



The Effect Of Shared Components In Fraction Comparisons

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Introduction

Fractions

- Difficult for students to master but key for overall math achievement (Siegler, Fazio, Bailey, & Zhou, 2013)
- One of these difficulties is managing the potential conflicting numerical information from components

The N400

- An event related potential (ERP) difference wave observed during semantic incongruence
- Paradigm used in language processing also adapted to numerical tasks
- N400 will be used to examine the role that shared components play in a fraction magnitude comparison task

Methods (continued)

Electrophysiology

- EEGs were recorded using a 32-channel system
- ERPs will be calculated for Match and Mismatch conditions across Shared and Nonshared group
- Mass Univariate Analysis will be used to determine significance (Groppe, Urbach, & Kutas, 2011)

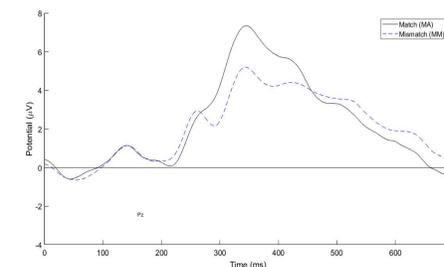


Figure 2. Typical ERP waveforms for electrode Pz showing averaged amplitudes.



Figure 3. 32 electrode EEG cap used in ELDEN lab.

Significance

- The N400 can be used for studying component effects in fractions
- The susceptibility to interference from shared components could highlight the presence of a Stroop-like conflict between a fraction's magnitude and its numerical components (Meert, Grégoire, & Noël, 2010)
- This finding would point to the need of inhibition in fraction processing

Future Directions

- Expand set of stimuli to other fractions (including double digit fractions)
- Study how the N400 is affected by numerical distance effect (NDE) of both magnitude and components

Methods

Participants

- 30 participants

Task

- Participants will judge whether a probe fraction (e.g. 3/6, 3/9 or 2/8) has the same magnitude (Match vs. Mismatch) as a target (1/2, 1/3 or 1/4)
- A further division will be made based on the presence of shared components making groups MatchShared (MAS), MismatchShared (MMS), MatchNonshared (MANS), and MismatchNonshared (MMNS)
- Participants will complete 600 randomized trials

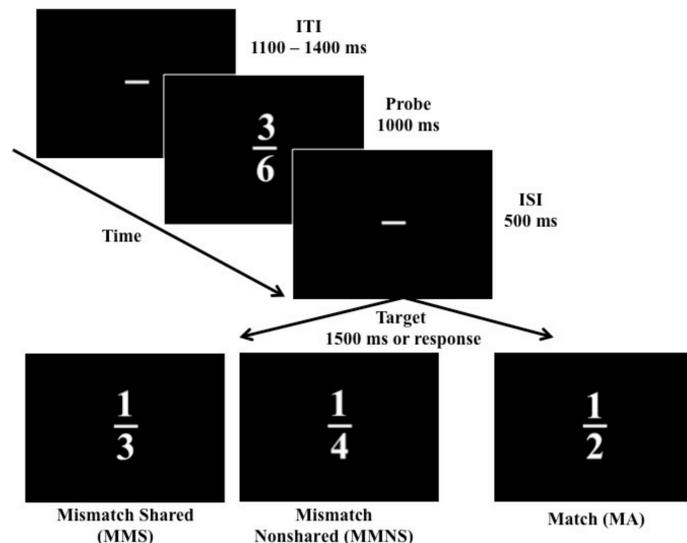


Figure 1. Experimental progression of a Match (MA) or Mismatch (MM) trial showing a MismatchShared(MMS), MismatchNonshared(MMNS), and MatchNonshared for 1/3, 1/4, and 1/2 respectively.

Expected Results

Behavioral Results

- A condition (Match/Mismatch) x component (Shared/Nonshared) interaction where the Shared component group in the Mismatch condition will show higher reaction times and lower accuracy when compared to the match condition

EEG Results

- Permutation-based cluster differences for all 32 electrodes will be calculated on the 0-600ms time range
- Shared components will modulate the amplitude of the N400 across match/mismatch comparisons showing componential interference

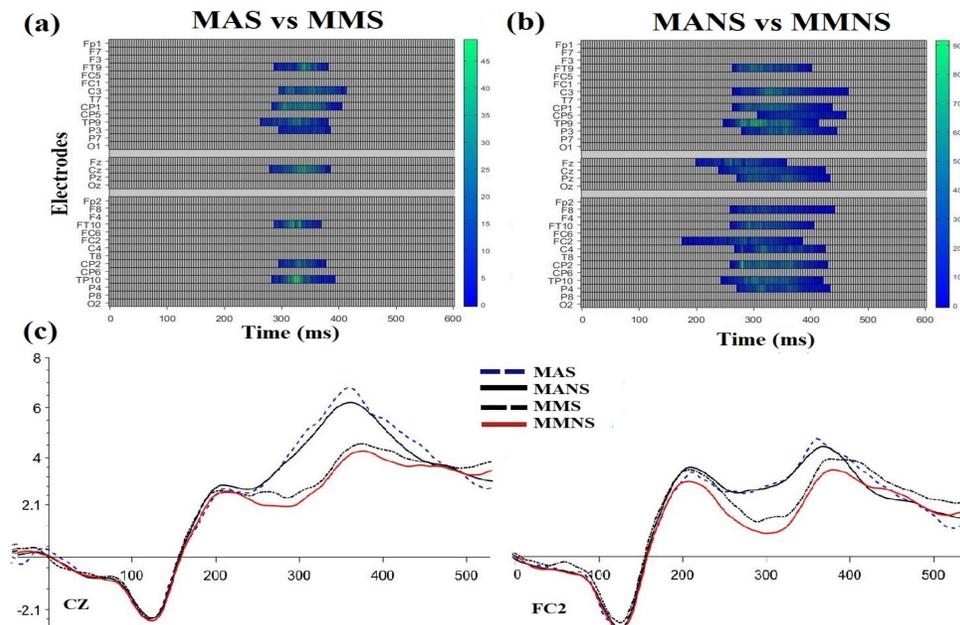


Figure 4: Hypothesized cluster differences between MatchShared (MAS) and MismatchShared (MMS) (a) and between MatchNonshared (MANS) and MismatchNonshared (MMNS) (b).

Educational Implications

- Inhibition might have a key role in the development of fractions
- Inhibition of interference can draw on attentional resources resulting in higher overall reaction times and higher N400 amplitudes
- Higher levels of inhibition have been shown to predict fraction comparison proficiency (Gómez, Jiménez, Bobadilla, Reyes, & Dartnell, 2015)
- Inhibition might not simply be a feature arising during fraction judgment but a cognitive function necessary for successful fraction processing

References

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