SUSTAINED EFFECTS OF AROUSAL AND VALENCE ON EPISODIC MEMORY IN HEALTHY YOUNG AND OLD ADULTS

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INTRODUCTION

- Episodic memory, related to experiences and events which are contextual in nature, is affected by salient stimuli, with arousal and valence playing key roles in influencing retrieval (Sharpe et al., 2004), in young and old adults (Nashiro et al., 2017).
- Although controlled comparisons between positive and negative stimuli are challenging due to methodological considerations, negative and positive information seem to be associated with distinct effects on memory retrieval (e.g., Mckell & Kensinger, 2008).
- Negative valence enhances memory by improving accuracy in retrieving arousing stimuli (Phillips & Sharot, 2008), while positive valence can enhance association memory (Madan et al., 2018).
- This retrieval advantage appears to become more prominent over time, inducing a slower forgetting of arousing stimuli (Yonelinas & Ritchey 2015).
- However, most studies explore the retrieval of those arousing stimuli themselves, and it remains unclear whether arousing cues influence episodic retrieval of details encoded following arousal exposure.
- Despite the decline in episodic memory observed in healthy ageing, characterised by old adults exhibiting reduced accuracy and slower retrieval (Spaniol & Grady, 2012), the arousal effect remains preserved (Nashiro & Mather, 2011).
- Therefore, it is also unclear whether potential sustained arousal effects are present throughout adulthood.
- In view of the preferable accessibility of arousing information, the objective of the study was to investigate the effects of arousal exposure to negative and positive stimuli on subsequent episodic memory retrieval, in young and old adults.
- We hypothesized better performance in both young and old adults following the presentation of an arousing stimulus.

METHODS

Participants
50 healthy young adults (age range = 18-34 years; mean age = 22 years, SD = 3.47; 14 males) and 52 healthy old adults (age range = 60-76 years; mean age = 66 years; SD = 4.65; 17 males). All participants completed the study online.

Stimuli
Images: 48 colour photographs displaying animals, humans and scenes used as visual-arousing cues. 24 images selected from the Open Affective Standardized Image Set (OASIS) database (Kurdi, et al., 2017) based on their arousal and valence ratings and depicted positive valence (range valence = 5.68-6.49; mean valence = 6.11; SD valence = 0.2; range arousal = 3.35; SD arousal = 0.49; Nashiro & Mather, 2011). 24 images selected from the Geneva Affective Picture Database (GAPED; Dan-Glauser & Scherer, 2011) based on their arousal and valence ratings and depicted negative valence (range valence = -0.41-98.74; mean valence = 44.45; SD valence = 25.23); range arousal 5.85-92.40 (mean arousal = 47.72; SD arousal = 19.46). A single black and white scrambled image was used as a neutral-control stimulus, abiding cueing valence and arousal effects, while guaranteeing its use for comparisons across conditions.

Video: 24 videos were selected from ActivityNet database (Heilbron et al., 2015). Each video was presented three times. Videos selected fall under these categories: sports/exercise, music/dancing, cleaning/cooking, playing/relaxed activity.

Experimental design
- 2 experimental and 1 control condition
- Experimental conditions: (i) high arousal with negative valence; (ii) high arousal with positive valence. The control condition was low in arousal with neutral valence
- 3x2 mixed-subjects design was utilised, with factors valence (negative vs. positive vs. neutral) and age (young vs. old).
- Dependent variables: reaction times and accuracy performance

Data Analysis
Outlier removal: Observations above and below 2.5 SDs from each participant’s average were removed with their accompanied accuracy responses. Average RTs and accuracy scores were re-calculated for each condition. RTs were then transformed into z-scores to gain greater control over the general slowing due to healthy ageing.

Bootstrapping: A bootstrapping procedure (e.g., Yankouskaya et al., 2022) was adopted where mean differences between conditions in RT (x) and accuracy (y) for each participant are paired as a single data point (x,y) for each condition. The data sets were resampled with a replacement but kept the same size as the number of participants. This procedure was repeated 2000 times, and each resampled set was plotted separately as a single data point for correct responses per condition and participant group.

Modelling
A linear mixed modelling approach (LMM) (Bates, Kliegl, Vasishth, & Baayen, 2015) was applied. A stepwise top-down approach was used for model specification and model comparison. Our final models used the following structure:

\[ \text{RT} \sim \text{Age} \times \text{Valence} + \text{Video repetition} + \text{Age} \times \text{Valence} + (\text{I}(\text{pp})) + (1 | \text{stim}) \]

RESULTS

OUTLIER-CORRECTED DATA

Fig. 1. Schematic Episodic Memory (EM) task representation: Each trial started with the presentation of an image (cue) for 1.5 sec; images were either (i) positive, (ii) negative, or (iii) neutral. An inter-stimulus-interval (ISI) followed for 1 sec, and then a video (per) appeared on the screen for 7 sec. A statement followed which was accompanied by three possible answers: 1) True, 2) False, 3) I don’t know. Participants had 7 sec to respond.

Fig. 2. Schematic representation of bootstrapped distribution: mean distribution for each condition of outlier-corrected data for accurate responses. The X-axis depicts RTs, and the Y-axis depicts accuracy percentage. The clouds represented by the Neutral and Positive conditions were closer to the upright left corner, indicating faster reaction times and better accuracy performance. A distribution cloud appeared in the lower right corner for the Negative condition, revealing slower reaction times and worse accuracy performance.

Fig. 3. A) Mean accuracy; B) Mean reaction times (on accurate responses) on outlier-corrected data. Points and lines are mean values. Participants were significantly slower and less accurate for the negative compared to the neutral and positive conditions. The neutral and positive conditions did not significantly differ. The graphs further show a repetition effect with both accuracy and response times improving from first to second video presentation, but not third. Age did not significantly impact performance.

DISCUSSION

- Our results support the engagement of distinct mechanisms following negative and positive valence. While negative valence prompted a lasting arousal effect, impairing the retrieval of information encoded after arousal exposure, positive valence did not influence episodic memory retrieval.
- The evidence validates the sustained nature of highly arousing negative stimuli by demonstrating the effect to remain present in healthy older adulthood.
- This study provides evidence in support of interactive interfering mechanisms following negative arousal, leading to retrieval difficulties of unrelated information, potentially prompting memory biases.
- Our findings highlight concern situations where negative events might be prevalent (e.g., post-traumatic stress disorder) and suggest further implications in various domains such as eyewitness testimony.