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# Auditory Bilateral Stimulation Effects on Episodic Memory Retrieval for Fearful Events

Matriculation number: 12008439

Acknowledgements

Sincerest thanks to my initial supervisor Dr. Carolyn Choudhary for her unwavering support, understanding and guidance. Furthermore, for generously allowing me to use the questionnaires she has developed, including the Film Rating Questionnaire, Free Recall Analysis Sheet, and the 'Silence of the Lambs' Multiple Choice Questionnaire. To Dr. Stuart Wilson, who gratefully took it upon himself to supervise this project in its final stages, helping me across the finish line. Your positive energy and straightforwardness was always well received. To my closest friends who, in all their ways, encouraged me to keep on fighting. You know whom you are, I could not have done this without you.

Abstract

Eye Movement Desensitising and Reprocessing (EMDR) has been established as an effective treatment for posttraumatic stress disorder (PTSD), of comparable effect to trauma-based cognitive behavioural therapy. Despite its status as a first-line treatment, the underlying mechanisms are still under investigation. This study, consisting of a non-PTSD sample of mainly undergraduate psychology students *(N* = 58), investigated the effects of the crucial bilateral stimulation component of EMDR. Employing a between subjects design, 48 participants were randomly allocated into two groups, either receiving alternating- or simultaneous auditory stimuli. The remaining 10 participants were assigned to a separate forced simultaneous group as their scores on the PDS reached clinical levels. Employing the film clip paradigm, positively shown to elicit emotional arousal of fear, participants' recall of film events was tested with both a free narrative recall and a cued recognition multiple choice questionnaire. Significant differences in emotional responses to the film stimulus are commented upon. The experimental hypothesis predicted that participants in the active condition, receiving alternating auditory bilateral stimuli would elicit enhanced memory recall for the film events. The hypothesis was rejected and possible theoretical explanations are discussed.

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Auditory Bilateral Stimulation Effects on Episodic Memory Retrieval for Fearful Events

Posttraumatic stress disorder, or PTSD, is a disorder that might have been around for more than five hundred years. Psychiatrist Jonathan Shay (1994, pp. 165–66) noted that Lady Percy's soliloquy in the Play Henry IV, Part 1 (act 2, scene 3, lines 40-62), which was written circa 1597, must be considered an unusually accurate description of today's diagnosis. Posttraumatic stress disorder, perhaps popularised by the many accounts from the two world wars, as well as the war in Vietnam (e.g. "shell shock" and "battle fatigue") saw its initial inclusion in DSM I (American Psychiatric Association, 1952, p. 326) where it was included under the label of "gross stress reaction". Today, PTSD is believed to be the result of a failure of the extraction process of episodic memories for traumatic events. As such, these memories are held back from their natural subsequent transference to semantic networks (Elzinga & Bremner, 2002). Thus, failing to follow the normal trajectory of recovery from trauma can be said to be characteristic of PTSD (Lancaster, Teeters, Gros, & Back, 2016). The overall lifetime prevalence of PTSD is thought to be one in ten, yet two out of three exposed to trauma do not develop PTSD, and left handers are considerably more susceptible than right handers (Choudhary & O'Carroll, 2007; Lancaster, et al., 2016). Traditionally, PTSD has been classified as an Anxiety disorder, but with the updated DSM-5 in 2013, it was classified under a new section, labelled "trauma- and stressor-related disorder". The new classification also introduced a separate set of criteria for children six years and younger, but as this is not relevant for the current study, only the above six years of age-criteria will be described here. There are eight criteria that must be fulfilled for a diagnosis of PTSD. These are: (A) exposure to actual or threatened death, serious injury, or sexual violence, (B) presence of intrusion symptoms associated with the traumatic event, (C) persistent avoidance of stimuli associated with the traumatic event, (D) negative alterations in cognitions and mood

associated with the traumatic event, (E) marked alterations in arousal and reactivity, (F) the duration of the disturbances (from criteria B, C, D, and E) must be more than one month, (G) the disturbance needs to cause clinically significant distress or impairment in social, occupational, or other important areas of functioning, and (H) the disturbance cannot be attributed to another medical condition or to the physiological effects of a substance such as alcohol or medication (consult DSM-5, 2013, pp. 271–272 for complete criteria).

Eye Movement Desensitisation and Reprocessing, or EMDR, has since its introduction in the late 1980s been a breakthrough in dealing with the many perils of Posttraumatic Stress Disorder, or PTSD (Shapiro, 1989). EMDR therapy has been the subject of both praise and criticism unlike few, if any, other modern therapies, and researchers and therapists alike have been presenting views ranging from its powerful effects in combatting traumatic memories, to it being nothing but placebo, or a hyped-up variant of exposure therapy (McNally, 1999). Nevertheless, results from a wide range of studies have brought EMDR-therapy to its current position as a best-practise therapy for PTSD, a position it is sharing with trauma-focused Cognitive Behavioural Therapy, or CBT (Bisson & Andrew, 2007; The NICE guidelines of Best Practice; World Health Organisation, 2013). EMDR was in its early years nothing more than a variant of Wolpe's (1958) Systematic Desensitization, whereas it has evolved into a complex and multifaceted intervention according to its inventor (Shapiro & Forrest, 1997). It is a therapy that has an established and rigorous eight-phase approach, with strict protocol and procedures. Therapists must undergo training at workshops, and certification is required.

Interestingly, the historical and sociological similarities between the long-since-debunked Mesmerism and the thriving EMDR therapy are many. McNally's (1999) comparative historical analysis between the two illuminate these brilliantly and opens the reader to a different point of

view, that of societal influence upon the increased hype surrounding the two therapies. Nonetheless, McNally highlights one important difference between the two, namely that whilst Mesmerising was discredited by a committee of prestigious scientists, EMDR therapy has been supported by the American Psychological Association, or APA, which stated that it is "probably efficacious for civilian PTSD" (1999, p. 235). However, as McNally eloquently points out, this support came after two studies (Rothbaum, 1997; Wilson, Becker, & Tinker, 1995) found EMDR therapy to be statistically superior to no treatment, a criterion that might have yielded similar results if Mesmerism was put to the test. As such, the underlying individual factors of EMDR therapy has yet to be validated beyond doubt.

EMDR therapy relies on the Accelerated Information Processing model, or AIP, wherein "the key to psychological change is the ability to facilitate the [...] connections between healthier associations" (Shapiro, 1995, p. 48). This theory relies on the concept that physiology is closely related to neurological processes, and as such defines pathology as "dysfunctionally stored information that can be properly assimilated through a dynamically activated processing system" (Shapiro, 1995, p. 52). Perhaps, these stored memories have been encoded with state-specific physiological arousal, such as hyper-vigilance resulting from trauma. When challenged by adaptive reprocessing they might become integrated with the larger adaptive semantic memory networks, thus reducing the effect of the state-specific arousal. Today, the ever-important saccadic eye movements are no longer viewed as an essential part of EMDR therapy, as Shapiro (1994) describes both hand-tapping, auditory signals, or even other similar alternating rhythmic bilateral stimuli can replicate the effects of eye movements.

The EMDR therapy sessions follows the following process. First, the client holds the most distressing memory in mind, along with any emotions and thoughts that might accompany

the memory. Second, the therapists subject the client to some form of alternating bilateral stimulation at the same time. Third, the client is asked about their current thoughts, feelings and sensations. This process is repeated until the experienced sensations reach a level of minimal distress. Following, in a guided-by-therapist fashion, the client replaces the negative memory with a positive one that the client has generated (Gunter & Bodner, 2008).

Van den Hout and colleagues (2012) found evidence of significant effects for eye movements in their experiment, and noted that tones were less effective and that they could not be certain that tones were more effective than no stimuli. However, their sample size consisted of only 12 participants, and they highlight the fact that previous research has shown that tones might not be taxing working memory to the extent that eye movements do. The current study is aiming to explore what effects alternating auditory bilateral stimuli might have upon both episodic memory recall and recognition. Episodic memory is understood as the autobiographical recollection of an event that they have experienced. Often, a range of people might experience the same event (e.g. a terrorist attack or a tsunami), yet have highly different recollections of said events.

As mentioned above, both trauma-focused CBT and EMDR have been recommended by the WHO guidelines for the management of conditions specifically related to stress, and have been evidenced to have similar therapy outcomes, with EMDR being rated as more effective by patients (World Health Organisation, 2013). Van der Kolk and colleagues (2007) found that EMDR was more successful than that of pharmacotherapy (Fluoxetine) in reducing PTSD and symptoms of depression. Interestingly, at a six-months follow-up, they discovered that 75.0 % of the individuals with adult-onset trauma and 33.3 % of those with child-onset trauma showed no symptoms. None of the patients in the pharmacotherapy group were void of symptoms at the six-

month follow-up. Based on this result, they concluded that although selective serotonin reuptake inhibitors, or SSRIs, still have a role to play as a first-line intervention for adult victims of PTSD, EMDR should be regarded as the gold standard in combating PTSD.

Lee and Cuijpers (2013) meta-analysis of the eye movements component of EMDR therapy divided the studies they included into two groups. In the group of comprising of clinical trials they found a moderate and significant (Cohen's $d = 0.41$) effect size for the addition of eye movements, whereas the effect size was large and significant ($d = 0.74$) in the laboratory studies group. This meta-analysis employed a random-effects model, more appropriate than previous meta-analysis due to the heterogeneity of the studies they encompassed.

Several theories have been suggested to explain the underlying mechanisms of EMDR therapy. Space constrictions limit the amount of detail which can be produced about these in the current paper. Nevertheless, a short informative overview is provided and for further information, Bergman's illuminating book, “Neurobiological Foundations for EMDR Practice” (2012), is suggested as a well-worth read.

Tulving, Kapur, Craik, Moscovitch and Houle (1994) have argued that the left hemisphere is specialised for the encoding of episodic memories and that the right hemisphere is specialised for retrieval of such memories. Their research led them to suggest that the Hemispheric Encoding/Retrieval Asymmetry model, or HERA, might give basis to the claim that bilateral eye movements should result in activation of both systems. However, it seems plausible that other mechanisms might be contributing, and the evidence for their claim could not be replicated by Samara, Elzinga, Slagter and Nieuwenhuis (2011). As such, the HERA approach is perhaps best highlighted by the lack of research, and as such it is too early to fall on either side of the fence (Jeffries & Davis, 2013).

Another theory that supposedly explains the underpinnings of saccadic eye movements is the Increased Hemispheric Connectivity theory, or IHC. Supposedly, the alternating horizontal eye movements strengthen the connection between the left and right hemispheres, ultimately leading traumatic events to be remembered without arousal of negative emotions such as fear. Neither vertical eye movement nor no eye movement yielded significant results in a study by Christman and colleagues (2003), whereas horizontal eye movement significantly differed from the aforementioned conditions, lending support to the IHC theory. Unfortunately, other studies have found no difference between vertical and horizontal eye movements (e.g. Gunter and Bodner, 2008). Nonetheless, Heller, Etienne and Miller (1995) suggest that because language and speech are both located in the dominant hemisphere of the brain, which is usually the left, eye movements might help reduce the emotional arousal, located primarily in the submissive hemisphere of the brain, seen in PTSD victims, by aiding in the desensitizing of traumatic memories. However, Gunter and Bodner (2008) have argued that while their studies did not suggest that saccadic eye movements enhanced recall and recognition of traumatic events, it is likely to act as a facilitator instead of being the cause of the effects that EMDR therapy has upon memories for traumatic events.

The other theory that has received much support is the neurobiological model that link EMDR and Rapid Eye Movement, or REM sleep. Initially suggested by Shapiro (1991), Stickgold (2008) suggests that there is in fact an orienting response that is supposedly linked into the process found in REM sleep. Several studies have supported the claims of Stickgold. Eye movements have been shown to enhance the retrieval of episodic memories (Christman, Garvey, Propper & Phaneuf, 2003), to increase attentional flexibility (Kuiken, Bears, Miall & Smith, 2002), and to increase recognition of true information (e.g. Parker, Buckley & Dagnall, 2009).

However, recent research by Kuiken, Chudleig and Racher (2010) suggests that there might be two different subsystems responsible for these reactions. Their findings lead to a modification of their earlier research (2002) towards the principle that "alerting reactions to unexpected stimuli are modulated by two separate neurocognitive systems, one that mediates the threat-fear related detection and recognition of unexpected stimuli and a second that mediates the loss-pain related monitoring of response alternatives during tasks with conflicting demands" (2010, pp. 240–241). This expansion allows for the differentiation between loss- and trauma related events. By facilitating novel shifts in the way clients respond to threat, responsibility and emotion, the eye movements may lead to therapeutic effects such as the diminishing of the feeling of threat, making clients realise that they are not responsible for their trauma, or facilitating a shift away from fearful emotions. As such this new divide might open the door for those suffering from non-trauma related distress (e.g. loss). However, it seems integral that caution is taken when considering EMDR therapy for other forms of distress as the subtle processes that are put into motion by the eye movement component of EMDR differ between the two.

EMDR therapy and REM sleep have also been shown to exhibit the same physiological responses, with an increase in peripheral body temperature during saccadic eye movements, as well as general decreases in heart rate and skin conductance (Söndergaard & Elofsson, 2008). As posttraumatic stress disorder seems to be accompanied with a correlating impairment in the REM sleep cycle, resulting in the dysfunctional storage of traumatic memories, the eye movements component of EMDR therapy is thought to lessen these impairments, providing room for proper memory consolidation in long term memory (Stickgold, 2008). Furthermore, Wolpe's (1958) seminal work on the predecessor of EMDR therapy, Systematic Desensitization, suggested that

eye movements activate reciprocal inhibition, thus allowing the body to negate its own stress responses (e.g. Relaxation and feeding negating fear and anxiety).

Baddeley and Hitch's multicomponent model of working memory, or WM (1994) comprises of a “central executive” and three subsystems, namely the “visuospatial sketchpad”, the “phonological loop”, and more recently the “episodic buffer” (Baddeley, 2000). Research on their model has provided insight to how alternating bilateral stimuli might affect memory of fearful events. Although both overload of the visuospatial sketchpad and of the phonological loop has been suggested as a mechanism underlying PTSD in the working memory account, several studies have pointed out the visuospatial sketchpad as the location wherein memories are kept during a session of EMDR therapy (e.g. Kavanagh, Freese, Andrade, & May, 2001). As these subsystems have a relatively low capacity, the working memory account of EMDR theorises that the eye movements might reduce the available resources to recall emotional memories. As these resources become reduced, the vividness of the memory lessens, cascading into reduced emotionality, thus facilitating the healthy progression into areas of long-term memory.

Several studies have supported a working memory account. For instance, Andrade and colleagues (1997) found that both eye movements and tapping reduced vividness and emotionality when compared to the control condition, with eye movements yielding the most significant result of the two. The length of the stimulus was a brief eight second manipulation, and as such, was followed up by Van den Hout, Muris, Salemink, and Kindt (2001) four years later, using a lengthy 90 second stimulus. Employing the same study design they discovered that while eye movements did reduce the vividness and emotionality, tapping did not. This could possibly provide trouble for the working memory account, yet Gunter and Bodner (2008) points

out that the tapping task was considerably less taxing than the one employed by Andrade and colleagues (1997), and as such not necessarily taxing the visuospatial sketchpad beyond its capabilities. Australian researchers found evidence that eye movements reduced the emotional vividness and intensity of visual images (Kemps & Tiggeman, 2007) and in his doctoral research, Maxfield (2004) proposed that higher taxing of the visuospatial sketchpad leads to a greater reduction in vividness and emotionality. Maxfield's research showed that fast eye movements outperform slow ones in lessening the vividness and emotionality, and that both fast- and slow eye movements were significantly better than controls.

However, Navarro and colleagues (2013) found eye movements to be of no significance in their study that compared eye movement and a rest condition within two groups upon results for two tasks from the Wechsler Memory Scale (2000), namely 'Corsi Cubes' and 'Digits'. Although they could not find support for eye movements having an effect, they note that their research might not have targeted autobiographical memory and by the fact that they used a non-clinical sample. Furthermore, they highlight that is seems unlikely that the taxation of working memory is the sole responsible mechanism behind the apparent efficiency of EMDR therapy. Adding to this, Kavenagh and colleagues (2001) found that reductions of vividness and emotionality was significantly reduced in both eye movements and controls at a seven-day follow-up session, suggesting that the mere task of holding a traumatic image in focus enacts this reduction. Eye movements might thus be a facilitator, making it easier to focus on emotional memories and as such act as a 'cognitive performance aid'. Unfortunately, as pointed out by the researchers themselves, their small sample size and brief stimulus exposure might also have been the cause of the eye movement group not being significantly different to controls. Gunter and Bodner's (2008) three experiments found compelling evidence to the possibility that the

underpinnings of the eye movement component of EMDR therapy might indeed be supported by a working memory account of taxing. However, their experiments resulted in a shift from the belief that this taxing occurs in the visuospatial sketchpad to the possibility that it is the central executive that is being taxed. By using two other tasks that supposedly tax the central executive, namely auditory shadowing and drawing, instead of eye movements, they found that these negatively correlated with working memory capacity, lending support to the working memory theory and that tasking of the central executive might be even more effective.

Coubard (2016) theoretical article suggests that an integrated model which considers both the neurological and the physiological underpinnings of EMDR might be the way forward in resolving the mystery of EMDR therapy. Two parallel processes might explain the underlying attentional control and bilateral stimulation contributions to EMDR therapy. The two processes, leading to activity level enhancement (attentional control component), and bilateral stimulation in any sensorimotor modality, both participating in lowering inhibition and thereby facilitating proper information processing with the added benefits of reducing emotional arousal (e.g. anxiety). Coubard's (2016, p. 13) novel idea thus proposes that “integrating theories of EMDR, eye movement neurophysiological findings, and functional brain imaging of PTSD and of EMDR intervention, may be a useful integrative model to study attentional and/or emotional disorders, such as anxiety disorders.”

Exposure to film clips have been shown to be the most effective way of eliciting both negative and positive emotional responses compared to other laboratory-based techniques (Westermann, Spies, Stahl, and Hesse, 1996). The technique can elicit strong subjective and physiological changes, is easily implemented in a laboratory and jumps through both the ethical and the practical hoops of real-life counterparts (Schaefer, Nils, Sanchez and Philippot, 2010).

Emotional memories usually take the form of episodic memories, which are known to be rich in sensory detail. Stickgold (2002) points out that reducing the vividness of such sensory details is likely to be key in trauma recovery. This study used an extended version of one of the film clips identified, by Gross and Levenson (1995), to elicit the arousal of fear. The clip from "The Silence of the Lambs" was extended to allow for a narrative arch in the storyline, thus making it easier for the participants to sympathise with the lone female FBI agent, investigating a serial killer, pursuing him into the abyss of a dark, disgusting, and labyrinth-like basement. Although Gross and Levenson's (1995) research also indicated that the clip elicited both interest and tension they noted that this might be seen to increase the validity of the stimuli, as well as being unavoidable as fear is strongly associated with both hyper-vigilance and the physiological stress response to anticipated threats.

The aim of this study is primarily, to test what effects alternating auditory stimuli would have on episodic recall of fearful events, and secondarily to confirm that the film clip is suited to eliciting a fear response in the participants. The alternating auditory bilateral stimulus is intended to replicate the function of eye movements in EMDR therapy, in accordance with Shapiro's (1994) statement that allowed for the extension into other types of alternating bilateral stimuli. Thus, it is predicted that the alternating auditory bilateral stimulation will result in increased memory recall for film events when compared to simultaneous auditory bilateral stimulation. Furthermore, it is also predicted that the participants placed in the forced control group due to clinical levels of PTS, receiving the same simultaneous stimuli, will show decreased recall for film events when compared to the control group.

## Method

### Participants

Participants were recruited out of the, mainly undergraduate, student body at Queen Margaret University in Edinburgh, Scotland. Most of the QMU students received credits towards a required module for their participation. The exclusion criteria for the participants were left-handedness, due to possible lateralisation effects; auditory defects, due to the main stimulus being sound; and age, a natural consequence of the chosen film stimulus being rated eighteen and above. Fifty-eight participants were recruited for the study which used only non-clinical participants, 43 females and 15 males, with a mean age of 24.5 years, *SD* = 6.660. Several participants failed to show up for the second part of the study *n* = 10; 8 females and 2 males, with a mean age of 22.40 years, *SD* = 2.797. The only data used from these participants were from the Film Rating Questionnaire in assessing emotional response to the film stimulus and as such no group comparisons included their data. Furthermore, the data from *n* = 10; 6 females and 4 males, with a mean age of 22 years, *SD* = 5.142, participants had to be excluded from the active condition due to meeting the diagnostic criteria for Posttraumatic Stress Syndrome, or PTSD, which was assessed using the Posttraumatic Diagnostic Scale, or PDS (Foa, Cashman, Jaycox & Perry, 1997). These participants were deliberately assigned to a forced control group (FCC), separate from the randomised control group, as to exclude possible adverse effects of the experimental stimulus as well as the possible skewing of data. Finally, the remaining participant's *n* = 38; 29 females and 9 males, with a mean age of 24.18 years, *SD* = 7.654 were randomly assigned to either the active condition (AC) n = 19; 15 females and 4 males, with a mean age of 21.42 years, *SD* = 5.738, or the control condition (CC) *n* = 19; 14 females and 5

males, with a mean age of 26.95 years, *SD* = 8.449. There were no significant differences regarding native language, second language or country of upbringing.

**Design**

This study mimics the design of the "Tactile Bilateral Stimulation Effects on Episodic Memory Retrieval of Fearful Events" (Wilde, 2014). It employs a between subjects research design wherein participants meeting the diagnostic criteria for PTSD, as assessed with the PDS (Foa, Cashman, Jaycox & Perry, 1997), were unknowingly allocated to a separate forced control condition by the experimenter. The remaining participants were randomly allocated between the study's control- and experimental conditions. The allocations into all conditions were made after the participants had completed the first session. The manipulated research variable was auditory stimulation in the form of oceanic wave sounds delivered at the beginning of session two. The participants were subjected to the stimuli for one minute and it was delivered either bilaterally in the experimental condition or simultaneously in the control- and the forced control conditions. Independent T-tests were used in analysis of the memory tests referenced in the measures section below.

**Apparatus and Materials**

An extended eight-minute excerpt from Jonathan Demme's 1995 film "The Silence of the Lambs" was used in adherence with Gross and Levenson's (1995) specifications. The extension allowed for the incorporation of a narrative arc from the film's storyline. Participants viewed the movie clip on a MacBook Pro (13-inch, Mid-2010) laptop with a 13,3-inch glossy LCD screen. The screen resolution was set to 1280 x 800 pixels and the LED backlight was set to the brightest

setting. The sounds clip comprised of a one minute recording of the ocean waves hitting the shore as well as squawking calls from gulls. Both the sound from the film clip and the audio stimulus was delivered via a Sennheiser Momentum Over-Ear headset, effectively blocking out other sound sources in the lab environment. An iPad Air 2 with the "iTalk Recorder Premium" application (Griffin, 2016) was used to record the participant's free recall of the film clip and was analysed later with the researcher using the same headset.

Measures

The Rey Auditory Verbal Learning Task, or AVLT, (Strauss, 2006) is a memory assessment tool employing a list learning format which has become the standard for verbal learning tests. The AVLT measures the participant's immediate recall and learning for words, as well as possible intrusions, and interference and decay after two subsequent time lapses, 20 minutes and seven days. At the start of this study back in 2015 there were several other studies utilising the same test and recruitment population, and as such an alternate list proven to be of comparable validity (Strauss, 2006) was sourced from Geffen, Butterworth and Geffen (1994; see appendix A) to avoid possible practice effects. In the second session seven days later the participants were subjected to the seven-day delayed recall, as well as the cued recognition test.

The Film Rating Questionnaire for "The Silence of the Lambs" developed by Choudhary (unpublished; see appendix B) was used to measure participants' emotional arousal on an eleven-point Likert scale, from "not felt at all" to "felt extremely strongly", in adherence with the recommendation by Gross and Levenson (1995). Emotions measured were anger, disgust, fear, sadness, as well as overall emotional arousal. The questionnaire also required the participants to indicate whether they had seen the film before, and if they had to indicate approximately how

many times, duration in weeks since last viewing, as well as to indicate on an eleven-point Likert scale, from “least favourite” to “most favourite”.

The Perceived Stress Scale, PSS10 (Cohen & Williamson, 1988; see appendix C), was employed to measure participants' subjective stress levels within the last month. It is an established scale and it has acceptable psychometric properties, but the test-retest reliability, criterion validity, and known-groups validity has not been properly evaluated (Lee, 2012).

The Hospital Anxiety and Depression Scale, HADS, (Zigmond & Snaith, 1983; see appendix D), was employed to measure participants’ subjective anxiety and depression levels within the last week. With the mean Cronbach's alpha for HADS-A and HADS-D being .82 and .83 respectively. The sensitivity and specificity for both scales are approximately .80 (Bjelland, Dahl, Haug, & Neckelmann, 2002).

A demographics questionnaire (see appendix E) was used to record participants' age, sex, native- and second language, and country of upbringing. The questionnaire ultimately included instructions informing participants that the next form asks about past exposure to stressful or traumatic events.

The Posttraumatic Diagnostic Scale, PDS, (Foa et al., 1997; see appendix F) is a self-report measure based upon the diagnostic criteria for posttraumatic stress disorder in the DSM-IV (APA, 1994). The PDS was employed to screen participants for possible PTSD symptoms, and participants reaching clinical levels were placed in a forced control group based upon their answers to the PDS. The scale measures perceived and actual danger, intensity of trauma, arousal, avoidance, everyday functioning, intrusive re-experiencing, and symptom duration. Foa and colleagues (1997) report good internal consistency of the scale, with Chronbach's Alpha

ranging from .78 to .92 in the different symptom clusters. The validity of the scale was .89 for construct sensitivity, with specificity .75.

The Delayed Memory Test for “The Silence of the Lambs”, developed by Choudhary (unpublished; see appendix G), was used to analyse the recordings of participants' surprise free recall in session two. The film paradigm provides a measurable autobiographical account that can be used in analysis as the facts can be checked, which is rarely the case with true autobiographical memories of traumatic events. Furthermore, the order of events can be analysed and as such allows testing of episodic memory. Participants were scored on a range of measures, and the analysis allowed for extra information to be noted down if not already on the form. Firstly, participants were scored on the number of correctly remembered events in each of the six film segments (introductory, chase 1, woman-in-pit, interlude, chase 2, climax, resolution). Secondly, recalled information were sorted into six categories to allow for a distinction between visual and verbal content (who, what, location, speech, sounds, visuals) which all received a recall score. Lastly, errors of fact, uncertainties, repetitions, and reversals of the temporal sequence of the film events were given individual scores.

The Film Recognition Multiple Choice Questionnaire for “The Silence of the Lambs”, developed by Choudhary (unpublished; see appendix H), tested participants' cued recognition of factual details from the film clip. The MCQ is comprised of 21 questions, all with four alternatives, wherein one is correct. Total correct answers were added together into a recall score out of 21.

**Procedure**

An institutional review board approved all procedures and measures. The study was advertised as "The effects of watching films on word tasks" accompanied by a short description of its contents as not to prime the participants in any way to the experimental effects (see appendix I). The participants were informed that they needed to be 18 or above to participate and that they needed to be right handed and have normal hearing. The participants were further told that they would be subjected to a word task as well as watch a short film clip that contained neither graphic violence nor pornographic material. However, the participants who were recruited in the second round of this project were told, due to a new ethical review process, that the clip consists of a scene considered to be one that elicits strong emotion. Furthermore, they were told that they would have to fill out several questionnaires and return a week later to complete the study.

In the first session participants were instructed to read through the information sheet (see appendix I) and informed that they were free to withdraw at any point without providing a reason. Subsequently, the participants were asked to sign the consent form if they so wished (see appendix J). In adherence with Giffen and colleagues (1994) the participants were subjected to the first seven stages of the AVLT (see appendix A). Upon completion of the first part of the AVLT the participants were told that they were about to watch a film clip. They were instructed to watch the clip through to the end, and to answer the questionnaire in front of them immediately after the film had come to an end (see appendix B). The participants were given headphones and told to make sure that they were resting comfortably over their ears.

After the participants had finished filling out the Film Rating Questionnaire (see appendix B) they were told to fill out two more questionnaires in the order they were presented

to them, namely the PSS (see appendix C) and the HADS (see appendix D). The participants were instructed to read the instructions carefully, as although the forms were similar they differed in the timeframe they considered. Upon completion of these questionnaires they were subjected to step eight of the AVLT, the 20 minutes delayed recall. They were told to repeat back as many words as they could remember from the first list presented to them, and that the order did not matter. When the participants signalled that they could not remember any more words they were told that they had one more form to fill out and presented with the PDS (see appendix F). They were further explained that this form asked for some basic demographics on the first page (see appendix E), and to read the instructions, which informed them that the questionnaire asked about past exposure to stressful or traumatic events, carefully.

In the second session which was conducted exactly seven days later, participants were instructed to take a seat in front of a computer screen displaying a white "+", in the centre of the screen, upon a black background. They were given instructions to sit still, while keeping their eyes fixed on the "+". They were presented with a headset and told to sit this way until the sounds in the headset expired and to remove the headset when the sounds stopped. The sounds comprised of a one minute recording of the ocean waves hitting the shore as well as squawking calls from gulls. In the experimental condition the sounds were alternating between the right and left ear in a gliding fashion, whereas in the control- and forced control conditions the sounds were present on both ears simultaneously. Upon the participants' removal of the headset they were immediately told to think back to the film they watched last week and to recount everything they could remember about it whilst having their recall recorded. The free recall was not ended before the participants indicated that they could not remember anything else.

When the participants indicated that they could remember nothing more they were presented with the Film Recognition MCQ (see appendix H) and informed that they needed to answer all the questions, thus if they were unsure, to make a best guess. Upon completion of the MCQ they were subjected to step nine of the AVLT, the seven-day delayed recall, which was administered identically to step eight of the AVLT in session one. The final part of the AVLT, the cued recognition test, was then administered by informing participants that the experimenter would read a list of words out loud, one by one, and that some of these words would be from the two AVLT lists and some would not be from those two lists. They were told in each case to tell the experimenter whether they believed the word was from the first list (list A), the second list (list B), or none of the lists. Again, if the participants did not know, they were told to give a best guess. The recognition format was chosen as the original format of letting the participant read a list of sentences, circling recognised words, or reading the matrix of the recognition test are ultimately testing visual verbal memory. As the rest of the AVLT measures auditory verbal memory, this makes little sense. Furthermore, good normative data for the matrix already exists (Strauss, 2006, p. 328). Finally, the participants were told to describe the sounds they heard in the headset at the beginning of the session, and a note of any answers that suggested that their hearing might have been compromised, although not the case with any of the participants in this study, would have been noted. In the end the participants were given a debrief sheet (see appendix K) and the experimenter answered the questions the participants might pose.

## Results

A total of 48 participants were divided into three groups, the active- (AC), control- (CC), and forced control (FC) condition, the former two consisting of 19 participants each, and the latter of 10. A one-way between groups ANOVA was used to assess whether participants from the three different groups differed in baseline AVLT scores. As Eta Squared is a biased measure of power, especially when dealing with in small sample sizes, the current study reports effect sizes with Omega Squared (Okada, 2013). No significant differences were found. Furthermore, no significant results were observed in any of the calculated scores from the seven days delayed recall of list A or in the recognition tasks of the AVLT, both taking place in session two. The results did indicate a trend towards significance, with a medium estimated effect size, for retroactive interference from the fifth recall of the AVLT to the seven-day recall between the groups $F$ (2,45) = 3.045, $p$ = .058, $\omega^2$ = .079. The control condition ($M$ = 3.84, $SD$ = 2.21) showed a trend towards being significantly different from the mean score for the active condition ($M$ = 5.63, $SD$ = 2.87), whereas the forced control condition ($M$ = 5.70, $SD$ = 2.16) showed no such trend towards significance.

A one-way between groups ANOVA was used to assess whether participants from the three different groups differed in PSS10 scores. Effect sizes were measured with Omega Squared. As seen in “Table 1”, there was a statistically significant difference, with a medium estimated effect size, $F$(2,45) = 4.171, $p$ = .022, $\omega^2$ = .117, in PSS10 symptom scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the forced control condition ($M$ = 21.60, $SD$ = 4.993) was significantly different from the mean score for the active condition ($M$ = 15.95, $SD$ = 3.659). The control condition ($M$ = 17.21, $SD$ = 6.206) did not differ significantly from the active- or forced control conditions. The internal validity of

the PSS10 were measured with Chronbach's Alpha ($\alpha$ = .830), however, it is noted that the validity in our sample would increase slightly with the omission of item nine ($\alpha$ = .851). In any case, an alpha above .70 is often assumed to be the lower limit (Lance, Butts, & Michels, 2006), yet Nunnaly and Bernstein (1994) believed .70 to be an acceptable level only if the scale was newly developed and that research should rely on scales that scores above .80. As such, it is evidenced that the internal validity is good in our sample.

Table 1

*Means and Standard Deviations of Symptoms Scores from the PSS10 and HADS.*

| **Scale Type** | **Active Condition Mean (*SD*)[a]** | **Control Condition Mean (*SD*)[b]** | **Forced Control Mean (*SD*)[c]** | **Significance Level** |
|---|---|---|---|---|
| PSS | 15.95 (3.659)* | 17.21 (6.206) | 21.60 (4.993)* | $p$ = .022* |
| HADS-A | 7.42 (3.097) | 6.63 (3.700)* | 10.50 (4.453)* | $p$ = .029* |
| HADS-D | 2.37 (1.978)* | 3.21 (2.149) | 4.80 (2.821)* | $p$ = .028* |

*Note.* *Significance at $p < .05$.

[a] $n$ = 19; [b] $n$ = 19; [c] $n$ = 10.

A one-way between groups ANOVA was used to assess whether participants from the three different groups differed in HADS scores and the results are incorporated in "Table 1". Effect sizes were measured with Omega Squared. There was a statistically significant difference, with a medium estimated effect size, $F(2,45) = 3.820$, $p = .029$, $\omega^2 = .105$, in HADS anxiety scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the control condition ($M$ = 6.63, $SD$ = 3.700) was significantly different from the

mean score for the forced control condition ($M$ = 10.50, $SD$ = 4.453). The active ($M$ = 7.42, $SD$ = 3.097) did not differ significantly from the control- or forced control conditions. There was a statistically significant difference, with a medium estimated effect size, $F(2,45) = 3.871$, $p$ = .028, $\omega^2$ = .107, in total depression scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the active condition ($M$ = 2.37, $SD$ = 1.978) was significantly different from the mean score for the forced control condition ($M$ = 4.80, $SD$ = 2.821). The control condition ($M$ = 3.21, $SD$ = 2.149) did not differ significantly from the active- or forced control conditions. The internal validity of the HADS subscales were measured with Chronbach's alpha. Both the anxiety subscale ($\alpha$ = .803) and the depression subscale ($\alpha$ = .654) consisted of 7 items. Again, it is noted that the validity in our sample would increase slightly with the omission of item 10 from the depression subscale ($\alpha$ = .693). However, following the aforementioned argument, it can be argued that the internal validity of both the original depression scale and the revised depression scale in our sample is not acceptable for use in research, as the HADS has been in extensive use for some time (Nunnaly & Bernstein, 1994).

A one-way between groups ANOVA was used to assess whether participants from the three different groups differed in PDS scores. Effect sizes were measured with Omega Squared. As “Table 2” indicates, there was a statistically significant difference, with a large estimated effect size, $F(2,25) = 8.517$ $p$ = .002, $\omega^2$ = .349, in PDS re-exposure scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the forced control condition ($M$ = 5.20, $SD$ = 3.326) was significantly different from the mean score for the control condition ($M$ = 1.00, $SD$ = 1.247), and the active condition ($M$ = 2.00, $SD$ = 1.927). There was no significant difference between the

active- and control conditions. There was a statistically significant difference, with a large estimated effect size, $F(2,25) = 10.844$, $p = .000$, $\omega^2 = .413$, in PDS avoidance scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the forced control condition ($M = 8.70$, $SD = 5.100$) was significantly different from the mean score for the control condition ($M = 1.20$, $SD = 2.201$), and the active condition ($M = 2.88$, $SD = 3.270$). There was no significant difference between the active- and control conditions. There was a statistically significant difference, with a large estimated effect size, $F(2,25) = 9.220$, $p = .001$, $\omega^2 = .370$, in PDS total scores between the groups. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the forced control condition ($M = 20.40$, $SD = 11.047$) was significantly different from the mean score for the control condition ($M = 4.80$, $SD = 4.685$), and the active condition ($M = 10.00$, $SD = 7.615$). There was no significant difference between the active- and control conditions.

There was a tendency towards a statistically significant difference, with a medium estimated effect size, $F(2,25) = 3.085$, $p = .063$, $\omega^2 = .130$, in PDS arousal scores between the groups. The forced control condition ($M = 6.50$, $SD = 3.566$) indicated a tendency towards a significant difference from the mean score for the control condition ($M = 2.60$, $SD = 3.272$) No such tendencies were observed between the active condition ($M = 5.13$, $SD = 3.870$) and the control condition, or between the forced control- and active condition. As the forced control condition included all the participants who scored above clinical levels of PTSD, a chi-square test was performed to check for a possible lack of balance between the number of participants who had experienced non-PTSD trauma in the active condition and the control condition $\chi(1, n = 38) = 0.185$, $p = .746$. No significant difference was observed, a result that is further supported by a t-test of aggregated PDS symptoms scores of re-exposure $t(16) = -1.333$, $p = .201$;

avoidance $t(16) = -1.298$, $p = .213$; arousal $t(16) = 1.501$, $p = .153$; and total symptom score $t(16) = 1.785$, $p = 0.93$, which all showed no significant difference between the two groups.

Table 2

*Means and Standard Deviations of Symptoms Scores from the PDS. No significant differences were found between the Active Condition and Control Condition.*

| PDS TYPE | Active Condition Mean (*SD*) [a] | Control Condition Mean (*SD*) [b] | Forced Control Mean (*SD*) [c] | Significance Level |
|---|---|---|---|---|
| Re-exposure | 2.00 (1.927) | 1.00 (1.247) | 5.20 (3.326) | $p = .002$** |
| Avoidance | 2.88 (3.270) | 1.20 (2.201) | 8.70 (5.100) | $p < .001$*** |
| Arousal | 5.13 (3.870) | 2.60 (3.272) | 6.50 (3.566) | $p = .063$ |

*Note.* **Significance at $p < .01$; ***Significance at $p < .001$.

[a] $n = 19$; [b] $n = 19$; [c] $n = 10$.

A Pearson product-moment correlation coefficient was used to investigate the relationship between the different trauma scores and baseline measures of the AVLT, and the significant correlations can be seen in "Table 3". In the active- and control conditions (AC + CC), which were calculated together, HADS anxiety positively correlated with two measures of delayed recall (AVLT 7-9), $r(38) = .409$, $p = .012$, and (AVLT 5-9), $r(38) = .336$, $p = .039$, as well as with the supra span measure (AVLT 6), $r(38) = .408$, $p = .011$. The PDS avoidance score positively correlated with proactive interference (AVLT 6-5), $r(18) = .553$, $p = .017$, and supraspan-twenty minutes delayed recall (AVLT 1-8), $r(18) = .520$, $p = .027$, The PDS re-exposure score negatively correlated with both retroactive interference (AVLT 5-7), $r(18) = -$

.495, $p$ = .037, and delayed recall (AVLT 5-8), $r(18)$ = -.480, $p$ = .044, as did the PDS arousal score (AVLT 5-7), $r(18)$ = -.500, $p$ = .035, and (AVLT 5-8), $r(18)$ = -.532, $p$ = .023. In the forced control condition (FCC) the PSS total score negatively correlated with delayed recall of both (AVLT 7-9), $r(10)$ = -.858, $p$ = .002, and (AVLT 5-9), $r(10)$ = -.856, $p$ = .002, as well as with supraspan-seven days delayed recall (AVLT 1-9), $r(10)$ = -.671, $p$ = .033. However, a positive correlation was found with the seven-day delayed recall score (AVLT 9), $r$ (10) = .649, $p$ = .042. The PDS re-exposure-, arousal-, and total symptom scores negatively correlated with the 20 minutes delayed recall (ALVT 7-8), $r(10)$ = -.851, $p$ = .002; $r(10)$ = -.652, $p$ = .041; $r(10)$ = -.717, $p$ = .020, whereas the avoidance-, arousal-, and total symptom scores negatively correlated with the seven-day delayed recall score (AVLT 7-9), $r(10)$ = -.728, $p$ = .017; $r(10)$ = -.783, $p$ = .007; $r(10)$ = -.741, $p$ = .014. No other correlations were found in any of the groups for other parts of the AVLT, including recognition scores, or in the total MCQ score.

Table 3

*Correlations between the different trauma scores and AVLT measures.*

| Measure | Active- and Control Conditions[a] | Forced Control[b] |
|---|---|---|
| PSS vs AVLT 1-9 | | -.671* |
| PSS vs AVLT 5-9 | | -.856** |
| PSS vs AVLT 7-9 | | -.858** |
| PSS vs AVLT 9 | | .649* |
| HADS-A vs AVLT 5-9 | .336* | |
| HADS-A vs AVLT 6 | .408* | |
| HADS-A vs AVLT 7-9 | .409* | |
| PDS Avoidance vs AVLT 1-8 | .520* | |
| PDS Avoidance vs AVLT 6-5 | .553* | |
| PDS Avoidance vs AVLT 7-9 | | -.728* |
| PDS Re-exposure vs AVLT 5-7 | -.495* | |
| PDS Re-exposure vs AVLT 5-8 | -.480* | |
| PDS Re-exposure vs AVLT 7-8 | | -.851** |
| PDS Arousal vs AVLT 5-7 | -.500* | |
| PDS Arousal vs AVLT 5-8 | -.532* | |
| PDS Arousal vs AVLT 7-8 | | -.652* |
| PDS Arousal vs AVLT 7-9 | | -783** |
| PDS Total vs AVLT 7-8 | | -.717* |
| PDS Total vs AVLT 7-9 | | -.741* |

*Note.* *Significance at $p = 0.5$; **Significance at $p < .01$; ***Significance at $p < .001$.

[a] $n = 38$; [b] $n = 10$.

The eight-minute excerpt from The Silence of the Lambs successfully elicited a fearful response ($N = 58$, $M = 4.86$, $SD = 2.899$), and as such confirmed the secondary part of the experiment. A paired-samples t-test was conducted to compare the elicited emotion fear to other emotions, the result of which can be seen in "Figure 1". Effect size were measured with Cohen's d. Fear ($M = 4.86$, $SD = 2.899$) versus anger ($M = 2.76$, $SD = 2.584$) $t$ (57) = 4.761, $p < .001$, $d = .251$; and fear ($M = 4.86$, $SD = 2.899$) versus sadness ($M = 2.84$, $SD = 2.574$) $t(57) = 5.540$, $p < .001$, $d = .734$; both elicited significantly greater fear. Fear ($M = 4.86$, $SD = 2.899$) versus overall emotional arousal ($M = 5.83$, $SD = 2.576$) $t(57) = -.5.201$, $p < .001$, $d = .344$, were significantly different, showing a stronger overall emotional arousal compared to fear. The only nonsignificant relation was fear ($M = 4.86$, $SD = 2.899$) versus disgust ($M = 4.93$, $SD = 2.871$) $t(57) = -.195$, $p = .846$, $d = .024$ interpreted as a combined effect. There were no significant differences in emotional arousal between those who had seen the film before ($n = 14$) and those who had not ($n = 24$), nor were there any significant differences in emotional arousal between the AC and the CC. As seen in "Figure 2", females ($n = 43$) showed both a significantly stronger arousal of fear $t(56) = 2.010$, $p = 0.49$, $d = .603$, a significantly stronger arousal of disgust $t(56) = 2.630$, $p = .011$, $d = .789$, and a significantly stronger overall emotional arousal $t(56) = 2.348$, $p = .022$, $d = .704$, when compared to males ($n = 15$). Both anger and sadness yielded insignificant differences, however the relatively few males in our initial sample should be considered. The final sample consisting of the participants in the AC and the CC groups ($n = 38$, $M = 5.08$, $SD = 3.053$) achieved similar results, with the exception that the significant gender difference for disgust was absent, and was used in further analysis.

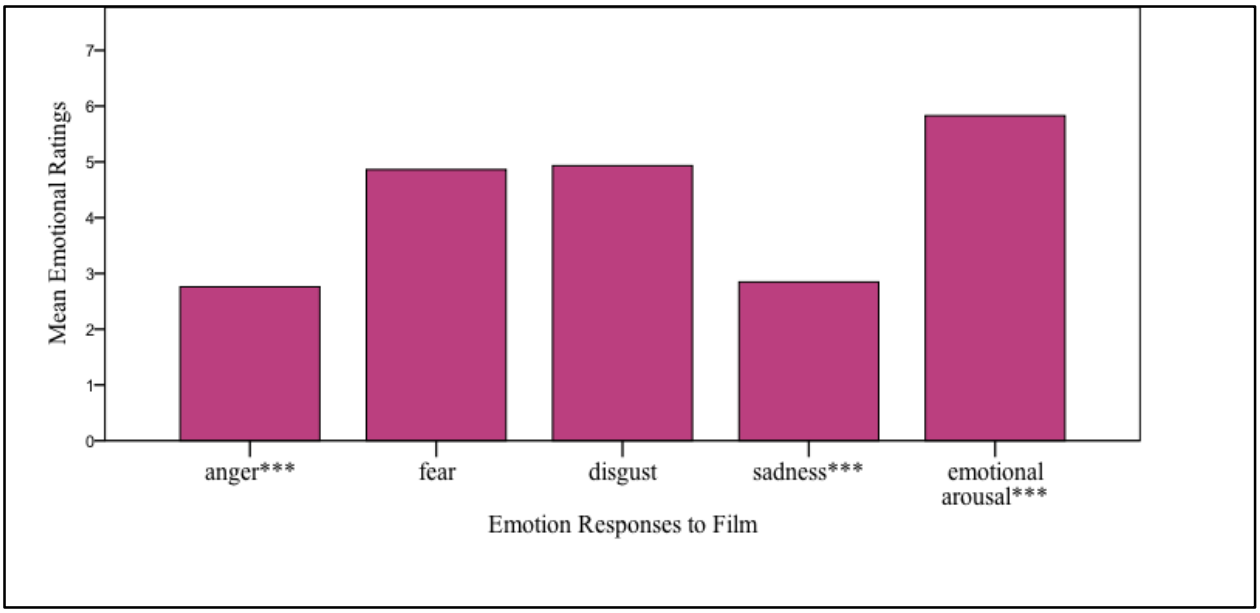


*Figure 1.* Emotional responses to film. Significance levels of fear response compared to other emotions

*Note.* ***Significance at $p < .001$.

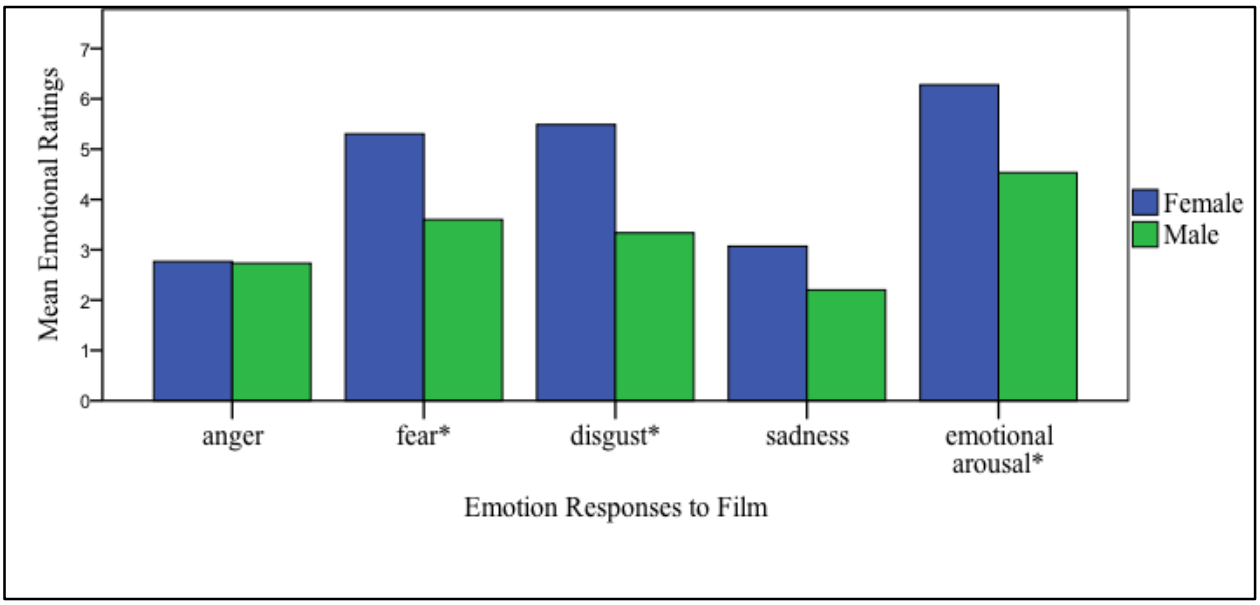


*Figure 2.* Sex differences in emotion responses.

*Note.* *Significance at $p < .05$.

A one-way between groups ANOVA was used to assess whether participants from the three different groups differed in MCQ scores. Effect sizes were measured with Omega Squared. There was a tendency towards significance, with a medium estimated effect size, $F(2,45) = 2.636$, $p = .083$, $\omega^2 = .064$ in MCQ scores between the groups wherein the active condition ($M = 8.79$, $SD = 3.137$) displayed a tendency towards a significant difference from the mean score for the control condition ($M = 10.79$, $SD = 2.658$). No tendencies toward significance were found between the forced control condition ($M = 9.90$, $SD = 1.524$) and the two other conditions. As the variance between the three groups was borderline unequal, thus possibly violated the ANOVA's assumption of homogeneity variance, a Kruskal-Wallis test was performed which yielded a similar trend towards significance ($p = .086$).

As for the free recall scores, A one-way ANOVA test showed that none of the measured type categories: who, what, location, speech, sounds, visuals, nor the temporal categories: intro, chase 1, woman-in-pit, chase 2, climax, resolution, were significantly different in any of the groups. Total memory scores were also non-significant. A Levene's test showed that the free recall subsets: errors of fact, repetitions, reversals, and uncertainties all violated the ANOVA's assumption of homogeneity of variance. As such, for these subsets a Kruskal-Wallis test was calculated, yielding non-significant result for all four categories across all three groups. Means and Standard Deviations for all measures are listed in “Table 4”. Ultimately, the free recall paradigm did not support the hypothesis that alternating auditory bilateral stimulus increases memory for fear.

Table 4

*Means and Standard Deviations of Free Recall Scores from "The Silence of the Lambs" Clip.*

| Memory outcome | Active Condition Mean (*SD*) [a] | Control Condition Mean (*SD*) [b] | Forced Control Mean (*SD*) [c] |
|---|---|---|---|
| Film scene: "intro" | 6.13 (2.475) | 6.42 (3.919) | 6.22 (2.949) |
| Film scene: "Chase 1" | 6.93 (2.890) | 7.42 (2.503) | 6.78 (3.193) |
| Film scene: "Woman-in-pit" | 4.13 (1.727) | 4.17 (2.125) | 5.11 (2.619) |
| Film scene: "Chase 2" | 2.73 (1.033) | 1.92 (1.311) | 2.22 (1.641) |
| Film scene: "Climax" | 5.87 (3.114) | 4.92 (3.753) | 5.22 (3.270) |
| Film scene: "Resolution" | 1.07 (1.223) | 1.08 (.996) | 1.00 (1.225) |
| Film category: "Who" | 9.40 (2.501) | 9.58 (2.811) | 9.00 (3.536) |
| Film category: "What" | 11.00 (2.104) | 10.67 (3.312) | 10.78 (3.930) |
| Film category: "Location" | 3.73 (3.035) | 3.08 (2.314) | 3.78 (2.048) |
| Film category: "Speech" | 1.27 (1.280) | .83 (.557) | .78 (.833) |
| Film category: "Sounds" | .40 (.632) | .67 (.778) | .89 (1.364) |
| Film category: "Visuals" | 1.07 (1.223) | 1.08 (.900) | 1.33 (.866) |
| Film error: "Error of fact" | .67 (.724) | .33 (.651) | .133 (1.414) |
| Film error: "Repetitions" | .20 (.414) | .00 (.000) | .33 (1.000) |
| Film error: "Reversals" | 2.33 (2.637) | .58 (.900) | 2.78 (2.489) |
| Film error: "Uncertainties" | .07 (.258) | .00 (.000) | .33 (.500) |
| Film total recall (scenes tot.) | 26.867 (7.453) | 25.917 (8.597) | 26.556 (10.138) |

*Note.* No significant differences were found.

[a] $n = 15$; [b] $n = 12$; [c] $n = 9$.

## Discussion

As for the secondary part of the current experiment, the eight-minute excerpt from The Silence of the Lambs proved to elicit a strong and significant fearful response, thus confirming the secondary aim of the experiment. However, in our sample a slightly stronger elicitation of disgust occurred, not significantly differing from the fear response. These results align identically with previous research using the same film on a student population (Wilde, 2014). As both Gross and Levenson (1995), and Schaefer and colleagues (2010) have pointed out, this might reflect the natural occurrence in real-life and has recently led researchers down a diverse path of mixed emotional response research. Furthermore, the whole clip is infused with disgusting images (e.g. skin-suits, degenerated corpse). Gender differences in emotion became apparent, and adhere to the findings of Gross and Levenson (1995) and those of Kring and Gordon (1998), wherein females elicited significantly stronger emotional arousal of fear, disgust and overall emotional arousal. As it is apparent through the current research, caution should be taken in interpreting these results as relatively few males were in the final sample which resulted in the absence of a significant gender difference for disgust. Nevertheless, these results are in line with evolutionary gender theory wherein males are prone to resort to anger and aggression in combatting fear, as well as having physical properties supporting such a reaction, whereas for the female and caretaker of the offspring this response might come at too great a cost and as such a greater fear response might make the female shun the possibly life-threatening situation (Campbell, 2006). However, individual differences are certainly a factor to be recognised. It is recommended that future studies encompassing the film paradigm identifies film stimuli that elicit a stronger arousal of fear, as to more effectively mimic traumatic events (for an updated battery of films eliciting a range of emotions see: Schaefer, Nils, Sanchez and Philippot, 2010).

Lee & Cuijpers' (2013) meta-analysis provide significant evidence for the working memory account of EMDR therapy. Their review found a large effect size in the non-therapy studies for reducing vividness of memories. Thus, with the mind set on an emotional memory, while completing a dual attention task such as eye movements disrupts the storage of said memory, leaving the episodic quality in a weaker state. However, they also point out that the therapy-based group had undergone several sessions of EMDR therapy and that several other underlying effects probably led to decreased symptoms in the groups, regardless of the eye movement component being present. Thus, the drop from a large to moderate effect size is not surprising. Lee and Cuijpers (2013) notes that the studies that cited the adherence to the EMDR treatment manual gained higher effect sizes than those who did not. Although these differences were not significant, and as such must be considered in caution, they nevertheless warrant the future consideration of using qualified personnel in future experiments. The current research did not include qualified personnel, or a dual task paradigm as neither the attentive watching of the film clip (encoding) nor the free recall or MCQ, as the auditory stimulus was presented prior to recall, included an additional demanding cognitive task. A comparison between the current study format with a dual-attention format wherein participants are asked to recall a specific scene from the film while simultaneously being exposed to stimuli, and measuring memory only for that image/scene. Providing these two conceptual formats yield similar results, problems arise for the dual attention explanation of working memory (Maxfield et al., 2008).

Although no significant result of the alternating auditory bilateral stimulus was found in the free recall scores, there are several factors that might have contributed to these results. First, as it follows from the working memory theory, it should be noted that the choice of calming waves hitting the shore might not have taxed neither the visuospatial sketchpad nor the central

executive, at least not to the extent that would result in a significant difference (Maxfield, 2004; Gunter & Bodner, 2008). Second, the REM theory (Stickgold, 2008) suggests that alternating eye movements might produce a "calming effect", thus facilitating the transfer of the disturbing memory into long term memory. It is possible that such a calming effect can be achieved without alternation, thus it might be that both the experimental- and control conditions improved retrieval at the same level, assuming the auditory stimuli were not taxing working memory. Third, as the auditory stimulus shifted from side to side in a gliding and relatively slow fashion it is also possible that low alternating speed reduced taxing to a nonsignificant amount. As such it is suggested to source auditory stimuli that mimics the alternating speed of significant eye movement findings since this increase should result in heavier taxing of the central executive in accordance with Maxfield's (2004) findings on the alternating speed of eye movements. It is further suggested that future experiments keep including auditory stimuli, perhaps in parallel with eye movements and tapping, providing experimenters source an auditory stimulus that can be shown to elicit sufficient levels of taxing upon working memory.

It is worth noting that while the study found a significant difference between anxiety and depression scores between the randomised groups and the forced control condition, the former was not significantly different for the active condition, and the latter was not significantly different from the control condition. Furthermore, while there was a significant difference in stress scores between the active condition and forced control condition, no such difference was apparent between the forced control condition and randomised controls. Upon analysing the PDS scores however, it is concluded that the re-exposure-, avoidance-, ant total PDS scores all significantly differed between the active- and control conditions, and the forced control condition. The arousal component of the PDS indicated similar patterns, but the result was

insignificant. The results of the FCC suggest that high levels of stress, as measured by the PSS, may lead to reduced retention of new information. Furthermore, the results indicate that experiencing PTSD related symptoms, as measured by the PDS, may also influence the ability to arbitrary information (i.e. words from a word list) into long term memory. The results from the two control conditions, which reported significantly lower trauma levels, suggests that mild levels of anxiety, in people with normal mental health, might facilitating learning, perhaps due to being more alert? Anxiety has recently been shown to improve learning in a recent study on perceptual-motor learning, where Hordacre, Immink, Ridding, and Hillier (2016) found that laboratory induced stress and anxiety improved motor learning.

The current study has several limitations. Sample size proved to be a complex issue. First, females are overrepresented in our sample, just as they are overrepresented in undergraduate Psychology courses. Second, the overall sample size did not provide enough participants to be located to the two random conditions, just as it did not source enough participants with clinical levels of PTSD to legitimise the forced control condition. Third, recruiting from a mainly undergraduate Psychology population proved difficult as nearly 21 % of the participants who returned for session two ($n$ = 10) scored above clinical levels of PTSD. Fourth, some participants had relatively high trauma scores. Choudhary & O'Carroll (2007) found that 8.6 % of their participants, half of which was recruited out of a student body, scored above clinical levels of PTSD using the PDS. Although not reaching clinical levels of PTSD, these participants might still be skewing the data. However, the amount and severity of trauma did not differ between the control- and active conditions. Using a fixation point might also be argued to be skewing the data, as Stickgold (2008) points out that even a fixation point alters the baseline reactions, and that tiny saccades still occur.

In further studies, it is thus suggested to recruit from different bodies as it is possible that trauma might be over-represented within fields of mental health. Second, to source enough participants to allow for larger groups in both randomised conditions. Adding to this, the forced control group, catering to those who report clinical levels of PTSD, should also have a similar sample size as to make sure a powerful comparison between participants with and without clinical symptoms of PTSD. These participants could also be clinically diagnosed by professional personnel according to current diagnostic standards (e.g. DSM/ICD). It might even be advisable, sample sizes permitting, to split both the active- and control groups in analysis, as non-PTSD related trauma might still alter the underlying memory processes. Ultimately, ethical issues might also be warranted a second consideration. If eye movements are indeed found to be the altering component of EMDR therapy, whether to subject trauma exposed participants to the active condition or not must surely be discussed. Following from this it is also worth noting that if eye movements are not the only crucial facilitator of EMDR therapy, delivering this component exclusively, might cause harm as the therapeutic process might be incomplete. Studies should also consider the updated diagnostic manuals and whatever change this might result in, as well as aim to combine data from psychological-, physiological-, and brain imaging techniques.

It is also suggested that studies such as the current one leaves the biased effect size measure Eta Squared behind, instead employing Omega Squared (or Epsilon Squared) as the current study did. Okada (2013) showed that a One-Way ANOVA (four groups of $n = 20$) with a medium effect size ($\eta^2 = 0.059$), on average will overestimate the effect size by .035, resulting in a reported Eta Squared of .093. This overestimation becomes even more problematic when dealing with small effect sizes ($\eta^2 = 0.0099$) as the overestimation becomes larger than the actual

effect size (One-Way ANOVAs with up to $n = 70$ in each condition). As such, an insignificant $p$ value could still yield a small to medium effect size if Eta Square is used, where as if researchers look behind the mainstream use of Eta Squared, and instead employ the somewhat used Omega Squared, or perhaps the even less biased, yet rarely used, Epsilon Squared (Okada, 2013), would reduce the chance of providing the wrong impression when reporting effect sizes.

Nevertheless, many randomised studies have supported both the REM- and working memory approaches. As such it seems plausible to entertain the idea that both provide integral insight to the underlying effects of EMDR therapy (Oren & Solomon, 2012). Incorporating these theories with the proposed physiological integrations of Coubard's (2016) interactive approach is suggested as an interesting way forward. Until the scientific community decipher or debunks the underlying mechanisms of EMDR therapy, it is likely to stay divided. Whether the therapy will experience the faith of Mesmerising or that of Semmelweis' asepsis theory, it will surely be intriguingly debated and followed into the future, hopefully leading to the discovery of these underlying processes and a solidification of EMDR as a primary therapy for trauma.

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