The role of reward in encoding and retrieving details of complex episodic memories for events

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Introduction

Experimental evidence indicates that the presence of reward when encoding items and associations[1,2,3] enhances memory performance. However, it is unclear whether the effect of reward is driven by memory processes, such as stronger encoding, or decision-making processes, such as more cautious deliberation.

Furthermore, episodic memories for complex events contain different types of detailed information[4,5], which are not necessarily captured by item and associative memory tasks. It is unknown how reward affects the retrieval of this kind of detailed information.

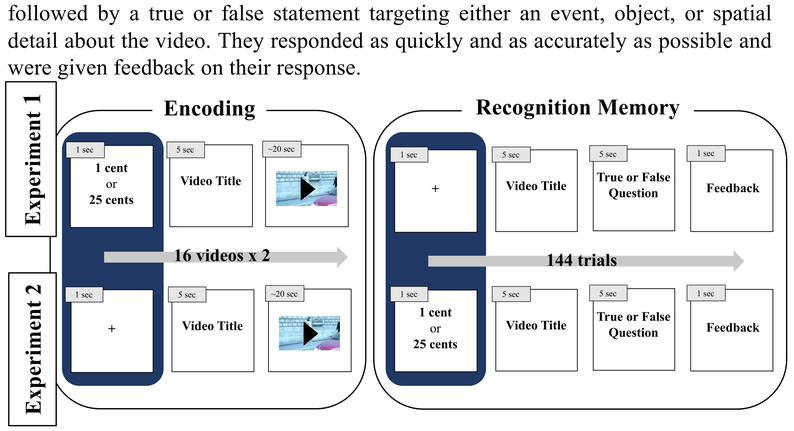
Design

Participants: A total of 90 healthy young adults (mean age = 20.67 years); 45 in Experiment 1 and 45 in Experiment 2.

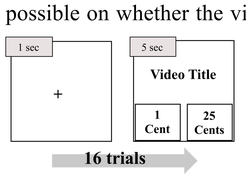
Encoding: Participants studied 16 unique video clips (15-20s in length) depicting every day events, Videos contained event (*what happened*), object (*what items were present*), or spatial (*where things were located*) details.

Participants viewed the reward value of the video (Experiment 1) or a fixation cross (Experiment 2). They then saw the title of the video before watching the video. After two repetitions, this was followed by a 10 minute delay.

Recognition Memory: Participants viewed a fixation cross (Experiment 1) or the reward value of the video (Experiment 2). They then saw the title of the video followed by a true or false statement targeting either an event, object, or spatial detail about the video. They responded as quickly and as accurately as possible and were given feedback on their response.



Explicit Reward Memory: In both Experiment 1 and Experiment 2, participants viewed a fixation cross followed by the title of a video. They responded as quickly and as accurately as possible on whether the video was associated with a 1 cent or a 25 cent reward.



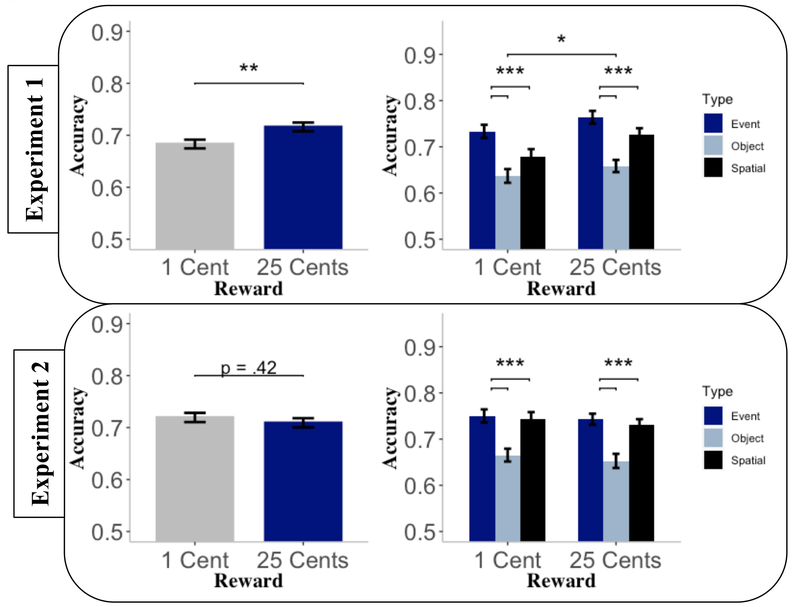
Analyses

The effect of reward on **recognition memory accuracy** was assessed with a t-test comparing the high and low reward conditions. To see if reward differentially impacted memory for different types of details, a 3 x 2 repeated measures ANOVA was used.

Drift diffusion modelling was then used to disentangle whether the effect of reward could be attributed to stronger encoding or more cautious decision-making.

Finally, we addressed whether **explicit memory for the reward** value of a video was correlated with memory accuracy.

Recognition Memory Accuracy



Experiment 1 revealed that recognition memory accuracy was higher on high reward trials than low reward trials. High reward had a global effect on event, object, and spatial detail memory.

In Experiment 2, there was no memory accuracy benefit on high reward trials compared to low reward trials. Memory for event, object, and spatial details were similar across both conditions.

The effect of reward on recognition memory accuracy takes place when reward is presented during encoding.

However, this may reflect either stronger memory encoding or more cautious deliberation during retrieval.

Drift Diffusion Model

Experiment 1

Estimate	Parameter	Mean	95% CI	p-value
Intercept (Low Reward)	Drift	0.34	[0.29,0.38]	< .0001
	Threshold	2.46	[2.40,2.50]	< .0001
	Non-Decision Time	1.01	[0.94, 1.09]	< .0001
High Reward	Drift	**0.06**	**[0.01, 0.10]**	**< .005**
	Threshold	0.03	[-0.02, 0.09]	0.12
	Non-Decision Time	-0.01	[-0.03, 0.01]	0.83

Experiment 2

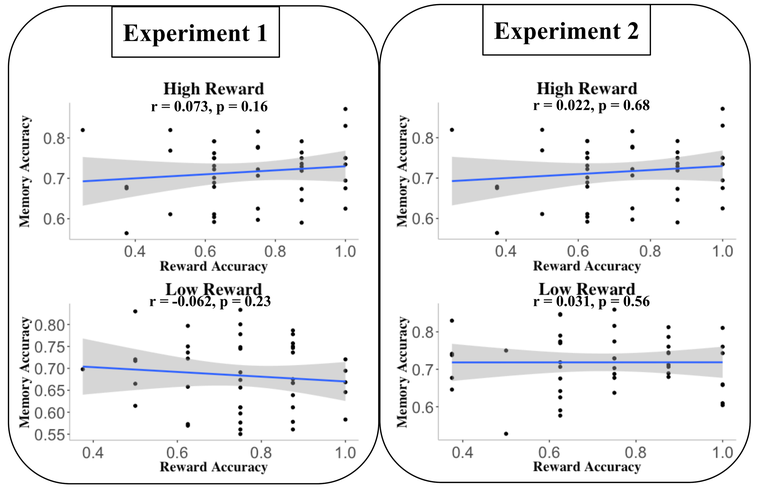
Estimate	Parameter	Mean	95% CI	p-value
Intercept (Low Reward)	Drift	0.41	[0.37,0.45]	< .0001
	Threshold	2.56	[2.47,2.64]	< .0001
	Non-Decision Time	0.96	[0.88, 1.05]	< .0001
High Reward	Drift	-0.01	[-0.05, 0.02]	.74
	Threshold	-0.02	[-0.09, 0.04]	0.77
	Non-Decision Time	**0.025**	**[-0.0007, 0.05]**	**0.03**

Experiment 1 revealed a higher drift rate for the high compared to the low reward condition, but no effect of reward on threshold or non-decision time effects.

Experiment 2 revealed no effect of reward on drift rate or threshold effects, but a moderate effect of reward on non-decision time.

The effect of reward is due to stronger memory encoding, rather than a change in decision-making strategy.

Explicit Memory for Reward



In Experiment 1 and Experiment 2, there was no correlation between explicit recall of the reward manipulation and recognition memory performance.

The effect of reward does not depend on explicit associative memory for the reward value of the video.

Summary

The effect of reward takes place at encoding, where it influences the strength with which an event is encoded.

Reward does not affect memory for different detail types, but instead has a global effect on recognition memory performance.

High reward improves the signal-to-noise ratio for encoded events compared to low reward, resulting in a higher drift rate. Thus, the effects of reward take place due to memory processes, specifically stronger encoding of events.

Explicit memory for the reward manipulation is unrelated to the effect of reward on memory for complex, episodic events.

References

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