Rhythmic Synchronization Ability Predicts Performance on a Melodic Intonation Therapy Task and Reading Fluency

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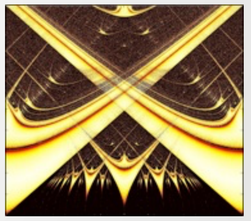


Introduction

- Rhythmic abilities are associated with many language processing abilities, in multiple language systems (Carr et al., 2014, Meng et al., 2005)
- Different clinical populations with different language deficits can show similar rhythmic synchronization impairments
  - ➢ Developmental language disorders (e.g., developmental dyslexia; Goswami et al., 2012)
  - ➢ Acquired language disorders (e.g., non-fluent aphasia; Zipse et al., 2014)
- Rhythm is a clinical language rehabilitation method
  - ➢ Melodic Intonation Therapy (MIT; Schlaug et al., 2009)
  - ➢ Other rhythm-based interventions (Bonacina et al., 2015)

Methods

- Subjects:
  - ❖ 17 Native Mandarin Speakers & 17 Native English Speakers
  - ❖ 12 Male, 22 Female
  - ❖ Age: 18 – 67 years old (m =27, sd = 9)
  - ❖ Years of instrument playing: 0~25 years (m = 5, sd = 5.7)
- Tasks:

T1: Synchronize taps to metronome (Large at al, 2002)

Phase Perturbation:

X X X X X X X | X X X X X X X X | X X X X X X X X

Tempo Perturbation:

X X X X X X X | X X X X X X X X | X X X X X X X

Red Xs indicate window of analysis (resynchronization window)

Perturbation direction and size: ± 8%, ± 15%, ± 25%

Base tempo of the metronome: 2Hz, 2.5Hz, 3Hz

T2: Metric Test

- The Montreal Battery of Evaluation of Amusia (Peretz et al., 2003)

T3: Coordinating taps with syllables (MIT task)

- 228 syllables per subject

T4: Synchronize syllables with metronome

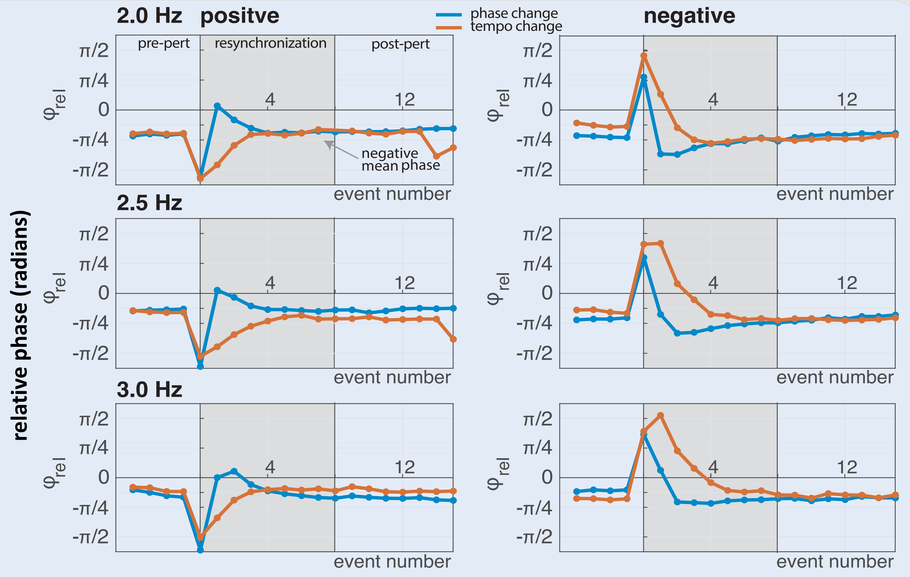
- 4.5 Hz metronome
- 232 syllables per subject

T5: Language assessment

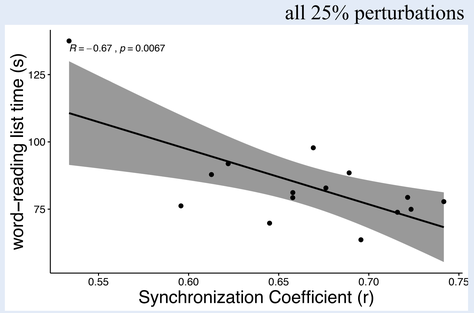
- English subjects:
  - WJ-III word-letter ID & word attack
  - Grey Oral Reading Test
    - Fluency and Comprehension
- Mandarin subjects:
  - Word Reading List
  - Reading Fluency & Comprehension test

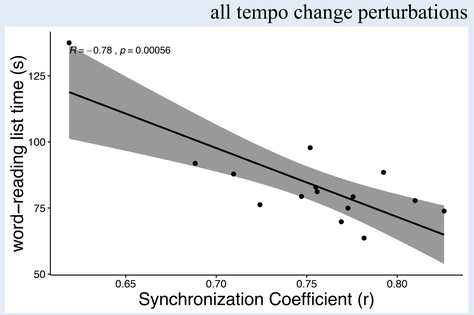
Results

- Linear mixed effects model showed a significant effect of trial window ($\chi^2 = 1389.4$, $p < 0.001$): during the resynchronization window the synchronization coefficient was significantly lower than during pre- and post-perturbation windows
- A hierarchical multiple regression model showed that, after controlling for age, years of experience, and metric test score, synchronization coefficients during the resynchronization trial window significantly predicted:
  - Ability to synchronize syllables with a metronome
  - Performance on the MIT task
  - Mandarin and English language fluency measurements

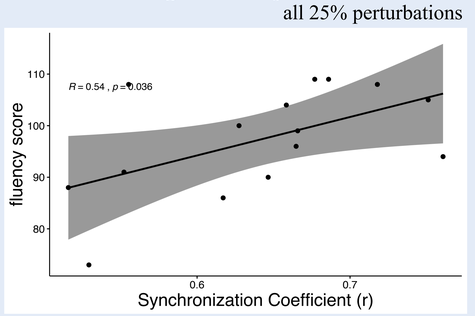


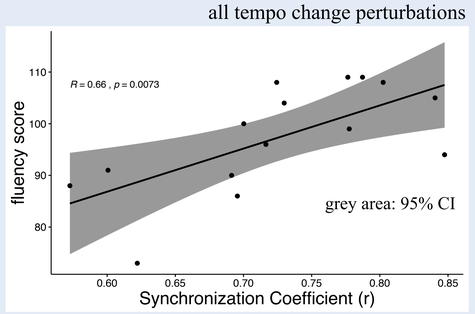
Mandarin Subjects



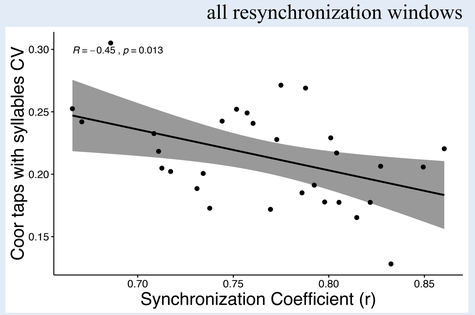


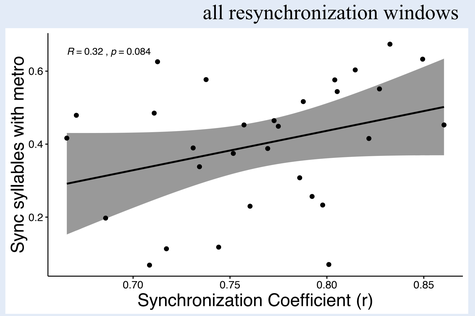
English Subjects





All Subjects





Conclusions and Implications

- Participants' ability to synchronize with a perturbed metronome correlates strongly with performance on the MIT task
- Synchronization performance also correlated strongly with language fluency scores
- Both findings generalized across English and Mandarin speakers
- Results support intervention and rehabilitation methods based on rhythmic synchronization training

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