

# Word problems: An event-related potential study on remembering semantically related and unrelated words

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## 1 Introduction

- Dual process models of recognition memory distinguish between familiarity, a feeling of “oldness” and recollection, the remembering of contextual details.<sup>1</sup>
- Previous research established a clear link between semantic processing and familiarity-based remembering, but was equivocal on whether familiarity benefits from facilitation of or increased demands on semantic processing.<sup>2,3</sup>
- Event-related potential (ERP) studies identified the P300 at encoding as a reliable predictor of subsequent (recollection-based) recognition (subsequent memory effect, SME),<sup>4,5</sup> but the results are mixed for the N400, a component associated with semantic processing, as a predictor of subsequent familiarity-based recognition<sup>4,5,6</sup>.

### Research Question:

Do increases or decreases in the N400 predict familiarity-based recognition?

## 2 Methods

### Participants

32 healthy, right-handed students (24 female, age: 18-30 yrs., median: 21 yrs.)

### Material

240 word sets, each with 3 primes, a target, and a distractor, were divided into three conditions:

- **Coherence:** The primes were semantically related with each other and the target (facilitation of semantic processing).
- **Deviance:** Primes were only related with each other but not with the target (increased demands on semantic processing).
- **Incoherence:** Primes were unrelated with each other and the target (control condition).

|            | Coherence<br>(80 sets) | Deviance<br>(80 lists) | Incoherence<br>(80 lists) |
|------------|------------------------|------------------------|---------------------------|
| Prime 1    | Glas                   | Hand                   | Castle                    |
| Prime 2    | Spoon                  | Toe                    | Uncle                     |
| Prime 3    | Plate                  | Foot                   | Stomach                   |
| Target     | Fork                   | Stroller               | Realism                   |
| Distractor | Knife                  | Highchair              | Cubism                    |

### Experiment Procedure

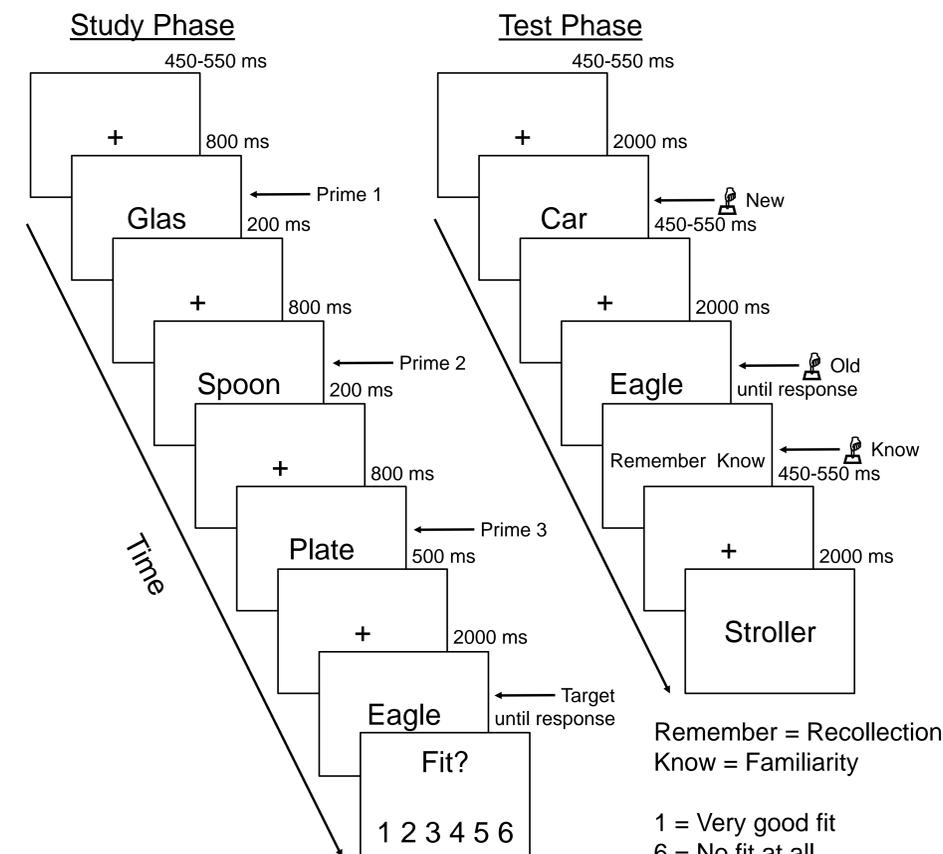
#### Study Phase:

- Participants rated the semantic fit between the target and the three primes.
- This task ensured semantic processing and incidental encoding.

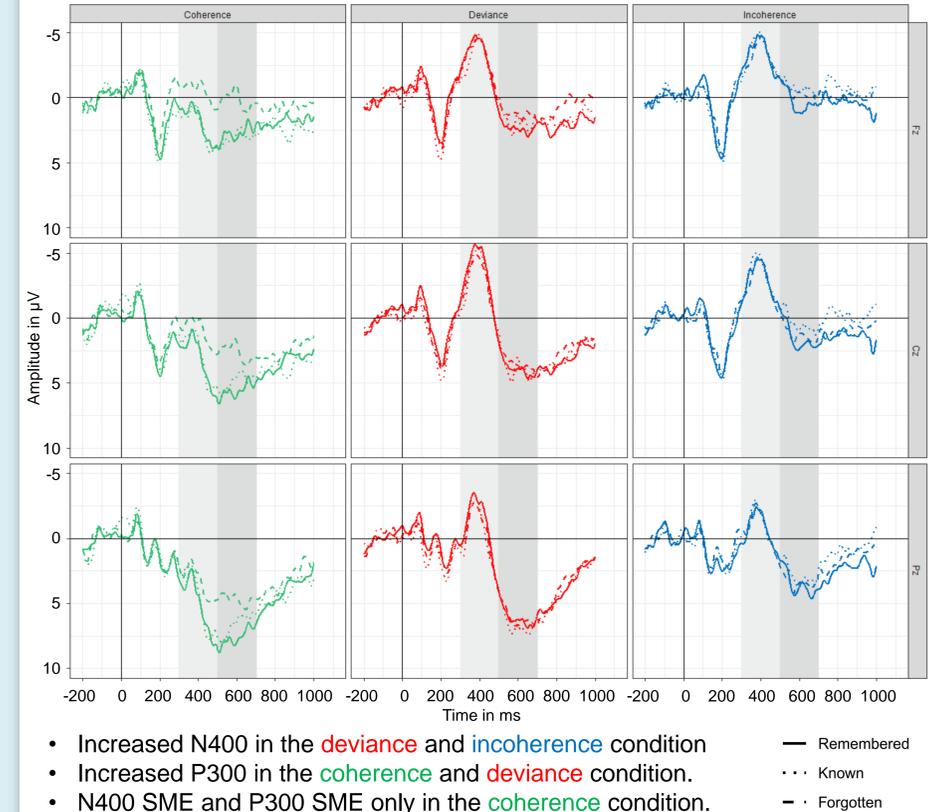
#### Test Phase:

- Old/New recognition judgment for old targets and unstudied distractors
- Remember/Know judgment<sup>7</sup> conditional on old response

### Trial Procedure



### ERP Results



## 3 Results

### Behavioral Results

Familiarity and recollection estimates were lowest for the incoherence condition. While recollection was higher in the coherence than in the deviance condition, familiarity did not differ between these conditions.

|              | Coherence          | Deviance           | Incoherence        |
|--------------|--------------------|--------------------|--------------------|
| Rating       | M (SD) 1.40 (0.50) | M (SD) 5.25 (0.80) | M (SD) 5.34 (0.58) |
| Hits         | .66 (.22)          | > .60 (.19)        | > .48 (.19)        |
| False Alarms | .30 (.15)          | > .26 (.13)        | > .22 (.13)        |
| Pr           | .36 (.13)          | ≈ .34 (.13)        | > .26 (.13)        |
| Br           | .49 (.25)          | > .41 (.21)        | > .31 (.19)        |
| Recollection | .43 (.24)          | > .33 (.17)        | > .23 (.13)        |
| Familiarity  | .42 (.25)          | ≈ .41 (.19)        | > .33 (.17)        |

## 4 Discussion

- Condition without semantic relationships revealed that memory benefits from both semantic processing styles (but to a different degree).  
→ Memory studies on congruency and expectancy violations should include control condition without semantic relationships.
- Facilitated semantic processing at encoding led to high recollection- and familiarity-based recognition and SMEs in the N400 and P300 time window.  
→ This replicates prior studies on the effect of congruency<sup>4,8</sup>.  
→ In contrast to prior studies<sup>5,9</sup>, the SMEs did not differentiate between familiarity and recollection.
- Increased demands on semantic processing led to high familiarity, but only moderate recollection and no SMEs.  
→ Encoding profited less from deviance processing in this case<sup>2,4,5</sup>.

### References

- <sup>1</sup> Yonelinas (2002). Journal of Memory and Language, 46, 441-517
- <sup>2</sup> Meyer et al. (2007). NeuroReport, 18, 1009-1013.
- <sup>3</sup> Opitz & Cornell (2006). Journal of Cognitive Neuroscience, 18(9), 1595-1605.
- <sup>4</sup> Fabiani (2006). In Hunt & Worthen (Eds.) Distinctiveness and memory, p. 339-360.
- <sup>5</sup> Weigl et al. (April, 2016). 23<sup>rd</sup> Annual Meeting of the CNS, New York, USA.
- <sup>6</sup> Mangels et al. (2001). Cognitive Brain Research, 11, 77-95.
- <sup>7</sup> Tulving (1985). NeuroReport, 18, 1009-1013.
- <sup>8</sup> Hölte et al. (2019). Neuropsychologia, 131, 285-293.
- <sup>9</sup> Friedman & Trott (2000). Neuropsychologia, 38, 542-557.