

Beyond Self-Report: Direct Detection of Depressive Symptoms from Neural Activity

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Introduction

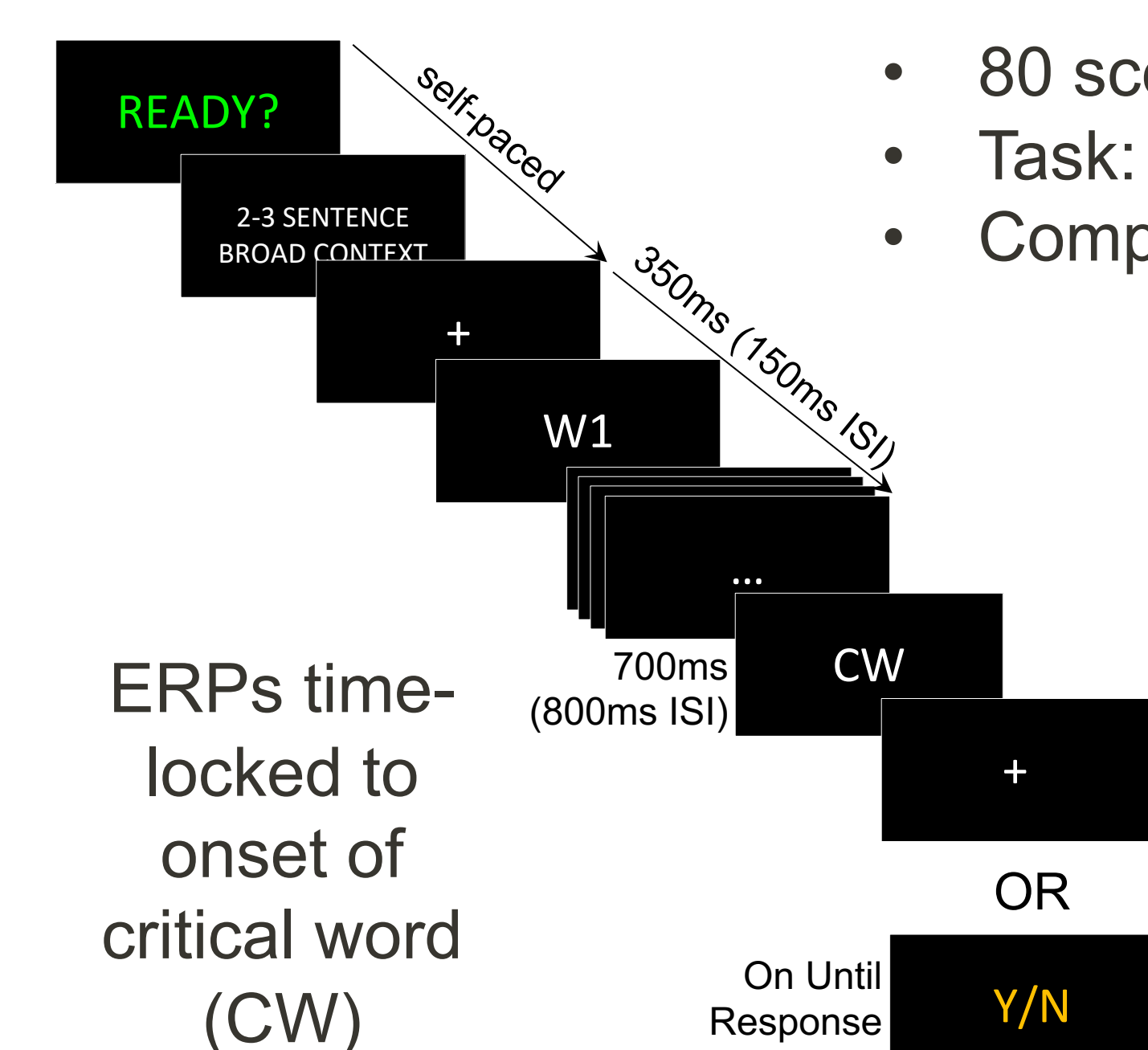
- Depression is typically assessed through clinical interviews and self-report questionnaires
- This Study: Developed scenarios targeting major domains of depression such as emotional (e.g., mood, guilt), cognitive (e.g., concentration, suicidal ideation), behavioral (e.g., motivation, withdrawal), and physiological (e.g., energy, appetite)
- Recorded EEG as healthy participants with a range of Beck Depression Inventory (BDI) scores read scenarios word-by-word
- Examined the **N400**, a measure of effects of implicit expectation [1], and the **Late Positivity (LPP)**, a measure of sustained attention to emotional stimuli [2]

Can we infer depressive symptoms by recording neural activity while reading sentences that probe self-experience and subjective beliefs?

Stimuli & Design

Self-relevant scenarios		Other-relevant scenarios	
Self-Experience	Final sentence ¹	Other-Experience	Final sentence ¹
Self-positive	Thinking about my recent emotional state, I've been feeling quite <u>resilient</u> .	Other-positive	Everyone who knows him can see that he is really <u>resilient</u> . [expected]
	Thinking about my recent emotional state, I haven't been feeling very <u>fragile</u> .		No one who truly knows him would describe him as <u>fragile</u> . [expected]
Self-negative	Thinking about my recent emotional state, I've been feeling quite <u>fragile</u> .	Other-negative	Everyone who knows him can see that he is really <u>fragile</u> . [unexpected]
	Thinking about my recent emotional state, I haven't been feeling very <u>resilient</u> .		No one who truly knows him would describe him as <u>resilient</u> . [unexpected]

¹Critical words are underlined in the table but were not underlined in the experiment itself.



- 80 scenarios per condition
- Task: read scenarios silently and naturally
- Comprehension question followed ~ 1/3 of trials
- 39 native English-speaking participants who were not experiencing a depressive episode
- Divided into 2 groups by median-split of BDI scores:

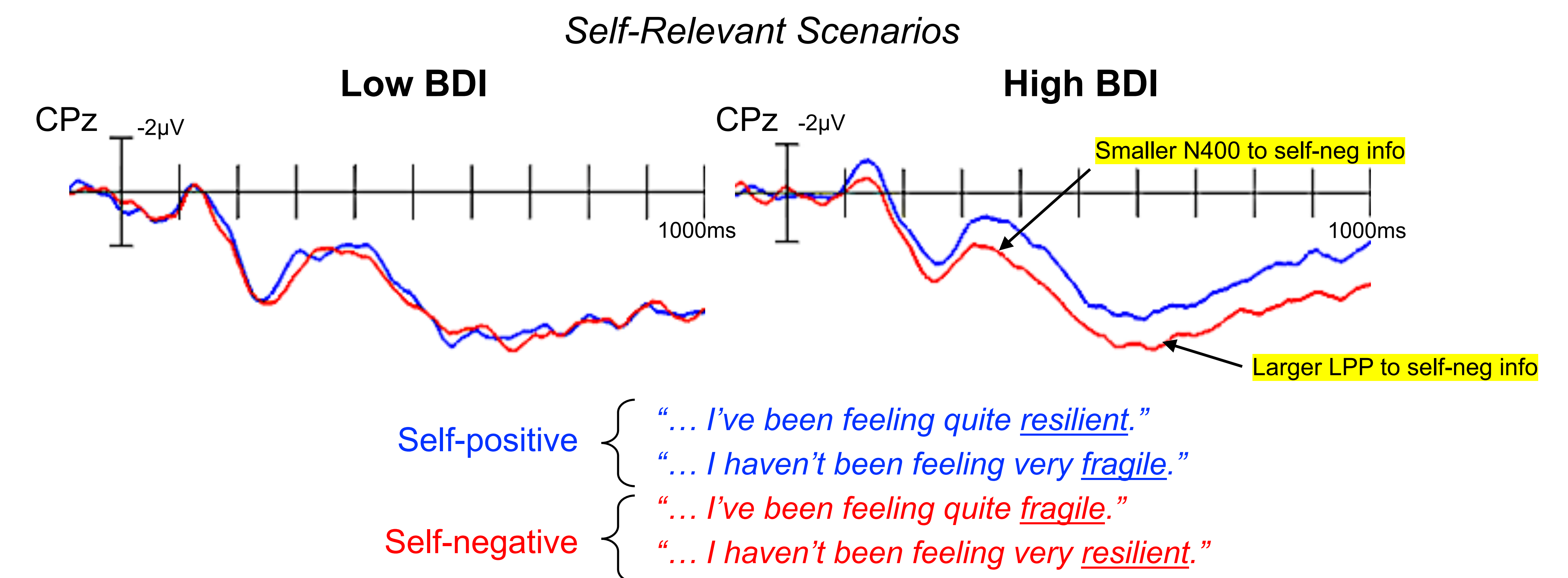
Group	n	Mean (SD)
Low BDI	20	1.6 (1.2)
High BDI	19	9.9 (5.6)

Results

Neural responses differ between people with High vs. Low BDI scores when reading sentences about self-relevant negative vs. positive beliefs and experiences

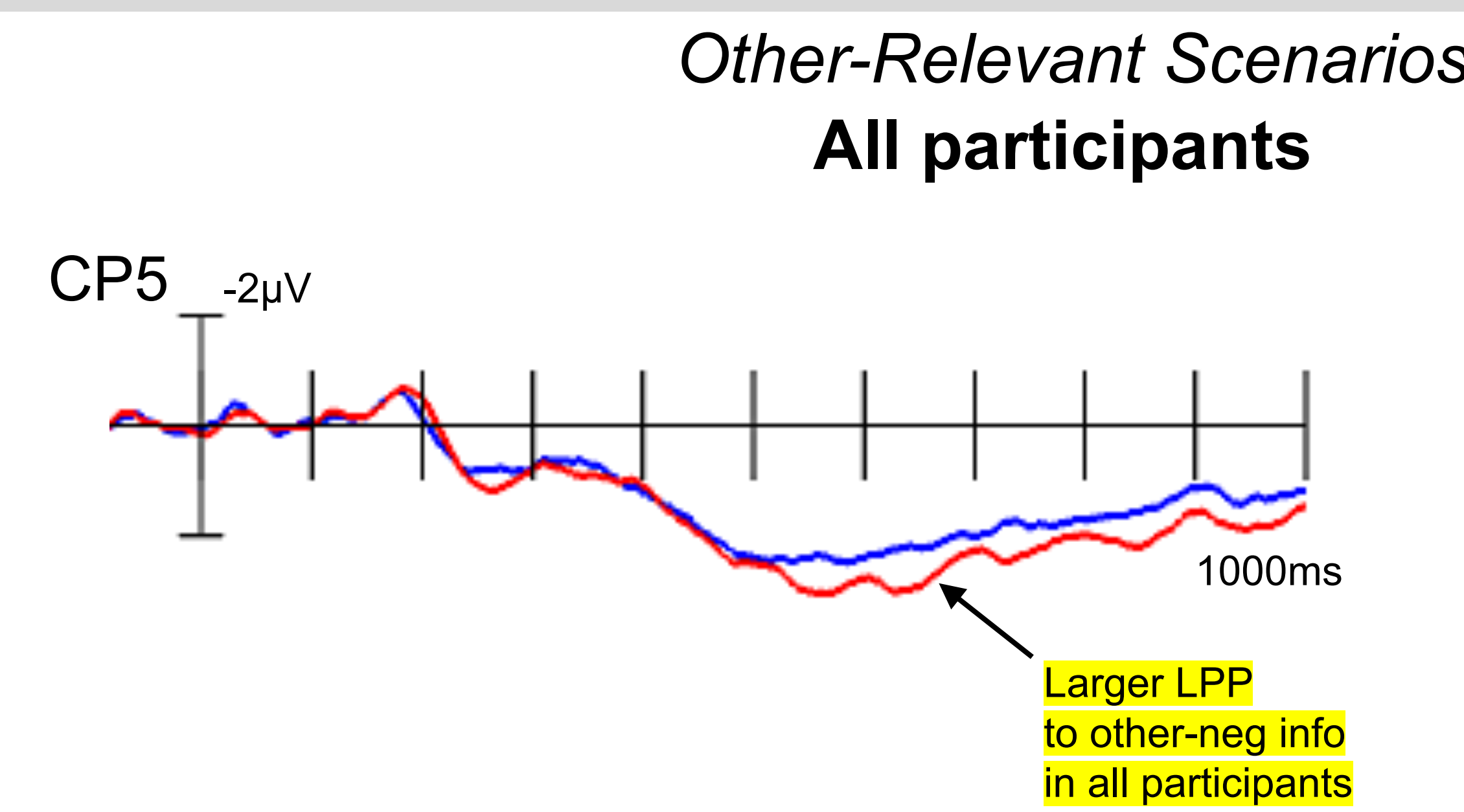
ANOVA:
Group (between-participants: High BDI vs. Low BDI)
x
Self-Experience (within-participants: Self-positive vs. Self-negative)

Group x Self-Experience Interaction in both N400 and LPP time windows



No difference in how people with High vs. Low BDI scores evaluate negative (vs. positive) outcomes about others

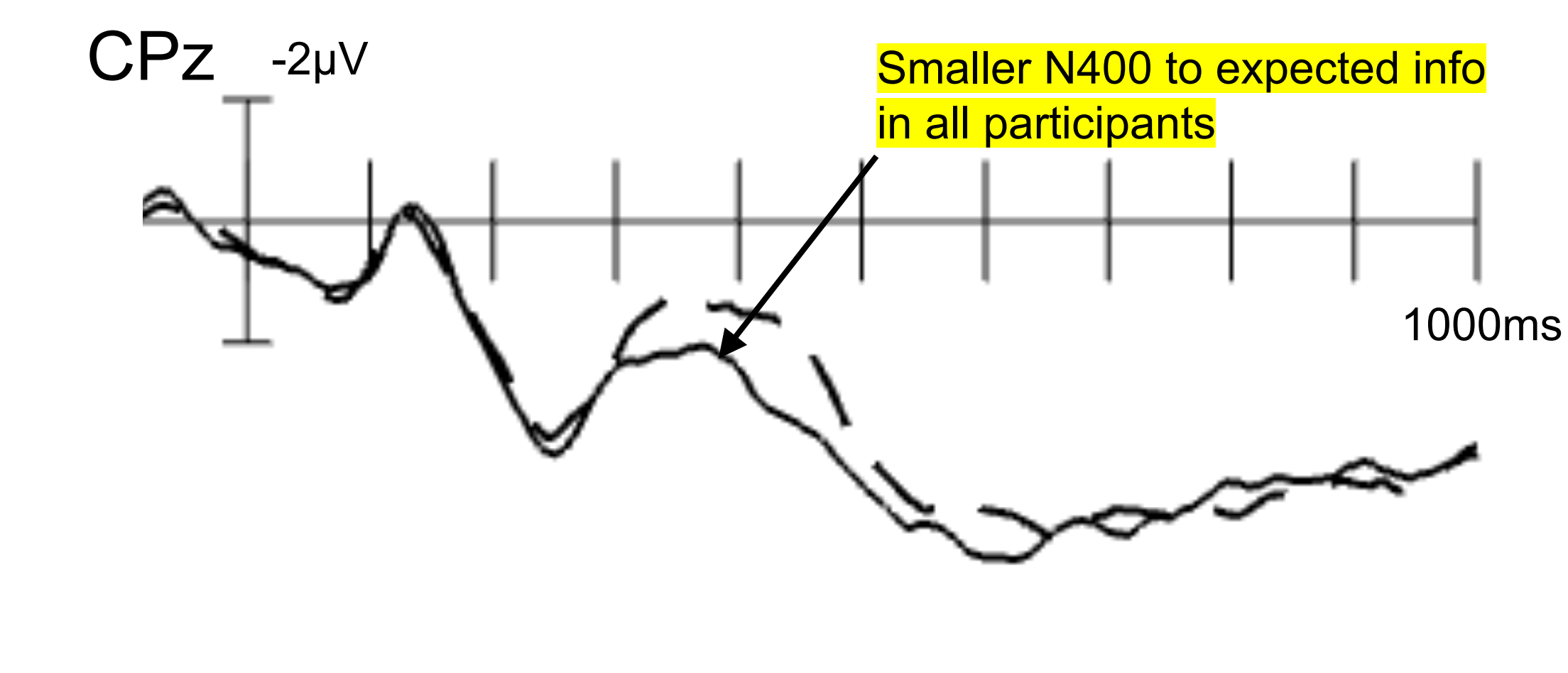
No difference in how people with High vs. Low BDI scores generate implicit predictions, in general



Main Effect of Other-Experience on early LPP: larger to negative outcomes BUT NO Group x Other-Experience Interaction

Other-positive {
"Everyone... can see he is really resilient."
"No one ... would describe him as fragile."
Other-negative {
"Everyone... can see he is really fragile."
"No one... would describe him as resilient."

Other-Relevant Scenarios All participants



Main Effect of Expectancy on N400: larger to unexpected outcomes BUT NO Group x Expectancy Interaction

Broad context: "...Colin never lets anything get him down..."
— Expected {
"Everyone... can see he is really resilient."
"No one ... would describe him as fragile."
- - - Unexpected {
"Everyone... can see he is really fragile."
"No one... would describe him as resilient."

Discussion

Even in subclinical populations, we can directly and selectively detect depression symptoms from neural activity during natural reading... from the earliest stages of access to meaning (300–500ms) to later implicit evaluative processing (500ms onward)

This study lays the groundwork for implicitly evaluating depressive symptoms, without the need for overt responses or conscious deliberation

References

- [1] Kutas, M., & Hillyard, S. A. (1984). Brain potentials during reading reflect word expectancy and semantic association. *Nature*, 307(5947), 161–163.
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- [4] Fields, E. C., & Kuperberg, G. R. (2020). Having your cake and eating it too: Flexibility and power with mass univariate statistics for ERP data. *Psychophysiology*, 57(2), e13468.

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