



Neural Correlates of Fast Mapping in Monolingual vs Bilingual Toddlers

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Background

- In fast mapping, new words are mapped to unfamiliar objects when contrasted with familiar objects through an indirect learning context (Halberda, 2003; Yeung & Werker, 2009)
- For a successful mapping, “referent selection” and “referent retention” must be performed (Spiegel & Halberda, 2011)
- Children do not retain new words learned through indirect contexts until around 3 years of age (Horst & Samuelson, 2008; Bion et al., 2013)
- Fast mapping may be more effective for monolinguals than bilinguals as knowledge of translational equivalents cause removal from one-to-one mapping strategy between word and concept (Byers-Heinlein & Werker, 2009; Houston-Price et al., 2010)
- Adult late second-language learners show greater left lateralization when a word is learned (Yang et al., 2015) and bilingual children show greater left lateralization to language exposure (Arredondo et al., 2019)
- Debates are present in developmental psychology regarding how the behavioural and neural mechanisms that support word learning in monolinguals and bilinguals might overlap and/or differ

Methodology

Participants:

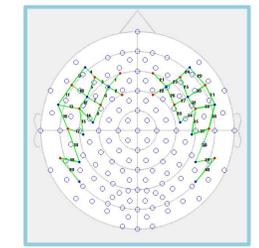
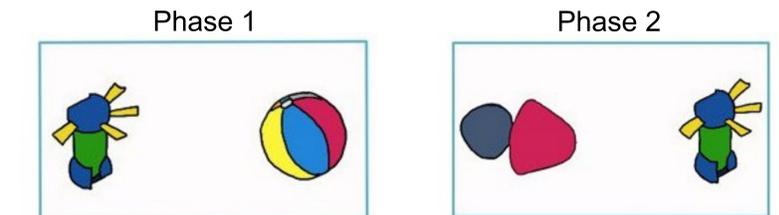
- 28 monolingual children & 26 bilingual children (28-32 month olds)

Design:

- 8 second long trials; 3 second pre-naming & 3 second post-naming phases
- 1-8 second long jitters (buffer stimuli)
- Measured looking time using eye-tracker and cerebral activation using fNIRS

Functional Near Infrared Spectroscopy (fNIRS):

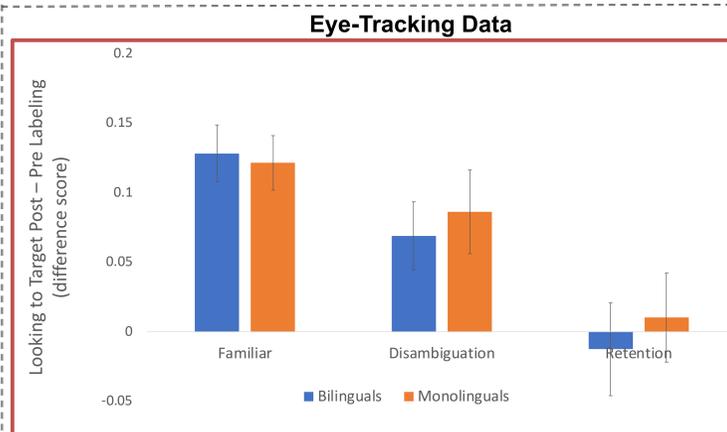
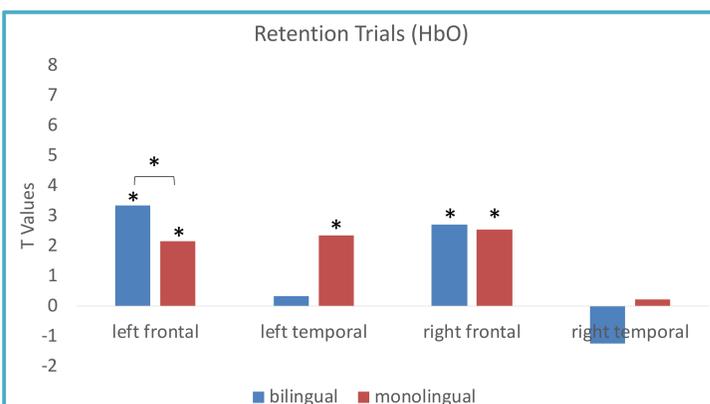
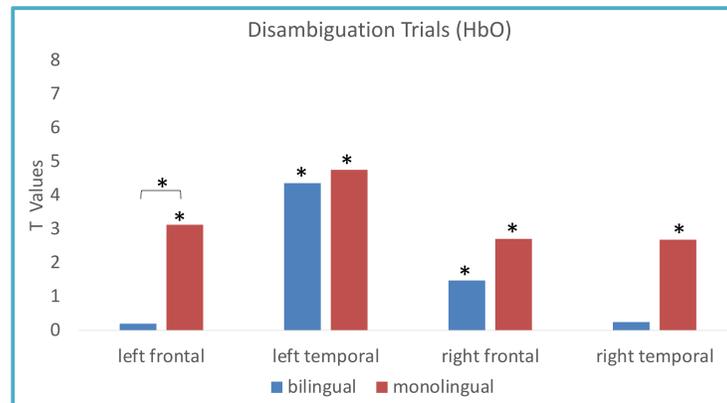
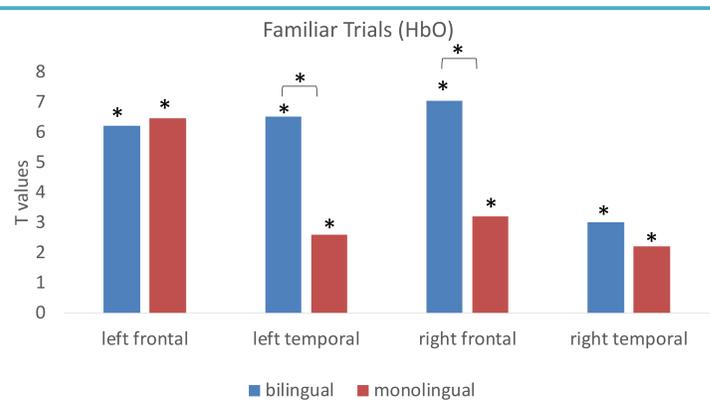
- Measures hemoglobin changes in the brain’s cortex using near-infrared light
- We used an LED-based NIRScout 16x16 system, 760nm & 850nm wavelengths
- 16 sources and 16 detectors, yielding 40 channels (20 per hemisphere)



Results

Preliminary Data Analysis using nirstoolbox plotting T values

* represents significant activation or difference



Discussion

Familiar:

- More right frontal and left temporal activation in bilinguals than monolinguals, consistent with activation patterns for memory retrieval (St-Laurent et al., 2016; Davis et al., 2008)

Disambiguation:

- Both monolingual and bilinguals show significant left temporal and right frontal activation consistent with activation patterns for learning novel words (Saykin et al., 1999; Davis et al., 2008)
- More left frontal and right temporal activation in monolinguals than bilinguals consistent with language processing functions and visual cues (Turken & Dronkers, 2011)
- Monolinguals and bilinguals perform equally well at disambiguation, but mechanisms driving disambiguation in bilingual toddlers may differ (Kalashnikova et al., 2018)

Retention:

- Individual differences are observed in retention; neuroimaging data can be analyzed further to compare between toddlers in each group who can and cannot retain words
- More left frontal activation in bilinguals and more left temporal activation in monolinguals

Overall:

- More frontal activation in bilinguals may be associated with greater executive functions as they require greater attention control in switching languages (Bialystok and Martin, 2004; Kaushanskaya and Marian, 2009; Kaushanskaya, 2012)
- The differential activation raises the question as to whether there is a different neural signature of word learning in bilingual children, which may explain why they often do not employ fast mapping (Houston-Price et al., 2010)

References

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