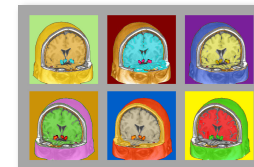


Eye movements and pupil dilation predict interactions of valence and memory

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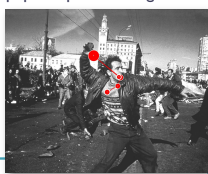


Hamann Cognitive Neuroscience Lab

Introduction

- Eye movements have been used to probe how attention is allocated during the encoding of declarative memories
- Recall is recollection of events or information from the past
 - Free Recall** – Information is recollected with no external cue
 - Cued Recall** – Information is recollected with a brief verbal description (more similar to recognition)
- Positive and negative emotion enhances recollection for previously seen items (Hamann, 2001)
- Previous studies have found that increased narrowing of visual attention during picture encoding is associated with enhanced episodic memory (Sharot, 2008)
 - This effect is most strong for negative items (Inman, 2011)
 - The pupil response is larger for subsequently retrieved emotional items

Encoding



Encoding

- Attentional capture by salient features
- Increased cognitive elaboration on salient features (deeper encoding)
- Arousal response to emotional stimuli

Retrieval

Recall or Recognition

DELAY

Retrieval

- Increased Recollection of salient features and episodic context
- Increased Recall or Recognition

Aim

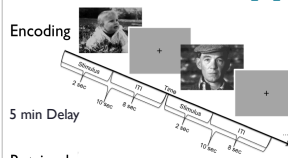
- To examine whether enhanced memory for negative emotional pictures is specifically related to increased visual attention to salient affective features
- To examine whether emotional arousal, as indexed by pupil dilation, is related to enhanced memory for emotional pictures

Hypotheses

- Emotion
 - Visual attention will be focused longer on the salient features of emotional than neutral stimuli.
 - Change in pupil dilation will be larger for emotional than neutral stimuli.
- Memory
 - Visual attention will be focused longer on the salient features of negative stimuli that are subsequently recalled than not recalled, but not positive or neutral.
 - Change in pupil dilation will be larger for emotional subsequently recalled items.

Methods

Encoding



Retrieval

- Free Recall**
 - Participant: "I remember a man throwing a rock in a riot."
- Cued Recall**
 - Experimenter: "Do you remember a street riot?"
 - Participant: "Yes, a man was throwing a rock."

Participants

- 18 participants (16 female)
- Ages 19-22, M = 19 ± 0.25

Procedure

- Study and Test design with 5-min delay
- Incidental Encoding of Pictures
- Free and Cued Recall Test
- Valence and Arousal Ratings (1-5 scale)

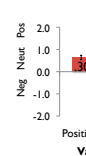


Stimuli

- 90 grayscale IAPS and other images
 - During encoding:
 - 30 Positive, 30 Negative, 30 Neutral
 - Arousal matched for Positive (M = 2.9) and Negative (M = 3.2) stimuli
 - Across the set of stimuli, pictures equated on:
 - Visual complexity
 - Social content
 - Luminance qualities

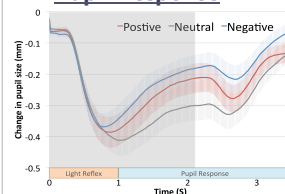
Eye Tracking Measurements

- Time (s) on Area of Interest =
 - AOI 1 + AOI 2
- Subsequent Memory Analysis
- Pupil Response
 - Dilation of pupil (mm) from a pre-stimulus 1 sec baseline



Results

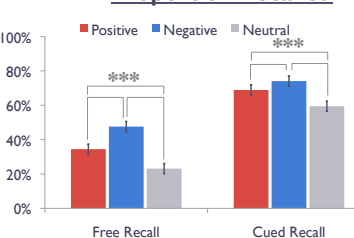
Pupil Response



Pupil Response. Shaded gray section is the stimulus presentation period. Error bars = SEM.

- Larger pupil dilation for emotional items (positive and negative) relative to neutral items
- Emotional pictures were physiologically arousing

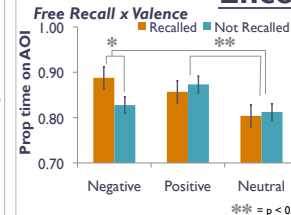
Proportion Recalled



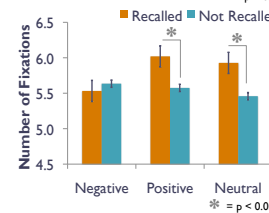
- Emotional Memory Effect for free and cued recall of positive and negative relative to neutral stimuli

Eye-Tracking Results

Encoding

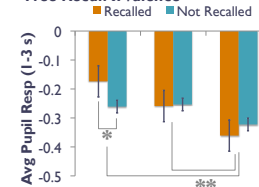


- Longer fixations to salient features of negative and positive stimuli than neutral stimuli.
- Consistent with our previous findings and attentional capture hypothesis, negative emotion influenced subsequent recall, with longer fixations to salient features of recalled negative items for free and cued recall.



Pupil Response

Free Recall x Valence



- More fixations to positive and neutral recalled stimuli than not recalled stimuli.

Attention capture and maintenance by negative salient features
Cognitive Elaboration
Recollection of the episodic context
Free and Cued Recall at Retrieval

Conclusions

- The specificity of the current memory findings to negative emotional stimuli may reflect attentional and memory biases that prioritize the processing of negative emotional stimuli.
- Preferential attentional capture by negative emotional stimuli and enhanced memory is consistent with an adaptive processing bias towards attending to and remembering potentially survival-relevant stimuli.
- Future studies should explicitly examine the extent to which attentional capture influences cognitive elaboration processes and consequences of those influences on subsequent memory.



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References

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Inman, C., & Hamann, S. (2011). Experience-related eye movements reflect declarative memory for emotional and neutral pictures. *Presented at CNS 2011*.
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