical study may not have taken account of important influencing factors. However, the analogue design does provide a forum in which to explore and isolate processes with experimental control and this can contribute to a wider understanding. Such experimental studies do not necessarily exclude the importance of other factors being involved. Focusing on specific symptoms rather than looking at one disorder in isolation may also facilitate the growth of the transdiagnostic approach and contribute to understanding different phenomena that occur on a continuum across clinical and non-clinical populations.

The Construct and Measurement of Intrusive Memories

Within DSM 5 the cluster of reexperiencing encompasses the terminology spontaneous memories and flashbacks (APA; 2013). Studies using LCA (Steenkamp et al., 2012) by contrast make the distinction between intrusive memories and flashbacks. Kvavilashvili (2014) makes the point that terms such as involuntary autobiographical memories, IM or flashbacks are often used interchangeably, and whilst these are on a continuum, they are qualitatively different experiences. This should therefore also be made within analogue trauma studies to improve the internal validity of measurement and to make the study more generalizable as a whole. However, distinctions are not always made by researchers. For example, analogue studies have used the term flashbacks to describe the participants' experiences (e.g. Holmes et al., 2010). It could be argued that these experiences are not analogues to real life trauma responses where there is a sense of an event actually happening again. Instead they are IM, which are about the negative event and are unwanted but not with the same sense of 'nowness' as flashbacks.

Analogue trauma design could be used to explore the range of reexperiencing phenomena, for example, nightmares as well as differences between IM and flashbacks. This might develop a better understanding of the relationship between IM, flashbacks and nightmares. Studies demonstrating the dimensionality of PTSD (Steenkamp et al., 2012) indicate the importance of identifying different symptomology, their ranging severity and quality. This is because whilst diagnostic criteria may not be met, individual symptoms can still cause significant distress and dysfunction.

The phenomenology and definition of intrusive imagery and memories continue to be explored (Brewin et al., 2010), as do the theoretical assumptions underpinning them. However, the conceptualisation and measurement of IM is made challenging by their being a subjective experience and being placed on a continuum. The process of the literature review further highlighted their transdiagnostic nature, and the range of measures that can be used. It was therefore challenging to bring the findings of different imagery restructuring studies together in a meaningful way. It also forced me to question what was actually being measured within the empirical study and where the IM reported by participants could be placed on a continuum that exists within PTSD as well as across other psychopathology (Brewin et al., 2010). In consideration of this, which terminology to use remained a dilemma throughout the research process.

The empirical study used a self-report diary to measure IM which only looked at frequency and associated distress. Using such a specific measurement therefore limited the richness of the data collected. However, the research process has given insight into the diverse experience of IM and the factors related to the experience of imagery (e.g. vividness). The range of responses given in diaries nonetheless reinforced the continuum nature of intrusive memories. This prompted further curiosity about the influence of the participants' wider context, risk and resilience factors and individual meaning within non-clinical as well as clinical populations (Summerfield, 2001).

Self-report measures provide an efficient way of collecting a wide range of data. However, they are known to lack validity (Barker, Pistrang & Elliot, 2002). Furthermore, human memory even outside of PTSD can be unreliable and fragmented (Brewin, 2013). Any

aspect of autobiographical memory is therefore difficult to conceptualise and measure. Transdiagnostic research has found that the type of measurement used has an impact on the findings around intrusive memory (Hagenaars, van Minnen, Hoogduin, & Verbraak, 2009). I therefore wondered how diary methodology in analogue trauma studies may influence the findings around IM.

Diary methodology is diverse and should be adapted to the specific study question and phenomenon (Bolger, Davis, & Rafaeli, 2003). The diary used time intervals (morning, afternoon, evening) as a structure for recording IM. However, any diary is subject to forgetfulness and retrospection bias and for recording ongoing experiences such as memories, a fixed-schedule interview has been recommended. Measuring for one week may also be arbitrary. Indeed, if there was no structured measure at all, both the frequency and duration with which IM are reported could differ.

A review by Pearson et al., 2013 provides a summary of different measures in imagery and recommendations for the different areas of measurement. This review and the limitations of analogue trauma studies may be helpful in thinking about measurement in future research. Qualitative measures could perhaps be used to enrich the understanding and conceptualisation of IM that are experienced within analogue trauma studies. Pearson et al proposes several areas for imagery measurement which analogue studies could employ. For example: appraisals and meaning of the trauma film, the impact, response to the images (e.g. internal and behavioural strategies used to avoid them or whilst they are experienced), controllability, intrusiveness, emotionality, physiological responses, perspective, sensory aspects, completeness, coherence, vividness, 'here and nowness'. Research so far shows

there to be differences and overlap between IM in PTSD and other psychopathology (Hagenaars et al., 2009). Using some of the aforementioned measures could therefore help explore whether IM in analogue studies are closer to those within PTSD or to those in other anxiety disorders. However, using multiple measures within diaries may reduce the reliability and validity of their completion and should therefore be kept relatively focused (Bolger et al., 2003) as the empirical study did.

Analogue studies and diary measures could perhaps be extended to imagery that might result from exposure to films of different types of traumatic and negative events. Ethics are of course a consideration, but such events could involve being subjected to virtual humiliation or ridicule as in social anxiety or to someone being harmed by a specific animal as may be the cause for specific phobia. The impact of visuospatial tasks on any intrusive imagery that ensues could then be investigated. This may indicate whether similar or different processes are involved in the encoding and consolidation of IM in PTSD and anxiety disorders.

Learning Experiences

Learning about analogue studies and the idea of exposing others to trauma films forced me to consider my stance on the ethics of such research. I started to consider the nature of stimuli that the general population are exposed to through media and conversation. It often seemed to include graphic and disturbing images and detail of events taking place within our community; not very different to that of the analogue trauma films. Therefore, a study which may contribute to the understanding of responses to such material in which screening took place, participants opted into and could withdraw from at any time seemed important and

justifiable. The withdrawal of one participant due to concerns about anxiety following the film led me to revisit the question of ethics. It also provided a useful learning experience in a number of different ways. One was reflecting on the difference in responding to a participant in the context of a research study rather than as a client within a mental health service. This drew on clinical skills but also required thought about boundaries, my limitations in intervening and professional responsibility. Involving supervisors appropriately was a key step in order to address the situation, report the incident to the ethics committee and make the necessary amendments. Negotiating the experience raised my own anxiety levels but negotiating these different stages enabled me to reflect on the importance of supervision and ethics committees. In addition, it also highlighted the potential for differentials within research studies, as has been much explored within therapeutic relationships (Perlin, 1991). As with any study, the point and right to withdraw at any time was emphasised and the participant was able to raise their concerns. However, the researcher power dynamic could still remain, one which may be particularly important to consider in studies which involve exposure to unpleasant stimuli.

The research process involved working with a research assistant who collected some of the data. This was a valuable experience and gave me insight into the position of a supervisor rather than a supervisee. It required negotiation of her role, time, explanation of the theory and emphasis on the importance of consistency within the experimental method, whilst also encouraging the assistant to feel confident in the role. During the process I came to consider the dynamics between a researcher and a research assistant, particularly as the main reasons and focus for being involved in a project may differ. Perhaps the main aims for the assistant are to gain experience, whilst also being conscientious to do a thorough job. The researcher

however is perhaps concerned with ensuring a methodologically and ethically sound study which results in reliable and valid data. This again caused me to reflect on the potential for power differentials. For example, in needing more data to be collected, but also recognising the assistant's own academic workload. The experience gave insight into balancing dependence and autonomy for the research assistant, and also the importance of providing a forum which is approachable in which questions can be asked and concerns can be raised.

Summary

The critical appraisal provided an opportunity to consider my own stance in relation to psychological disorders and symptoms. In particular, the use of categories and continuums and how this has been influenced by the research process and clinical experience. My views have broadened, particularly when thinking about multiple perspectives, the role of different factors and their dynamic interplay within mental health. These multiple perspectives are in contrast to focusing on one specific theory which was at the core of the study. The issue of conceptualising subjectively experienced phenomena has also been highlighted as well as the challenges this presents for measurement. Finally, the research process has provided valuable personal and professional experience for potential clinical, supervisory and research roles in the future.

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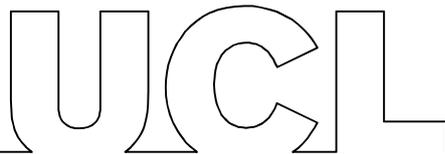
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Appendices

Appendix A: Information Sheet and Consent Form



RESEARCH DEPARTMENT OF
CLINICAL, EDUCATIONAL AND
HEALTH PSYCHOLOGY



Dr Sunjeev Kamboj
UCL Tel: 0207 679 1897
UCL Fax: 0207 916 1989

VOLUNTEER INFORMATION LEAFLET

Emotional and spatial information processing and simulated trauma memories: An experimental investigation.

Recognising and remembering emotional information is a key part of human cognition. For example, being able to remember where and when an event was and how you felt at the time. The flip side of this is that some emotional information can be processed in unhelpful ways. In order to gain a better understanding of human emotional processing we are examining how people process spatial information, as well as how they lay down memories for emotionally salient events.

Who may take part?

Healthy men and women aged 18-40 years AND for whom are fluent in English AND who have not received any treatment for any previous mental health problem AND have not taken part in a similar study before.

Do I have to take part?

Your participation in the study is entirely voluntary and you are free to withdraw from the study at any time without giving a reason, even if you have previously given your written consent. If you do agree to take part, you will be asked to sign a consent form and will be given this information sheet to keep.

What will happen to me if I take part?

We will arrange for you to attend 1 appointment at UCL and to complete some questions via email 1 week later. At session 1 you will be asked to complete some questionnaires about your current mood and usual emotional state. You will then be asked to complete a computer task which involves remembering the location of different objects. Following this, you will watch a short film (~20 minutes), and complete some more questionnaires. You should be aware that the film contains graphic scenes including injury and death which some people may find distressing. Session 1 will last for approximately 1-1.5 hours. Between session 1 and 2 you will fill in a simple paper diary of any spontaneous flashbacks / memories about the film. You will be reminded to do this by daily SMS text

messaging. 7 days later you complete some questions about the film and any effects it had on you. This will last for approximately 5-10 minutes. Once these questions and your diary have been completed and returned (your diary will be returned by free post) you will receive an expenses payment. You may contact the researchers at any time during or after the study if you experience any difficulties.

What do I have to do?

If you agree to take part in the study you will be expected to:

- § Attend UCL for 1 session and participate in 1 email correspondence 1 week later (totalling 1.5-1.75 hours)
- § Complete pen and paper questionnaires
- § Watch a short film which contains some graphic scenes and complete two computer tasks
- § Fill in a pre-prepared paper diary for the week between sessions

What are the benefits of taking part?

By taking part in this research you will be helping us to gain a clearer understanding of human information processing associated with spatial and emotional memory. You will be paid a fixed rate of £10.00 or 3 course credits to thank you for your time.

What are the possible risks of taking part?

You should be aware that the film contains graphic scenes including those of injury and death which some people may find distressing. After the film some people may have spontaneous thoughts and images or experience mood changes. In previous research with this film involving over 100 participants, no long-standing emotional problems have been reported but it is impossible to guarantee zero risk to you.

Will my taking part in the study be kept confidential?

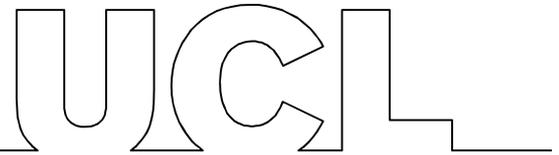
Data will be collected and stored in accordance with the Data Protection Act 1998. Any information you give about yourself in addition to the results of any tests will be held in confidence and will not be made public or disclosed to anyone other than the investigators. Your results will not be identified by your name as you will be given a participant number. Therefore, if the results of the study are later published for scientific purposes (e.g. in an academic journal) you will not be identified. You will receive feedback when the study is completed.

Who should I contact for further information?

Any questions you may have about the study should be directed in the first instance to the researchers Rebecca Polack who is contactable by telephone: [REDACTED] email: r[REDACTED]
If they are unable to answer your questions you may also contact the principal researcher Dr Sunjeev Kamboj by telephone: 0207 679 1958 or email: sunjeev.kamboj@ucl.ac.uk



**RESEARCH DEPARTMENT OF CLINICAL,
EDUCATIONAL AND HEALTH
PSYCHOLOGY**



Informed Consent Form for Participants in Research Studies

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Project Title: Emotional and spatial information processing and simulated trauma memories: An experimental investigation.

This study has been approved by the UCL Research Ethics Committee
[Project ID Number]: 3233/001

- § Thank you for considering to take part in this research. The person organising the research must explain the project to you before you agree to take part.
- § If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.
- § I understand that if I decide at any other time during the research that I no longer wish to participate in this project, I can notify the researchers involved and be withdrawn from it immediately.
- § I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
- § I understand that I am being paid for my assistance in this research and that some of my personal details will be passed to UCL Finance for administration purposes.
- § I understand that I must not take part if I am outside the age range 18-40 years; if I am not fluent in English language, if I have received any treatment for any previous mental health problem, or if I have taken part in a similar study before.
- § I understand that the information I have submitted will be published as a report. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.

Participant's Statement

I
agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project and I understand what the research study involves.

Signed:

Date:

Researcher's Statement

I...Rebecca Polack/Leonora Marshall

confirm that I have carefully explained the purpose of the study to the participant and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed:

Date:

Appendix C: Information for Participants on Intrusive Memories and Initial Intrusive

Memories Question

Spontaneous Memories

Please read the following information on spontaneous memories and answer the questions below.

Please ask your researcher if you have any questions

By 'spontaneous' I mean memories of the film that suddenly pop into your mind automatically. I do not mean times when you deliberately think about it or mull it over. These spontaneous memories may take the form of images of the film you saw or thoughts about it.

What does 'image' mean?

If you find that you have a visual image like a single snapshot or even a short movie running through your mind of a part of the film you saw today, that would count as an image.

What does 'thought' mean?

If you find that you have a thought about a part of the film you saw today but without a movie running through your mind, that would count as a thought.

For example:

Imagine that you are walking down the street on your way to work and you see a woman cycling along the road. She cycles over a pothole that she has not seen in the road. She loses control of the bike and falls off hard onto her knee. Several passers by immediately go to help her so you do not need to stop. You think to yourself, "Ouch, I bet that hurt! How embarrassing, I hope she's alright." Later that day you are walking down a different street on your way home from work and you notice a small pothole in the pavement. This makes you immediately think of the woman falling from the bike this morning and you think to yourself "I hope she was alright, it looked like a bad fall." That would be an example of a SPONTANEOUS MEMORY THOUGHT. At the same time in your mind's eye you very briefly see the woman landing hard on her knee, like a movie clip. This image flashes through your mind so quickly that you barely notice it. That would be an example of a SPONTANEOUS MEMORY IMAGE. As you arrive home to the flat that you rent with your friends, they ask you how your day was. You tell them about the woman you saw falling off the bike this morning and how painful it had looked. As you tell them the story you can see a movie clip of the incident running through your mind and you think out loud, "I hope she was ok, there were lots of people around so I didn't need to stop to help." These would be examples of VOLUNTARY MEMORIES which you are deliberately trying to recall in order to tell your friends the story. They are **not spontaneously** occurring memories.

Did you experience any spontaneous memories whilst completing the computer task (please circle)? Yes/No

If yes how many spontaneous memories did you experience.....

If yes, how many of the spontaneous memories were thoughts.....or

how many of the spontaneous memories were images..... or

how many of the spontaneous memories were both thoughts & images

(at the same time).....

Appendix D: Instructions for Intrusive Memory Diary

Completing your diary

Please see the diary sheets that the researcher has provided and read the following instructions.

You will be prompted by email/SMS to record each day:

- | The total number of spontaneous memory experiences, **if you did not experience any, please put a zero.**
- | For each memory whether it was primarily an image or a thought
- | Brief details about the content of each memory
- | How much (if any) distress accompanied the spontaneous memory

Please record the spontaneous memory experience on your diary immediately after it happens or as soon after as is possible.

It may be helpful set aside a time each day to complete your diary in case you are not able to complete the diary at the time of the spontaneous memory, or you forget.

An SMS text message will be sent to you once a day as a reminder for you to fill in the paper diary. If you find that you remember a thought or an image because you were prompted by the text/email reminder, this does not count as a spontaneous memory. The SMS text message that you will receive will be from 07828 722 342 beginning DIARY COMPLETION. It will include the researcher's name (Rebecca Polack/Leonora Marshall) so you will know that it is from us.

It is important that you only record the images or thoughts that pop into your mind spontaneously when you have not deliberately thought about them during the week.

If you are unsure what to do please read this instruction leaflet again to remind yourself. If you are still unsure, or you experience any problems at any time please do not hesitate to contact the experimenters.

Finally, you will receive an email in 7 days time titled: 'Rebecca Polack MEMORY Research Project Please Complete and Return Today'. You will need to open the attachment, complete the questions (lasting ~5 minutes), then save and attach the completed questionnaire (clicking reply to the email). Once the diary and this email has been completed and returned you will receive your payment/course credits.

Appendix E: Example of Intrusive Memory Diary

EXAMPLE	Number of Spontaneous Memories (put 0 if none experienced)	Memory Content (briefly describe each spontaneous memory)	Type of memory (please tick for each spontaneous memory)			How much <u>distress</u> did each memory cause you? 0 1 2 3 4 5 (0 = none at all, 5=extreme distress)
			Thought	Image	Both	
Morning	2	Boy falling from Ferris wheel		X		2
		That man in the cage must have been so terrified	X			3
Afternoon	0					
Evening	1	Motorcyclists being impaled, they must have been in so much pain	X			5

Appendix F: Descriptive Data of Transformed Intrusive Memory Variables

Effects of experimental conditions on intrusive memories (transformed variables)

	Condition								
	Control Group (N=15)			Fixed-View Group (N=15)			Shifted-View Group (N=15)		
	M	SD	Median	M	SD	Median	M	SD	Median
Images	1.75	0.64	1.38	0.78	0.73	.69	1.31	0.56	1.67
Thoughts	0.41	0.48	.69	0.8	0.81	.69	0.75	0.61	0.35
Images/Thoughts	0.55	0.76	.69	1.3	0.71	1.42	0.89	0.79	0.55

See pages 89-91 for analyses of group differences for intrusive memories and for untransformed means and standard deviations.

Appendix G:

<i>CBT</i>	Cognitive Behavioural Therapy
<i>CS</i>	Conditioned Stimulus
<i>DRT</i>	Dual Representation Theory
<i>DSM</i>	Diagnostic and Statistical Manual of Mental Disorders
<i>ES</i>	Effect Size
<i>FBC</i>	Feeling of Being Contaminated
<i>FNE</i>	Fear of Negative Evaluation
<i>IE</i>	Imaginal Exposure
<i>IM</i>	Intrusive Memory
<i>IR</i>	Imagery Restructuring
<i>LCA</i>	Latent Class Analysis
<i>LTM</i>	Long-term Memory
<i>MTL</i>	Medial Temporal Lobe
<i>NICE</i>	National Institute for Health and Clinical Excellence
<i>OCD</i>	Obsessive Compulsive Disorder
<i>PTSD</i>	Post-traumatic Stress Disorder
<i>RCT</i>	Randomised Controlled Trial
<i>RSC</i>	Retrosplenial cortex
<i>UCL</i>	University College London
<i>US</i>	Unconditioned Stimulus
<i>VE</i>	Virtual environment town square task (tested spatial recognition memory from either egocentric or allocentric viewpoint).

Appendix H: Ethics Approval



Dr Sunjeev Kamboj
Research Department of Clinical, Educational and Health Psychology
Sub-department of Clinical Health Psychology
UCL

16 August 2011

Dear Dr Kamboj

Notification of Ethical Approval

Ethics Application: 3223/001: Emotional information processing and simulated trauma memories: an experimental investigation

I am pleased to confirm that further to your satisfactory responses to the Committee's concerns, your project has been approved by the UCL Research Ethics for the duration of the study (i.e. until July 2012).

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: <http://www.grad.ucl.ac.uk/ethics/> and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events

For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

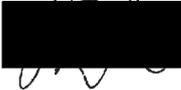
Reporting Serious Adverse Events

The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

With best wishes for the research.

Yours sincerely

A black rectangular redaction box covers the signature of Sir John Birch. Below the box, there are faint, illegible handwritten marks.

Sir John Birch
Chair of the UCL Research Ethics Committee



Amendment Approval Request Form

1	ID Number: Re: 3223/001	Name and Address of Principal Investigator: Dr Sunjeev Kamboj, Research Dept Clinical, Educational and Health Psychology
2	Project Title: Emotional information processing and simulated trauma memories: An experimental investigation.	
3	Information about the amendment: (a) Is the amendment purely administrative? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A (b) Has the Participant Information Sheet/Consent Form been changed as a result of the amendment? If yes, please enclose a copy. <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A (changes to info sheet are in bold)	
4	Summarise the issues contained in the amendment: We have made several amendments to the information sheet to reflect the design of the experiment (e.g. one task has been removed; return of paper-based questionnaire by post) and amount of reimbursement / course credit awarded is less. Finally we ask that the project be extended to December 2015 to allow additional data to be collected by a trainee from the 2012 DClinPsy cohort.	
5	Please give any other information you feel may be necessary: N/A	
Signature of Principal Investigator:		Date of Submission: 14/06/2013
<div style="border: 1px solid black; width: 100px; height: 50px; margin-bottom: 10px;"></div> <p>FOR OFFICE USE ONLY: Amendments to the proposed protocol have been <i>approved</i> by the Research Ethics Committee.</p> <p>Chair's Signature: Date: <i>17/6/2013</i></p> <p style="text-align: right; margin-right: 50px;"><i>Prof. J. Foreman</i></p>		

Please return completed form to:
 Secretary of the UCL Research Ethics Committee
 Graduate School, North Cloisters, Wilkins Building
 Gower Street, London WC1E 6BT



Amendment Approval Request Form

1	ID Number: Re: 3223/001	Name and Address of Principal Investigator: Dr Sunjeev Kamboj, Research Dept Clinical, Educational and Health Psychology
2	Project Title: Emotional information processing and simulated trauma memories: An experimental investigation.	
3	Information about the amendment: (a) Is the amendment purely administrative? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A (b) Has the Participant Information Sheet/Consent Form been changed as a result of the amendment? If yes, please enclose a copy. <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A (changes to info sheet are in bold)	
4	Summarise the issues contained in the amendment: We request an amendment that would allow us to replace our current computerised tasks which either interfere with visuospatial working memory or verbal working memory (two versions of an 'n-back task') with a memory task that selectively engages allocentric- (hippocampal-dependent) or egocentric- (parietal lobe-dependent) based memory systems. The replacement task is a simple spatial navigation task presented on a personal computer requiring participant to learn the location of objects. Recall then occurs from either the same perspective as during learning (egocentric) or from an altered perspective (allocentric). The task is virtually identical to the one used in our other current study (Project ID number: 1338/005). We believe the allocentric condition of the task is sufficiently selective and 'potent' to allow changes in intrusive memories to be found (they were not found using the visuospatial n-back task in our previous study). A suitable project student has been selected for this project (a trainee clinical psychologist on the DClinPsy). Such trainees typically start data collection in the first term of their second year (from Oct 2012) and continue until their second term of their third year. We would therefore like to request an extension of 18 months for this project to allow 90 participants to be tested.	
5	Please give any other information you feel may be necessary: N/A	
Signature of Principal Investigator:		Date of Submission: 12/07/2012
<div style="background-color: black; width: 100px; height: 40px; margin-bottom: 10px;"></div> <p>FOR OFFICE USE ONLY: Amendments to the proposed protocol have been <i>approved</i> by the Research Ethics Committee.</p> <p>Chair's Signature: [REDACTED] Date: <i>16/7/2012</i></p> <p style="text-align: center;"><i>Prof. J. Foreman</i></p>		