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Effects of Visuospatial Tasks on Desensitization to Emotive Memories

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Running Head: Eye Movements and desensitization to emotive images

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Abstract

Objectives: Vivid and intrusive memories of extreme trauma can disrupt a stepwise approach to imaginal exposure. Concurrent tasks that load the visuo-spatial sketchpad (VSSP) of working memory reduce memory vividness during imaginal exposure. Such tasks may help maintain a progressive exposure protocol while minimizing distress during treatment. The current study tested whether relief of distress from a competing VSSP load during emotive imagery is at the cost of impaired desensitization.

Design: This study examined repeated exposure to emotive memories using 18 unselected undergraduates, using a within-subjects design.

Method: Participants recalled three positive and three negative self-related memories, and rated the vividness and emotiveness of the image. Participants then received all three conditions (Eye Movements; Visual Noise; Control) in a counterbalanced order. One positive and one negative recollection were used for each condition. They then rated the vividness of the image and their emotional response before proceeding to the next trial. There were 8 trials for each image. At a non-interference session one week later, participants recalled each image, rating its vividness and their emotional response.

Results: Consistent with previous research, vividness and distress during imaging were lower during eye movements than in exposure alone, with passive visual interference giving intermediate results. A small reduction in emotional responses a week later was of similar size for the three conditions.

Conclusion: Visuospatial tasks may provide a temporary response aid for imaginal exposure without affecting desensitization.

Exposure treatments are well established for phobic conditions, and form the basis for the cognitive-behavioural management of Post-Traumatic Stress Disorder (PTSD; Devilly & Spence, 1999; Foa, Dancu, Hambree, Jaycox, Meadows, & Street, 1999). However there appears to be a problem with some PTSD sufferers experiencing negative reactions to exposure sessions (Boudewyns & Hyer, 1990; Jaycox & Foa, 1996). There is a danger that high levels of anxiety could trigger premature withdrawal from treatment or attempted suppression of extremely distressing memories.

A progressive or stepwise exposure to fear stimuli was a feature of the earliest behavioural treatments for anxiety disorders (Jones, 1924; Wolpe, 1958). Such an approach is particularly consistent with a model of fear reduction that includes the acquisition of relevant skills and self-efficacy in being able to deal with the feared situation (Bandura, 1986). Despite careful design and preparation, there are sometimes transitions in live exposure that constitute leaps of difficulty and fear level. Often these involve a qualitative change in the stimulus (touching a snake; allowing an elevator to move; taking off in a plane). One way of dealing with this problem is to provide a performance aid that moderates the degree of increased difficulty and fear. So, the snake phobic who has difficulty with the transition from close proximity to holding the snake might initially be provided with a pair of gloves (Bandura, 1986). Such strategies are not critical to the process of change itself, but they address potential blocks to progress and minimise the distress experienced during treatment. The addition of performance aids can allow treatments to be as successful with more strongly affected individuals as with less severe reactions (Bandura, 1986).

Imaginal procedures provide substantial opportunity for stimulus modification. However, sometimes a highly traumatic memory is so easily elicited by associated cues, that it can disrupt early steps in imaginal exposure. But there is still a potential for extremely distressing memories to be elicited early in the treatment of post-trauma reactions. Research into the role of working memory in vivid imagery suggests a solution that therapists might add to their existing repertoire to deal with this situation. The working memory model (Baddeley, 1986; Baddeley & Hitch, 1974, 1994) incorporates an attentional component (the central executive) and two temporary storage systems, the phonological loop and the visuospatial sketchpad (VSSP), which store auditory and visual information respectively. These ‘slave systems’ have limited capacity, so that if people do two visual (or two auditory) tasks at once, this limited capacity is shared between them. This property of the systems implies that if people are attempting to recreate a complex visual memory while undertaking another visuospatial task, the amount of visual information about the image that can be held in working memory will be reduced and the vividness of the image will decrease. Thus, laboratory research by Baddeley and Andrade (in press) showed that loading the VSSP, by requiring participants to tap a pattern on a keyboard or watch a dynamically changing visual stimulus, selectively reduced their ratings of the vividness of concurrent visual imagery. Conversely, engaging the phonological loop by a concurrent counting task selectively reduced the vividness of imagined sounds.

Testing an unselected sample, Andrade, Kavanagh and Baddeley (1997) examined whether this reduction in image vividness was associated with a reduction in the emotional response to the image. They confirmed that tasks requiring the VSSP (spatial tapping and lateral eye movements) reduced the vividness of visual images triggered by emotive photographs or personal visual memories. A task requiring the phonological loop (counting aloud) had no significant effect. When in Experiment 4 the participants recollected happy or distressing experiences, concurrent eye movements suppressed their subjective emotional response to the image as well as the vividness of their image. The tapping task had a smaller effect than eye movements on vividness and emotional response, perhaps because it required only spatial processing whereas eye movements also involved the intrusion of extraneous visual material that competed for processing space with the visual information in the image. If as these findings suggest, a reduction in image vividness corresponds to a reduction in the emotional impact of the image, then the inclusion of a visuospatial task within imaginal exposure may provide a response aid analogous to the gloves used within *in vivo* exposure treatments of snake phobias.

There is a potential risk that such strategies might reduce the effectiveness of treatment, either by reducing habituation or by reducing the opportunities for imaginal rehearsal (McGlynn, Mealiea & Landau, 1981). The data on this issue are mixed (Rodriguez & Craske, 1993). One study compared effects of attention diversion and focussed attention in exposure treatment of obsessive-compulsive disorder , and found a greater rebound in anxiety at a second exposure session from attention diversion (Grayson, Foa & Steketee, 1982). However a second study failed to replicate that result (Grayson, Foa & Steketee, 1986). A third study found that verbal distraction during *in vivo* exposure for panic disorder and agoraphobia resulted in greater initial improvement than focussed attention to somatic sensations (Craske, Street & Barlow, 1989), but focussed attention gave superior results at a 6-month follow-up. While the available data are not clearcut, they suggest that distraction from *in vivo* exposure may at best be a mixed blessing, and that any immediate benefits may be offset by later problems. It is conceivable that distraction from imaginal exposure may present similar effects.

Another set of existing data suggests that a dual task may not affect the outcomes of imaginal exposure. These data come from outcome research into Eye Movement Desensitization-Reprocessing (EMDR; Shapiro, 1989a, 1991, 1995). This treatment incorporates several elements, including imaginal exposure, somatic and cognitive awareness, and either a concurrent visuospatial task (usually eye movements) or some concurrent rhythmic stimulation (Shapiro, 1995). EMDR has not lived up to its claims as a major treatment advance over existing treatments (Lohr, Tolin & Lilienfield, 1998; cf Shapiro, 1995). However, there is little evidence that it is any worse than standard imaginal desensitization, either. In particular, forms of the treatment with and without the eye movement component are of approximately equal effectiveness (Boudewyns & Hyer, 1996; Devilly, Spence & Rapee, 1998; Dunn, Schwartz, Hatfield, & Weigele, 1996; Lohr, Kleinknecht, Tolin & Barrett, 1995; cf. Shapiro, 1989b; Wilson, Silver, Covi & Foster, 1996). The apparent conflict between the detrimental impact of attention diversion within an *in vivo* context or with pictorial stimuli and the lack of eye movement effects in EMDR deserves further investigation.

A possible resolution to the paradox lies in the extent that participants continue to attend to the emotive stimulus. Competition for limited VSSP resources is not equivalent to a change in attention to the available stimuli, because in the working memory model of Baddeley (1986), attention is mediated by the Central Executive rather than by the storage systems. This provides an opportunity to allow emotional habituation to a degraded image before moving to a clearer or more emotive one. A concurrent VSSP task might then be an aid to imaginal exposure, rather than an impedance to therapy.

To test whether emotional suppression during exposure impedes desensitization, studies need to assess the participants' emotional response both during the dual task and after exposure. The measure of desensitization should, like the Pretest measure, be uncontaminated by any temporary suppression effect of the dual task, so it ideally should not be taken immediately after the exposure trials. The number of exposure trials should be strictly controlled between conditions, and there should not be additional treatment between the initial exposure trials and later measures of emotional response to the images.

We reviewed the existing literature to see whether any previously published studies fulfilled these requirements, and found none that did so. For example, numbers of trials or exposure sessions were not equalised in some studies (Renfrey & Spates, 1994; Wilson et al., 1996). Some studies also provided additional treatment between the exposure trials and measures of emotional response that were taken in later sessions (Bauman & Melnyk, 1994; Wilson et al., 1996), so that only responses during the treatment session—possibly reflecting temporary interference from the dual task—are available for comparison. Existing research on imaginal desensitization with dual tasks (including EMDR research) often does not report both the degree of suppression during the tasks and differences in sustained desensitization in the same study.

The present study met the key requirements. We examined the effects of concurrent eye movements on the distress induced by repeated exposures to emotive memories. All participants completed eight competing-task trials and two pure exposure sessions. We tested both distress during the dual tasks, and emotional responses to the memories that were reported one week later without the competing task being present. In this initial study, we tested an unselected sample of undergraduates to avoid ethical problems that might be raised by prematurely conducting a treatment comparison trial with highly traumatised individuals. While there may be qualitative differences between the responses of PTSD patients and unselected people to distressing imagery (Strosahl, Ascough & Rojas, 1986), the use of personal memories with highly emotive connotations provides a close analogue of trauma images. A within-subjects design was employed to minimize the impact of individual differences in habituation rates or in the subjective perception of imagery vividness and emotionality. To check whether effects were limited to negatively charged images or reflected a more general response to emotion, we also tested the impact of the task conditions on positive images.

Previous research has especially focussed on the impact of eye movements, because of their relationship to EMDR. If eye movements affect images because they involve a competition for VSSP resources, there would be no reason to suppose that the exact format of the concurrent visuospatial task would be important. For example, Quinn (1994) showed that a predictable spatial tapping task interfered as much with visual imagery when the experimenter moved the participant's hand as when the participant moved their hand by themselves. On the other hand, there is some evidence (reviewed by Logie, 1995) that visual and spatial tasks have separable effects on VSSP function. We suspected that the clinical choice of eye movements as the concurrent task may be serendipitous because it combines spatial (side-to-side tracking) and visual (changing visual stimulation as eyes move) processing. If the spatial and visual components of the eye movements task contributed to interference in an additive fashion, then eye movements should reduce emotional responses to visual images more than a task that involved spatial or visual processing but not both. The data of Andrade et al. (1997) supported this hypothesis by showing larger effects on imagery from concurrent eye movements than from concurrent spatial tapping tasks in which participants could not look at the board they were tapping. The present study aimed to compare the effects of concurrent eye movements with those from a type of visual interference that required no spatio-motor control.

Quinn & McConnell (1996) reported a task that met our need. Their task requires participants to watch an array of small squares that constantly and randomly change between black and white. This dynamic visual noise appears to involve VSSP, since it interferes with learning a word list when the learning is mediated by visual imagery, but not when it is mediated by verbal rehearsal (Quinn &

McConnell, 1996). Visual Noise also reduces subjective ratings of image vividness (Baddeley & Andrade, in press). We predicted that the combination of visual and spatio-motor processes would be necessary for a maximal concurrent effect on emotive images. Therefore, Visual Noise would reduce vividness and emotion ratings of emotive recollections, but to a lesser extent than concurrent eye movements.

To summarise, the present study tested the hypothesis that loading the VSSP of working memory reduces vividness of imagery and emotional responses *during* a visual imagery task but does not interfere with desensitization. Effects of rapid eye movements were compared with a purely visual competing task (dynamic visual noise), and with a control condition that had no concurrent task.

Method

Participants

Participants in this study were 18 introductory Psychology students (7 men and 11 women) at the University of Sydney who responded to a request for participants to take part in a study on imagery in return for course credit. They ranged in age from 18 to 29 (mean = 20 years, median = 19).

Procedure

After providing informed consent, participants were asked to recall three situations where they were very happy and three where they were very fearful or distressed. Happy memories ranged from meeting romantic partners, receiving gifts or passing examinations to parties or holidays. Distressing memories included illness or death of relatives, parental divorce, threats from animals, arguments with friends, and horror movies. Participants were asked to re-create each event in imagination and rated the image's vividness from 0, no image at all, to 10, perfectly clear, as vivid as normal vision. They also rated their emotional response when recalling the image, from -10, extremely negative, to 10, extremely positive. These ratings were identical to those used in Andrade *et al.* (1997), and the negative range of the emotion rating was analogous to a rating of Subjective Units of Distress (Wolpe, 1958). The initial vividness and emotion ratings formed the *pre-exposure* assessments.

Participants then received all three VSSP interference conditions (Eye Movements; Visual Noise; Control) in a counterbalanced order. One positive and one negative recollection were used for each condition. Memories were ordered by degree of emotional response, and allocated to condition using random permutations, to allow counterbalancing of the Pre-exposure emotional response across conditions.

In each condition, participants were seated 45 cm in front of a 25 cm computer screen and given two practice trials to familiarize themselves with the task and in re-creating their experience while looking at the screen. On each competing-task trial participants generated the image during the first 5 s, and then retained it for another 8 s while they performed the dual task. They then rated the vividness of the image and their emotional response before proceeding to the next trial. There were 8 trials for each image.

For the *Eye Movement* condition, a similar procedure was used as in Andrade et al. (1997). Lower case letters in bold type, 4 mm in height, were presented for 200 ms on alternate sides of the screen (21.5 cm apart) with a 200 ms inter-stimulus interval (there were thus twenty eye movements during the 8 seconds of the dual task, and the eye movements subtended an angle of 27^{o}). On 95% presentations the displayed letter was a ‘p’; on 5% a ‘q’. They were instructed to hold their head still and move their eyes to focus on the letter. To ensure that participants complied with the instructions, they were asked to say ‘Now’ whenever a ‘q’ appeared. The experimenter confirmed that they did comply with these instructions and recorded the accuracy of their responses.

The program for the *Visual Noise* condition was developed by Quinn and McConnell (1996) and adapted to run on a Macintosh LC computer. Participants were asked to fixate centrally on a 17 x 17cm array comprising 80 black or white squares in each row and column. Random squares were selected by the program and changed from black to white (or vice-versa) at a rate of approximately 500 per second. This created a flickering effect throughout the array.

In the *Exposure Control* condition (Control), participants fixated centrally on the blank screen while imagining the scene. This condition is therefore identical to the two VSSP-loading tasks in terms of procedure and exposure to the emotional images, with the exception of any competing task.

A session was scheduled at *One-Week Post-Exposure*, in which participants again recalled each image while fixating on the blank screen and then rated the images' vividness and their emotional response. They were then debriefed.

Results

Vividness and emotion ratings were analyzed using a Repeated Measures ANOVA which had 3 conditions (Control, Visual Noise, Eye Movement) x 10 occasions of measurement (Pre-exposure, 8 trials, 1-week Post-exposure) x 2 memory valences (positive, negative), and had repeated measures on all factors. The sum of squares was partialled into orthogonal contrasts that allowed a direct test of our primary hypotheses (Tabachnik & Fidell, 1983, p. 43)[1].

The effect for occasions of measurement was divided into three orthogonal contrasts:

(O1) A contrast of the ratings at Pre-exposure and 1-week Post, with ratings that were obtained during the eight treatment trials.

(O2): Trial 1 vs. Trial 8 of the treatment task (testing within-session habituation);

(O3) Pre-exposure ratings vs. those at 1-week Post-exposure (assessing desensitization).

The contrasts for Condition were:

(C1) a linear trend from Eye Movements through Visual Noise to Control.

(C2) departure from linearity, or Eye Movements and Control vs. Visual Noise.

We predicted that eye movements would suppress vividness and distress during the competing task phase of the study in comparison with exposure alone (i.e., O1 x C1 would be significant). Visual Noise was expected to produce effects midway between Eye Movements and Control (i. e. O1 x C2 would not be significant).

We expected both within-session habituation (O2) and desensitization (O3) should occur. We did not expect that these effects would interact with treatment conditions. We also tested for effects due to image valence, but made no specific predictions.

Insert Figure 1 about here

Vividness

Mean vividness ratings are displayed in Figure 1. Positive and negative memories had similar vividness across trials, ($F(1,17) = 0.42$, n. s., $\eta^2 = .024$). During the eight competing-task trials the vividness ratings across the conditions were significantly lower than at Pre-exposure and at 1 week Post-exposure ($F(1,17) = 11.99$, $p < .01$, $\eta^2 = .414$). As Figure 1 shows, this effect was primarily due to suppression by the competing tasks. During the competing-task trials, eye movements suppressed the vividness of the images in comparison with the Control task (O1 x C1: $F(1,17) = 69.39$, $p < .001$, $\eta^2 = .803$), and results for Visual Noise fell midway between those for Eye Movements and Control (O1 x C2: $F(1,17) = 2.88$, n. s., $\eta^2 = .145$) [2].

Apparent reductions in vividness across all conditions from the first to last competing-task trials fell short of the .05 significance level ($F(1,17) = 3.49$, $p < .08$, $\eta^2 = .170$). Negative memories did significantly reduce in vividness over the trials ($F(1,17) = 5.07$, $p < .05$, $\eta^2 = .230$), but positive ones did not ($F(1,17) = 0.67$, n.s., $\eta^2 = .038$). Contrary to our expectations, eye movements did produce a significantly greater drop in vividness from Trial 1 to Trial 8 than did exposure alone (O2 x C1: $F(1,17) = 9.13$, $p < .01$, $\eta^2 = .349$), and Visual Noise produced intermediate effects (O2 x C2: $F(1,17) = 1.61$, n. s., $\eta^2 = .087$) [2].

There was a significant reduction in vividness from Pre-exposure to Post-exposure (O3: $F(1,17) = 7.30$, $p < .02$, $\eta^2 = .300$) which was restricted to the negative images (Negative: $F(1, 17) = 21.75$, $p < .001$, $\eta^2 = .561$; Positive: $F(1,17) = 0.65$, n.s., $\eta^2 = .037$). As expected, the drop from Pre-exposure to Post-exposure was comparable for all conditions (O3 x C1: $F(1,17) = 0.04$, n. s., $\eta^2 = .003$; O3 x C2: $F(1,17) = 0.41$, n. s., $\eta^2 = .023$) [2].

Insert Figure 2 about here

Emotional response

Analyses of emotional response reversed the sign of the ratings to distressing images so that the strength of positive and negative ratings could be directly compared. Mean ratings of emotion strength are shown in Figure 2. Positive memories generated stronger emotion ratings than the negative memories ($F(1,17) = 8.73$, $p < .01$, $\eta^2 = .339$). Emotional responses during the eight competing-task trials were weaker than at Pre-exposure and Post-exposure ($F(1,17) = 4.75$, $p < .05$, $\eta^2 = .538$), especially for positive memories (Positive: $F(1,17) = 10.20$, $p < .01$, $\eta^2 = .853$; Negative: $F(1,17) = 1.17$, n. s., $\eta^2 = .176$).

As in Experiment 4 of Andrade et al. (1997), there was a suppression of emotion during concurrent eye movements in comparison with ratings during exposure alone (O1 x C1: $F(1,17) = 31.59$, $p < .001$, $\eta^2 = 1.00$). Results of Visual Noise were midway between the other two conditions (O1 x C2: $F(1,17) = 1.57$, n. s., $\eta^2 = .220$) [2].

There was no evidence of within-session habituation of the emotional response (O2: $F(1,17) = 0.54$, n. s., $\eta^2 = .106$), or of within-session habituation being affects by competing tasks (O2 x C1: $F(1,17) = 2.00$, n. s., $\eta^2 = .266$; O2 x C2: $F(1,17) = 0.01$, n. s., $\eta^2 = .051$) [2]. However there was a significant drop in emotional response from Pre-exposure to Post-exposure (O3: $F(1,17) = 10.03$, $p < .01$, $\eta^2 = .847$), showing an apparent “treatment” effect. Consistent with our prediction, this fall was of similar size for the three task conditions (O3 x C1: $F(1,17) = 0.70$, n. s., $\eta^2 = .124$; O3 x C2: $F(1,17) = 3.31$, $p < .10$, $\eta^2 = .404$) [2].

Discussion

We successfully replicated the results of Andrade et al. (1997) Experiment 4 in the present study, using repeated exposure trials. When participants were engaging in rapid eye movements while creating an image of an emotive experience, the subjective vividness of the image was reduced and they reported less extreme emotion than when recalling an image without a concurrent task. An intermediate reduction was produced by a flickering pattern that participants passively observed: in Andrade et al Experiment 4 a similar intermediate effect was produced by having participants tap a pattern on a keyboard. This supports the notion that competition of information in VSSP can produce interference in emotional responses to concurrent images. Results suggest that the interference to imagery arises from two sources: competing spatial information, related to monitoring the production of lateral eye movements or of the tapping of patterns on a keyboard, and interference that is produced by the discrepant visual data that is received when we move our eyes or see a flickering pattern.

The present study also tested whether the concurrent activities affected desensitization of emotional responses from the Pre-test to one week Post-exposure. In this respect, the study was a small-scale analogue of imaginal desensitization in a non-clinical sample. With only ten brief exposures in total, we expected that the effect on emotion ratings would be small. However this change from Pre-to Post-assessments was statistically significant. As predicted, differential desensitization of emotional responses for the three conditions did not occur.

Despite the presence of a significant reduction in emotional response to the memories for Pre-treatment to one-week Post-exposure, there was no significant habituation of the emotion across the

10 exposure trials. Why the one occurred without the other is unclear. It is possible that this reflects some insensitivity of the emotion rating in the middle range, or it may be that participants undertook additional exposure in the week after the first session.

This study provided little support for Eye Movements or Visual Noise either assisting or impeding desensitization. We argue that this is because their effect on emotion is insufficient to eliminate emotional reactions to the memory. Our results are consistent with observations of no significant difference in overall therapeutic effectiveness between EMDR and similar procedures without eye movements (Lohr et al., 1998). The failure of eye movements to affect desensitization can be seen as a significant potential advantage. If further research confirms that a concurrent visuospatial task can blunt the emotional impact of traumatic memories without substantially affecting the course of treatment, the method could be of significant benefit. Should a therapist experience problems with a highly salient and traumatic memory intruding on a stepwise sequence of images, a VSSP-loading task such as eye movements could be used during initial exposure to the problematic memory. Given that visuo-spatial tasks such as keyboard tapping or visual noise have intermediate effects on concurrent images, tasks other than eye movements could be then used to titrate the degree of interference, allowing further refinement to the articulation of the steps in imaginal exposure and a gradual fading of the interference. Under this argument, the dual task would not be continued throughout therapy, any more than the snake phobic would leave treatment armed with gloves for their next snake encounter. The dual task would simply be seen as a temporary prop. This procedure should allow an avoidance of any delayed negative effects from the strategy (cf. Craske *et al.,* 1989).

We predict further that a dual task that involved the Phonological Loop such as articulatory suppression might also have utility. While our previous study suggested that these tasks may have limited use in moderating the vividness of visual images (Andrade *et al.,* 1997), they may be useful aids in situations where the image had primarily auditory characteristics (a scream, a gunshot, or the sound of a car crash). They may also have an application where a temporary suppression of verbal elaboration was needed. Further investigation of these notions is needed.

It is likely that dual tasks will not routinely be required in treatment of anxiety disorders—rather, they might be restricted to individual cases where some steps in a treatment hierarchy are particularly large, where intrusions of extremely traumatic memories present difficulties, or where clients suppress images during the sessions. Often, the use of dual tasks may not be the only way of overcoming the difficulty. But if they can be reliably shown to assist treatment in these cases, they will be an important addition to the therapist's armoury.

Views on the effectiveness or otherwise of EMDR are polarized (Devilly *et al.,* 1998; Lohr *et al*., 1995*;* Shapiro, 1996), as are views on the utility of laboratory research that is theoretically related to the therapeutic procedure. Some question the value of research into general psychological processes that may underpin a therapeutic technique that they regard as unproven. Others appear to take the view that laboratory studies can never shed light on clinical experience. We disagree with both these positions. As Borkovec (1997) points out, "the greatest progress in developing more effective psychotherapies will come from a renewed emphasis on designing and conducting therapy research as basic science devoted to the acquisition of cause-and-effect relationships and from collaborations between clinical researchers and basic researchers from other domains of psychology" (p.145). Our research and the balance of the outcome literature on EMDR suggest that eye movements and other dual tasks do not involve a new and revolutionary treatment but constitute a response aid, analogous to the use of gloves in early exposure trials for snake phobia. This may help explain why EMDR appears to work dramatically for some individuals, yet show no benefit for others. While less exciting, a response aid for imaginal exposure may nevertheless be an important contribution to the anxiety treatment repertoire.

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Footnotes

1. For readers who prefer to see overall repeated-measures ANOVAs, the effects for Occasions, Condition, and their interaction were significant for both vividness of the images (Occasions: $F(9, 153) = 7.37$, $p < .001$, $\eta^2 = .302$; Condition: $F(2, 34) = 13.66$, $p < .001$, $\eta^2 = .446$; Condition x Occasions: $F(18, 306) = 13.02$, $p < .001$, $\eta^2 = .434$) and for emotional responses to them (Occasions: $F(9, 153) = 4.05$, $p < .001$, $\eta^2 = .192$; Condition: $F(2, 34) = 9.47$, $p < .001$, $\eta^2 = .358$; Condition x Occasions: $F(18, 306) = 5.15$, $p < .001$, $\eta^2 = .233$).

2. These effects were not modified by the valence of the image.

Figures

Figure 1. Mean vividness ratings, collapsing across positive and negative memories

Figure 2. Mean strength of emotion, collapsing across positive and negative memories.