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Evidence of maturational processes in linguistic brain (fNIRS) and physiological emotional (Thermal IR) responses in hearing infants to signing virtual humans

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Question

What drives babies' language learning?

- H1 Presence of Humans (Predicted)
- H2 Presence of Specific Linguistic Patterning

Participants

9 Hearing Non-Sign exposed

2 Groups: 6-7 mths (5); 10-11 mths

Background

- Babies possess peaked sensitivity to rhythmic temporal patterning in maximal contrast about ~1.5 Hertz. Permits discovery of phonetic-syllabic units in native language[1-8]
- Sensitivity changes over time from an open capacity to discern phonetic-syllabic contrasts (~6mths) to a honed capacity to do so uniquely in their native language (~11mths)[9,10]

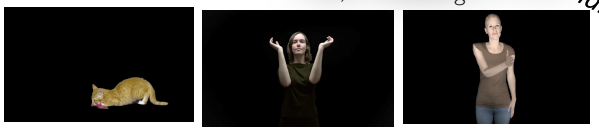
Innovation Language & Emotion

Measurement of Neural Activity fNIRS

Measurement of Emotional Arousal/ Attention Thermal IR Imaging

Time locked brain and physiological data[11-15]

Three Conditions, Block Design



Cat in Motion
-human
-language

Dancer in Motion
+human
-language

Avatar in Motion Signing Rhythmic Temporal Nursery Rhymes in American Sign Language (~1.5 Hertz)
+human
+language
+human-like form

Language Condition

Surprise Finding

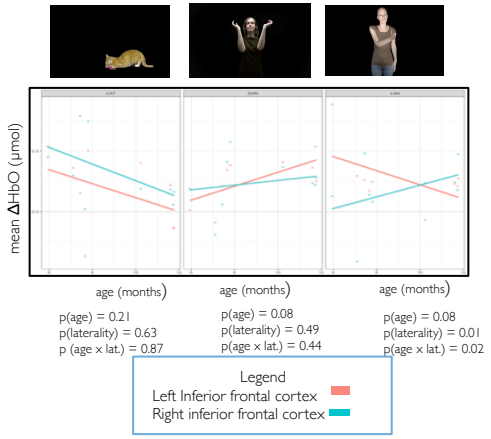
Only Avatar elicited classic language neural activity, but not Human

1. Language was not in babies' native modality (sign language)
2. Language had no semantic content for babies
3. Not due to Animacy or Motion
4. Attention to Language in Avatar appears not due to confusion that the Avatar was human

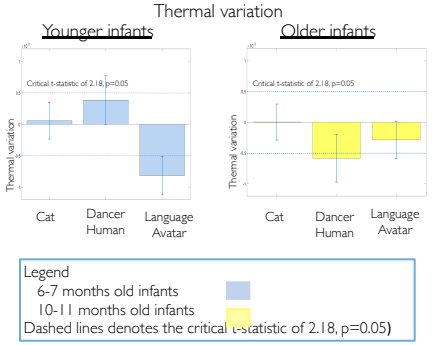
Conclusion

- H2 Supported - Phonetic-syllabic rhythmic temporal patterning is important
- Neural Processing of Language and Emotional arousal are linked in early language learning[16-20]
- Broad Impact: Building augmentative language learning tools for babies: RAVE (Robot Avatar Thermal Enhanced)[16-20]

fNIRS Only Avatar Nursery Rhyme Language Condition activated classic language brain regions, and showed age related changes over time in the Inferior Frontal Cortex



Thermal IR Imaging Avatar Nursery Rhyme Language Condition showed heightened Sympathetic Autonomic NS responses in younger babies, suggesting that they were possibly discriminating real human vs nonhuman features of the Avatar stimuli (Nose tip ROI)



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