The Arithmetic N400 in Fraction Processing

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Introduction

Event Related Potentials (ERPs)
• Bain responses from specific events
• Measured by electroencephalography (EEG)

N400
• A negative peak between 400 and 600 ms
• Particularly seen in semantic mismatch tasks
• Also used in arithmetic studies
  • 4 x 8 = 32 and 4 x 8 = 24

Fractions
• Difficult topic for young students to grasp
• Key to more complex math topics
  • Siegler (2011)
• Not well studied using EEG
This experiment proposes the use of the N400 to investigate how fractions are processed in the brain.

Methods

Participants
• 20 participants
• Controlling for math proficiency

Stimuli
• Fractions are presented for 250 ms
• Target fraction is always a unit fraction (1/2 – 1/9)
• Fractions presented are limited to ones made out of single digits

Task
• Participant respond whether the fractions are the same or different
• A controller is used to indicate response
• Participants complete 810 randomized trials

Methods & Expected Results

Electrophysiology
• EEG will be recorded using a 32-channel cap
• Regions for analysis will be C3, Cz, C4 (central), P3, Pz (parietal), PO3, POz, PO4 (parieto–occipital), O1, Oz and O2 (occipital)

Data Analysis
• N400 component grand averages will be analyzed for central, parietal, and occipital clusters
• Differences in N400 amplitude between congruent and incongruent grand averages is predicted
• Number distance effect will also be analyzed
• Higher N400 amplitude differences are predicted for larger numerical distances between congruent and incongruent grand averages

Conclusions/Significance

N400
• The present study will determine if the same N400 component present in numerical processing extends to rational numbers
• Could hint at verbal network involved in numerical cognition in fractions
• This finding could show the N400 is a viable method to investigate fraction processing.

Fractions
• Results can hint at similarities and differences between how fractions and numbers are processed in the brain

Future Directions

Fraction Research
• Numerical distance of incongruent fractions on N400 onset and latency
• Study same effect with double digit fractions as stimuli
• Differences between decimals and fractions can also be studied
• The arithmetic N400 in fractions can be used to further study fraction arithmetic: addition, subtraction, multiplication and division
• See if findings extend to younger students

References

