

About the Data

The data used in this research was obtained from the Open Science Framework (OSF) repository, the dataset is titled 'The Role of Prediction Error in the Reconsolidation of Episodic Memories'. Contributed by Diane H Moon, Holley Bowen, and Sara D. Davis. The dataset is available at <https://osf.io/4wrf9/>.

Data Description

This dataset contains two studies used to better understand the reconsolidation of episodic memories.

Study 1

Study 1 recorded how much prediction error certain cues elicited. Participants were recruited via Amazon Mechanical Turk (MTurk) using CloudResearch and Prolific.

Study 2

Study 2 used the cues normed from Study 1 to test memory recall of participants in a three-day structured experimental paradigm. The participants consisted of undergraduates and others collected around the Dallas area.

Overview of Methods

The purposes of study 1 and study 2 align and compliment each other. The information found and normed from study 1 was used to inform the experiments in study 2. Both studies looked at many factors, such as age, gender, employment status, weather on days of experiments etc. However, the main pieces of data we will utilize in this presentation are outlined to the right!

Study Methods

Study 1

In this study, participants were recruited via Amazon Mechanical Turk (MTurk) using CloudResearch and Prolific platforms.

Participants were presented with a variety of reactivation cues, in the form of videos, designed to trigger episodic memory responses. Participants were tasked with providing self-reported measures on three key dimensions: arousal (emotional activation caused by the cue), valence (whether the cue evoked positive or negative emotions), and familiarity (how recognizable the cue was).

Measures were collected through an online survey format, where participants recorded their responses after viewing or interacting with the cues

Surprise, as inferred from these measures, was used as a proxy for prediction error—the mismatch between participants' expectations and the actual content of the cues. This approach allowed researchers to quantify and standardize reactivation cues based on their prediction error levels.

Study 2

Study 2 built on the results from Study 1 by applying the standardized reactivation cues in a memory reconsolidation experiment.

Participants, recruited from undergraduate populations and the local community in Dallas, engaged in a structured, three-day experimental paradigm. On each day, participants were presented with reactivation cues to trigger memory recall. Their task was to attempt reconsolidation by recalling and updating episodic memories.

During the experiment, the researchers recorded participants' responses, focusing on many key measures such as confidence (how certain they were in their answers) and correctness (accuracy of recall). Researchers used these and other factors to quantify the mean error of each of the cues used. This design allowed the researchers to test how varying levels of prediction error, identified through surprise in Study 1, influenced memory reconsolidation processes over multiple sessions.

Research Focus and Motivations

Although this data provides many insights into the factors that effect memory recall and reconsolidation, this presentation focuses on the affect of surprise the cues illicited and its effect on the mean error of the cues. Furthermore arousal, familiarity, and valence are all also utilized in answering research questions. Although there were many more factors in this data, these are the most suited to our questions.

The Research questions I chose for this project were motivated by a curiosity in memory. I personally visualize in my head for most mental operations, so I was curious of the effects a medium like videos could have. In general I wanted to know how the surprise caused by videos may increase or decrease how well we can remember things. Also, as this source did not explain much, I wanted to know more about how the 'surprise' feature was effected by the other responses videos illicited.

Big Question

How does the surprise rating of cues affect the reactivation and reconsolidation of memories?

Hypothesis

Higher surprise in reactivation cues will result in more error when recalling memories.

Plan

- The plan for for adressing this question is to use data from both study 1 and study 2.
- Study 2 has columns labeled MEQ1-19. These represent the mean error of each of the video cues in the second study's expirement. Once these have been separated and averaged, we move to study 1.
- For each of the cues, 1-19, in study 1 the average surprise rating at the end of the study will be calculated. Finally the average surprise ratings of each of these video cues will be plotted against the mean error of the same cues in study 2 to discover if there is a trend as surprise ratings go up.
- If the hypothesis is correct, as surprise levels rise, so will the mean error of the cues.

Fork Question

How do self-reports (arousal, valence, familiarity) affect surprise?

Hypothesis

Arousal ratings are hypothesized to correlate closely with surprise ratings (e.g., higher arousal leads to higher surprise while lower arousal leads to lower surprise).

Plan

- The plan for adressing this fork question is to plot the three main categories of self reporting: arousal, familiarity, and valence.
- The frequency at which they were each rated at ceratin surprise levels will be examined by the shape of these plots. The aim of this is to see how much and in what way certain categories effect the surprise rating of a cue.
- For example, if the hypothesis is true the higher arousal ratings will be more frequently associated with high surprise.



Plot Info

This plot depicts the surprise normed from study 1 against mean error found in study 2 for each of the video cues. The surprise ratings were originally rated from 1-5 (discrete). The mean error was also between 1-5 discrete, meaning no normalizing was needed.

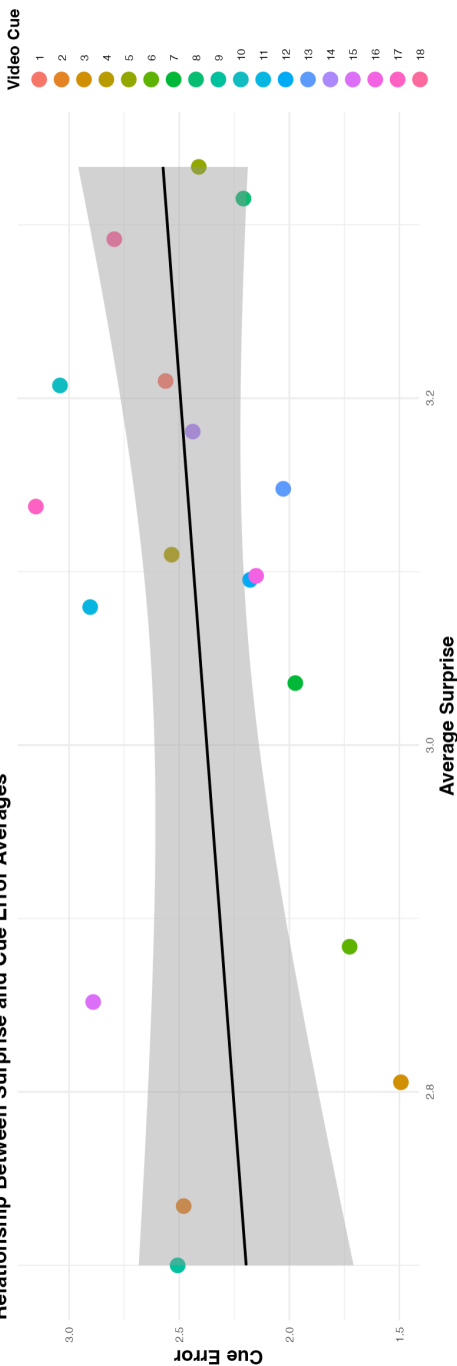
Below is a table more clearly showing the surprise and mean error values of each of the video cues.

Video Data Table

Video Cue	Average Surprise	Mean Error (MEQ)
1.00	3.21	2.56
2.00	2.73	2.48
3.00	2.81	1.49
4.00	3.11	2.53
5.00	3.33	2.41
6.00	2.88	1.73
7.00	3.04	1.97
8.00	3.32	2.21
9.00	2.70	2.51
10.00	3.21	3.04
11.00	3.08	2.90
12.00	3.10	2.18
13.00	3.15	2.03
14.00	3.18	2.44
15.00	2.85	2.89
16.00	3.10	2.15
17.00	3.14	3.15
18.00	3.29	2.79

Big Question Plot

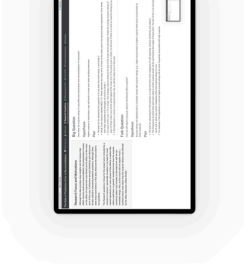
Relationship Between Surprise and Cue Error Averages



The role of prediction error in the reconsolidation of episodic memories. Resource created on September 16, 2021. Open Science Framework. Retrieved from <https://osf.io/4wrt9/>.

Interpretation

This plot shows a trend upwards. As the average surprise increases, the mean error also increases. However, how much the mean error increases is sporadic. For example Video 4 and 16 are .01 surprise apart but vary .38 in error. While video 1 and 14 are .03 apart and vary by .12 in mean error. Furthermore, although the relationship is distinct, it is not very strong. The line has a small slope and many points are distant from the line of best fit.



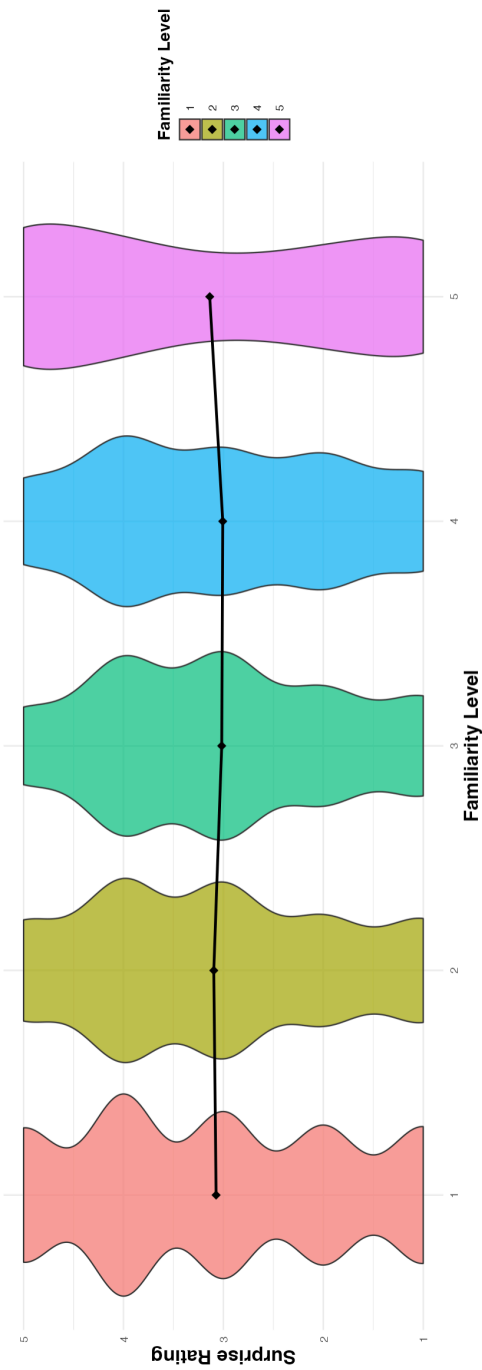
Plot Controls

Select a variable to plot against Surprise:

Familiarity Level

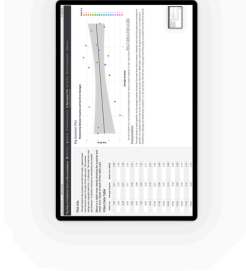
Interactive Plot

Surprise Ratings by Familiarity



Interpretation

The violin plots being thick on average indicate that the familiarity reports were more evenly distributed among surprise categorizations. However, the lowest categorization was a familiarity of 3 being labeled as surprise of 3, while all other familiarities were most frequently categorized higher, showing that familiarity also lends to higher surprise.



Research Interpretations

This section discusses the final interpretations on the research questions, as well as the implications and potential for future research.

Big Question Interpretation

The plot of the data showed an increase in mean error for the cues as the surprise rating of the cues increased. However the slope of the line of best fit was low, indicating it may not be as strong an effect as I had presumed. This answers the question that there is a correlation between the surprise level of reactivation cues and the accuracy of memory recall. However it was not as clear as anticipated, and could benefit from more research.

Fork Interpretations

All of the self-report categories tended to be categorized most frequently as higher surprise, however they all had a mean very close to 3. Fields like arousal and familiarity had a more intense effect on surprise than valence level. However, the observation that the different report measures mostly had similar averages indicates they did not vary as much as anticipated. Finally, the hypothesis that the arousal would correlate one to one, ie arousal 1 = surprise of 1, was proven incorrect. The arousal had means very close to 3 with distributions more even than expected.

Future Research

The lack of alignment with some of my hypothesis leads me to ideas for future research. I believe one good idea for future research would be to do research over a longer period of time than the 3 days of this experiment. Furthermore, my analysis of the self-report measures for my fork question leads me to believe research with more affect measures as well as a more uniform distribution of surprise would make for more reliable data.

