Resting-state electroencephalography and event-related potentials to lexical tone processing in bilingual Mandarin-English children

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Introduction

- Resting-state brain activity is the intrinsic neural activity of the brain when an individual is not partaking in an attention-demanding task.
- Resting activity has long been used as an index for brain development, as it is able to provide insights into the baseline organization of the brain that "task-based" activity cannot.
- However, it remains unclear how brain connectivity differs between resting-state and speech processing, and what is the developmental trajectory of brain connectivity across time.

Methodology

Participants:

Bilingual: English/Mandarin	N	Age range	Gender
Children: Younger	18	5 - 7 Yrs	10 M
Children: Older	17	8 – 10 Yrs	11 M
Adult	17	22 - 34 Yrs	9 M

Electroencephalography

- 65 Event-related scalp sites
- Sampling Rate: 1000 Hz
- Bandpass filter: 0.1 - 1000 Hz

Offline Process:

- AEP source montage for speech conditions, and DMN resting-state source montage for the resting condition

Time-frequency and brain connectivity analysis: 1-40 Hz, wavelet length:3, wavelet oscination: 5

Objective

The objective of this study is to examine the developmental changes of brain connectivity for speech processing and resting-state changes in Mandarin-English Bilinguals.

Methodology

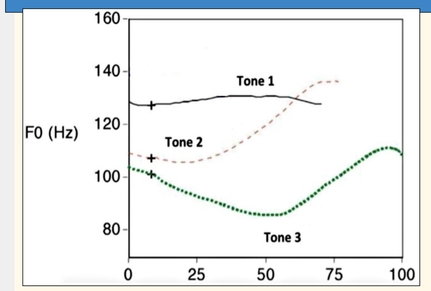


Fig. 1. Fundamental Freq. of Mandarin lexical tone contrasts

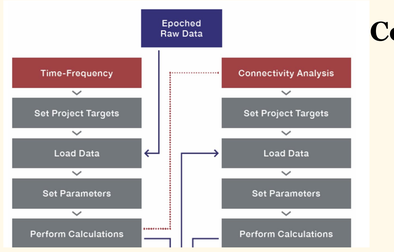


Fig.2. data analysis flow for time-frequency & connectivity

Connectivity methods:
coherence;
phase locking value;
phase lag index value;
weighted phase lag index value

Results

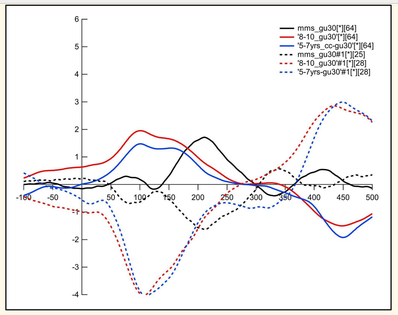
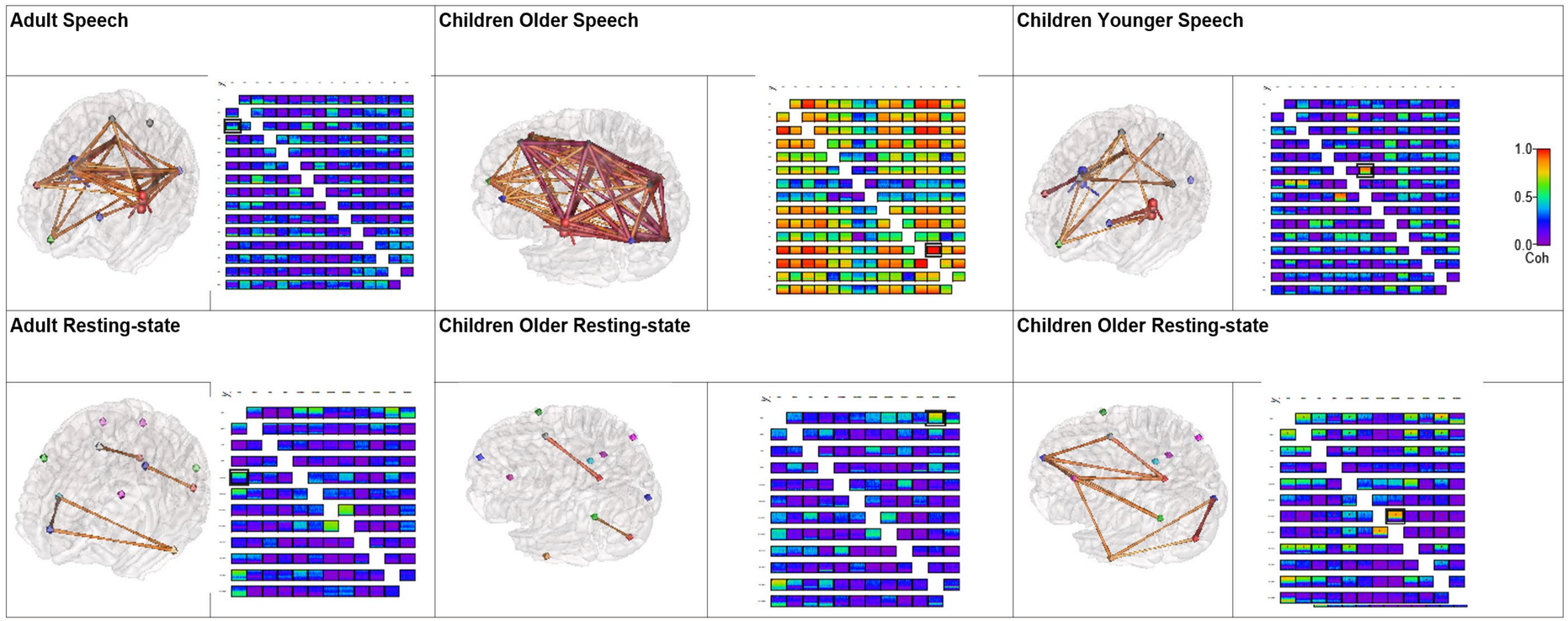


Fig. 4. Waveforms at Cz and left mastoid for three age groups from gu3pa (Tone 3, standard condition)

Results



Conclusion

In speech processing, neural network is less organized in young children. Older children (8-10 yers) showed the strongest connectivity and brain coherence. The less dense connectivity in adults probably indicates higher level of automaticity in speech processing. Resting-state neural network coherence does not change much across time from early childhood to adulthood.