Retrieval-based and Calculation-based Arithmetic: Comparing Bilinguals and Monolinguals

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Research Questions
1. How do bilinguals process arithmetic (addition) in their first and second languages?
2. How do language differences influence retrieval-based (single-digit) and calculation-based (double-digit) arithmetic processes?
3. Do monolinguals and bilinguals process arithmetic differently?

Hypothesis

- Parietal activation (see above)
- Frontal activation due to attentional demands and increased cognitive load

Preliminary Results

- Both types of addition (retrieval and calculation) occur within the first 150 ms after stimulus for all participants
- In the first 150 ms after stimulus, bilinguals showed the most divergence in frontal and parietal sites followed by central and fronto-central sites
  - could be different pathways for processing retrieval and calculation
- Frontal and Parietal sites showed the most divergence in the first 150 ms when bilinguals performed tasks in 2 languages
  - could be different pathways for processing arithmetic in L1 and L2
- Pattern of activation for retrieval and calculation-based addition is distinct during the first 150 ms in English.
  - Patterns of activation are similar for:
    - 0-150 ms in native language
    - 150-300 ms in native language
    - 0-150 ms in English

Introduction

- Bilinguals process arithmetic faster in their original language of learning
- Bilinguals are slower when transferring calculations from language of learning to second language
- Event-related potentials (ERP) can provide temporal resolution on millisecond level
  - measures brain (electrophysiological) response to a stimulus
  - ERP components – N1, P2, and N400 – shown to be active in arithmetic (see below)

Methods

- Design of trials within each block

![Figure 1: Design of trials within each block](image)

N1: Whole brain
P2: Frontal regions

PARTICIPANTS (N = 7)
- n = 3 adult Monolinguals
- n = 4 adult Bilinguals

Future Directions

- Increase sample size: n = 20/group
- Distinguish between the type of bilinguals – English language learners and Foreign language learners – for consistency

Conclusions


References