

RANDOMIZED STUDIES OF HYPOTHESES REGARDING EYE MOVEMENTS

Numerous memory researchers have evaluated the eye movements used in EMDR therapy. It is hypothesized that a number of mechanisms interact synergistically. The following studies have tested specific hypotheses relevant to standard EMDR clinical practice regarding mechanism of action and found a direct effect on emotional arousal, imagery vividness, attentional flexibility, retrieval, distancing and memory association.

Andrade, J., Kavanagh, D., & Baddeley, A. (1997). Eye-movements and visual imagery: A working memory approach to the treatment of post-traumatic stress disorder. *British Journal of Clinical Psychology*, 36, 209-223.

Tested the working memory theory. Eye movements were superior to control conditions in reducing image vividness and emotionality.

Barrowcliff, A.L., Gray, N.S., Freeman, T.C.A., & MacCulloch, M.J. (2004). Eye-movements reduce the vividness, emotional valence and electrodermal arousal associated with negative autobiographical memories. *Journal of Forensic Psychiatry and Psychology*, 15, 325-345.

Tested the reassurance reflex model. Eye movements were superior to eyes-fixed in reducing image vividness, emotionality and electrodermal arousal.

Barrowcliff, A.L., Gray, N.S., MacCulloch, S., Freeman, T. C.A., & MacCulloch, M.J. (2003). Horizontal rhythmical eye-movements consistently diminish the arousal provoked by auditory stimuli. *British Journal of Clinical Psychology*, 42, 289-302.

Tested the reassurance reflex model. Eye movements were superior to control conditions in reducing arousal provoked by auditory stimuli.

Christman, S. D., Garvey, K. J., Propper, R. E., & Phaneuf, K. A. (2003). Bilateral eye movements enhance the retrieval of episodic memories. *Neuropsychology*, 17, 221-229.

Tested cortical activation theories. Results provide indirect support for the orienting response/REM theories suggested by Stickgold (2002, 2008). Saccadic eye movements, but not tracking eye movements were superior to control conditions in episodic retrieval.

Christman, S. D., Propper, R. E., & Brown, T. J. (2006). Increased interhemispheric interaction is associated with earlier offset of childhood amnesia. *Neuropsychology*, 20, 336.

“The results of the current Experiment 2 suggest that the eye movements employed in EMDR may induce a neurobiological change in interhemispheric interaction and an attendant psychological change in episodic retrieval.”

De Jongh, A., Ernst, R., Marques, L. & Hornsveld, H. (2013). The impact of eye movements and tones on disturbing memories of patients with PTSD and other mental disorders. *Journal of Behavior Therapy and Experimental Psychiatry*, 44, 447–483.

“The findings provide further evidence for the value of employing eye movements in EMDR treatments. The results also support the notion that EMDR is a suitable option for resolving disturbing memories underlying a broader range of mental health problems than PTSD alone.”

Engelhard, I.M., van den Hout, M.A., Janssen, W.C., & van der Beek, J. (2010). Eye movements reduce vividness and emotionality of “flashforwards.” *Behaviour Research and Therapy*, 48, 442–447.

Distressing images were randomly assigned to two conditions. “This study examined whether eye movements reduce vividness and emotionality of visual distressing images about feared future events. . . . Relative to the no-dual task condition, eye movements while thinking of future-oriented images resulted in decreased ratings of image vividness and emotional intensity.”

Engelhard, I.M., van Uijen, S. & van den Hout, M.A. (2010). The impact of taxing working memory on negative and positive memories. *European Journal of Psychotraumatology*, 5623 - DOI: 10.3402/ejpt.v1i0.5623.

“The effects of EM and Tetris on negative and positive memories did not differ, even though Tetris taxed WM to a greater extent than EM.”

Engelhard, I.M., et al. (2011). Reducing vividness and emotional intensity of recurrent “flashforwards” by taxing working memory: An analogue study. *Journal of Anxiety Disorders* 25, 599–603.

“Results showed that vividness of intrusive images was lower after recall with eye movement, relative to recall only, and there was a similar trend for emotionality.”

Gunter, R.W. & Bodner, G.E. (2008). How eye movements affect unpleasant memories: Support for a working-memory account. *Behaviour Research and Therapy* 46, 913– 931.

Three studies were done that cumulatively support a working-memory account of the eye movement benefits in which the central executive is taxed when a person performs a task while attempting to hold a memory in mind.

Homer, S. R., Deeprose, C., & Andrade, J. (2016). Negative mental imagery in public speaking anxiety: Forming cognitive resistance by taxing visuospatial working memory. *Journal of Behavior Therapy and Experimental Psychiatry*, 50, 77-82.

As hypothesised, representative imagery was established and reduced in vividness more effectively by the eye movement task than the auditory task. The public speaking scenario was then visualised less vividly and generated less anxiety when imagined after performing the eye movement task than after the auditory task.

Kavanagh, D. J., Freese, S., Andrade, J., & May, J. (2001). Effects of visuospatial tasks on desensitization to emotive memories. *British Journal of Clinical Psychology*, 40, 267-280.

Tested the working memory theory. Eye movements were superior to control conditions in reducing within-session image vividness and emotionality. There was no difference one-week post.

Kearns, M, & Engelhard I. M. (2015). Psychophysiological responsivity to script-driven imagery: An exploratory study of the effects of eye movements on public speaking flashforwards. *Frontiers in Psychiatry*, 6, doi:10.3389/fpsy.2015.00115

“Relative to the control condition (imagery only), those who made eye movements whilst holding a mental image of this scenario in-mind demonstrated a significant decrease in heart rate, which acted as a measure of emotionality.”

Kuiken, D., Bears, M., Miall, D., & Smith, L. (2002). Eye movement desensitization reprocessing facilitates attentional orienting. *Imagination, Cognition and Personality*, 21, 3-20.

Tested the orienting response theory related to REM-type mechanisms. Indicated that the eye movement condition was correlated with increased attentional flexibility. Eye movements were superior to control conditions.

Kuiken, D., Chudleigh, M. & Racher, D. (2010). Bilateral eye movements, attentional flexibility and metaphor comprehension: The substrate of REM dreaming? *Dreaming*, 20, 227–247.

This study adds additional support to the orienting response theory related to REM-type mechanisms. Evaluations of participants experiencing significant loss or trauma demonstrate differential effects in a comparison of eye movement and non-eye movement conditions.

Lee, C.W., & Drummond, P.D. (2008). Effects of eye movement versus therapist instructions on the processing of distressing memories. *Journal of Anxiety Disorders*, 22, 801-808.

“There was no significant effect of therapist’s instruction on the outcome measures. There was a significant reduction in distress for eye movement at post-treatment and at follow-up. . . . The results were consistent with other evidence that the mechanism of change in EMDR is not the same as traditional exposure.”

Maxfield, L., Melnyk, W.T. & Hayman, C.A. G. (2008). A working memory explanation for the effects of eye movements in EMDR. *Journal of EMDR Practice and Research*, 2, 247-261.

In two experiments participants focused on negative memories while engaging in three dual-attention eye movement tasks of increasing complexity. Results support a working memory explanation for the effects of eye movement dual-attention tasks on autobiographical memory.

Nieuwenhuis, S., Elzinga, B. M., Ras, P. H., Berends, F., Duijs, P., Samara, Z., & Slagter, H. A. (2013). Bilateral saccadic eye movements and tactile stimulation, but not auditory stimulation, enhance memory retrieval. *Brain and Cognition*, 81, 52-56.

Increased memory retrieval in two experiments support “the possibility that alternating bilateral activation of the left and right hemispheres exerts its effects on memory by increasing the functional connectivity between the two hemispheres.”

Parker, A., Buckley, S. & Dagnall, N. (2009). Reduced misinformation effects following saccadic bilateral eye movements. *Brain and Cognition*, 69, 89-97.

Bilateral saccadic eye movements were compared to vertical and eye fixation. "It was found that bilateral eye movements increased true memory for the event, increased recollection, and decreased the magnitude of the misinformation effect." This study supports hypotheses regarding effects of interhemispheric activation and episodic memory.

Parker, A. & Dagnall, N. (2007). Effects of bilateral eye movements on gist based false recognition in the DRM paradigm. *Brain and Cognition*, 63, 221-225.

Bilateral saccadic eye movements were compared to vertical and eye fixation. Those in the bilateral eye movement condition "were more likely to recognise previously presented words and less likely to falsely recognize critical non-studies associates."

Parker, A., Relph, S. & Dagnall, N. (2008). Effects of bilateral eye movement on retrieval of item, associative and contextual information. *Neuropsychology*, 22, 136-145.

The effects of saccadic bilateral eye movement were compared to vertical eye movements and eye fixation on the retrieval of item, associative and contextual information. Saccadic eye movements were superior on all parameters in all conditions.

Sack, M., Zehl, S., Otti, A., Lahmann, C., Henningsen, P., Kruse, J., & Stingl, M. (2016). A comparison of dual attention, eye movements, and exposure only during eye movement desensitization and reprocessing for posttraumatic stress disorder: Results from a randomized clinical trial. *Psychotherapy and Psychosomatics*, 85(6), 357-365.

Bilateral eye movements were compared to eye fixation and an exposure control. Both eye conditions were equally effective and superior to exposure alone at posttest.

Samara, Z., Bernet M., Elzinga, B.M., Heleen A., Slagter, H.A., & Nieuwenhuis, S. (2011). Do horizontal saccadic eye movements increase interhemispheric coherence? Investigation of a hypothesized neural mechanism underlying EMDR. *Frontiers in Psychiatry*, 2, 4. doi: 10.3389/fpsy.2011.00004

The study demonstrated that 30 seconds of bilateral saccadic EMs enhanced the episodic retrieval of non-traumatic emotional stimuli in healthy adults. There was no evidence for an increase in interhemispheric coherence. However, a number of caveats regarding interpretation are noted.

Schubert, S.J., Lee, C.W. & Drummond, P.D. (2011). The efficacy and psychophysiological correlates of dual-attention tasks in eye movement desensitization and reprocessing (EMDR). *Journal of Anxiety Disorders*, 25, 1-11.

"EMDR-with eye movements led to greater reduction in distress than EMDR-without eye movements. Heart rate decreased significantly when eye movements began; skin conductance decreased during eye movement sets; heart rate variability and respiration rate increased significantly as eye movements continued; and orienting responses were more frequent in the eye movement than no-eye movement condition at the start of exposure."

Sharpley, C. F. Montgomery, I. M., & Scalzo, L. A. (1996). Comparative efficacy of EMDR and alternative procedures in reducing the vividness of mental images. *Scandinavian Journal of Behaviour Therapy*, 25, 37-42.

Eye movements were superior to control conditions in reducing image vividness.

Smeets, M. A., Dijs, M. W., Pervan, I., Engelhard, I. M., & Van den Hout, M. A. (2012). Time-course of eye movement-related decrease in vividness and emotionality of unpleasant autobiographical memories. *Memory*, 20, 346-357.

"Results revealed a significant drop [in eyes moving condition] compared to the [eyes stationary] group in emotionality after 74 seconds compared to a significant drop in vividness at only 2 seconds into the intervention. These results support that emotionality becomes reduced only after vividness has dropped."

van den Hout MA, Eidhof MB, Verboom J, Littel M, Engelhard IM. (2014) Blurring of emotional and non-emotional memories by taxing working memory during recall. *Cognition and Emotion*, 28 (4):717–27

"Compared to a pre-test, a post-test (without concentrating on the dot) replicated earlier findings: negative memories are rated as less vivid after "recall + EM" but not after "recall only". This was not found for neutral memories"

van den Hout, M., Engelhard, I.M et al. (2011). EMDR: Eye movements superior to beeps in taxing working memory and reducing vividness of recollections. *Behaviour Research and Therapy*, 49, 92-98.

"Vividness of negative memories was reduced after both beeps and eye movements, but effects were larger for eye movements. Findings support a working memory account of EMDR and suggest that effects of beeps on negative memories are inferior to those of eye movements."

van den Hout, M., Muris, P., Salemink, E., & Kindt, M. (2001). Autobiographical memories become less vivid and emotional after eye movements. *British Journal of Clinical Psychology*, 40, 121-130.

Tested their theory that eye movements change the somatic perceptions accompanying retrieval, leading to decreased affect, and therefore decreasing vividness. Eye movements were superior to control conditions in reducing image vividness. Unlike control conditions, eye movements also decreased emotionality.

Van den Hout, M.A., Rijkeboer, M.T., Engelhard, I.M., Klugkist, I., Hornsveld, H., Toffolo, M., & Cath, D. (2012). Tones inferior to eye movements in the EMDR treatment of PTSD. *Behaviour Research and Therapy*, 50, 275-279.

"Ems outperformed tones while it remained unclear if tones add to recall only."

van Veen, S. C., van Schie, K., Wijngaards-de Meij, L. D., Littel, M., Engelhard, I. M., & van den Hout, M. A. (2015). Speed matters: relationship between speed of eye movements and modification of aversive autobiographical memories. *Frontiers in psychiatry*, 6, 45.

Although predicted that highly vivid images are more affected by fast EM and less vivid images are more affected by slower EM. . . "Crucially, image vividness did not interact with condition on the decrease of emotionality over time, which was inconsistent with the prediction."