Monolingual and Bilingual Baby Brains: A New Look at Infant Phonetic Discrimination Using Event-Related fNIRS

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INTRODUCTION

Infants start life with a **universal** capacity to discriminate between linguistic-phonetic units from any of the world's languages (*e.g.*, [ba]-[da], English; [ta]-[ṭa], Hindi). By ~10-12 months, they narrow in on the phonetic inventory of their **native** language.[1,3,16] *What are the neural mechanisms underlying the transition from universal to native language phonetic discrimination?*

In Monolingual infants, Superior Temporal Gyrus (STG, BA 21-22) is recruited during phonetic processing[2,10,13]

NEW Bilingual infants: Computationally different! Impact on neural processing?

2 HYPOTHESIZED MECHANISMS

Auditory General[4,5,14,15] Infants begin life generally able to discriminate sounds in their environment. This enables *learning* of native language phonetic units only after *sufficient* exposure.

Prediction (1)
Monolingual and Bilingual older infants will demonstrate **different** STG recruitment than younger infants

Language-dedicated[1,7-13] Infants begin life with brain tissue dedicated to processing specific rhythmic temporal patterning underlying aspects of linguistic structure (phonetic, etc). Native language phonetic discrimination is built up from this capacity.

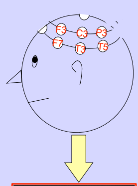
Prediction (2)
Monolingual and Bilingual older infants will demonstrate **similar** STG recruitment than younger infants

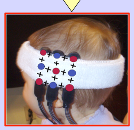
METHODS

PARTICIPANTS

LINGUISTIC MILESTONE: Age	Langauge Background	
	Monolingual (n = 27)	Bilingual (n = 34)
UNIVERSAL: 2 to 6 months	17	15
NATIVE: 10 to 15 months	10	19

10 x 20 Coordinates[3]





Bilateral temporal probe placement

NEUROIMAGING MEASUREMENTS

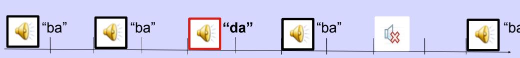
Functional Near Infrared Spectroscopy (fNIRS) optically measures the hemodynamic response:
- Spatial resolution: 2cm
- Temporal resolution: 10 Hz
- Measures: Oxygenated & Deoxygenated hemoglobin

TASK

TWO Language Conditions

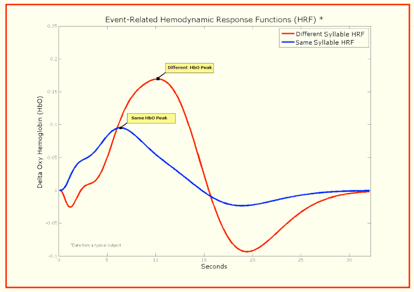
NATIVE (English) Syllables [ba] and [da][16]
NON-NATIVE (Hindi) Syllables [ta] and [ṭa][16]

Phonetic Discrimination *Oddball Event-Related Paradigm*



RESULTS

IS THERE A DIFFERENCE IN INFANT BRAIN RESPONSE TO "SAME" VS. "DIFFERENT" SYLLABLES?

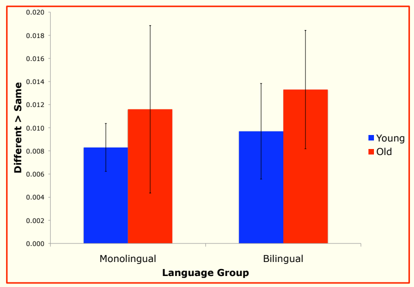


YES

Red – Blue = Increased activation for "different" syllables

Indicates that the infants perceived the difference between syllable types

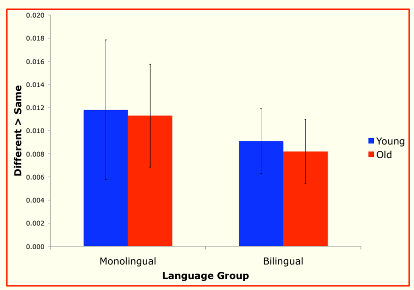
DO MONOLINGUAL AND BILINGUAL INFANTS SHOW AN AGE DIFFERENCE IN STG RECRUITMENT FOR *NATIVE LANGUAGE* CONTRASTS?



NO

All infants show similar STG recruitment for *native* contrasts

DO MONOLINGUAL AND BILINGUAL INFANTS SHOW AN AGE DIFFERENCE IN STG RECRUITMENT FOR *NON-NATIVE LANGUAGE* CONTRASTS?



NO

All infants show similar STG recruitment for *non-native* contrasts

The simultaneous analysis of fNIRS and behaviour data has allowed us a new and exciting look into the development of native language phonetic perception in infancy!

CONCLUSIONS

What are the neural mechanisms underlying the transition from universal to native language phonetic discrimination?

Monolingual and Bilingual infant groups demonstrated **similar recruitment** of STG for native and non-native phonetic processing across ages

SUPPORTS THE LANGUAGE-DEDICATED HYPOTHESIS

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