



Synesthesia, Visual Search, and the N2pc

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Background, Rationale, Methods

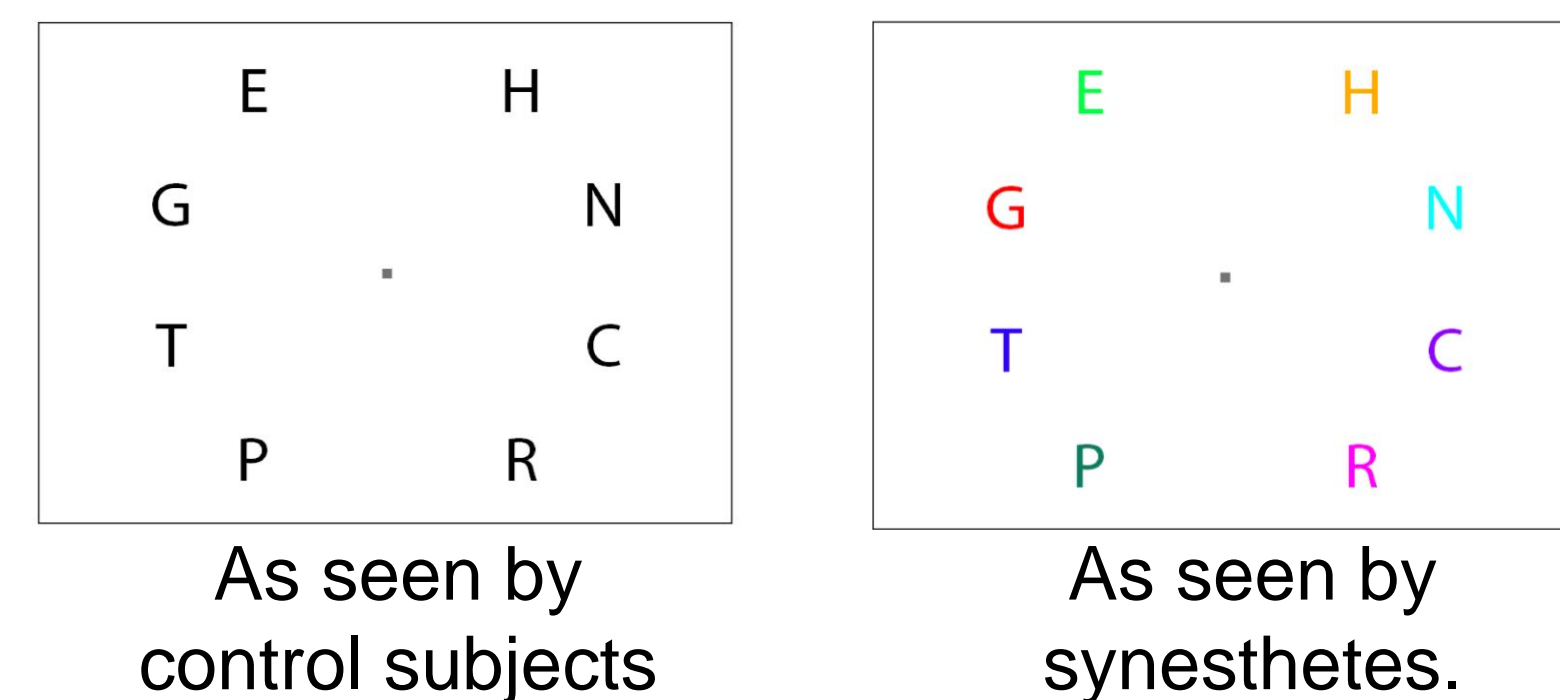
Individuals with grapheme-color synesthesia perceive specific colors when viewing monochromatic letters or numbers. The stage of processing in which these synesthetic color perceptions are formed remains unknown.

Questions: Can synesthetes use their color percepts to outperform non-synesthetes in visual search?
If so, does this synesthetic advantage manifest at early or late stages of processing?
Are synesthetic advantages in visual search specific to grapheme stimuli?

EEG/ERP Methods: 96 channels, equidistant, 500Hz sampling rate, hardware filter: 0.1 – 150Hz, offline filter: 30Hz low pass, baseline correction: -200–0ms

Exp 1:

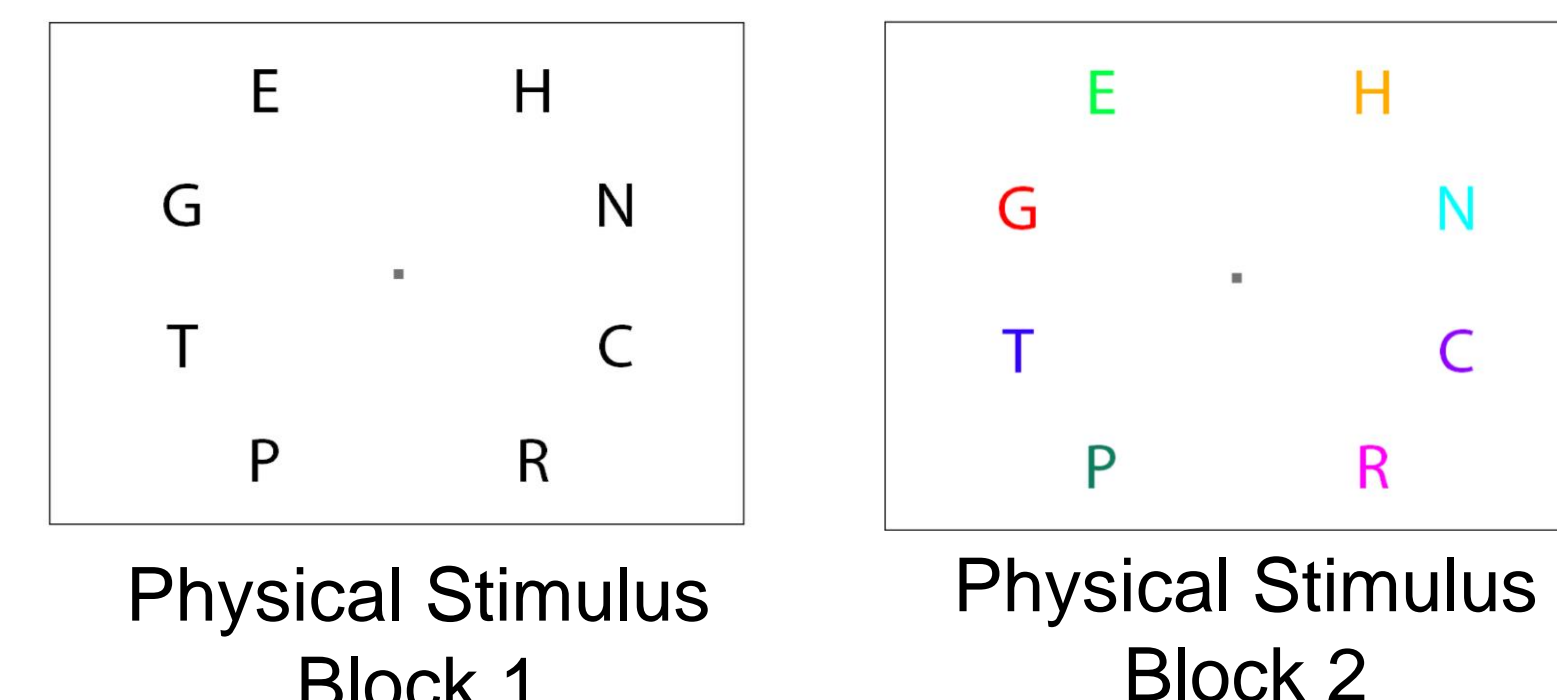
• Stimuli:



- All participants completed the Eagleman Synesthesia Battery¹ [N=24; 12 synesthetes]
- Stimuli: 9 letters tailored for each synesthete
- 2 targets with similar color associations
- 7 distracters with different color associations
- 1 target + 7 distracters presented on each trial
- Task: report which target was present (2AFC)
- All letters presented in black on white background

Exp 2:

• Stimuli:

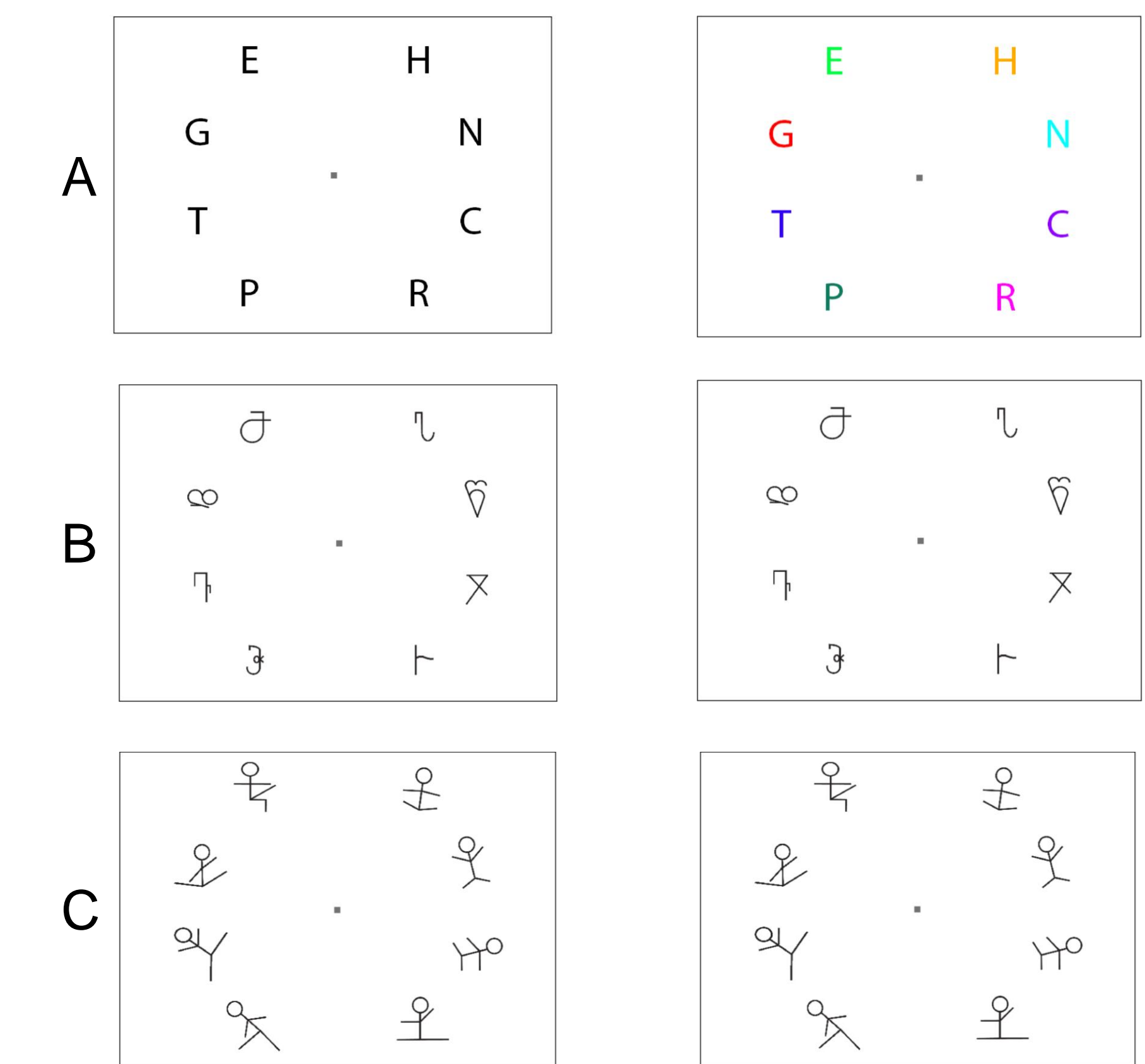


- Non-synesthetes [N=12] completed visual search tasks on the same letter stimuli used in Exp 1.
- In alternating blocks of trials, the letter stimuli were black & white or were physically colored to match synesthetes' color associations from Exp 1.

Exp 3:

• Stimuli:

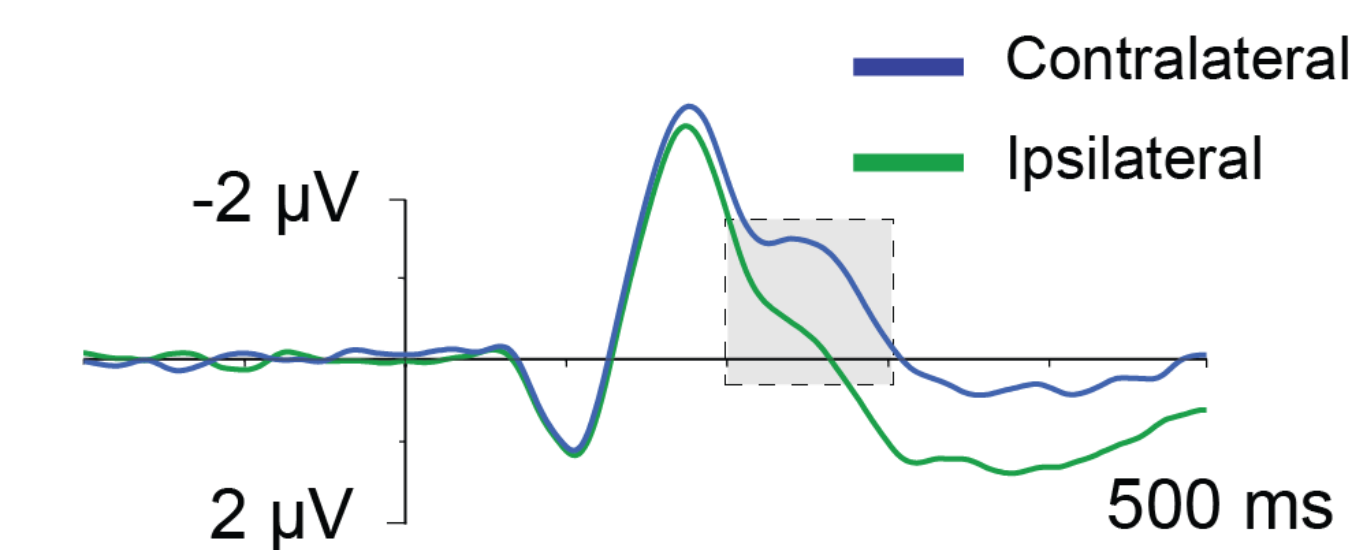
Physical Stimuli
(and as perceived by controls)



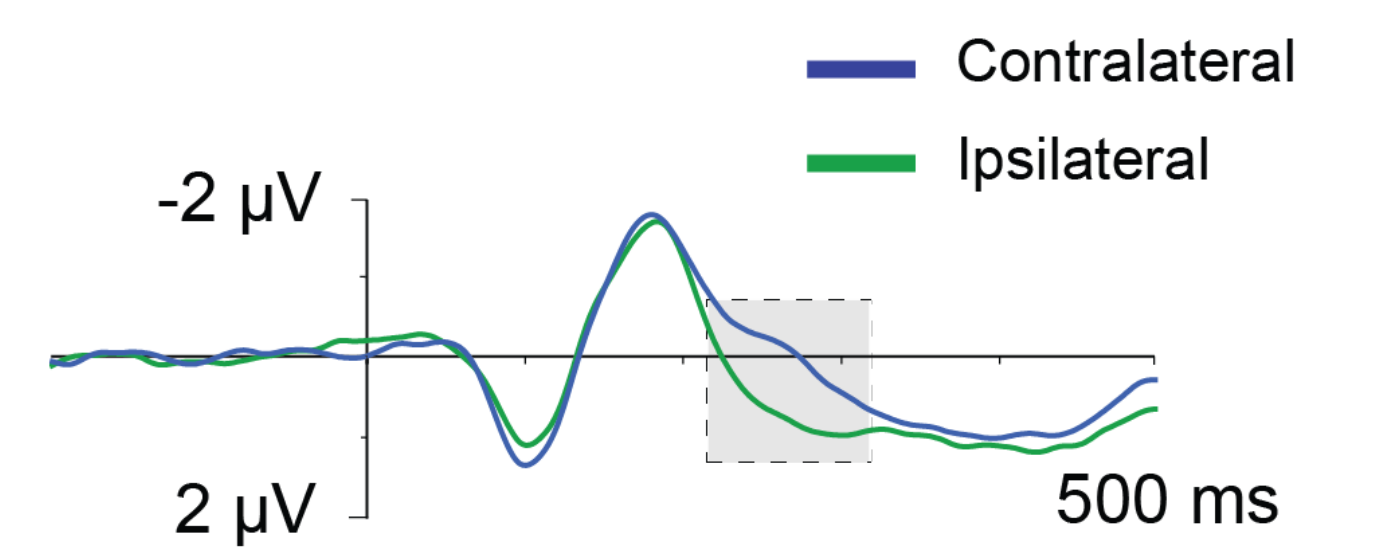
- Participants [N=24; 12 syn] performed visual search on 3 stimulus sets: A. familiar letters, B. unfamiliar letters (Georgian Alphabet), C. stick figures
- All stimuli presented in black on white background
- Most synesthetes only reported seeing color in the familiar letters stimuli

Exp 3: Results

Letter Condition Synesthetes

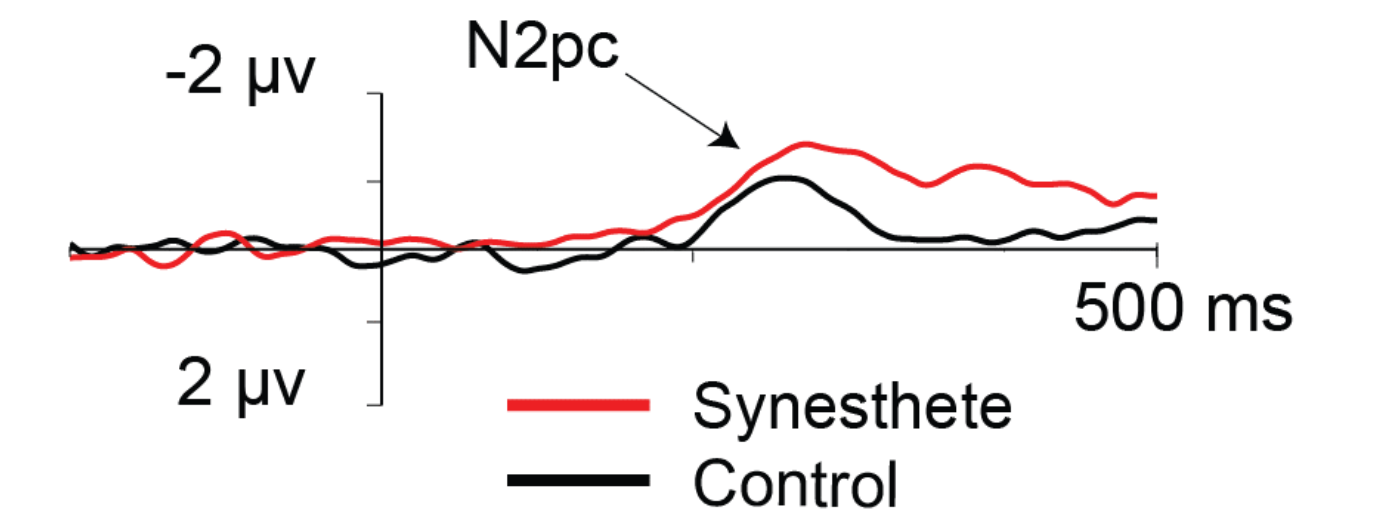


Letter Condition Controls

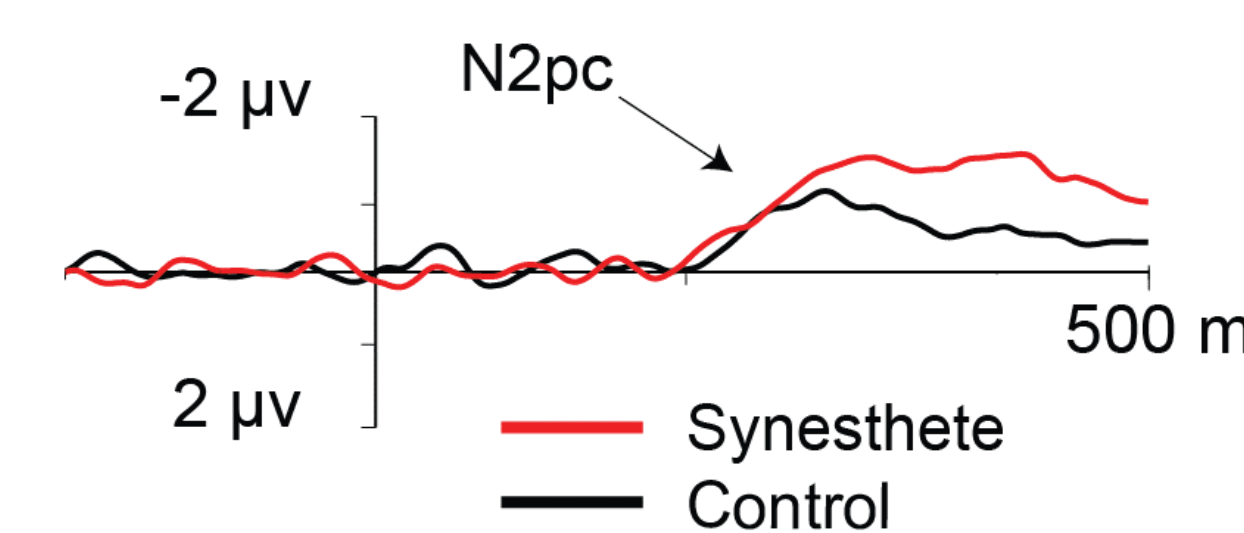


- Synesthetes showed an earlier latency and larger amplitude N2pc than controls for letters and stick figures. N2pc amplitudes were small and equal across groups for Georgian Alphabet.

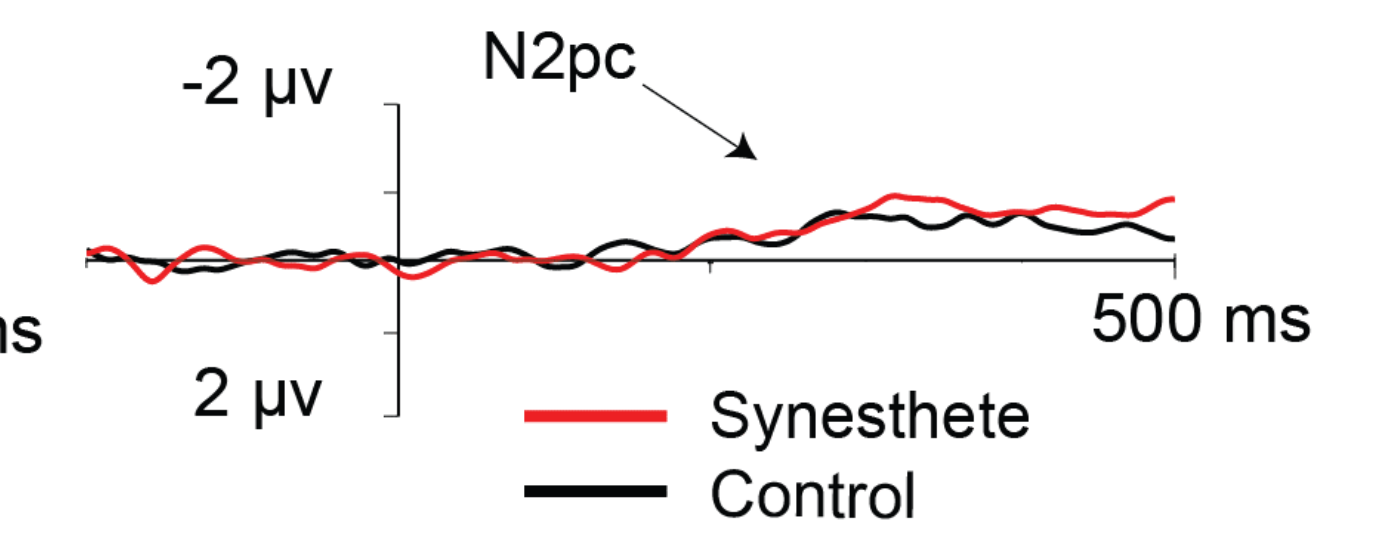
Difference Wave Letters



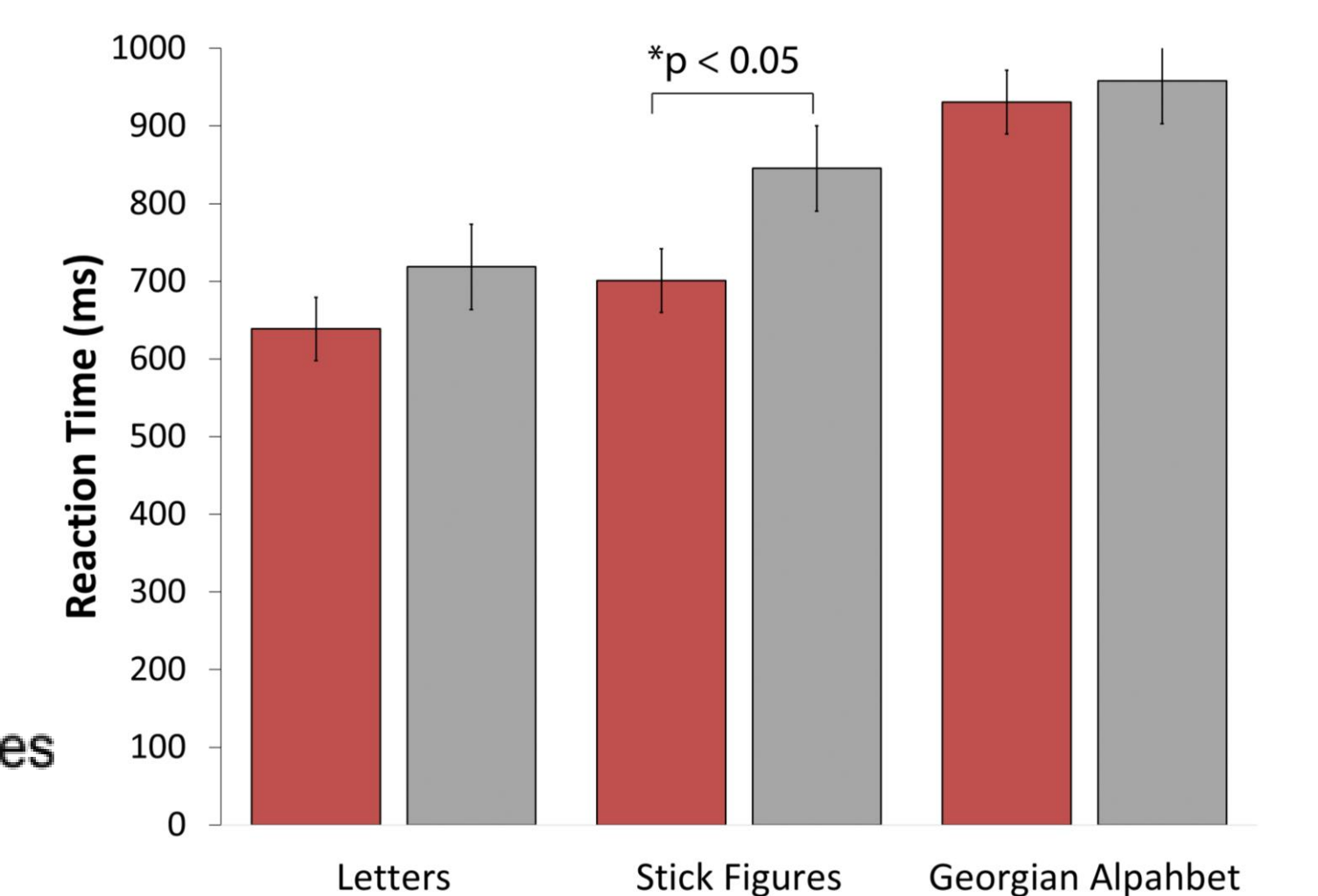
Difference Wave Stick Figures



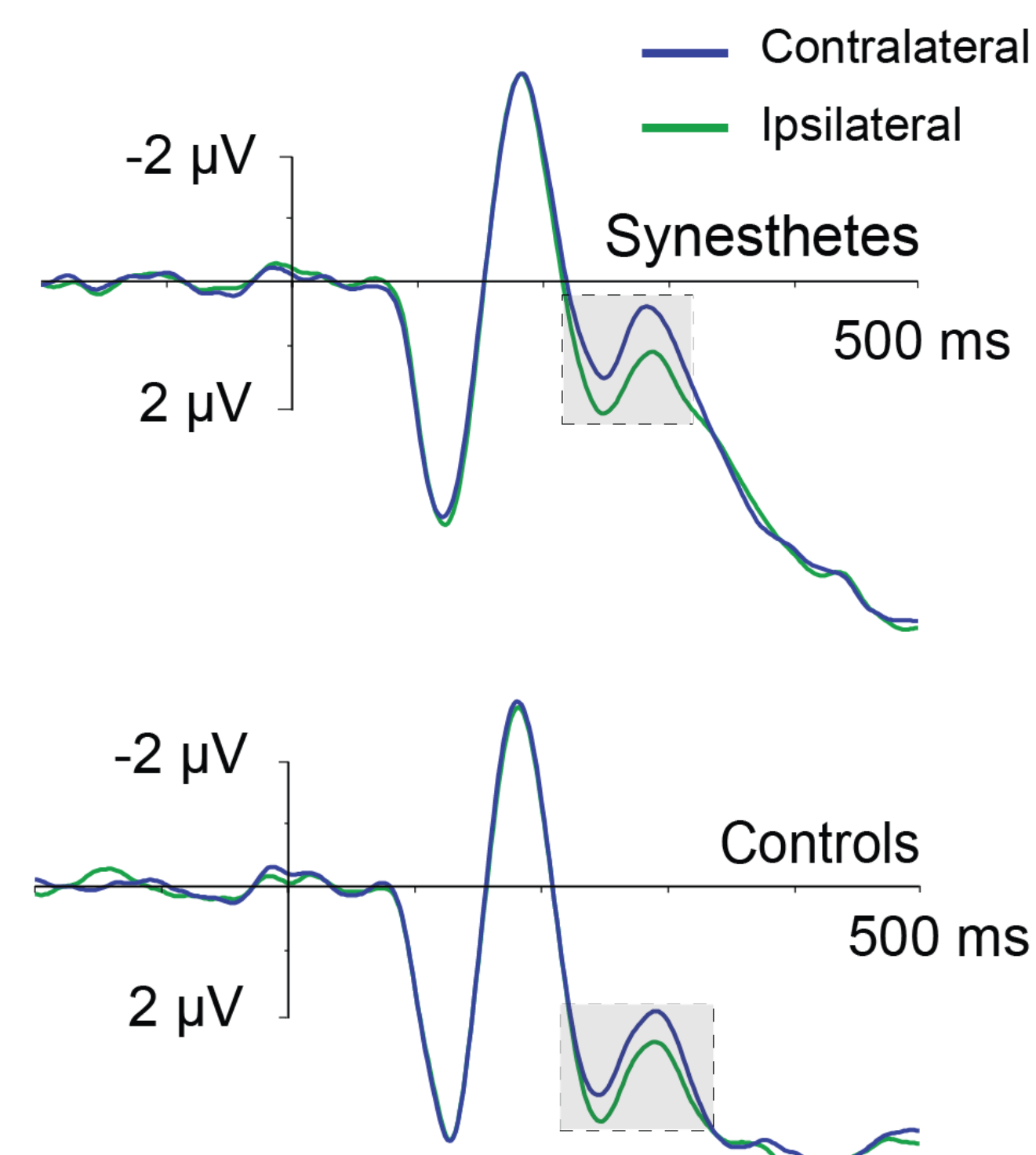
Difference Wave Georgian Alphabet



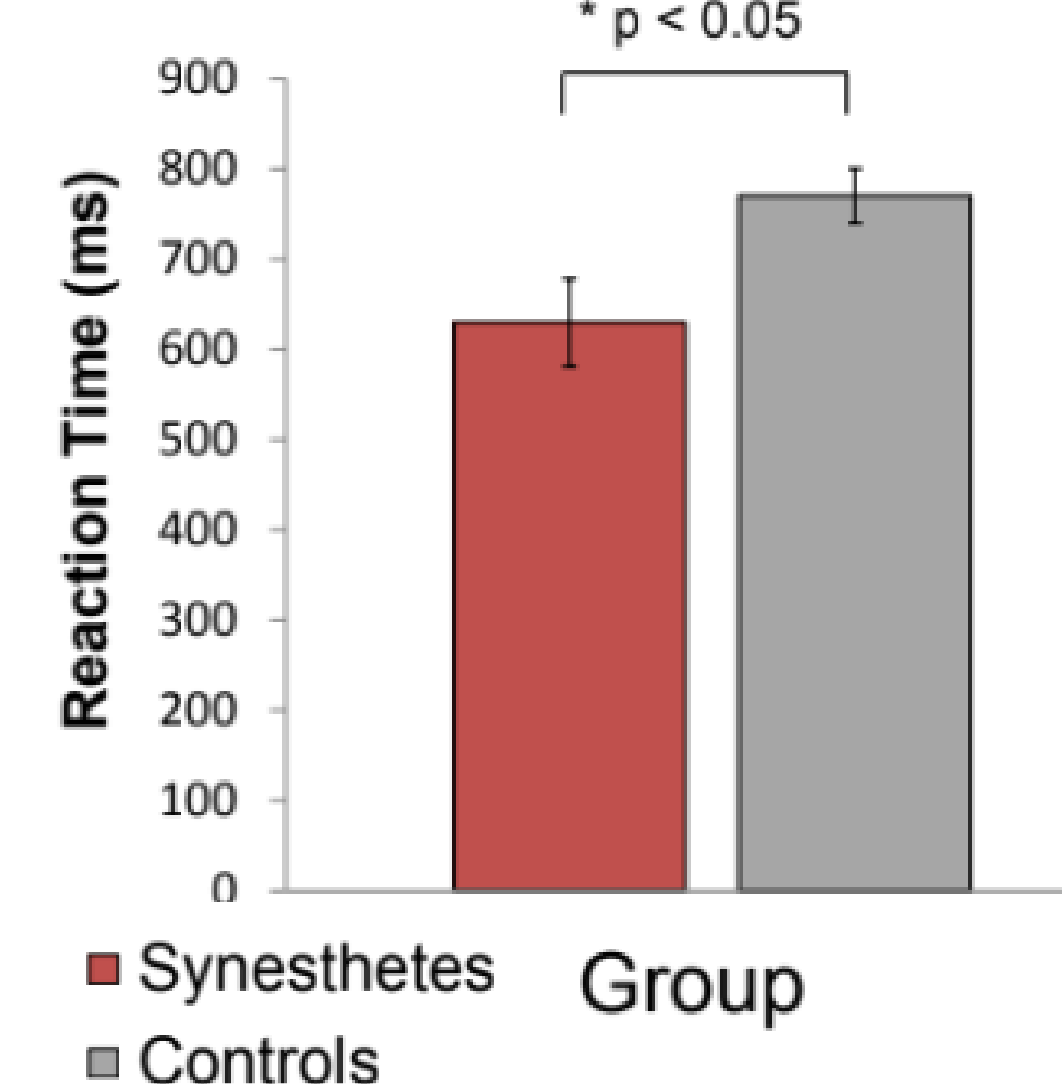
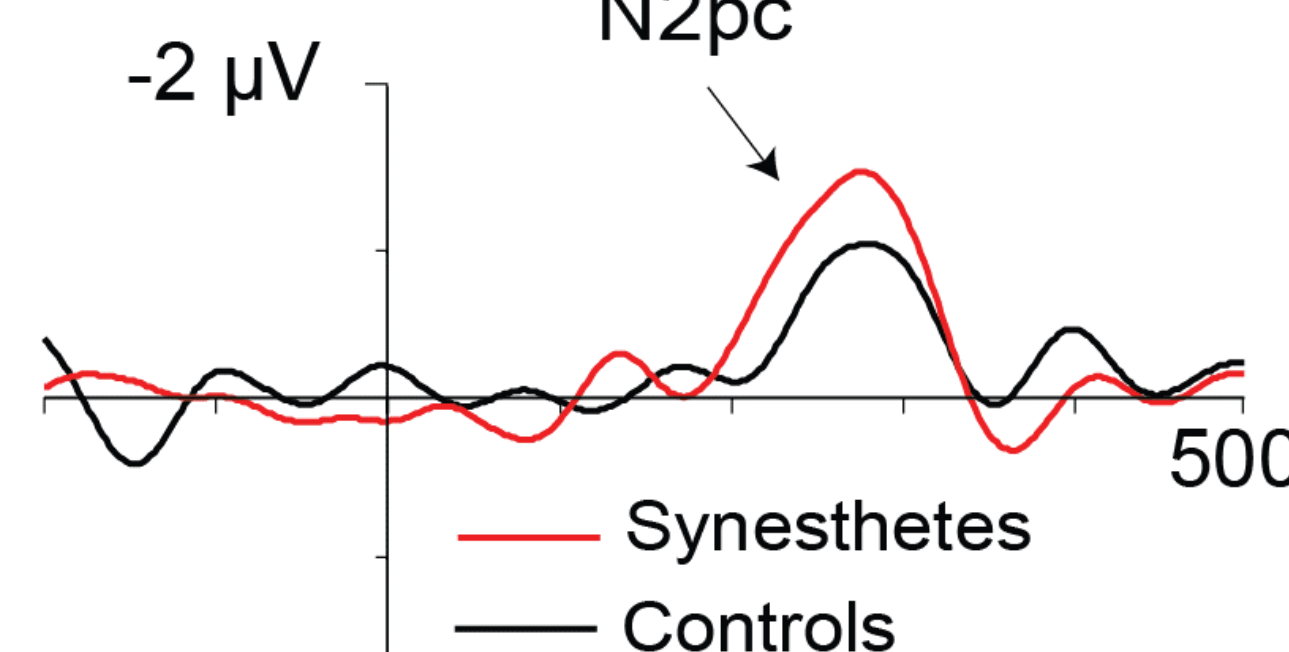
- Synesthetes showed faster reaction times for letters and stick figures compared to controls. RTs were slow for Georgian Alphabet in both groups.



Exp 1: Results (Synesthetes vs. Controls)

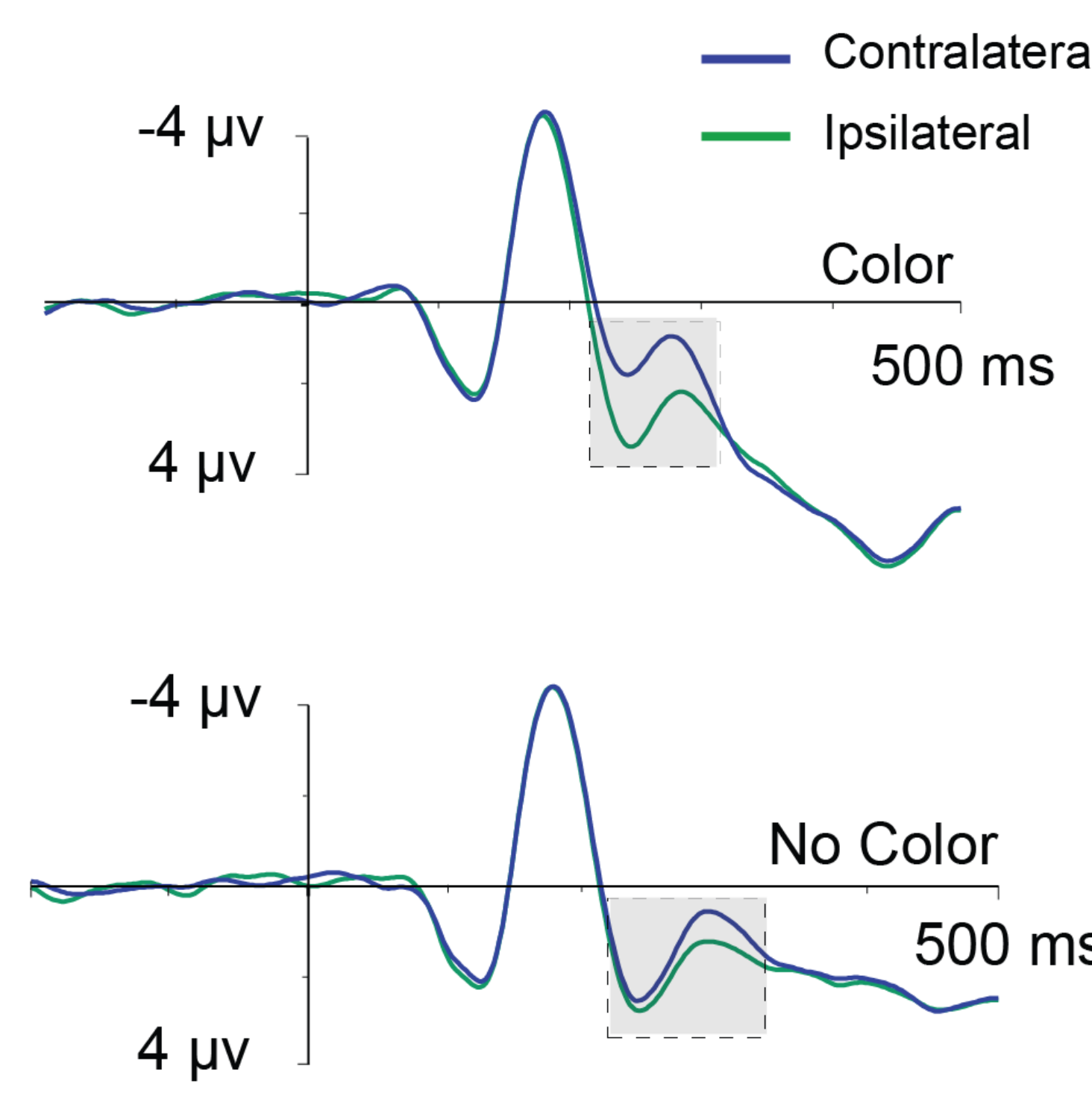


Difference Wave Contra-Ipsi

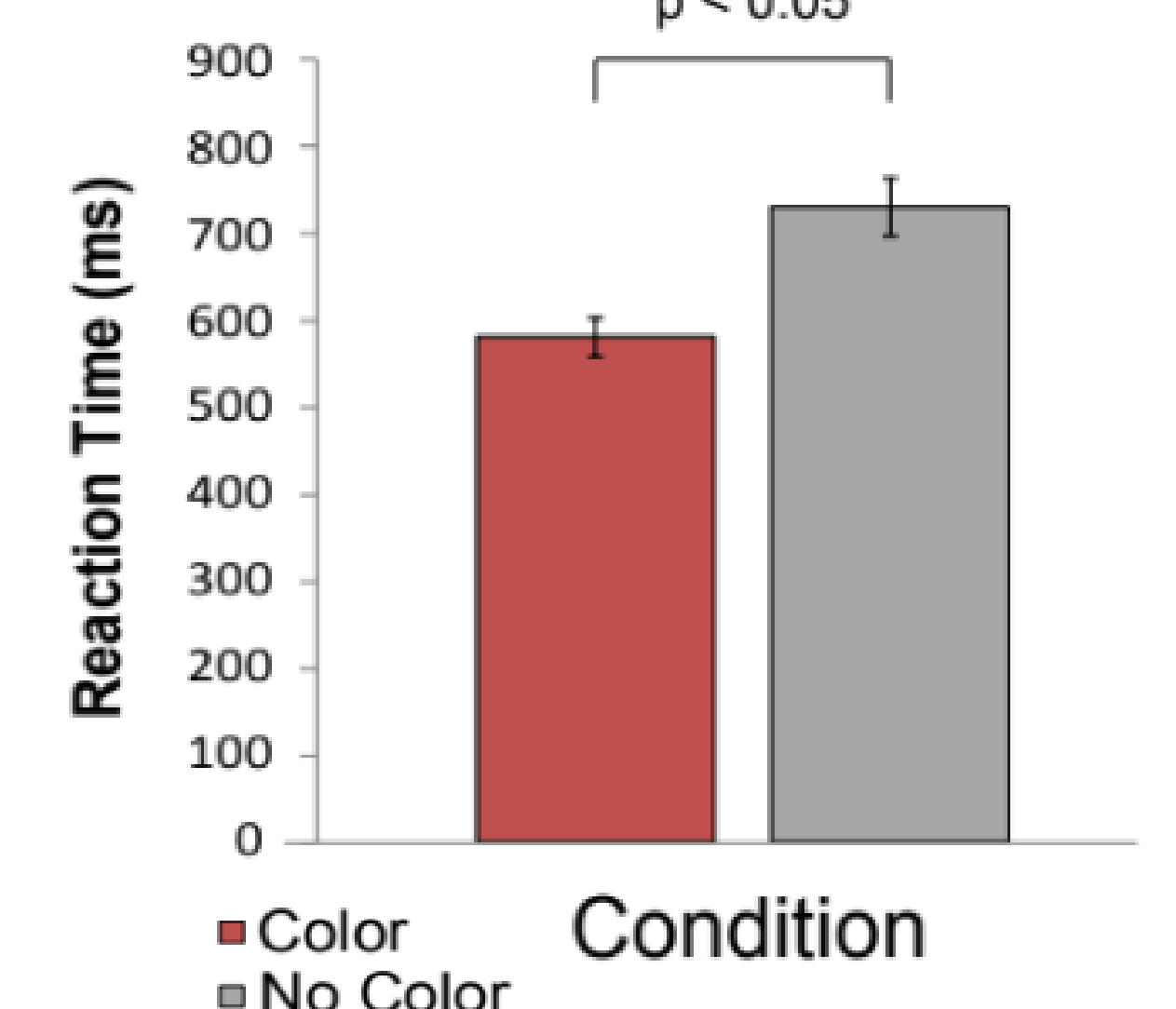
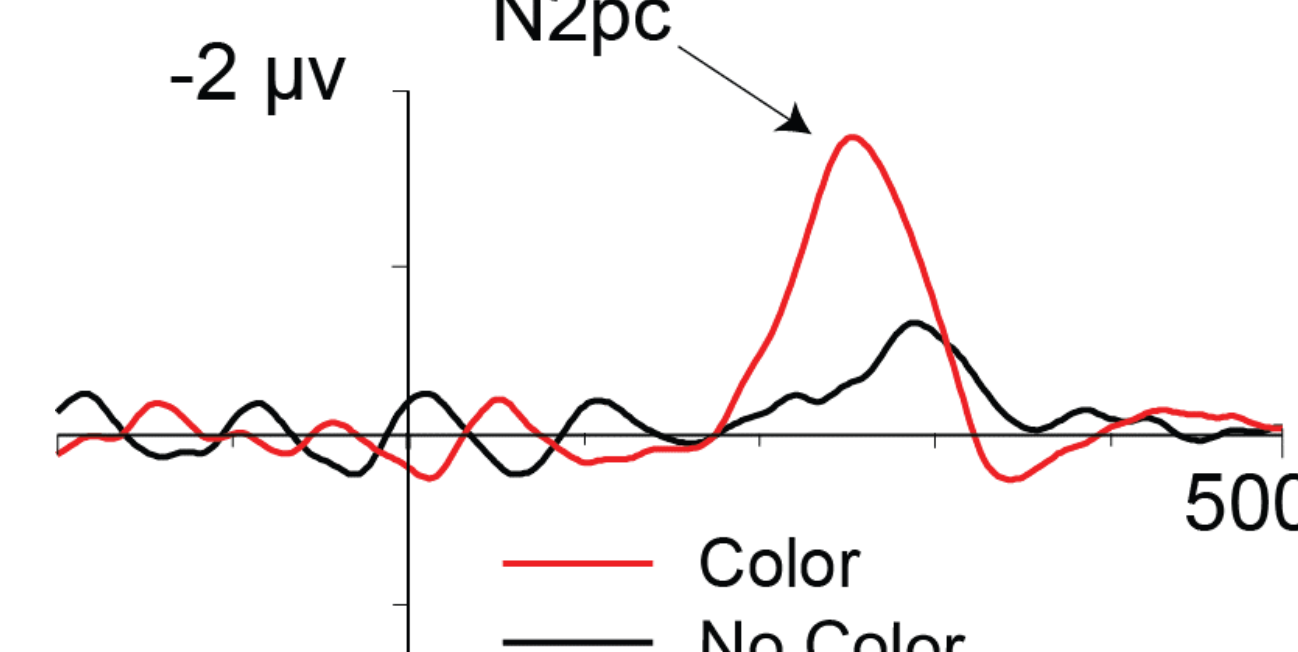


- Synesthetes showed an earlier latency and larger amplitude N2pc compared to control group
- Synesthetes showed faster reaction times compared to control group

Exp 2: Results (Controls: Color vs. Non-Color)



Difference Wave Contra-Ipsi



- Non-synesthetes showed an earlier latency and larger amplitude N2pc for physically colored vs. non-colored stimuli
- Non-synesthetes showed faster reaction times for physically colored vs. non-colored stimuli

Summary / Discussion

- Synesthetes may use color percepts to guide visual search (Exp 1)
- Color helps controls to guide search with the same stimuli (Exp 2)
- Synesthetic advantage may not be restricted to graphemes (Exp 3)
- Georgian alphabet results likely due to a floor effect (a new version of Exp 3 is currently underway)
- Synesthetic advantages begin early in processing (N2pc latency, Exp 1 & 3), but also involve later processes (RT diffs > N2pc diffs, Exp 1 & 3)

References

1. Carmichael, D. A., Down, M. P., Shillcock, R. C., Eagleman, D. M., & Simner, J. (2015). Validating a standardized test battery for synesthesia: Does the Synesthesia Battery reliably detect synesthesia? *Consciousness and Cognition*, 33, 375–385.