

# An Electrophysiological Exploration of Metacognitive Errors in Recognition Memory

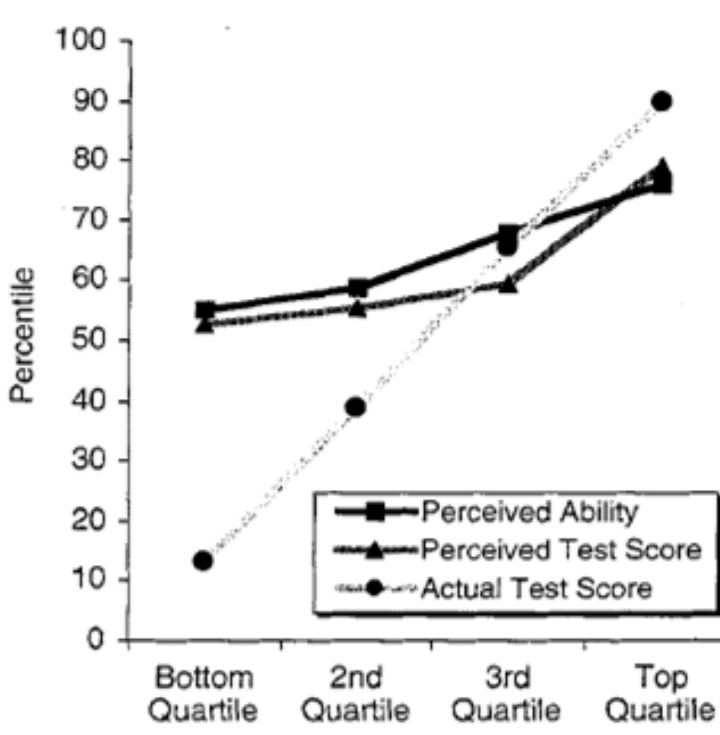
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## Introduction

*When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it; -this is knowledge.* ~Confucius, 500 BC

- The Dunning-Kruger Effect (DKE) describes a pattern of overconfidence and under-confidence (Kruger & Dunning, 1999).
- Metacognitive errors of illusory superiority and inferiority:
  - Low performers:** overestimate abilities
  - High performers:** underestimate abilities
- The DKE has been elicited in many different types of tasks, largely focusing on logical reasoning and math (Kruger & Dunning, 1999; Schlösser et al., 2013; Ryvkin et al., 2012), but has not yet been directly explored in memory tasks despite decades of research on false memory confidence.
- Accounts of DKE have focused on competency and training (Stone & Opel, 2000; Zechmeister et al., 1986), but cognitive models of the phenomenon remain scarce and the illusion is poorly understood.
- No physiological correlates of the DKE have been reported, yet these measures could tangibly inform our understanding of this pervasive (and common) phenomenon (it affects us all!).

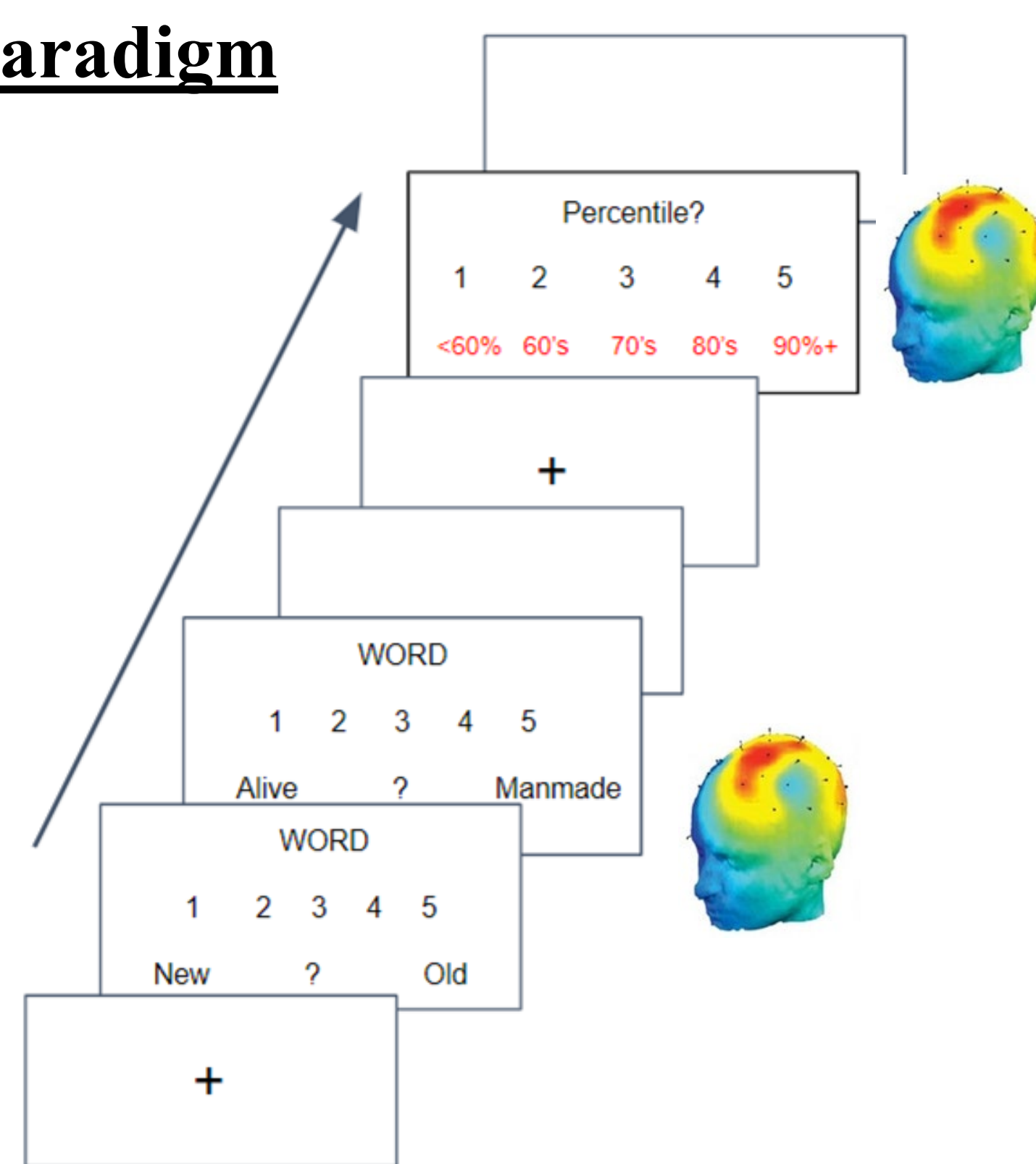


## Methods

### Participants

- N = 62 CSUSB students: Right-handed, English-speaking, no neurological/psychiatric disorders/diseases or problems with memory/attention

### Paradigm



### Memory Encoding

- 4 lists: 54 words each
- 2 decision tasks
  - Alive
  - Man-made

### Memory Retrieval

- 6 lists of 54 words each
- DKE after every 10<sup>th</sup> trial
- Post-test DKE after 6<sup>th</sup> block

## Hypotheses

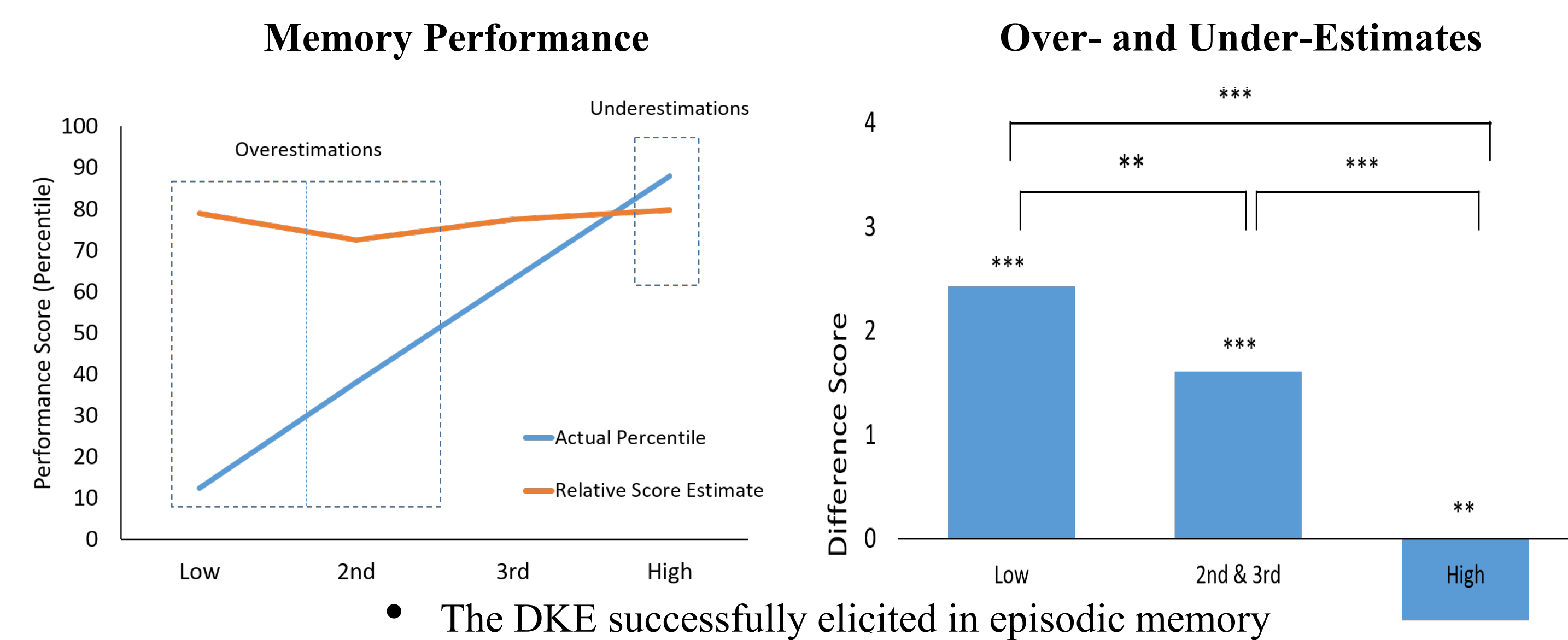
- Bottom memory performers will overestimate their score
- Top memory performers will underestimate their score.
- Over-estimators will use more familiarity than under-estimators when making metacognitive judgments
- Under-estimators will use more recollection than over-estimators when making metacognitive judgments

## Behavioral Results

### Memory

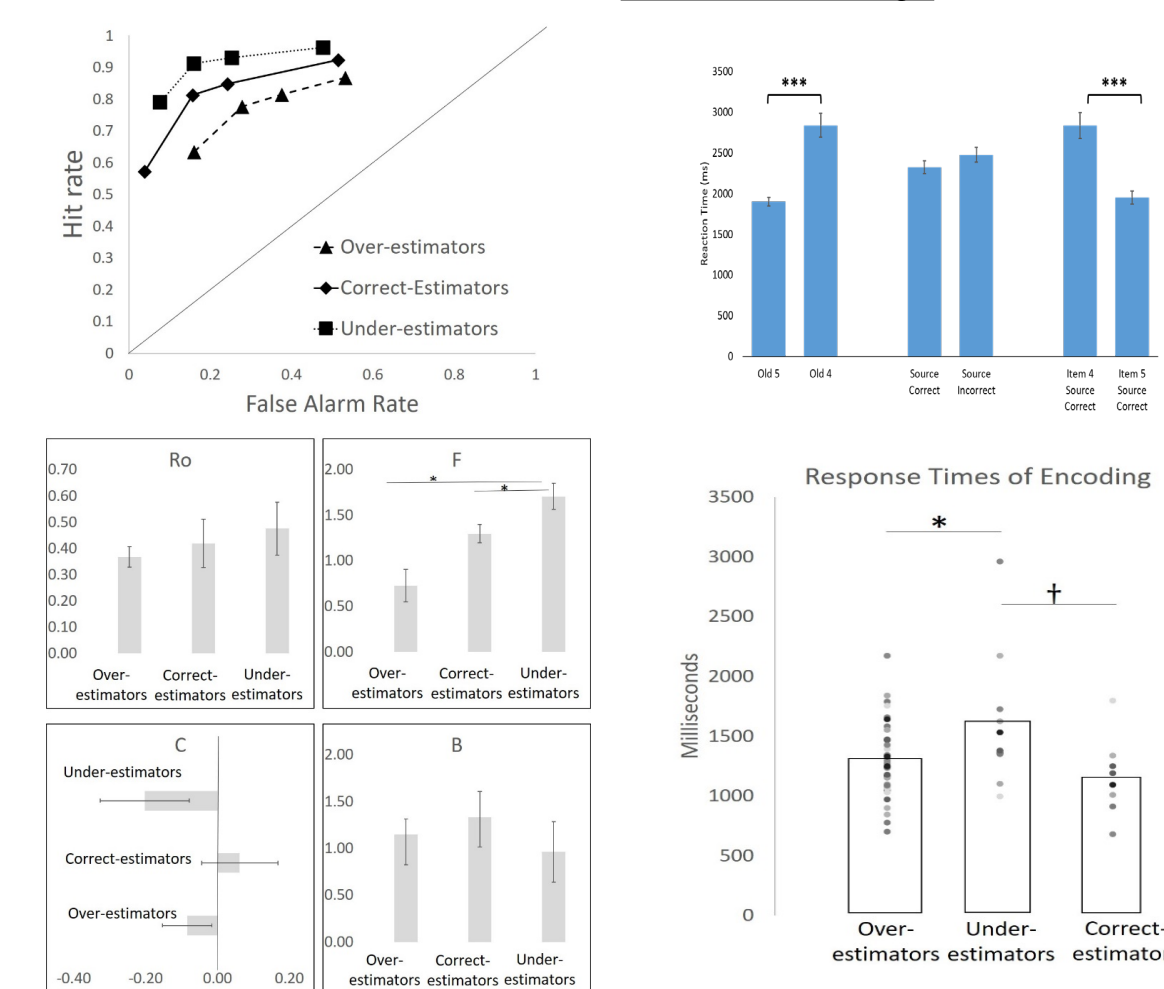
- Memory (pHit-pFA) above chance ( $M = .57, SD = 0.15, t(55) = 3.59, p < .001$ )
- Source memory above chance ( $M = .30, SD = 0.19, t(55) = 11.78, p < .001$ )

### Dunning-Kruger

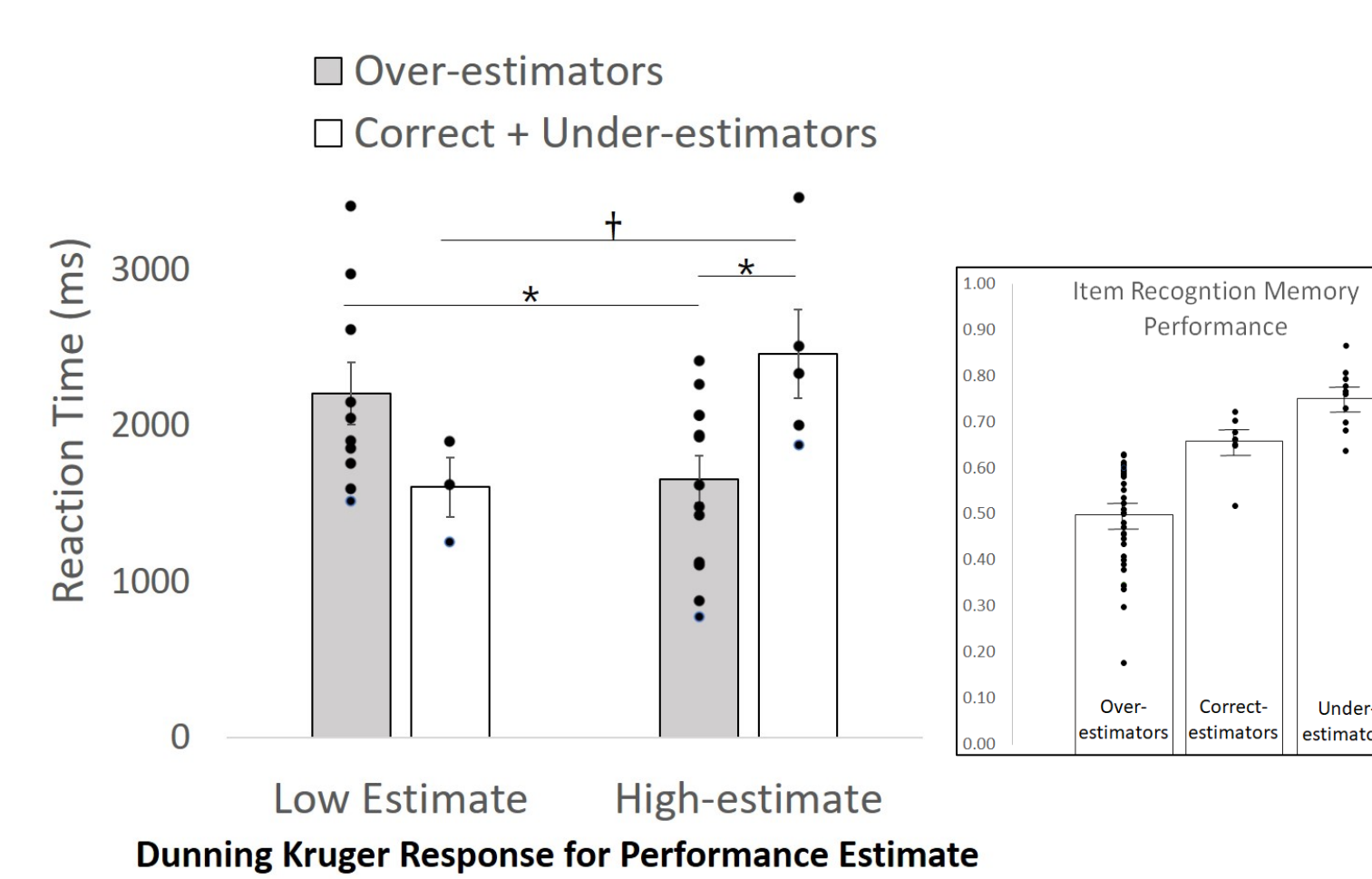


- The DKE successfully elicited in episodic memory

### Memory



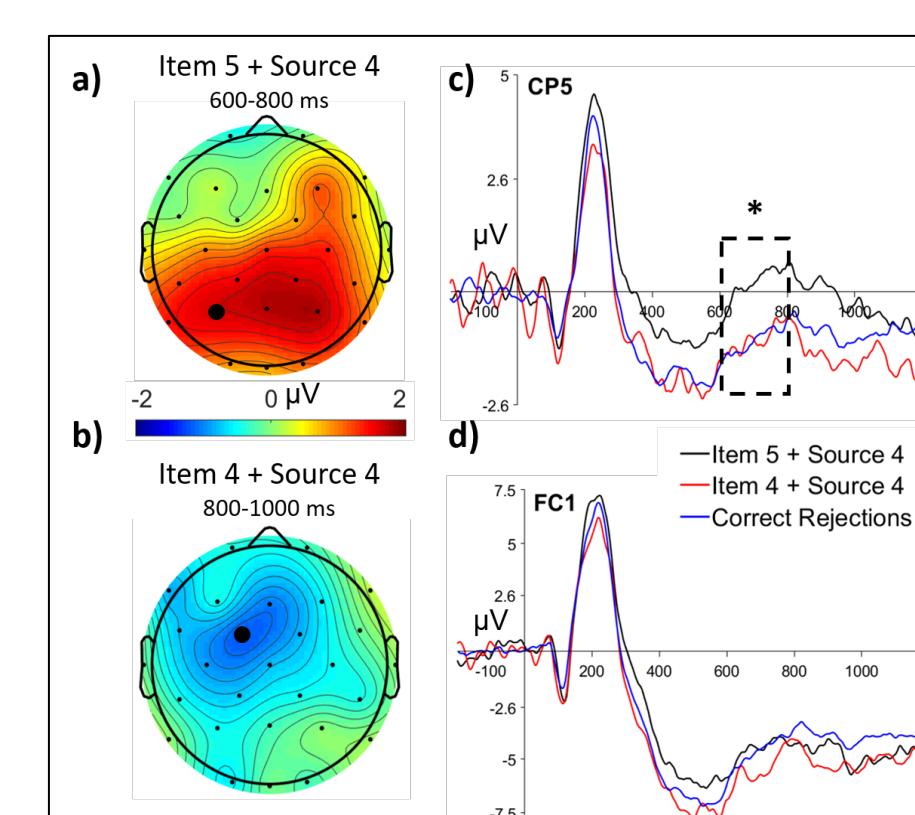
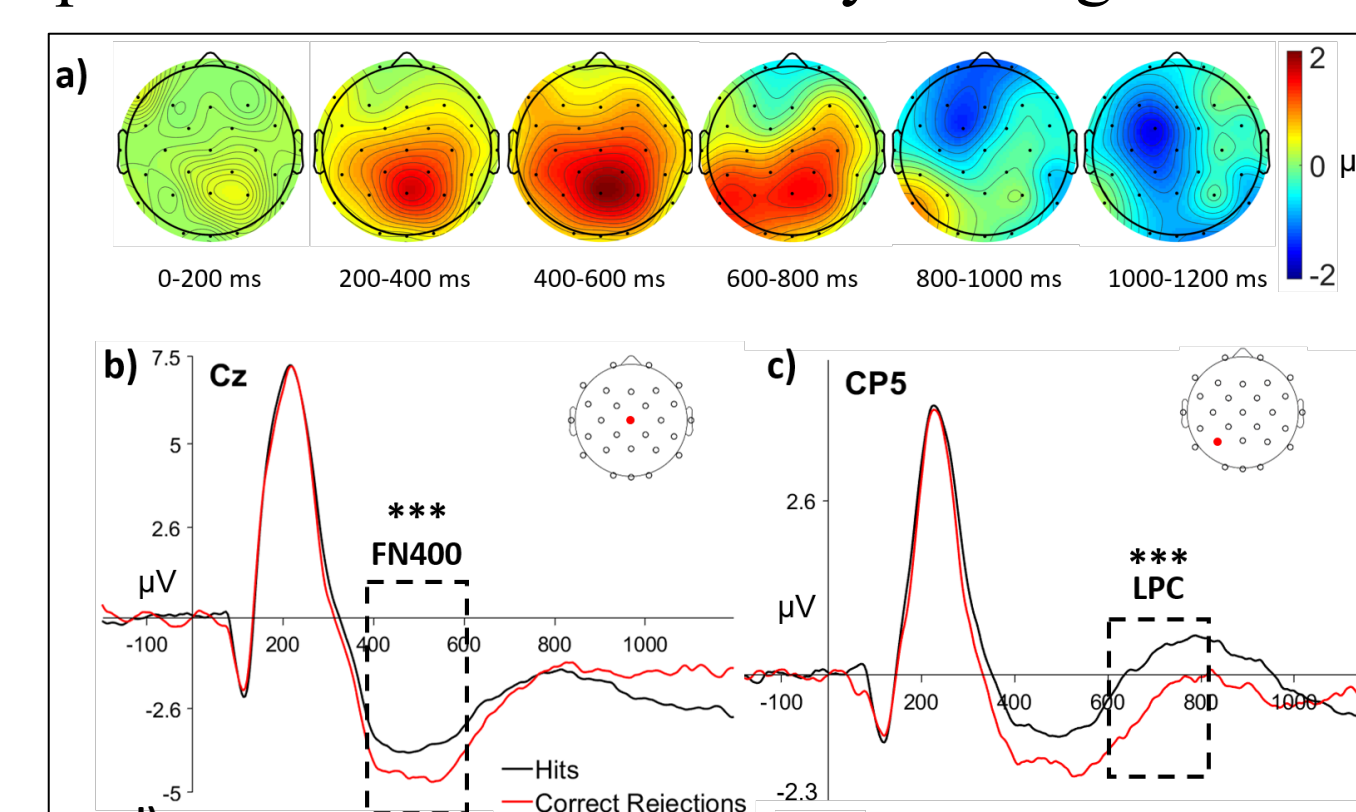
### Dunning-Kruger



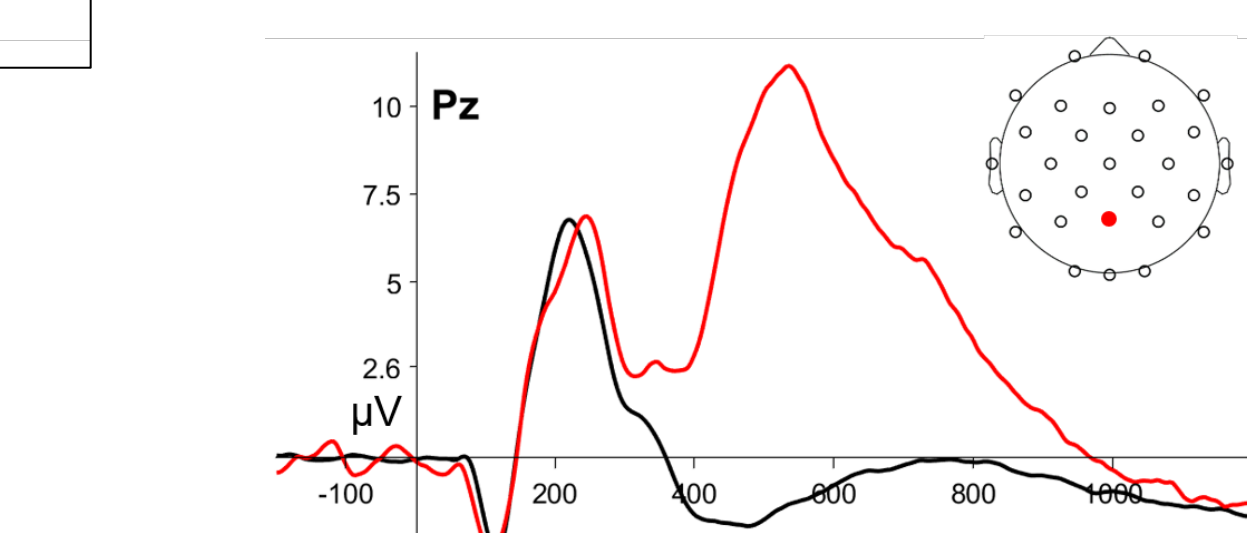
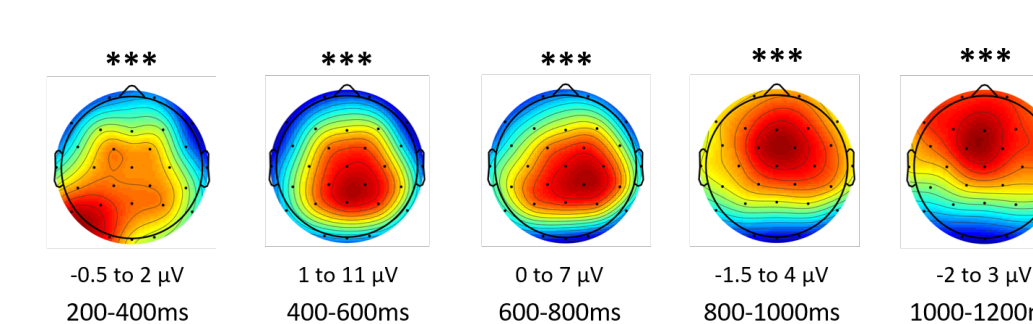
- No differences evident in how people used decision strategies (e.g.: Criterion, Bias)
- Subjects responded differently at encoding
- Faster RT for high confidence items with source correct than low confidence items with source correct (Addante et al., 2012)
- Over-estimators faster to rate themselves in the top percentile than Correct and Under-estimators
- Over-estimators faster to rate themselves in the top percentile than the bottom percentile
- Correct and Under-estimators marginally faster to rate themselves in the bottom percentile than the top percentile
- No overlap in performance among groups

## ERP Results: Memory

- Memory ERP effect replicated: FN400 and LPC evident in ERPs of hits vs correct rejections
- Replication of source memory findings called "context familiarity" (Addante et al., 2012)



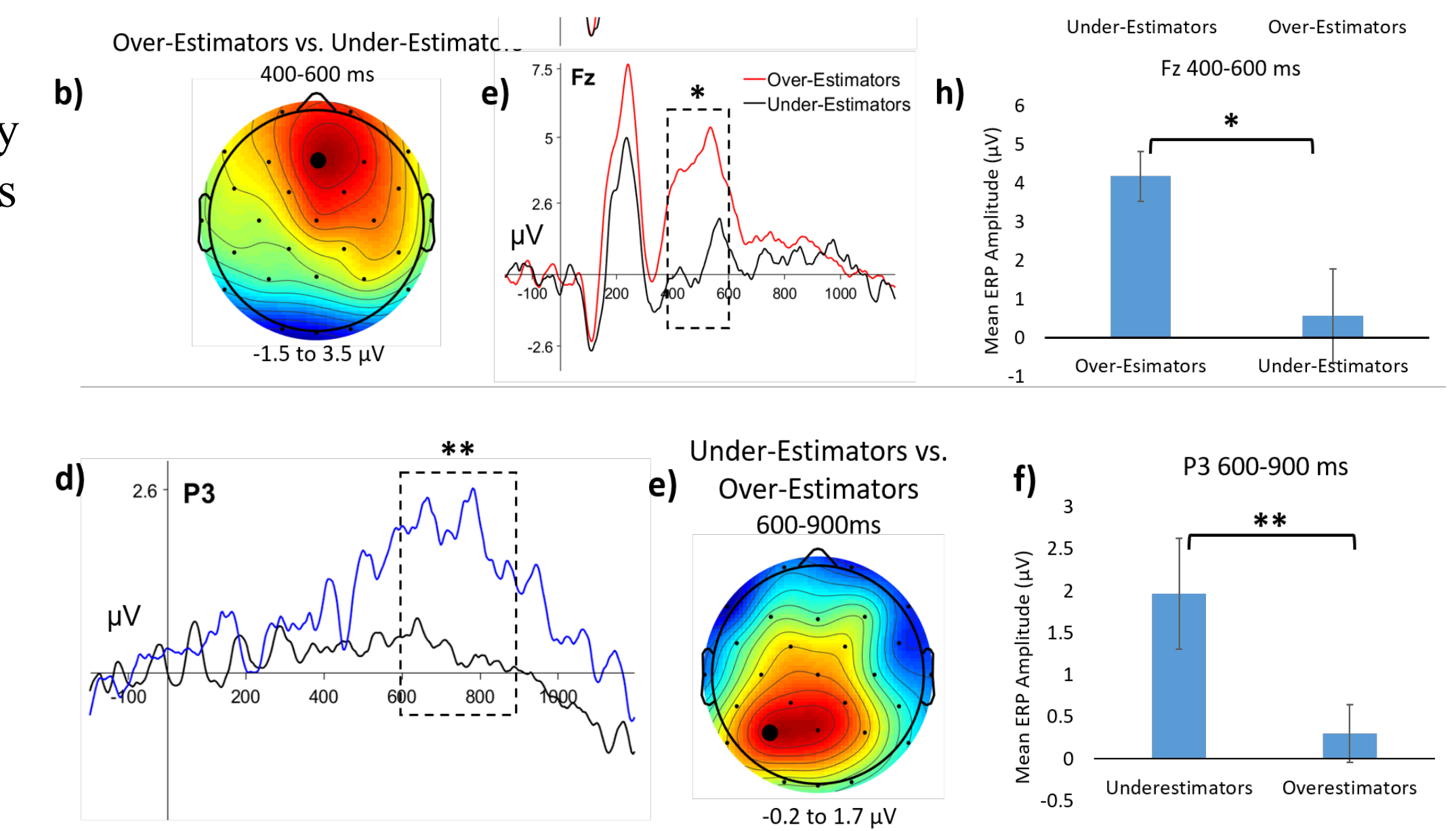
### Memory vs. Metacognition



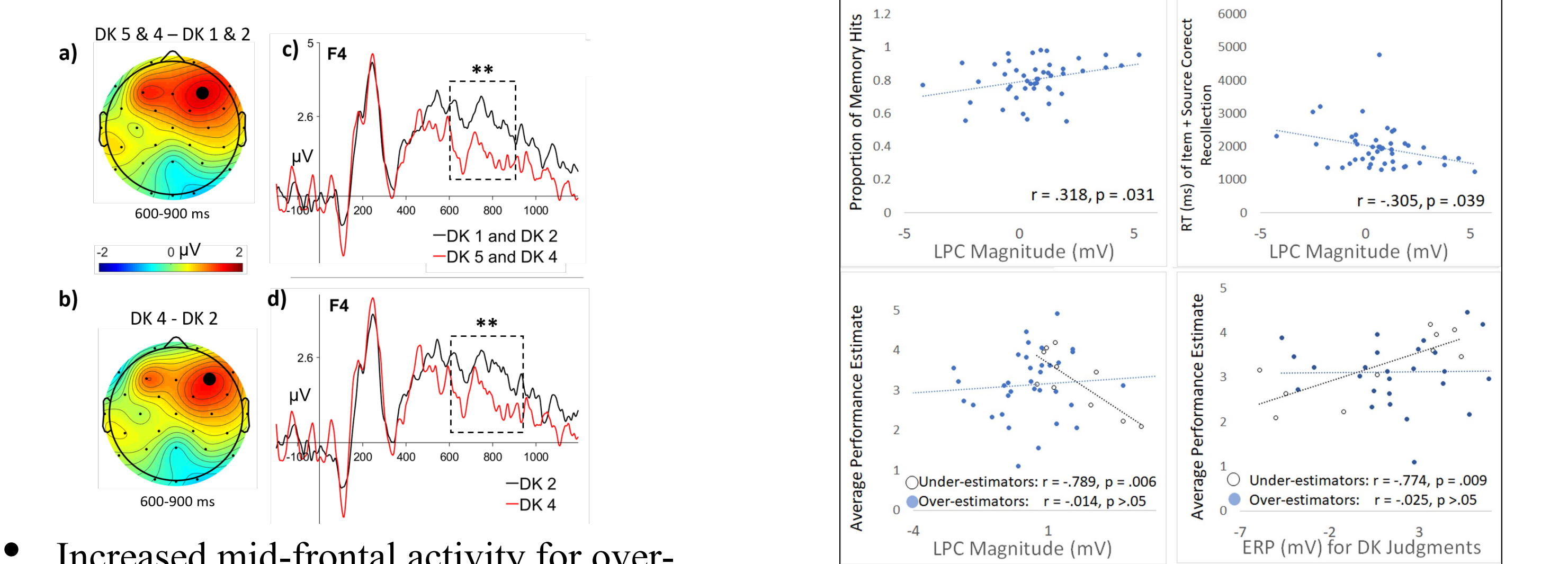
- ERPs of metacognition differ from memory

## ERP Results – Dunning-Kruger Effect

- During metacognition, increased frontal activity evident from 400-600ms for over-estimators vs. under-estimators
- During memory, larger LPC evident for under-estimators vs over-estimators



### High Estimates vs. Low Estimates



- Increased mid-frontal activity for over-estimators compared to under-estimators

### Relationships of Behavioral and Brain Measures for Memory and Metacognition

## Conclusions

- Successfully extended the Dunning-Kruger Effect to episodic memory
- Novel addition to memory paradigm of repeated Dunning-Kruger estimates throughout the task to collect reaction times and allow for analysis of ERPs during metacognition
- Increased mid-frontal activity for over-estimators than under-estimators during metacognition suggesting that low performers rely on familiarity to inform their metacognitive judgments
- Larger LPC during memory for under-estimators than over-estimators suggesting that high performers use more recollection than low performers during the task
- Prior ERP effects of memory, source condition comparisons, and context familiarity (Addante et al., 2012) replicated and extended with analysis of reaction times
- Future work will focus on differing metacognitive physiology between Dunning-Kruger groups and how this affects memory-related performance

## References

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