Eye-Movement does not reduce ratings of vividness and emotionality or the number of intrusive thoughts of unpleasant memories: Implications for Eye-Movement Desensitisation and Reprocessing (EMDR).

By

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Abstract

Eye-Movement Desensitisation and Reprocessing (EMDR) is a psychotherapy that incorporates the use of saccadic Eye-Movements (EM) to alleviate distress caused by traumatic memories. Although EMDR is recognised as a front-line treatment for individuals suffering from Posttraumatic Stress Disorder (PTSD), the mechanisms underlying the efficacy of the EM component remain a point of contention. The aim of the current research was to investigate first, whether EM reduced ratings of memory vividness and emotionality by taxing Working Memory (WM) capacity, and second, to examine whether EM lowered the number of intrusive thoughts under two opposing suppression conditions. In two experiments, 244 non-clinical participants were asked to recall an unpleasant memory while simultaneously engaging in fast-EM, slow-EM or a no-EM control. Participants then received an instruction to intentionally avoid thinking about the memory, or to think about whatever came to mind. Relative to no-EM, fast-EM and slow-EM had no significant effect on vividness and emotionality ratings, nor did they influence the number of intrusive thoughts. In addition, the level of suppression intent had no impact on memory outcomes. Overall, the results from these two experiments oppose earlier findings in support of WM theory, and a significant body of research that has demonstrated the efficacy of the EM component. Implications for the EM component in EMDR are discussed, and an alternative explanation for EM is offered.

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Chapter 1: Literature Review

Introduction

Throughout our lives we might experience traumatic events that elicit strong emotional responses. While these reactions are normal, they can often be overwhelming, causing significant levels of distress and discomfort. For most people, the stress following a traumatic event reduces over time and can be successfully resolved without the need for professional assistance. However, for others, a traumatic event can leave a long lasting impression, affecting social, psychological and physiological functioning (Bisson, 2007; Schubert & Lee, 2009).

Posttraumatic Stress Disorder (PTSD) is a psychological disorder that may develop following an extremely distressing situation or event in which the individual has directly experienced, witnessed or learned of a perceived or actual life threatening event (5th ed.; DSM-5; American Psychiatric Association [APA], 2013; NICE, 2005). PTSD is characterised by four major symptom clusters including; re-experiencing aspects of the traumatic event(s), relentless avoidance of stimuli relating to the event(s), increased negative mood and associated cognitions, and changes in the level of arousal and reactivity (APA, 2013). Unlike many other psychological disorders, PTSD has a known aetiology (Stein, Friedman, & Blanco, 2011). The most common situations found to precipitate the onset of PTSD include witnessing severe injury or death, being involved in a life threatening accident or assault, or enduring a natural disaster, such as an earthquake or flood (Creamer, Burgess, & McFarlane, 2001; Kessler et al., 2005; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995).

Although a large number of people are likely to be exposed to a traumatic event, only a small percentage will develop PTSD (Breslau, 2009; Keane, Marshall, & Taft, 2006). In the Australian National Survey for Mental Health and Wellbeing study, Creamer and colleagues (2001) found that as many as 64.6% of men and 49.5% of women had been exposed to a traumatic event at some point in their life, however, as little as 1.3% met diagnostic criteria for PTSD over a 12-month period. In a New Zealand mental health survey, Oakley-Brown, Wells, Scott, and McGee (2006) found that the overall lifetime prevalence rate of PTSD was 6%. Similarly, Kessler, and colleagues (2005) found a lifetime prevalence rate of 8.6% in a United States sample, making it the fifth most common psychiatric illnesses in the U.S.

Risk Factors for Posttraumatic Stress Disorder

Research exploring the epidemiology of PTSD has identified a number of vulnerability factors that may account for the discrepancy between the rates of trauma exposure and the rates of PTSD. Pre-existing risk factors specific to the individual has remained a contentious topic with studies producing mixed results. However, the majority agree that being female (Norris et al., 2003; van Ameringen, Mancini, Patterson, & Boyle, 2008), having a history of psychiatric illness (Perkonigg, Kessler, Storz, & Wittchen, 2000), having a lower level of education and living in a poorer socioeconomic area (Rosenman, 2002) are associated with higher rates of trauma exposure, and subsequently, PTSD.

Arguably, the most important determinant of PTSD is the event itself (Rosenman, 2002). The type of traumatic events experienced has been extensively studied with clear differences in the likelihood of developing PTSD (Breslau, 2002; Perkonigg et al., 2000). Breslau (2002) found that personal attacks including rape, torture and being held captive were more likely to result in PTSD than less personally involved events, such as witnessing an injury or learning that a loved one has died. This and other similar findings suggest that the degree of personal involvement may be a factor in the development of PTSD (Hapke, Schumann, Rumpf, John, & Mayer, 2006). Similarly, research has shown that experiences during the time of the event, or ‘peritraumatic factors’, are largely associated with the likelihood of developing PTSD. A recent meta-analysis concluded that cognitive processes, such as an individual’s perceived threat to life and dissociation during the traumatic event, were among the strongest predictors of PTSD (Ozer, Best, Lipsey, & Weiss, 2008).

Finally, events following a traumatic event can increase an individual’s vulnerability to PTSD. Although this area remains largely unexplored, two meta-analyses have looked at the relationships between post-trauma support and other significant correlates of PTSD. Results showed that social support played a significant role following exposure to a traumatic event (Brewin et al., 2000; Ozer et al., 2008). While Brewin et al. (2000) found that a lack of social support was the largest predictor of PTSD, Ozer and colleagues (2008) reported that perceived social support was related to a reduction in symptom severity and diagnostic criteria. It is clear from the research just described, that an individual’s response to a traumatic event is determined by a complex interaction of personal characteristics and situational factors. Further investigation is required to draw more definitive conclusions about the nature and direction of these relationships (Stein et al., 2011).

Conventional Treatment for Posttraumatic Stress Disorder

The costs associated with PTSD are widespread and affect many aspects of life. Individuals experiencing PTSD are more likely to have alcohol and drug dependence, a concurrent psychiatric disorder, poorer physical health, and are at increased risk of suicide (Foa, Keane, Friedman, & Cohen, 2008). These individuals are further prone to interpersonal difficulties, marital conflict, and lost vocational opportunities. Together, these factors place a significant strain on mental health and other related community services.

Although PTSD is a chronic and often debilitating disorder, it can be treated effectively (Bradley, Greene, Russ, Dutra, & Westen, 2005; Friedman, Keane, & Resick, 2007; Foa et al., 2008; Taylor et al., 2003). The following section of this thesis briefly examines the empirical evidence for interventions currently available for treating PTSD.

Pharmacotherapy. Pharmacological interventions are based on the idea that exposure to a traumatic event can cause an imbalance in the neurochemicals responsible for regulating arousal and emotional processing. Drug therapies such as Paroxetine, a Selective Serotonin Re-uptake Inhibitor (SSRI), have shown to be effective in reducing the severity of PTSD symptoms (Marshall, Beebe, Oldham, & Zaninelli, 2001; Önder, Tural, & Aker, 2005; Tucker et al., 2004). Although drug therapies appear to be a promising option, the use of medication is controversial. Currently, few clinical trials exist to support the use of SSRIs with the available studies varying in treatment response. In their review, Steckler and Risbrough (2012) highlight that while 60% of patients responded positively to SSRIs, as little as 20-30% reached full remission. It is worth noting that longitudinal research is largely lacking for SSRIs, with those that do exist often failing to consider the low rates of treatment adherence (Van Etten & Taylor, 1998). This finding may be explained by the unpleasant side effects of medication such as nausea, a diminished libido and changes in body weight (Marshall et al., 2001; Steckler & Risbrough, 2012), Nevertheless, Paroxetine has been recommended as a second-line treatment for PTSD, favoured in the absence of psychological treatment gains and the presentation of an accompanying mood disorder. Further empirical evidence validating the use of pharmacological interventions is required, as clinically significant benefits are lacking (NICE, 2005).

Cognitive-Behavioural Therapy for PTSD. To date, the most effective form of treatment for PTSD is psychotherapy (NICE, 2005). Of the available therapies, the most extensively studied treatment is Cognitive-Behavioural Therapy (CBT). CBT is an empirically validated approach that incorporates techniques such as psychoeducation, exposure therapy and cognitive restructuring to reduce the pervasiveness of trauma symptoms (Cahill, Rothbaum, Resick, & Follette, 2008). The predominant theory underpinning CBT for PTSD is grounded in learning principles of classical conditioning. In brief, the traumatic event (unconditioned stimulus) elicits a strong fear response (unconditioned response) that, as a result, becomes conditioned to other event related stimuli (conditioned stimuli; Charney, Deutch, Krystal, Southwick, & Davis, 1993). PTSD symptoms such as re-experiencing aspects of the event or physiological arousal are conditioned responses cued by distressing environmental stimuli (Cahill et al., 2008). Under these principles, recovery requires the extinction of the conditioned responses. Accordingly, the goal of treatment is to repeatedly expose the individual to the traumatic reminders via the use of exposure (flooding, *in vivo* or imaginal) until the fear response decreases and the stimuli are no longer viewed as threatening (Davis & Myers, 2002).

The cognitive component of CBT was introduced as researchers began to explore the role of the maladaptive cognitions individuals developed following traumatic events. Cognitive therapy is based on the work of Beck who theorised that unhelpful thoughts, beliefs and assumptions about the self, world and others, are responsible for the negative emotional response one experiences (Beck, 1976). In this approach, the individual identifies the unhelpful or negative cognitions (e.g., dependency/trust, safety, power, independence, esteem and intimacy), and one by one examines the available evidence (McCann & Pearlman, 1990). The therapist and client then work together to replace the thought with an alternative, more balanced thought in a process of cognitive restructuring.

The past 30 years has seen a surge in research exploring the effectiveness of CBT. Bradley and colleagues (2005) conducted a meta-analysis on the literature of psychotherapy for PTSD and found that the majority of individuals who had received CBT either improved or no long met criteria for PTSD. These findings have gained support from the National Institute for Clinical Excellence (2005) who found clinically improved benefits for CBT over controls on all measures of PTSD symptoms. As a result, a number of organisations have recommended CBT as a front-line treatment for PTSD (NICE, 2005; U.S. Department of Veteran Affairs & U.S. Department of Defence, 2014).

A new treatment approach: Eye-Movement Desensitisation and Reprocessing (EMDR)

Eye-Movement Desensitisation and Reprocessing (EMDR; Shapiro, 1989) is a psychotherapy developed by Francine Shapiro to address the distressing nature of traumatic memories in PTSD. EMDR is known for its highly controversial use of saccadic Eye-Movements, hand tapping or audio tones (Jaberghaderi, Greenwald, Rubin, Zand, & Dolatabadi, 2004). EMDR is comprised of eight phases that integrate typical clinical procedures, such as comprehensive assessment and formulation, and its defining features of desensitisation and installation (see Shapiro, 2001). Much scepticism emerged following early publications of EMDR’s effectiveness in treating PTSD (Davidson & Parker, 2001). Early researchers criticised EMDR studies on the grounds of flawed methodology, highlighting the lack of standardised measures and reliance on single case studies (Acierno, Hersen, Van Hasselt, Tremont, & Meuser, 1994; Davidson & Parker, 2001; Herbert & Mueser, 1992; Oren & Solomon, 2012).

Herbert and Mueser (1992) conducted a critique of existing literature and argued that EMDR studies relied heavily on client evaluation through verbal reports. In EMDR therapy, client progress is typically measured through an assessment of the client's Subjective Units of Distress (SUDS; Wolpe, 1990), a rating of fear triggered by the imagined image, and improvements in Validation of Cognitions (VoC), a measure of how much the individual believes the newly formed cognition is associated to the feared memory or image (Davidson & Parker, 2001). Critics have disparaged this form of evaluation on the basis of two measurement errors. First, for the individual to complete treatment they need to have achieved a sizeable reduction in their SUDS ratings, and second, the majority of studies lacked the use of empirically grounded measures to gauge change in symptomology. Herbert and Mueser (1992) concluded that without an objective evaluation, EMDR literature lacked the most important ingredient in clinical research.

EMDR versus waitlist/controls. The push for empirically based research into EMDR resulted in the application of randomised controlled trials (RCT; Rosen, 1999). RCTs are considered the 'gold standard' in assessing treatment fidelity and provide the methodological rigor required for empirical evaluation (Rosen, 1999). The introduction of RCTs showed EMDR's efficacy compared to waitlist/control groups (Edmond & Rubin, 2004; Edmond, Rubin, & Wambach, 1999; Högberg et al., 2007; Marcus, Marquis, & Sakai, 2004; Van Etten & Taylor, 1998; Wilson, Becker, & Tinker, 1995; 1997). In a typical study, Rothbaum (1997) evaluated the effectiveness of EMDR compared to a wait-list control group. A total of 18 female survivors of sexual assault completed pre, post and three month assessments following four weekly sessions of EMDR. Participants who completed EMDR experienced a significant reduction in traumatic and depressive symptoms compared to the wait-list control group, maintaining these benefits at a three month follow-up.

In a similar study, Edmond et al. (1999) evaluated the use of EMDR in a sample of 59 female survivors of childhood sexual abuse. Participants were randomly assigned to one of three conditions: EMDR, routine individual treatment (comprised of 20 different forms of individual therapy) or a delayed treatment control condition. Participants in both treatment conditions received a total of six 90 minute sessions, once a week for six weeks. Results indicated that participants who received EMDR and routine individual treatment had significantly fewer symptoms of PTSD, anxiety and depression than the delayed treatment group. However, at three month follow-up participants who received EMDR had maintained their treatment gains compared to those who had received individual treatment. Edmond and Rubin (2004) conducted an 18 month follow-up study and found that participants in the EMDR group had maintained treatment gains, and in all cases had improved on measures of anxiety, depression and PTSD. From these and other similar findings, it is clear that EMDR is an effective and durable treatment for individuals experiencing PTSD.

EMDR versus other trauma-focused treatments. EMDR's efficacy relative to wait-list/control groups is now well established and a growing body of literature has shown EMDR to be an effective intervention when compared to other forms of treatment for PTSD (Bradley et al., 2005; Ironson, Freund, Strauss, & Williamson, 2002; Lee, Gavriel, Drummond, Richards, & Greenwald, 2002; Power et al., 2002; van der Kolk et al., 2007). Power and colleagues (2002) compared EMDR to Exposure plus Cognitive Restructuring (E+CR) and no-treatment in a sample of 105 individuals who met DSM IV criteria for PTSD. In each treatment condition, participants received ten weekly, 90 minute sessions of either EMDR or E+CR, while the no-treatment condition participants were subject to a wait-list period. Significant improvements were found in EMDR and E+CR compared to the wait-list control group. In addition, recipients of EMDR reported an increase in social functioning and a greater reduction of depressive symptoms. After a 15 month follow-up, participants in both treatment conditions had maintained treatment gains (Power et al., 2002).

Davidson and Parker (2001) conducted a meta-analysis of 34 studies comparing participants under four separate conditions: EMDR, exposure therapy, an alternative form of treatment and no-treatment. Overall, findings indicated that when compared with no-treatment and non-specified therapies, individuals achieved greater reductions in PTSD symptoms following EMDR therapy. Furthermore, when compared with exposure-based treatments, no significant differences in treatment outcomes were found. The authors concluded that EMDR is an effective treatment for individuals suffering from PTSD.

In a recent meta-analysis, Seidler and Wagner (2006) conducted a review of seven RCTs comparing treatment outcomes of Trauma Focused Cognitive Behavioural Therapy (TF-CBT) and EMDR. Findings suggest that both forms of treatment were successful in reducing PTSD symptomology, although no one therapy was more effective than the other. Seidler and Wagner (2006) noted that while there was no statistically significant difference in treatment outcomes, EMDR recipients were more likely to achieve a greater reduction in SUDs per session, over fewer sessions. Overall, the literature supports the use of EMDR as a treatment for PTSD (Tarquinio, Brennstuhl, Reichenbach, Rydberg, & Tarquinio, 2012). Many major professional bodies now endorse EMDR as an efficacious treatment, validating its use in clinical settings (APA, 2013; Australian Centre for Posttraumatic Mental Health, 2007; NICE, 2005; U.S. Department of Veteran Affairs & U.S. Department of Defence, 2014).

While psychological therapies are the best treatment available, there is no ideal treatment for PTSD (Bisson, 2007). Research indicates that around half of those individuals who engage in treatment for PTSD fail to fully recover (Bradley et al., 2005). This raises the question – Can treatment outcomes be improved by analysing how EMDR therapy reduces the distress caused by symptoms of PTSD? In an attempt to answer this question, researchers have directed their attention to EMDR's most distinguished feature, Eye-Movement (EM). With little known about the role of EM in EMDR (Bradley et al., 2005; Seidler & Wagner, 2006) research has focused on dismantling the procedure in an attempt to understand the underlying mechanisms (Leer, Engelhard, & van den Hout, 2014). With a theoretical explanation, discovering exactly how EMDR works creates the opportunity for improving treatment protocol and subsequently, treatment outcomes (Keane, 1998; Jeffries & Davis 2013). The following section of this thesis will discuss the highly controversial topic of EM in EMDR therapy.

Eye-Movement in EMDR

Since the initial development of EMDR, the role of EM has remained a contentious issue (Jeffries & Davis 2013; Rafferty, 2005). Research has isolated the EM component from normal treatment protocol and systematically explored whether they are indeed a "crucial component" of EMDR or a novel, but otherwise irrelevant task (Shapiro, 1989, p. 220). Early research revealed a lack of convincing evidence, suggesting that EM adds little or no benefit to treatment outcomes (Boudewyns & Hyer, 1996; Cahill, Carrigan, & Frueh, 1999; Davidson & Parker, 2001; Lohr, Lilienfeld, Tolin, & Herbert, 1999). In a typical study, Renfrey and Spates (1994) explored the role of EM in 23 adults diagnosed with PTSD. Participants were randomly allocated to a normal EM condition (outlined in Shapiro's treatment protocol), a light tracking variant of EM or a fixed stimulus control condition. Other than manipulating the EM component, all participants received standard EMDR treatment. Results of this study showed a considerable reduction in symptoms of PTSD across all three treatment conditions. The authors concluded that while EMDR is an effective treatment for alleviating symptoms of PTSD, the addition of the EM component provides no incremental benefit to treatment outcomes.

In contrast, more recent studies have found that EM plays an important role in reducing the vividness, emotionality and physiological arousal of traumatic memories within a therapeutic context (de Jongh, Ernst, Marques, & Hornsveld, 2013; Schubert, Lee, & Drummond, 2011; van den Hout et al., 2012). Lee and Drummond's (2008) study examined the role of EM in EMDR by randomly allocating 48 individuals to EMDR with EM or EMDR without EM. Participants received an additional instruction to either relive or distance themselves from the distressing memory. Ratings of vividness and emotional distress were recorded prior to and following the EM condition. Findings revealed that EM significantly reduced levels of emotional distress and memory vividness when participants were asked to deliberately disconnect from the distressing material.

In another study, Schubert et al. (2011) administered a single session of EMDR to 62 participants that had an unpleasant memory of a distressing event. Participants were randomly allocated to either a fixed rate EM, a varied rate EM or no-EM condition. EMDR was administered in accordance to Shapiro's (2001) treatment protocol with ratings of vividness and emotionality taken pre and post treatment. Schubert and colleagues (2011) obtained additional measures of physiological arousal by assessing changes in heart rate and skin conductance. When EM was compared to no-EM, results showed that EM lowered overall ratings of vividness and emotionality, contributing significantly to a reduction in physiological arousal.

A separate body of literature has begun investigating the role of EM under controlled laboratory conditions. These studies, commonly referred to as ‘analogue laboratory studies’, focus entirely on the function of EM in the absence of a therapeutic context. Healthy participants are required to recall an unpleasant image or autobiographical memory of an event that has some emotional impact. Measures of vividness and emotionality are taken pre and post EM and the degree of variance is measured. A number of laboratory studies have demonstrated that EM has a unique role in facilitating treatment outcomes (Jeffries & Davis, 2013); that is, when participants recall a distressing memory while simultaneously engaging in EM, a reduction in post treatment ratings is observed (Andrade, Kavanagh, & Baddeley, 1997; Barrowcliff, Gray, Freeman, & MacCulloch, 2004; Engelhard, van den Hout & Smeets, 2011; Gunter & Bodner, 2008; Kavanagh, Freese, Andrade, & May, 2001; Maxfield, Melnyk, & Hayman, 2008).

van den Hout, Muris, Salemink, and Kindt (2001) investigated the role of EM, finger tapping and no-task in 60 healthy university students. Participants were divided in to two groups, with half recalling three positive autobiographical memories and half recalling three negative autobiographical memories. The study utilised a within subject design during the treatment phase with each participant receiving EM, finger tapping and no task; one for each of the three memories. Results indicated that when compared to a finger tapping task or no-task, EM produced a greater reduction of vividness and emotionality in both positive and negative valance memories.

In a similar study, Smeets, Dijs, Pervan, Engelhard, and van den Hout (2012) explored the time over which ratings of vividness and emotionality decreased among 61 individuals with unpleasant memories. Participants were randomly assigned to an EM or fixed EM condition and asked to retrieve an unpleasant memory. Throughout the duration of the experiment, multiple ratings of vividness and emotionality were obtained to pinpoint the exact time at which memory clarity and emotional distress decreased. Consistent with earlier findings, a significant reduction in vividness and emotionally was demonstrated only in the EM group. Interestingly, ratings of vividness dropped almost immediately, within 2 seconds of beginning EM. In contrast, ratings of emotionality gradually decreased with significant differences obtained following a period of 74 seconds.

In a recent meta-analysis, Lee and Cuijpers (2013) examined the role of EM in both clinical trials and analogue laboratory studies. Study one consisted of 15 clinical trials, comparing EMDR with EM and EMDR without EM, whereas study two explored the role of EM compared to no-EM on negative memories in 11 analogue laboratory studies. Standardised mean differences were obtained by calculating Cohen's *d*. Data analysis revealed a significant moderate effect size for clinical trials ($d = 0.41$) and a large significant effect size for laboratory studies ($d = 0.74$). Taken together, these findings show that when the EM component is isolated from normal treatment protocol, EM provides a unique benefit, reducing both emotional distress and clarity of negative memories. These findings suggest that EM contributes positively to treatment outcomes and the overall efficacy of EMDR therapy. In the following section of this thesis, the leading theories that attempt to explain how EM reduces the disturbing nature of traumatic memories will be discussed.

Theoretical Underpinnings of Eye-Movement in EMDR

Adaptive Information Processing Model (AIP). Shapiro's (1995) theoretical framework of EMDR is based on the Adaptive Information Processing Model (AIP), which suggests that stimuli constantly flows in and out of the brain's processing system, integrating information in a series of memory networks. For the purposes of learning and development, memories are stored to assist the individual in their surrounding environment (Shapiro, 2001; Shapiro & Solomon, 1995). However, when these normal cognitive processes are overwhelmed by a traumatic experience (e.g. sexual assault), the information is stored in an isolated memory network, unable to integrate with networks more adaptive for human functioning (Oren & Solomon, 2012). Consequently, the individual continues to re-experience the memory with its associated affect, cognitions and somatic symptoms. Shapiro (2001) believes that through bilateral EM, clients are able to reprocess their traumatic memory through developing new associations and allowing the memory to be stored in a more adaptive arrangement. Reprocessing of trauma related information, Shapiro argues, is facilitated by three underlying mechanisms: (1) a relaxation response through the process of unconditioning, (2) strengthening weak memory associations, and (c) attending to the traumatic material while simultaneously focusing on a separate task (e.g., EM; Shapiro, 2001). A number of theories have been established in an attempt to further examine the mechanisms proposed by the AIP model (Schubert & Lee, 2009).

Orienting Response Theory. The Orienting Response (OR) theory stems from the early work of Pavlov (1927). The OR is believed to be an innate reflex or response, with the primary purpose of selectively attending to information in the individual's environment that may be of significant importance. In other words, this is the 'what is it?' response, triggered by new information that has come to attention

(Armstrong & Vaughan, 1996). This reflex has a unique evolutionary basis that has developed to assist the individual in evaluating a situation for threat and opportunity (Barrowcliff, Gray, Freeman, & MacCulloch, 2003). Accordingly, the OR is characterised by two equally important phases. In the first phase, the individual experiences an alarm response to a foreign stimulus that increases both parasympathetic (increase heart rate) and sympathetic activity (increased skin conductance; Öhman, Hamm, & Hugdahl, 2000), whereas in the second phase, the stimulus is repeatedly presented and no longer perceived as threatening (Sokolov, 1963). This process is referred to as 'habituation' and results in a decrease of physiological arousal and the OR.

In EMDR, EM is elicited by following the lateral movements of the therapist's index finger (Shapiro, 1989). Armstrong and Vaughan (1996) argue that during memory recall the individual quickly responds to the finger movement, creating an association between the distressing memory and the novel stimulus. As a result, the finger movement triggers an OR. While this initially leads to an increase in arousal, the response is rapidly extinguished as the finger movement is recognised as a non-threatening stimulus.

In support of the OR theory, Stickgold (2002) emphasised the relationship between induced EM and the natural processes observed during Rapid Eye Movement (REM) in sleep. In brief, Stickgold builds on Shapiro's (1995) theory, supporting the notion that a lack of memory consolidation and integration is largely attributed to the persistent and intrusive memories experienced in PTSD. The normative process of 'interleaved replay', in which episodic memories are transferred to semantic memory networks, fails to integrate in traumatic memories. Thus, the memories and the associated affect are maintained in the form of episodic memories. Stickgold's (2002) more refined explanation of EM in PTSD places a greater emphasis on the neurobiological and physiological underpinnings of memory consolidation, which he explains occur 'off-line' during REM sleep. Accordingly, processes assisting memory consolidation in REM sleep are hypothesised to facilitate the processing of traumatic memories. The saccadic EM induced in EMDR therapy is suggested to mimic that observed in REM sleep and consequently 'kick start' the mechanisms underlying memory consolidation and integration (Nelson, McCarley, & Hobson, 1983).

Increased Hemispheric Communication Theory. The Increased Hemispheric Communication Theory (IHC) recognises PTSD as a dissociative disorder, highlighting the intrusive, recurrent and disturbing nature of traumatic memories (Propper, Christman, & Phaneuf, 2005). Indeed, research investigating this theory has identified that individuals with PTSD are likely to experience greater difficulties in retrieving episodic memories (Propper & Christman, 2008). It is this memory dysfunction that proponents of the IHC theory believe is the basis of PTSD symptomology.

The IHC theory is best understood in the context of the Hemispheric Encoding/Retrieval Asymmetry (HERA) model; a framework of episodic memory proposing that both encoding and retrieval of episodic memories occur in different hemispheres of the cerebrum (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994). Accordingly, while the left hemisphere is tasked with encoding new information, the right hemisphere is responsible for the retrieval process (Tulving et al., 1994).

Christman and Propper (2001) proposed that an increase in communication between the two cerebral hemispheres facilitates episodic memory retrieval. A number of studies have explored this notion with a growing body of literature in support of this claim (Christman, Propper, & Dion, 2004; Propper et al., 2005). One particular method that has demonstrated this effect is saccadic horizontal EM. Propper and Christman (2008) argue that EM increases the interaction between the two hemispheres, and should therefore improve episodic memory retrieval. Indeed, research has found elevated levels of activity at the contralateral hemisphere while simultaneously engaging in EM (Bakan & Svorad, 1969; Christman & Garvey, 2001).

This theory has specific implications for the role of EM in EMDR. Propper and Christman (2008) propose that the benefits received following a treatment session of EMDR may come as EM allows the disorganised and fragmented memories to surface, becoming readily accessible and consequently, improving memory accuracy. The authors suggest that the increase in hemispheric communication facilitates neurological changes and reduces the dissociative amnesia that commonly occurs in PTSD.

Working Memory Theory. The other, arguably more plausible theory derived to explain the underpinning mechanisms of EM is based on a Working Memory model (WM; Baddeley, 1986; Baddeley & Hitch, 1974). Baddeley's (1986) multicomponent model of WM, describes WM as an overarching system that allows an individual to briefly hold and manipulate information that is required for cognitively demanding tasks. The system is comprised of two subsystems known as the 'slave systems'. The Visuospatial Sketchpad (VSSP) is responsible for briefly storing and rehearsing visual and spatial information, whereas the primary function of the Phonological Loop (PL) is to process any verbal and auditory information, such as speech and language. Consider an example of a math equation. When attempting to solve the equation (e.g., 2 + (3 x 4)), an individual may draw a visual representation or mental image of the equation using visuospatial resources. While doing so, they may use phonological resources, rehearsing numbers to remind them of smaller sections that have already calculated. The interaction of the two slave systems is a fundamental part of WM and is needed for all higher order functioning. It is guided by Baddeley's last system, the Central Executive (CE), or 'attentional-controller'. The CE has the responsibility of inserting, retrieving and translating information between the two slave systems to effectively accomplish a task (Baddeley, 1992).

It has been suggested that traumatic memories frequently manifest as disturbing visual images (Engelhard, van den Hout, Arntz, & McNally, 2002; Holmes & Bourne, 2008). The WM theory suggests that during a session of EMDR the individual temporarily holds the traumatic memory/image in the VSSP while simultaneously engaging in bilateral EM (Kavanagh et al., 2001). When the two tasks make attentional demands for limited capacity, performance on one of the tasks deteriorates. Proponents of the WM theory argue that the demanding dual task of simultaneously processing EM and mental imagery decreases the vividness of the memory, and as a result, reduces the associated emotion (Andrade, et al. 1997; Lilley, Andrade, Turpin, Sabin-Farrell, & Holmes, 2009; van den Hout & Engelhard, 2012).

In a series of four experiments, Andrade et al. (1997) investigated the role of EM, hand tapping and a verbal processing task while simultaneously focusing on neutral and negative mental images. Although the concurrent verbal processing task had little therapeutic effect on memory ratings, the two visuospatial tasks (EM and a complex tapping task) were associated with reduced ratings of memory clarity and emotional distress. Interestingly, a significant difference was found only after the tapping task increased in complexity, highlighting the need for a taxing WM task. The authors concluded that any benefit received from EMDR was likely due to the EM component taxing the VSSP.

van den et al. (2001) conducted a similar study examining the role of EM on personal autobiographical memories. Thirty non-clinical participants were divided in to one of three different groups: EM, hand tapping or no-EM. The task required participants to recall three positive and three negative autobiographical memories and rate the vividness and emotionality of these memories before and after the treatment condition. Results showed a significant reduction in ratings of vividness and emotionality for both positive and negative memories following the EM task. In contrast, participants from the no-EM condition reported an increase in vividness from positive memories and no significant difference from negative memories. van den Hout and colleagues (2001) suggest that these findings are best explained by the VSSP account of the WM hypothesis.

If WM is responsible for the changes observed in vividness and emotionality, then any suitable task that taxes WM should in theory, reduce memory ratings. Engelhard, van Uijen, and van den Hout (2010) found the game ‘Tetris’, a relativity demanding visuospatial task, produced similar effects to those observed from EM. That is, playing Tetris while simultaneously recalling a negative autobiographical memory lowered subsequent ratings of vividness and emotionality. These findings are consistent with other dual-attention task studies, suggesting that taxing WM resources plays a fundamental role in reducing memory clarity and emotionality of negative memories (Andrade et al., 1997; Gunter & Bodner, 2008; Kemps & Tiggemann, 2007; van den Hout et al., 2010).

Maxfield and colleagues (2008) suggested that if the WM theory best explained the changes observed in memory ratings, then a more taxing task should result in a greater reduction of vividness and emotionality than a less taxing task. In two experiments, the authors tested this hypothesis by randomly assigning 60 participants to a fast-EM, slow-EM, or no-EM condition. Results were consistent with the WM hypothesis; fast-EM and slow-EM decreased participant ratings on all three measures. Furthermore, fast-EM did so to a greater extent than slow-EM, whereas no-EM had no effect.

Gunter and Bodner (2008; Experiment 3) examined the effects of EM, a complex drawing task and an auditory shadowing task on WM, while simultaneously holding a distressing memory in mind. The authors suggested that the EM and drawing task differed in the degree of complexity, and therefore, the demand on WM resources. In addition to ratings of vividness and emotionality, measures of individual WM capacity were obtained. In all three conditions, ratings of vividness and emotionality reduced. Consistent with the findings from Maxfield et al. (2008), a larger effect was found from a task more taxing on WM (drawing task). Furthermore, greater benefits were achieved for individuals with less WM capacity as measured by a reading span task (Engle, Tuholski, Laughlin, & Conway, 1999). Together, these findings suggest a possible dose-response relationship; that is, when a task becomes increasing demanding of WM resources, the image quality and associated emotion of the memory decreases.

Although it appears that the dose-response relationship may be linear, more recent research suggests an ‘inverted U’ shape (van den Hout & Engelhard, 2012). Gunter and Bodner (2008) alluded to this idea by proposing that “a task that is overly taxing might preclude holding a memory in mind, thereby precluding benefits” (Gunter & Bodner, 2008, p. 926). For an adequate level of competition between WM resources, the secondary task of EM needs to be taxing enough to produce the desired effects, though not so taxing that memory recall becomes inaccessible.

Engelhard et al. (2011) investigated the dose-response relationship using a mental arithmetic task. Eighty non-clinical participants were randomly allocated to one of four different conditions: exposure (control), a simple, intermediate or complex subtraction task. Manipulation checks were completed prior to the experiment and showed that each condition taxed WM in a dose-dependent manner. Consistent with previous findings, a mental arithmetic task that taxed WM lowered the clarity and emotionality of a distressing memory (van den Hout et al., 2010). Engelhard and colleagues (2011) found the predicted dose-response relationship for emotionality, though not for vividness. Although the reasons for this outcome remain unclear, the results indicate that there is an optimal level of taxing WM after which WM becomes over-taxed and the therapeutic benefits decrease (Engelhard et al., 2011).

A large body of EM research has focused on the reduction of vividness and emotionality of distressing memories, another key symptom of PTSD. Less attention however, has been given to other symptoms of PTSD, such as intrusive thoughts and images. As discussed, research has found that some individuals no longer meet diagnostic criteria following EMDR therapy. Therefore, it is possible that EM plays a role in reducing the intrusive nature of unpleasant memories. The next section of this thesis will introduce the topic of thought suppression, before discussing its implications in EM research.

PTSD and Thought Suppression

Thought suppression can be understood as the process of deliberately trying to avoid or remove certain cognitions from one’s consciousness (Rassin, Merckelbach, & Muris, 2000). From the outset, thought suppression may appear to be a simple process of mental control, however, the ability to voluntarily inhibit particular thoughts can be a challenging task (Wenzlaff & Wegner, 2000).

The intrusive and pervasive nature of traumatic memories is a hallmark symptom of PTSD (APA, 2013). For individuals experiencing PTSD, repeated attempts are made to avoid thoughts that elicit strong unwanted memories. When these thoughts occur, the common response is to redirect attention by suppressing the unwanted memory in an effort to avoid any negatively associated emotion. The tendency to avoid such a memory can, however, be counter-productive, often leading the memory to resurface (Abramowitz, Tolin, & Street, 2001; Brewin & Beaton, 2002; Wenzlaff & Wegner, 2000). This phenomenon, known as the ‘post-suppression rebound effect’ (Wegner, Schneider, Carter, & White, 1987), is a paradoxical effect that can occur following an intentional attempt to suppress an unwanted thought.

Wegner and colleagues (1987) first identified the rebound effect in their famous ‘white bear’ experiment. Participants were randomly assigned to an initial suppression group or initial expression group. In the initial suppression group, participants were asked to supress any thoughts of a white bear for 5 minutes (suppression period), before receiving an instruction to think about a white bear for 5 minutes (expression period). For the initial expression group, the instructions were reversed. During each period participants were required to ring a bell each time they thought about the white bear. Findings revealed that participants were unable to completely avoid thoughts about the white bear during the suppression period, and secondly, the suppression group were more likely to think about the target thought during the expression period than the initial expression group.

Some researchers suggest that individuals with PTSD experience greater difficulty in suppressing unwanted memories (Brewin & Saunders, 2001; Purdon, 1999; Shiperd & Beck, 1999). Shipherd and Beck (2005) studied the role of the post-suppression rebound effect in 55 survivors of motor vehicle accidents. Thirty participants with a clinical diagnosis of PTSD were compared to 25 non-clinical participants in a trauma related and trauma unrelated (neutral) suppression task. Participants were asked to undergo each of the two separate suppression tasks with a thought monitoring phase (where participants would write down anything they were thinking), before and after each period. Relative to the non-clinical group, participants with PTSD experienced a surge in target thoughts following the trauma related suppression task. However, no effect was found in either group when the target thought was unrelated to the traumatic event. The authors suggested that the rebound effect was related to the traumatic thought and may play a role in maintaining the intrusiveness of traumatic memories.

Other studies however, have found conflicting results (Harvey & Bryant, 1998; Rassin et al., 2000). Beck and colleagues (2006) investigated the rebound effect on deliberate thought suppression in 44 individuals diagnosed with PTSD and 26 healthy controls. Replicating Shipherd and Beck's (2005) earlier study, participants were exposed to the same suppression tasks and monitoring phase. In contrast to earlier findings, a rebound effect was observed in both groups following an instruction to deliberately suppress target thoughts. The authors suggested that a group of help-seeking controls may have confounded the study's outcome. However, this hypothesis was not tested directly. The results illustrate that the literature surrounding rebound effects in PTSD is mixed.

In a recent review, Magee, Harden, and Teachman (2012) examined the existing literature on thought suppression in various forms of psychopathology. Consistent with earlier meta-analytic findings (e.g., Abramowitz et al., 2001), intrusive thoughts were found to be more prevalent in individuals diagnosed with

PTSD, however, the post-suppression rebound effect was comparable across clinical and non-clinical studies.

Regardless of whether individuals' with diagnoses of PTSD have greater difficulties in suppressing unwanted thoughts, it is clear that intrusive thoughts occur more frequently in those with PTSD, resulting in higher levels of thought suppression. Currently, the available research examining why some individuals develop more unwanted thoughts than others is limited (Holmes, Brewin, & Hennessy, 2004). Research has turned to investigating the processes during which distressing memories are encoded. Analogue laboratory models, such as the 'trauma film paradigm', provide a unique way of studying trauma response under controlled laboratory conditions. The model requires non-clinical participants to view distressing material under various encoding conditions and record the number of trauma-related thoughts or images that follow (Stuart, Holmes, & Brewin, 2006).

Brewin and Saunders (2001) hypothesised that performing a complex tapping task while simultaneously watching a distressing film would divide attention, induce temporary dissociation and therefore increase the number of target related images. Contrary to expectations, participants who performed a concurrent visuospatial task (tapping task) had significantly fewer intrusive thoughts than participants who had only watched the film.

In a similar study, Holmes and colleagues (2004; Experiment 1) compared a visuospatial task, a dissociation task and a no-task control. Findings indicated that watching a trauma film while concurrently performing a complex tapping task resulted in fewer reports of intrusive images. In a follow-up experiment, Holmes et al. (2004; Experiment 2) found that as the visuospatial task became increasing complex, the number of intrusive images decreased in a dose-dependent manner. The authors argued that as the visuospatial task becomes increasing demanding of WM resources, the ability to encode film content reduces, and therefore lowers the number of intrusive thoughts.

While research has demonstrated that a visuospatial task can lower the number of intrusive images during encoding, more resent research has investigated the effect on consolidated memories. In a series of six experiments, Patel (2014) explored the role of EM in reducing the number of intrusive thoughts of distressing memories. An EM laboratory model was adapted by including two suppression periods; a pre suppression period before EM, and a post suppression period following EM. In each suppression period an instruction was given to intentionally suppress any thoughts related to the distressing memory. If a thought did occur, then participants were required to press a response button. From the five studies that measured vividness and emotionality, two found that EM reduced memory vividness, whereas only one decreased in emotionality. Interestingly, four of the five studies revealed that EM lowered the number of intrusive thoughts. Together, these findings support the hypothesis that a concurrent task that taxes WM can lower the number of intrusive thoughts of consolidated memories.

Patel's (2014) studies show that EM can lower the number of intrusive thoughts of unwanted memories. However, support for the WM theory remains mixed, raising questions about the study's design. The author suggested that integrating a suppression task into an EM laboratory study may have in some way, contributed to the mixed findings, "perhaps through some kind of rebound effect" (Patel, 2014, pp.108). Similar to the white bear experiment, Patel's (2014) studies utilised instructions with a high level of intent. Participants were instructed to actively avoid thoughts about the memory, in the same way that participants of the white bear study were instructed to avoid thoughts related to a white bear. As such, the possibility of a post-suppression rebound effect becomes plausible.

Previous studies have shown that task instructions can influence the number of target thoughts that follow a suppression period (Merckelbach, Muris, van den Hout, & Jong, 1991; Rassin, Muris, Jong, & Bruin, 2005). Although completely eliminating intent altogether is unlikely, implementing more liberal instructions, such as “you can think about the memory, but you do not have to” (see Merckelbach et al., 1991) can lower the level of intent, and therefore reduce the likelihood of a rebound effect (Rassin, et al., 2005).

Introduction to the Current Research

Research exploring the role of EM on intrusive thoughts in consolidated memories is in its infancy. Previous studies have used task instructions with a high degree of suppression intent. This form of instruction poses a potential risk to study outcomes, considering the sensitivity of the post-suppression rebound effect (Wenzlaff & Wegner, 2000). To our knowledge, there has been no research exploring the role of EM on intrusive thoughts with a more liberal instruction and lower level of suppression intent. In the current research, two experiments were conducted to build on existing WM and EM literature. The goal of this research was twofold. First, we tested whether a dual-attention task (EM) reduced ratings of vividness and emotionality by taxing WM. Specifically, participants were assigned to one of three separate EM conditions (no-EM, slow-EM and fast-EM), each varying in demand for WM resources. Second, we examined whether EM lowered the number of intrusive thoughts, and to what degree two instructions influencing the level of intent, would affect suppression outcomes. Based on previous literature, the following hypotheses were tested:

Hypothesis 1: A main effect for EM was expected such that compared to no-EM, slow-EM and fast-EM will decrease ratings of memory vividness in a dose-dependent manner. Fast-EM will result in larger decreases in ratings of memory vividness than Slow-EM. Further, it was expected that there would be an interaction between EM and intent. Specifically, in the high intent condition the effect of EM will result in a smaller reduction in vividness ratings than in the low intent condition.

Hypothesis 2: A main effect for EM was expected such that compared to no-EM, slow-EM and fast-EM will decrease ratings of emotionality in a dose-dependent manner. Fast-EM will result in larger decreases in ratings of memory emotionality than Slow-EM. Further, it was expected that there would be an interaction between EM and intent. Specifically, in the high intent condition the effect of EM will result in a smaller reduction in emotionality ratings than in the low intent condition.

Hypothesis 3: A main effect for EM was expected such that compared to no-EM, slow-EM and fast-EM will reduce the number of intrusive thoughts of unpleasant memories in a dose-dependent manner. Fast-EM will result in less intrusive thoughts than Slow-EM. Further, it was expected that there would be an interaction between EM and intent. Specifically, in the low intent condition the effect of EM will result in less intrusive thoughts than in the high intent condition.

Chapter 2: Experiment One

Method

Design. The current study employed a between-group design comparing fast-Eye-Movement (EM), slow-EM and no-EM in both a high intent and low intent suppression group. Participant were randomly allocated to one of the three EM conditions and then to one of the suppression conditions. Participants were asked if they had any knowledge of Eye-Movement Desensitisation and Reprocessing (EMDR) therapy and those that did, were excluded from the final data set. All participants were blind to the experimental manipulations. The number of intrusive thoughts during a suppression period and subjective ratings of vividness and emotionality were the dependent variables, while EM and level of suppression intent were the independent variables.

Participants. One hundred and twenty two Victoria University of Wellington psychology undergraduate students (30 males and 92 females) participated in the study in return for course credit. Participants ages ranged from 17 to 53 (M=18.94, SD=3.51). All procedures were approved by the School of Psychology, Human Ethics Committee, under delegated authority of Victoria University of Wellington's Ethics Committee.

Apparatus and materials. All participants received a pen and a piece of lined paper to record in detail, one autobiographical memory. An envelope was provided to store the written memory so that no one else could see the text.

In all three EM conditions a black dot measuring 1cm in diameter appeared at the centre of a white screen. During the no-EM condition the black dot remained in a fixed position on the screen for a total of 25 seconds. Immediately after this, there was a 5 second rest period where the text "rest your eyes and relax" was displayed on the computer screen. This continued five more times before the phase of the experiment was complete. The slow-EM and fast-EM conditions used the same stimulus (black dot) and rest intervals as the no-

EM condition, however in these conditions the dot moved horizontally from one side of the screen to the other. In the slow-EM condition the dot moved at a rate of one movement per second, whereas in the fast-EM condition the dot moved at a rate of 2 movements per second.

The suppression periods measured the number of intrusive thoughts related to the distressing memory. Participants were randomly allocated to either one of two suppression conditions, each differing in the level of suppression intent. In the 'high intent' suppression group, individuals were instructed to try and avoid thinking about the memory, whereas in the 'low intent' suppression group, participants were instructed to think about anything they like. In both conditions the screen remained blank (white) while participants were instructed to press a response button (spacebar) every time a thought related to the memory came to their attention. The computer programme recorded the total number of presses over a 5 minute suppression period, as well as the response time between each press. Participants completed a total of two suppression tasks. The 'pre-suppression' period occurred prior to the EM condition, while the 'post-suppression' period occurred immediately after the EM condition. Participants then completed some scales.

Visual Analogue Scales. The Visual Analogue Scales (VAS) are a simple and effective way of measuring memory unpleasantness (van den Hout & Engelhard, 2012). The VAS are frequently used in laboratory models studying the role of EM in EMDR (Gunter & Bodner, 2008; Maxfield et al., 2008; van den Hout & Engelhard, 2012). Participants are asked to recall an image or memory as vividly as possible that had a significant emotional impact. Participant then rate that memory in terms of vividness (*1 = not clear, 10 = extremely clear*), and emotionality (*1 = not at all distressing*, *10 = extremely distressing*) on two 10-point Likert scales. In the current study, baseline scores were recorded prior to the first suppression period, and then immediately after the post-suppression period. These scales provided a means of measuring the change in memory unpleasantness following the treatment condition (EM).

Impact of Event Scale-Revised. The Impact of Event Scale-Revised (IES-R; Weiss & Marmar, 1997) is a 22-item screening tool used to measure an individual's subjective response to a traumatic event over the past week. Items of the IES-R are closely matched to DSM-IV criteria of Posttraumatic Stress Disorder (PTSD) and capture core diagnostic information across three subscales; intrusion (*e.g.,* "*any reminder brought back feelings about it"*), avoidance (*e.g., "I tried not to think about it"*) and hyperarousal (*e.g., "reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart"*). Participants were asked to read the items and then indicate how distressing each had been with respect to their chosen memory. Item responses were recorded on a 5-point Likert scale (*0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, 4 = extremely*) and added to produce participants' overall score. Higher scores on the IES-R indicate higher levels of post event stress. The IES-R was used in the current study to help ensure that memories of events were similar across groups. The IES-R total scale has been found to have high internal consistency (α = .96), as well as in all three subscales (intrusion α = .92; avoidance α = .85; hyperarousal α = .89; Creamer, Bell, & Failla, 2003).

Directed Forgetting Task. The Directed Forgetting Task (DFT; Bjork, LaBerge, & LeGrand, 1968) is an experimental paradigm that illustrates the phenomenon of memory impairment after an instruction to forget unwanted material (Anderson, 2005). There are two main versions of the DFT paradigm that currently exist. The first, known as the *item-method*, requires participants to view a series of items (usually words) with an instruction to either remember (RRRR) or forget (FFFF) following each item. Once all items have been displayed, a simple recall or recognition test is administered. Results typically indicate a significant increase in recall of remember words, and a decrease in recall of forget words.

The second version of the DFT is the *list-method.* In this version, rather than receiving an instruction to remember or forget each item, participants are required to learn two separate lists of words with a recall test on both (Sahakyan & Delaney, 2002). The manipulation occurs when a ‘to-be-forgotten’ group is instructed to forget the first list of words immediately following display, while the ‘to-be-learned’ group continues to remember both the first and second list. The phenomenon, often referred to as the ‘directed forgetting effect’, results in (a) increased memory impairment for list one (to-be-forgotten group), and (b) enhanced memory recall for list two (to-be-forgotten group). Bjork (1989) suggests that directed forgetting results from the instruction to forget list one. He hypothesised that this instruction affects memory retrieval, subsequently suppressing access to items from the first list.

The current study was interested in measuring participants’ ability to suppress already encoded information (distressing image or memory). For this reason, the list-method version of the DFT was the more suitable option, as it requires participants to first encode material (list one and two), before supressing the information from list one. Since this experiment is only interested in participants’ ability to suppress material, all participants were subject to the forget condition. List items were adopted from Patel (2014) and counterbalanced, with half of the participants receiving list one first (odd subject number) and the other half receiving list two first (even subject number). The DFT measured individuals’ ability to suppress the retrieval of unwanted memories across both the high and low intent suppression groups.

Automated Version of the Operation Span Task. The Automated Version of the Operations Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005) is a computerised version of the Operation Span Task (OSPAN; Turner & Engle, 1989), an instrument designed to measure an individual’s capacity of working memory (Unsworth et al., 2005). The advantage of the AOSPAN over more tradition working memory span tasks (e.g., reading span), is that it allows for individual administration among large groups with limited experimenter input (Unsworth et al., 2005).

The AOSPAN is divided into two main tasks; a letter span task and math equation task. Participants were first required to run through a three part practice session. This allowed participants to become familiar with each task's procedure, before combining the two tasks together. In the letter span task, participants were required to recall a series of individually displayed letters in correct sequential order by numbering each letter in a 4 X 3 matrix displayed at the end of the task. Feedback on the total number of letters recalled correctly was provided immediately after the matrix was completed (*e.g., "you recalled 2 letters correctly out of 6"*).

The next section of the practice session required participants to solve a series of math equations (*e.g., (2*3) +2 =?*). An instruction was given to solve each equation as quickly as possible before clicking the computer mouse to reveal a single numeral value (*e.g., 7*). Participants responded with either 'true' or 'false' depending on their answer to the equation. A total of 15 practice equations were administered. A mean response time was calculated from the total time taken to solve all 15 equations, providing a time limit (± 2.5 *SD*) for the set of test trials. This time limit served to prevent participants from rehearsing the sequence of letters when combined with the math equations.

The final practice section combined the letter span task and math equation task, mirroring the test trial procedure. Participants were required to first solve the math equation in the same way as the second practice section. Immediately after, a to-be-recalled letter appeared at the centre of the screen. Each equation and to-be-recalled letter made up a single *set*. Participants were given three practice trials, each with 2 sets.

Once participants had become familiar with the AOSPAN, they moved on to the block of test trials. The full AOSPAN task included three trials of each set, ranging from set size 3-7. In total, participants were required to solve 75 equations and recall each corresponding letter. The total number of correctly recalled letters was equal to the individual's overall AOSPAN score. Higher AOSPAN scores indicate a greater working memory capacity, while lower scores suggest a smaller working memory capacity. Research has found that the AOSPAN is both a valid and reliable measure, demonstrating good internal consistency ($\alpha = .78$) and test-retest reliability (.83). Furthermore, the AOSPAN correlates well with other working memory measures, such as the Ospan ($r = .45$, $p < .01$; Unsworth et al., 2005).

Procedure. Testing was conducted in groups of approximately 10, with participants completing the experiment individually on a desktop computer, under the supervision of a researcher. Other than writing down a specific memory or recalling two lists of words, participants completed the entire experiment on Apple iMac computers using E-prime® version 2.0 software. The computer screen measured 30cm x 30cm with participants sitting at a distance of approximately 50-60cms from the screen. The procedure was carried out by following instructions displayed on the screen to minimise experimenter input. A brief explanation about the purpose of study was provided and written consent was obtained.

The first phase of the experiment required participants to recall a distressing memory. They were then asked to provide a written description based on protocol from van den Hout et al. (2001) and adapted by Patel (2014):

> Please recall an event that made you feel very fearful, anxious, or distressed. This event should still have some emotional impact. Examples of this type of event include going unprepared into an examination or witnessing an accident. When you have an event in mind please write a few sentences describing the event on the sheet of paper provided. You will have 5 minutes to complete this task. Once you have completed this task, please place the sheet of paper inside the envelope provided.

All participants were then required to form an image or memory of their chosen event and record baseline measures of memory unpleasantness using the VAS:

> Form an image or memory of the event described on your sheet, and keep your eyes open. Remember where it happened, who was present, and anything else you can think of. Bring it to mind as vividly as if it were happening right now. On the scales provided, please rate how vivid and how emotional the memory is.

In the next phase of the experiment, participants received one of two instructions. Each instruction differed depending on the level of suppression intent. During the ‘high intent’ suppression condition, participants received the following:

> Try to avoid thinking about the memory. Whenever you do have a thought about the memory, press the spacebar once.

In the ‘low intent’ suppression condition, participants received:

> Think about anything you would like. However, if you do have a thought about the memory, press the spacebar once.

Following the pre-suppression period, participants were randomly allocated to one of the three EM conditions; no-EM, slow-EM or fast-EM:

> In this part of the experiment you are required to think about the memory while looking at a dot on the computer screen. It’s important that you keep your eyes on the dot on the screen and your head as still as possible, but blink whenever you need to. Concentrate on your thoughts of the memory as much as possible. You will get short breaks where you can rest your eyes and think about something else.

Immediately after the EM phase, participants completed the final suppression period. Under the same instructions, they spent 5 minutes either trying not to think about the memory, or thinking about whatever came to mind. Participants were then asked to recall the same image or memory and rate the unpleasantness of the memory using the VAS. Once all participants had finished making their ratings, they completed the DFT and AOSPAN tasks.

At the conclusion of the experiment, the researcher thanked participants for completing the study requirements and provided a written debrief explaining the nature of the study.

Results

Two-way, between-groups analysis of variance (ANOVA) was performed to explore the role of EM on the vividness and emotionality of distressing memories. The experiment further examined whether an instruction, influencing the level of intent, affected the number of intrusive thoughts following a no-EM, slow-EM or fast-EM condition.

Separate index scores were calculated for vividness and emotionality by subtracting post-EM ratings from pre-EM ratings. A positive score indicated a reduction in memory rating, whereas a negative score indicated an increase. A thought intrusion index score was also obtained and reflected a difference in the number of intrusive thoughts following an EM condition. Mean scores and standard deviations of pre and post memory ratings, and the number of presses during each suppression period are provided in Table 1. For all analyses, the significance level was set at $p < .05$.

Table 1

Experiment one: Means and (SDs) of pre and post memory ratings and presses during suppression periods.

	Vividness		Emotionality		Thought Intrusion	
	Pre	Post	Pre	Post	Pre	Post
High Intent						
Fast-EM	7.29 (1.65)	7.24 (1.87)	7.76 (1.64)	7.43 (1.57)	10.14 (9.59)	8.10 (8.17)
Slow-EM	7.71 (1.95)	7.14 (1.90)	7.90 (2.05)	6.90 (2.41)	5.86 (6.16)	4.33 (5.11)
No-EM	7.70 (1.69)	7.40 (1.67)	6.60 (1.88)	6.25 (1.61)	9.40 (8.39)	8.35 (7.39)
Low Intent						
Fast-EM	6.48 (2.18)	5.90 (2.10)	5.81 (2.38)	4.29 (2.49)	11.95 (10.90)	7.86 (7.92)
Slow-EM	7.60 (1.79)	6.30 (2.11)	7.35 (1.87)	5.70 (2.70)	4.10 (4.66)	6.55 (7.76)
No-EM	7.70 (2.13)	6.60 (1.98)	7.50 (1.99)	6.65 (2.21)	14.60 (15.70)	10.35 (13.59)

Note: Pre and post memory ratings are measured on two 10-point Likert scales; Vividness (1 = not clear, 10 = extremely clear), and emotionality (1 = not at all distressing, 10 = extremely distressing).

Preliminary analysis. A two-way ANOVA was conducted to examine whether participants' memories differed in the level of subjective stress across EM and intent conditions. No main effect was found for EM $F(1,116) = .19$, $p = .83$, however, there was a main effect for intent $F(1,116) = 9.82$, $p = .002$. Differences in IES-R scores showed that participants who received a low intent instruction rated their memories as less distressing ($M = 35.49$, $SD = 2.07$) than participants who received a high intent instruction ($M = 44.58$, $SD = 2.03$). The Intent by EM interaction did not reach significance, $F(2,116) = 1.09$, $p = .34$.

Individual differences in working memory capacity, as measured by the AOSPAN, were compared across EM and intent conditions. Analysis revealed a main effect for intent $F(1,114) = 5.13$, $p = .03$, indicating that participants in the low intent suppression condition has significantly greater working memory capacity ($M = 56.33$, $SD = 1.92$) than those participants in the high intent condition (*M* = 50.18, *SD* = 1.92). There was no main effect for EM, *F*(2,114) = .74, *p* = .48, nor was there an interaction between Intent and EM, *F*(2,114) = .37, *p* = .69.

To assess for individual differences in suppression ability, independent-sample *t*-tests were performed to compare thought intrusion scores, as measured by the DFT, between EM conditions and the level of intent. Scores were not significantly different for no-EM (*M* = 0.70, *SD* = 3.11) and slow-EM (*M* = 1.02, *SD* = 3.25); *t*(79) = -.46, *p* = .65, or slow-EM (*M* = 1.02, *SD* = 3.25) and fast-EM (*M* = .18, *SD* = 3.00); *t*(78) = 1.21, *p* = .23, nor was there a significant difference between fast-EM (*M* = .18, *SD* = 3.00) and no-EM (*M* = 0.70, *SD* = 3.11); *t*(77) = .76, *p* = .45. Similarly, no significant difference was found between the low intent (*M* = 1.11, *SD* = 3.17) and high intent (*M* = .15, *SD* = 2.99); *t*(118) = 1.71, *p* = .90 conditions.

Differences in vividness and emotionality ratings and thought intrusions (measured by presses) during each suppression condition were tested with separate 2 (Intent: low *vs.* high) x 3 (EM: no-EM *vs.* slow-EM *vs.* fast-EM) ANOVA. Analysis showed that for vividness ratings, there was a significant main effect for intent, *F*(1,110) = 3.76, *p* = .06, though not for EM, *F*(2,110) = .85, *p* = .43. The main effect of intent was reflected in a greater reduction in vividness in the low intent condition (*M* = 1.05, *SD* = 2.09) compared to the high intent condition (*M* = .34, *SD* = 1.77). There was no significant interaction between Intent and EM, *F*(2,110) = .17, *p* = .85.

A similar pattern emerged for ratings of emotionality. The main effect for intent was significant, *F*(1,110) = 4.58, *p* = .04, whereas the main effect for EM was not, *F*(2,110) = 1.09, *p* = .34. The main effect of intent was reflected in a greater reduction in emotionality ratings in the low intent condition (*M* = 1.41, *SD* = 1.97) compared to the high intent condition (*M* = .61, *SD* = 2.10). The interaction between Intent and EM did not reach significance, $F(2,110) = .22$, $p = .80$. Together, these findings indicate that while ratings of vividness and emotionality differ between high and low suppression intent, they do not differ across EM conditions.

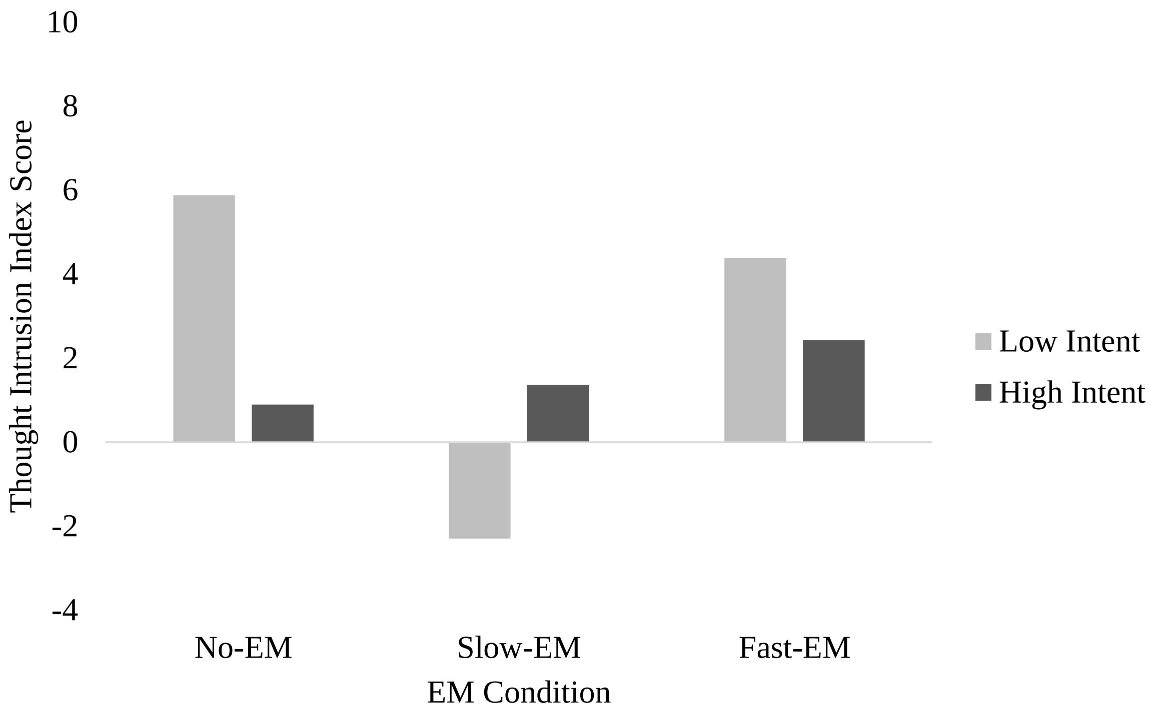

Figure 1. Thought intrusion index scores for the no-EM, slow-EM and fast-EM conditions in experiment one.

For thought intrusion ratings, there was no main effect for intent, $F(1,110) = .59$, $p = .45$. There was however, a main effect for EM, $F(2,110) = 3.70$, $p = .03$, and a significant interaction between Intent and EM, $F(2,110) = 3.52$, $p = .03$. *Post hoc* analyses showed that for the high intent condition, EM had very little effect on the number of intrusive thoughts. Evident in *Figure 1*, thought intrusion index scores remained relatively stable across the three EM conditions. For low intent the number of intrusive thoughts varied considerably depending on the EM condition, with participants in the no-EM and fast-EM condition experiencing less intrusive thoughts overall. Participants in the fast-EM condition experienced less intrusive thoughts than those individuals assigned to slow-EM condition.

Discussion

Experiment one showed that recalling a distressing memory while simultaneously engaging in EM does not reduce ratings of vividness or emotionality, compared to a no-EM control. In addition, no dose-response relationship was obtained, with participants producing comparable effects regardless of EM condition. These findings oppose Working Memory (WM) literature (Engelhard et al., 2011; Gunter & Bodner, 2008; Holmes & Bourne, 2008; Jeffries & Davis, 2013; Lee & Cuijpers, 2013; van den Hout & Engelhard, 2012), and are inconsistent with Maxfield et al's. (2008) earlier findings that demonstrate the effectiveness of higher taxing tasks on reducing memory ratings. Interestingly, when participants were separated by task instruction, and therefore suppression intent, there was an effect on memory ratings. Participants in the high intent suppression condition received a smaller reduction in vividness and emotionality ratings over those participants assigned to a low intent condition.

Although EM did not produce the expected decrease in memory ratings, it did appear to influence the number of intrusive thoughts. Depending on the level of suppression intent, the influence of EM on intrusive thoughts varied considerably. For participants who were required to intentionally supress their memories, there were no differences in the number of intrusive thoughts following no-EM, slow-EM or fast-EM. In contrast, when a more liberal instruction was given, and suppression intent was reduced, EM had a significant influence on the number of intrusive thoughts. Compared to slow-EM, participants in the fast-EM and no-EM conditions experienced fewer intrusive thoughts overall. These findings did not show the predicted pattern of change, indicating the absence of a dose-response relationship.

Taken together, the findings from experiment one are inconsistent with our hypotheses. Furthermore, they can not be explained by subjective differences in the level of memory distress, suppression ability or working memory capacity. Given the extensive body of WM and thought suppression literature, questions concerning the overall quality of the data arise. For this reason, the aim of experiment two is to replicate experiment one and explore whether these findings are the result of an anomaly in the sample, or perhaps the outcome of a fault in our methodology.

Chapter 3: Experiment Two

Method

Design. As in experiment one, experiment two employed a between-group design comparing no-Eye-Movement (EM), slow-EM and fast-EM in both a high intent and low intent suppression group. The number of intrusive thoughts during a suppression period and subjective ratings of vividness and emotionality were the dependent variables, while EM and level of suppression intent were the independent variables.

Participants. One hundred and twenty two Victoria University of Wellington psychology undergraduate students (28 males and 94 females) participated in the study in return for course credit. Participants ages ranged from 16 to 41 (M = 18.94, SD = 2.78). One participant was excluded from the final data set, having prior knowledge of Eye-Movement Desensitisation and Reprocessing (EMDR) therapy. All procedures were approved by the School of Psychology, Human Ethics Committee, under delegated authority of Victoria University of Wellington's Ethics Committee.

Apparatus, materials and procedure. The apparatus, materials and procedure used in this experiment were the same as those used in experiment one.

Results

Preliminary analysis. ANOVA showed that participants' ratings of memory distress, as measured by the DFT, were not significantly different across EM or suppression intent conditions. No main effect was found for EM, $F(2,116) = .06$, $p = .94$, or intent $F(1,116) = .15$, $p = .70$, and there was no interaction between Intent and EM, $F(2,116) = 1.58$, $p = .21$.

Analysis of AOSPAN scores revealed no significant differences in participants' Working Memory (WM) capacity across EM and suppression intent conditions. There was no main effect for intent $F(1,116) = 1.35$, $p = .25$, or EM, $F(2,116) = 1.65$, $p = .20$, nor was there an interaction between Intent and EM, $F(2,116) = 1.39$, $p = .25$.

Lastly, participants did not differ in suppression ability across EM and suppression intent conditions. There was no significant difference between no-EM (*M* = 0.55, *SD* = 3.43) and slow-EM (*M* = 0.58, *SD* = 3.19); *t*(78) = -.03, *p* = .97, or slow-EM (*M* = 0.58, *SD* = 3.19) and fast-EM (*M* = .76, *SD* = 3.71); *t*(79) = -.24, *p* = .82, nor was there a significant difference between fast-EM (*M* = .76, *SD* = 3.71) and no-EM (*M* = 0.55, *SD* = 3.43); *t*(79) = .26, *p* = .80. Furthermore, no significant difference was found between the low intent (*M* = .70, *SD* = 3.69) and high intent (*M* = .55, *SD* = 3.16); *t*(119) = .248, *p* = .81 conditions.

Table 2
Experiment two: Means and (SDs) of pre and post memory ratings and presses during suppression periods.

	Vividness		Emotionality		Thought Intrusion	
	Pre	Post	Pre	Post	Pre	Post
High Intent						
Fast-EM	6.81 (1.81)	6.76 (1.81)	6.86 (1.62)	6.19 (1.91)	9.95 (8.97)	6.52 (7.65)
Slow-EM	7.90 (1.83)	7.45 (1.73)	7.45 (2.14)	6.65 (2.41)	12.55 (9.86)	7.70 (6.77)
No-EM	8.20 (1.99)	7.90 (1.89)	7.55 (1.79)	6.95 (1.82)	9.85 (5.98)	8.75 (4.34)
Low Intent						
Fast-EM	8.14 (1.56)	7.43 (1.80)	7.57 (1.86)	6.81 (1.81)	10.29 (9.14)	10.02 (11.15)
Slow-EM	7.65 (1.60)	6.85 (2.16)	7.50 (1.82)	5.90 (2.15)	12.70 (17.57)	5.05 (5.36)
No-EM	7.45 (1.99)	7.80 (1.91)	6.90 (2.27)	6.35 (2.76)	4.15 (4.04)	7.35 (6.90)

Note: Pre and post memory ratings are measured on two 10-point Likert scales; Vividness (1 = not clear, 10 = extremely clear), and emotionality (1 = not at all distressing, 10 = extremely distressing).

Experiment two conducted separate, two-way, between-groups ANOVA to explore the role of EM on the vividness and emotionality of distressing memories. In addition, the experiment examined whether an instruction, influencing in the level of intent, affected the number of intrusive thoughts following a no-EM, slow-EM or fast-EM condition.

To investigate whether changes in vividness and emotionality ratings and the number of thought intrusions occurred following no-EM, slow-EM and fast-EM, a series of 2 (Intent: low *vs.* high) x 3 (EM: no-EM *vs.* slow-EM *vs.* fast-EM) ANOVAs were performed. Results showed that for vividness, there was a no main effect for intent, $F(1,114) = .041$, $p = .84$, or EM, $F(2,114) = 1.22$, $p = .30$, nor was there a significant interaction between Intent and EM, $F(2,114) = 1.55$, $p = .22$. Similarly, for emotionality, the main effect for intent, $F(1,114) = .71$, $p = .40$, and EM was not significant, $F(2,114) = 1.46$, $p = .19$, and there was no interaction between Intent and EM, $F(2,114) = .46$, $p = .63$. The absence of differences between EM conditions suggest that the varying rates of EM had no significant impact on the vividness and emotionality of unpleasant memories.

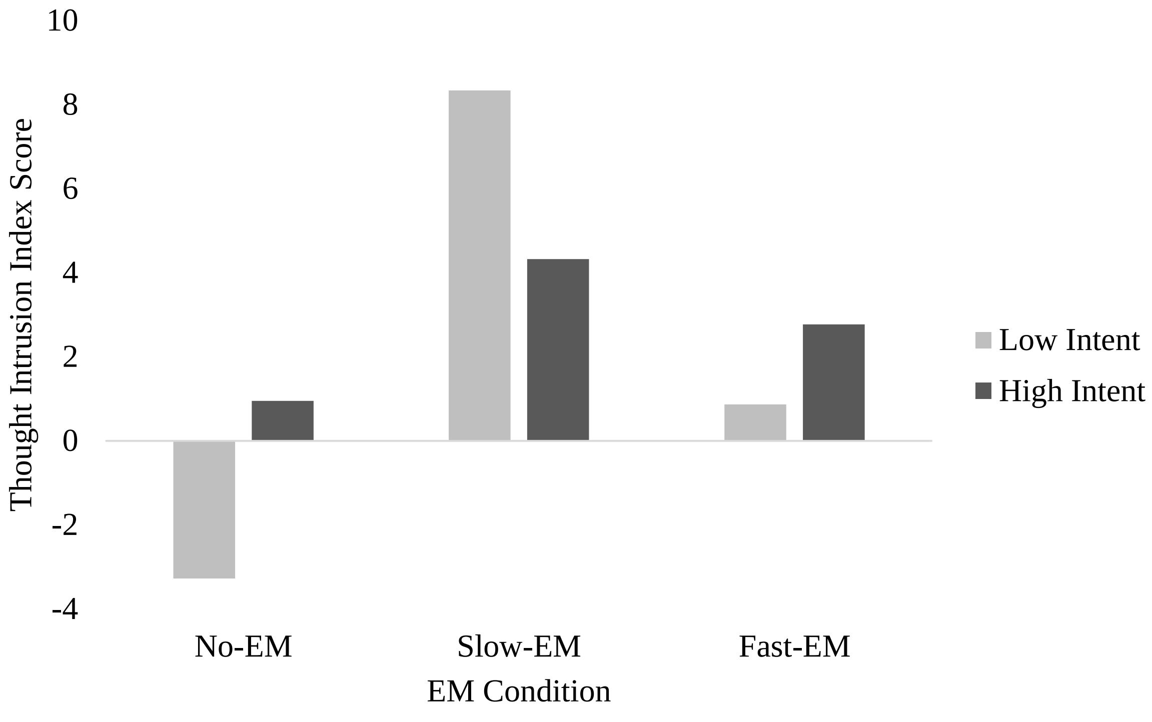

Figure 2. Thought intrusion index scores for the no-EM, slow-EM and fast-EM conditions in experiment two.

For thought intrusions, no main effect was found for intent, *F*(1,114) = .18, *p* = .67. There was however, a statistically significant effect for EM, *F*(2,114) = 6.88, *p* = .002, such that participants in the slow-EM (*M* = 6.25, *SD* = 10.92) condition experienced a larger decrease in intrusive thoughts than participants in the no-EM (*M* = -1.05, *SD* = 6.35) and fast-EM (*M* = 1.79, *SD* = 9.71) conditions (shown in *Figure 2*). The Intent by EM interaction was not statistically significant, *F*(2,114) = 2.15, *p* = .12.

Discussion

Results from experiment two showed that eliciting a distressing memory while concurrently engaging in EM does not reduce ratings of vividness and emotionality when compared to a no-EM control. As in experiment one, similar effects on memory ratings were obtained irrespective of EM condition, indicating that task more taxing of WM resources has no significant benefit over a less taxing task. Interestingly, in the current experiment, the two opposing task instructions had no effect on memory ratings, suggesting that the level of suppression intent did not interfere with either the vividness or emotionality of participants' memories. Again, these findings challenge WM theory (Engelhard et al., 2011; Gunter & Bodner, 2008; Jeffries & Davis, 2013) and oppose earlier findings of a dose-response relationship (Gunter & Bodner, 2008; Maxfield et al., 2008).

In contrast with experiment one, EM did not influence the number of intrusive thoughts of unpleasant memories. Results showed that participants in the slow-EM and fast-EM conditions experienced similar numbers of target related thoughts to those participants assigned to the no-EM condition. In addition, the level of suppression intent had no effect on the number of intrusive thoughts, suggesting the absence of a rebound effect. These findings did not show the predicted dose-response relationship, and are inconsistent with previous studies that have shown a decrease in intrusive thoughts following a dual-attention task (Patel, 2014).

Chapter 4: General Discussion

The aim of the current research was to explore the role of Eye-Movement (EM) on ratings of memory vividness and emotionality, and intrusive thoughts of unpleasant memories. Previous studies have shown that recalling a distressing memory while simultaneously engaging in EM can lower the number of intrusive thoughts (Patel, 2014). However, when memory ratings are also obtained, the predicted decrease in vividness and emotionality is not consistently found. This raises a number of questions regarding the methodology of the EM paradigm. One possible explanation is that task instructions require participants to intentionally suppress memory related thoughts, therefore resulting in a post-suppression rebound effect (Wenzlaff & Wagner, 2000).

The two experiments conducted in this thesis are unique, and to our knowledge, are the first to compare two task instructions, that differ in their influence on suppression intent. Consistent with previous research, we tested whether a dual-attention task (EM) reduced ratings of vividness and emotionality by taxing Working Memory (WM). Participants were assigned to one of three separate EM conditions (no-EM, slow-EM and fast-EM), each varying in demand for WM resources. We then examined whether EM lowered the number of intrusive thoughts, and to what degree two different instructions affected suppression outcomes.

Summary of Findings

Experiment one. The findings from experiment one showed that recalling a distressing memory while simultaneously engaging in EM did not reduce ratings of vividness or emotionality, relative to a no-EM control. Participants assigned to a task that was more taxing of WM resources (fast-EM) received no additional benefit to memory ratings over participants assigned to a less taxing task (slow-EM), indicating the absence of a dose-response relationship. However, when participants were divided by task instruction, manipulating suppression intent, a significant effect on vividness and emotionality ratings was obtained. Specifically, those participants instructed to intentionally supress their memories received a smaller reduction in vividness and emotionality ratings than their liberal instruction counterparts.

Experiment one also showed that the number of intrusive thoughts following no-EM, slow-EM and fast-EM, differed across intent conditions. For participants who received a high intent instruction, there was no difference in the number of intrusive thoughts across EM conditions. However, when participants received a low intent instruction, the number of intrusive thoughts varied considerably. Compared to the slow-EM condition, participants assigned to the no-EM and high-EM conditions received a greater reduction in intrusive thoughts. However, this was not entirely in the predicted direction and the dose-response relationship was not found.

Experiment two. Consistent with experiment one, experiment two found that recalling a distressing memory while concurrently engaging in EM did not reduce ratings of vividness or emotionality compared to a no-EM control. Regardless of demand for WM resources, slow-EM and fast-EM produced comparable effects on memory ratings, indicating the absence of a dose-response relationship. Furthermore, there were no differences between intent conditions, with participants providing similar memory ratings irrespective of task instruction.

Experiment two also showed that EM did not reduce the number of intrusive thoughts. There were no differences in the number of intrusive thoughts following no-EM, slow-EM or fast-EM, nor were they influenced by suppression intent.

Taken together, the two experiments presented in this study show that a dual-attention task did not reduce ratings of memory vividness and emotionality by taxing

WM. These findings not only oppose WM theory (Engelhard et al., 2011; Gunter & Bodner, 2008; Holmes & Bourne, 2008; Lee & Cuijpers, 2013; van den Hout & Engelhard, 2012), but also oppose a considerable body of research that has demonstrated the efficacy of the EM component (Andrade et al., 1997; Barrowcliff et al., 2004; Jeffries & Davis 2013; Kavanagh et al., 2001). While it remains unclear as to why these effects were not obtained, it should be mentioned that previous EM studies have found inconsistent results. For example, some studies have found the expected decrease for vividness, but not emotionality (Lee & Drummond, 2008; Patel, 2014), and others have found the expected decrease for emotionality, but not for vividness (Engelhard et al., 2010; Engelhard et al., 2011; Patel, 2014).

According to van den Hout et al. (2001) “it is not uncommon in experimental research on EM that effects do not materialise on vividness or emotionality” (p.429). The authors argue that the variation in study outcomes could be considered the result of insufficient statistical power. In the current research, we sought to resolve this issue by using a typical EM paradigm with significantly larger sample sizes. Despite conducting two experiments, the desired reduction in vividness and emotionality ratings was not found.

Considering the aforementioned findings, it may be argued that the effect of EM on memory ratings is not as robust as initially thought. One possible explanation may reside in the methodology used in laboratory studies. Research focused on isolating the EM component from Eye-Movement Desensitisation and Reprocessing (EMDR) therapy adopt rigorous methods to control for possible confounding factors. While these measures are necessary for attributing outcomes to treatment conditions (e.g., EM), the current EM paradigm may be too far removed from standard EMDR protocol (Maxfield et al., 2008). Analogue studies typically restrict participants to recall only one distressing memory, rating the vividness and emotionality before and after engaging in EM. However, EMDR employs a technique known as ‘free association’. In this process clients have the ability to freely move between distressing memories, noticing the associated thoughts and images as they arise (Shapiro & Maxfield, 2002). To our knowledge, research has not yet determined whether assigning participants to a single distressing memory can be utilised as a valid substitute for the process of free association. Shapiro and Maxfield (2002) argue that the process of free association is a distinct and fundamental difference that separates EMDR from traditional exposure therapies. With free association absent from laboratory studies, the question remains – is it possible that the mechanisms underlying change in EM research are the same as those processes underlying exposure?

An alternative explanation may be that EM provides no incremental benefit to memory ratings, rather acts as a temporary ‘performance aid’, while participants are subject to exposure (Kavanagh et al., 2001; Lilley et al., 2009). Proponents of exposure theory have been criticised on the basis that interference during exposure has shown to hinder treatment outcomes (Foa & Kozak, 1986). This remains a point of contention, as more recent findings indicate that a distraction task may actually facilitate the process of habituation to a feared stimulus (Johnstone & Page 2004; Oliver & Page, 2003).

Gunter and Bodner (2008) propose that rather than distracting the individual from engaging in the process of exposure (i.e. not letting the individual think about the traumatic memory), EM may simply reduce the level of attention towards the memory. Indeed, the role of EM has been argued to regulate the degree of fear or discomfort one experiences during exposure (Kavanagh et al., 2001). Analogous to a pair of gloves for the snake phobic, EM may provide a form of scaffolding that assists the individual through a less distressing form of exposure (Kavanagh et al., 2001). This stepped care approach to trauma treatment has been found to lead to higher rates of treatment adherence in EMDR, compared to more aversive treatments often associated with dropout (e.g., prolonged exposure; Ironson et al., 2002).

The theory of exposure may be particularly important for the current research given the absence of significant findings. Laboratory studies exploring the role of EM vary significantly with respect to the length of treatment periods; specifically, the number of EMs per set, and the number of sets per treatment period. While the length of treatment period is largely dependent on the authors' discretion, duration of EM and therefore memory exposure may have significant implications for treatment outcomes. Interestingly, of those studies that have obtained mixed results, many have adopted paradigms with shorter treatment periods (e.g., Andrade et al., 1997; Kavanagh et al., 2001; Leer et al., 2014).

Leer et al. (2014) conducted a study exploring the role of EM on ratings of vividness and emotionality. The authors sought to examine whether the effect of EM on memory ratings was related to treatment duration. Participants were assigned to two separate conditions; one with four periods of 24 seconds, and the other with eight periods of 24 seconds. Results showed that the group who received eight periods of EM was the only group to achieve decreases in memory vividness and emotionality immediately after testing, and at a 24 hour follow-up.

In the current research, participants across all three EM conditions received five brief treatment periods, each lasting for 25 seconds. We found slight reductions in vividness and emotionality ratings from pre-test to post-test, however these were comparable across all EM conditions. Similar findings have been identified in previous EM studies, and have largely been attributed to the effects of habituation (Kavanagh et al., 2001; Lilley et al., 2009). Therefore, it is plausible that our intervention duration, and thus exposure to the distressing memory, was too short to produce the desired changes in memory ratings and intrusive thoughts.

Limitations and Further Research

There are a number of limitations of this research that warrant discussion. Arguably, the most relevant limitation relates to all analogue studies exploring the role of EM in EMDR; that is, the issue of ecological validity. The extent to which non-clinical findings can be generalised to a clinical population remains unclear, with little known about the wider cognitive implications in trauma victims. For example, deficits in WM capacity have been identified in individuals experiencing Posttraumatic Stress Disorder (PTSD). With research yet to explore how these deficits may interact with WM processes, potential challenges arise given the correlations found between WM capacity and the effectiveness of EM (Gunter & Bodner, 2008; van den Hout & Engelhard, 2012). Nevertheless, studies have replicated similar results in clinical samples using an analogue design, showing that EM alone can lower ratings of vividness and emotionality of traumatic memories (Lilley et al., 2009).

A further limitation of the current research is the absence of a manipulation check for each EM condition. Studies examining the effects of a dual-attention task on WM capacity frequently perform manipulation checks, such as the Reaction Time task (RT; van den Hout & Engelhard, 2012), prior to beginning testing. The manipulation check assesses whether a task taxes WM resources, and to what degree that task makes demand for WM capacity (Engelhard et al., 2011). Although the two experiments conducted in this thesis did not assess the precise capacity required by each EM task, it is unlikely to have influenced the overall findings. Previous studies using comparable designs have found the expected dose-response relationship between no-EM, slow-EM and fast-EM conditions, regardless of measuring cognitive load (Maxfield et al., 2008).

To our knowledge, this thesis provides some of the first research exploring the role of EM on intrusive thoughts. As of yet, no studies have explored this relationship in clinical samples. Future research is required to examine the potential value of WM tasks in clinical populations diagnosed with PTSD. This is a particularly pertinent direction given the uncertainty of WM processes and suppression ability in clinical populations (Schubert et al., 2011; Shipherd & Beck, 1995; Shipherd & Beck, 2005).

Future research should also explore whether exposure theory can explain the role of EM in treatment outcomes. More specifically, research should investigate the notion that EM may act as a performance aid, moderating the degree of attention one provides throughout the exposure process. Laboratory studies could investigate this theory by manipulating the duration of EM (exposure time), assigning individuals to brief, moderate and long treatment periods. Alternatively, clinical research could examine EMDR with and without EM, paying direct attention to treatment adherence as a separate dependent variable. Greater treatment adherence in the EM condition would provide supporting evidence for EM as a performance aid, addressing potential blocks to progress and improving treatment retention.

Lastly, to advance the utility of laboratory research, measures need to be taken to increase the validity of the EM paradigm. Including a short interval of free association following EM is one way in which the laboratory model can align more closely with Shapiro's fourth phase of EMDR (see Shapiro, 2001). Currently only two studies have employed this technique (Yaggie et al., 2015). Research would not only benefit from a paradigm more akin to EMDR protocol, but also from understanding the role of free association in reducing the vividness and emotionality of distressing memories.

Theoretical and Practical Implications

Given the nature of this research, there are a number of clinically relevant implications for EMDR therapy. As previously noted, EM has remained a contentious topic and the utility of this procedure has been the topic of much debate. The present findings provide little clarity on this matter, casting doubt over the use of EM in EMDR therapy. Although the theory of exposure has not been tested directly in the current research, we argue that this alternative explanation may account for the non-significant findings.

In accordance with exposure theory, EM provides no direct therapeutic effect, rather acts as a performance aid, moderating the degree of distress one experiences while undertaking exposure (Kavanagh et al., 2001). It follows that any secondary task that can regulate the level of attention, may be of equal benefit in resolving traumatic memories. Indeed, many studies investigating the effects of dual-attention tasks on distressing memories have found significant reductions in ratings of vividness and emotionality through drawing (Gunter & Bodner, 2008), counting (van den Hout et al., 2010), finger tapping (Andrade et al., 1997) and computer games (Engelhard et al., 2010). Although WM theorists may attribute these reductions to deterioration in memory quality, it is plausible that these tasks share an alternative mechanism of action; facilitating treatment progress through a stepwise exposure process.

Considering EM as a performance aid to exposure therapy is informative for current EMDR protocol. At present, EMDR guidelines stipulate a fixed rate of EM that remains the same, regardless of the individual's presentation (Shapiro, 2001).

However, subjective experiences, content and interpretation of the distressing event(s) differ considerably across individuals diagnosed with PTSD, eliciting variation in emotional responses (Keane et al., 2006). Depending on the emotional intensity of the memory, clinicians could regulate the degree of interference by modifying the rate of EM. In this case, EM provides a form of graded exposure in which more distressing memories are subject to higher rates of EM. As habituation occurs, the performance aid is of less use and the EM procedure can be gradually withdrawn (Kavanagh et al., 2001).

Conclusion

To conclude, we examined whether a dual-attention task (EM) reduced ratings of memory vividness and emotionality by taxing WM resources. In addition, we examined whether EM lowered the number of intrusive thoughts, and to what degree two instructions differing in their influence on intent, affected suppression outcomes. Contrary to our hypotheses, EM did not reducing ratings of vividness and emotionality, nor did it lower the number of intrusive thoughts. These findings not only conflict with a considerable body of literature that has demonstrated the efficacy of EM component, but also, with the theory of WM.

While the predicted outcomes were not obtained, it is possible that findings can be explained by mechanisms underpinning exposure. We argued that EM provides no additional benefit to memory ratings, rather acts a temporary performance aid, assisting individuals through a more manageable form of exposure. Consistent with this theory, the lack of significant findings may be attributed to short periods of EM, and therefore, exposure to the distressing memory. Nevertheless, future research is needed to ascertain whether manipulating the duration of EM affects memory ratings and the number of intrusive thoughts of unpleasant memories.

The research conducted in this thesis raises a number of questions regarding the application of EM in EMDR therapy. Given the aforementioned findings and proposed function of EM, this research could assist in improving future EMDR protocol, and subsequently, treatment outcomes.

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