1. **Data Collection: Have any data been collected for this study already?**

No, no data have been collected for this study already.

1. **Hypothesis: What’s the main question being asked or hypothesis being tested in this study?**

In daily life, individuals constantly must make decisions against environmental uncertainty based on whatever information is available. However, sources of uncertainty manifest both consciously and subconsciously. Therefore, rational decision-making requires individuals to evaluate the uncertainty of their decisions effectively. To achieve this objective, decision-makers can leverage confidence – defined as the degree of belief that an individual’s judgment about given information is correct (Peters, 2022). When looking at the effect of negative stimuli on confidence, previous research shows that emotional events enhance mnemonic confidence, but may or may not improve memory accuracy for contextual details (Talarico & Rubin, 2003; Rimmele, Davachi, & Phelps, 2012). On the other hand, viewing neutral stimuli has been associated with both higher mnemonic confidence and better memory for neutral information and their contextual details (Perfect, 1996). More recently, it has been shown that enhanced mnemonic confidence corresponds to enhanced metacognitive efficiency for emotional vs. neutral items, but not their associated details (Castillo et al., in prep). Metacognitive efficiency generally measures our decisions’ rationality by comparing idealized discrimination performance – based on an individual’s reported confidence – to actual discrimination performance (Fleming & Lau, 2014). In this study, metacognitive efficiency will reflect the degree to which judgments of decision confidence align with the accuracy of decisions. A primary function of memory is to guide future decisions, and previous research has examined the role of episodic memory in guiding choices (Bornstein & Norman, 2017; Duncan & Shohamy, 2016). It is already known that people are more confident in their memories of highly emotional events, but the present study will investigate whether using episodic memories involving emotional information to make choices leads individuals to be more confident in their decisions. Specifically, we will explore if enhancements in confidence and the increased metacognitive efficiency observed for memories involving emotional information extend to decision confidence when leveraging these memories to guide choices.

1. **Dependent Variable: Describe the key dependent variable(s) specifying how they will be measured.**

The main dependent variables in this study will be total dollars earned, discrimination sensitivity (d’), response bias (c), and metacognitive efficiency (meta-d’/d’). These dependent variables will enable us to investigate whether response behavior and metacognition differ across valence and decision types to characterize how individuals use previous experiences to guide their current behavior.

Our experiment will include an intentional encoding phase where participants choose between pairs of images, and a value-based decision-making task where individuals can leverage their memory to earn more money. The primary goal of part one is for participants to memorize images along with their associated monetary values, while the primary goal of part two is for participants to test their memory by having them select the image they believe to have the highest associated monetary value. In part two, individuals will also report their metacognitive confidence in their decision. Our response scale will be a nested yes-no recognition judgment with three ordered confidence levels for each response: not confident, somewhat confident, and very confident. Thus, our response scale will enable us to simultaneously collect information about confidence and accuracy. After collecting data on metamemory confidence and decision accuracy we will relate these aspects of memory together to calculate the metacognitive efficiency of individuals’ mnemonic decision making.

1. **Conditions: How many and which conditions will participants be assigned to?**

Participants will intentionally encode images and their associated point value during part one, and use their memory when selecting between pairs of previously seen (old) and new images in part two. The experimental design will be a 2 x 2 fully-crossed within-subjects design with 4 total conditions: 2 conditions for each kind of card pairing presentation – old-new (ON) and old-old (OO) – and 2 conditions for the valence of images in each pairing (negative-negative, and neutral-neutral). Participants will be exposed to every condition, and comparisons of interest will be decision accuracy, mnemonic confidence, and metacognitive efficiency across pairing (OO/ON) and valence (negative/neutral) conditions.

1. **Analyses: Specify exactly which analyses you will conduct to examine the main question/hypothesis.**

We want to examine how decision-making behavior differs across pairing and valence conditions. Therefore, we will conduct statistical analyses to determine how these conditions are associated with differences in item memory, mnemonic confidence, metacognitive efficiency, and value-based decision-making.

In the present study, we will compare metacognitive performance across decision type and valence conditions. This data will be analyzed using MATLAB software along with the H-Meta-d’ toolbox for analyzing metacognitive efficiency which estimates the posterior distributions over model parameters (https://github.com/metacoglab/HMeta-d). Our Bayesian estimation processes will leverage Just Another Gibbs Sampler (JAGS) and Markov Chain Monte Carlo (MCMC) sampling (Plummer, 2003). The significance of parameter values will be assessed by evaluating whether 89% Highest Density Intervals (HDIs) on the posterior distributions include zero. This will determine whether the observed effects are statistically meaningful.

To analyze differences in discrimination sensitivity and response bias, we will leverage linear mixed effects models with decision type and valence as categorical predictors and participant IDs as random intercepts. This method will enable us to analyze the effects of emotion and decision type on response behavior while accounting for the nested structure of the data. To evaluate whether decision type affects response behavior we will contrast trials involving novel and familiar stimuli (80 trials). To determine whether valence affects response behavior we will contrast trials involving negative and neutral stimuli (80 trials). Additionally, we will evaluate potential interaction effects by comparing trials involving novel emotional stimuli with familiar emotional stimuli (40 trials), and novel neutral stimuli with familiar neutral stimuli (40 trials).

We also plan to analyze the relationship between metacognitive confidence judgments and decision accuracy to characterize the efficiency of individuals’ metacognitive abilities. To determine whether valence influences metacognitive efficiency we will contrast trials involving neutral and arousing, negatively valenced stimuli (80 trials). To investigate whether metacognition differs across decision types we will contrast decisions involving only familiar stimuli with those including novel stimuli (80 trials).

Lastly, we will assess how value is associated with valence and decision type by leveraging mixed-effects logistic regressions to determine how differences in value ((|∆\_value|) between paired choice options relate to the accuracy of decisions. This will enable us to determine how differences in the values associated with stimuli influence decision-making beyond emotional valence and decision type.

1. **Outliers and Exclusions: Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.**

The only outliers which are likely to arise in our experimental design are due to misestimation of hierarchical metacognitive efficiency (H-meta-d’) which can occur when an insufficient amount of data is available, or d’ is extremely low (<0.5); in these cases, H-meta-d’ would be greater >1.6 or negative -- nonsensical values which should be removed from analyses before drawing conclusions (Guggenmos, 2021). However, these cases should be rare due to our extensive exclusion criteria.

Observations will be excluded for participants who:

(A) exit the experiment early

(B) do not use the complete range of the confidence scale (as explicitly instructed)

(C) with poor (<60%) discrimination for higher valued item (d’ < 0.5)

(D) who fail to respond on more than 4 encoding trials (>1%)

(E) who perform below 90% on the encoding attention checks.

(F) H-meta-d’ < 0 or H-meta-d’ > 1.6

1. **Sample Size: How many observations will be collected or what will determine sample size? (No need to justify decision, but be precise about *exactly* how the number will be determined.)**

Our previous research examined the metacognitive efficiency of recognition confidence judgments across memory type and valence. Specifically, item memory and memory for associated details across neutral and negatively valenced images. This research revealed that a difference in memory type has a discernible effect size on signal detection sensitivity (d’) of 0.89, while valence exhibits a smaller effect size of 0.37. To ensure that we can detect an effect if it exists for valence in decision-making, we used this smaller effect size in our power calculation.

A power calculation was conducted using the `WebPower` package in R, and the specified power was 0.8 while alpha was set to .05 to determine our required sample size. This ensured that our study had an 80% probability of detecting a significant effect if it was truly present, with a traditional significance level of 0.05. Although we do not intend to use null-hypothesis significance testing, and instead plan to use Bayesian statistics for our analyses, this sample size will nonetheless help us obtain robust evidence in favor of or against the presence of an effect of valence. To ensure a statistical power 0.8 we will therefore continue to collect participants until we have 60 pairs of observations (across each part of the experiment).

1. **Other: Anything else you would like to pre-register?**

No.

1. **Name: Give a title for this AsPredicted pre-registration (Suggestion: use the name of the project, followed by study description)**

MnemonicConfandEmoDecisions: the association of memory accuracy and confidence in emotional value-based decision-making

1. **Type of study:**

Experiment