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Background

A **sensitive period** is a developmental window during which early enhanced experience has a long-term effect on brain and behavior¹. Our lab has identified a sensitive period for music training between the ages of 5 and 9 years old².

- Musicians who started training before 7 years old outperform later-trained musicians on rhythm synchronization tasks².
- Early trained musicians also exhibit differences in brain regions important for auditory-motor integration this includes increased grey matter in the ventral premotor-cortex³ and enhanced white matter connectivity in the corpus callosum⁴.

Auditory-motor synchronization refers to the capacity to coordinate movements to rhythmic auditory stimulus.

- Requires the ability to process temporal aspects of sound which music training can help promote.
- Music training is associated with increased synchronization to speech sounds⁵ while better synchronization is also related to an improved capacity to identify statistical relations between syllables via traditional statistical learning paradigm^{5,6}.

We propose that age of start (AoS) of music training plays a role in auditory-motor synchronization and speech skills because it creates a scaffolding effect upon which overlapping neural networks can develop due to training induced neuroplasticity.

Goals

1. Expand our knowledge of sensitive periods for music training
 - Determine if AoS impacts auditory-motor synchronization and statistical word-learning performance.
 - Determine if auditory-motor synchronization is related to neural encoding of speech sounds and if **AoS of training mediates this effect**.
2. Explore if AoS of training is associated with other music-related cognitive skills.

Hypotheses

Musicians will be better at synchronizing and at identifying statistical relations between syllables than non-musicians while musicians who started training before age 7 will **outperform later trained musicians**.

Early trained musicians will exhibit **enhanced neural encoding** of speech sounds as indexed by more precise frequency-following responses.

Early trained musicians will outperform late trained and non-musicians on other music-related cognitive skills.

Measures

Participants

- 105 participants between 18 and 35 years old
- Three groups (early-trained, late-trained and non-musicians)
- Musicians will be recruited from Concordia and McGill Universities' music departments.
- Musicians must be currently practicing their instrument or singing and must have a minimum of three years of formal music training.

Tasks



Music

- Revised-Music Experience Questionnaire
- Barcelona Music Reward Questionnaire
- Computerized Beat-Alignment Test
- Rhythm Synchronization
- Musical Ear Test
- Music-in-Noise Task



Language

- Speech-to-speech synchronization (see Figure C)
- Speech-to-tone synchronization
- Statistical language learning
- Speech-in-Noise Task

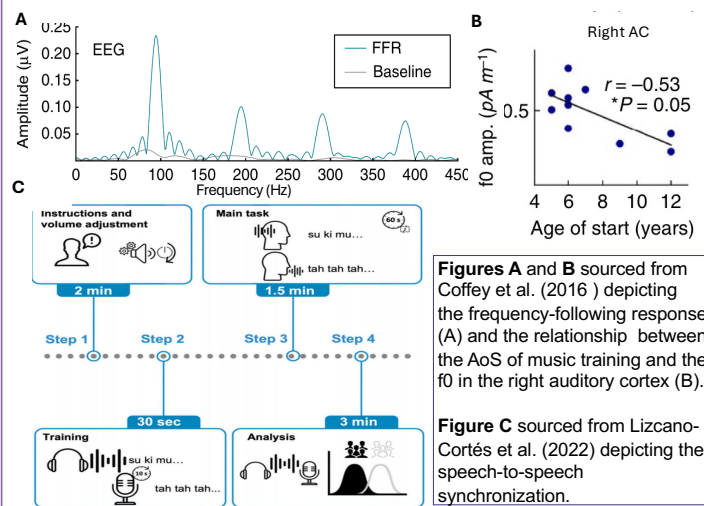


Neural

- Frequency-following response: collected via 64-channel electroencephalography (see Figures A & B)

To ensure that behavioral and neurophysiological differences between groups can be attributed to AoS, the music groups will be matched according to total years of practice, years of formal training and current hours of practice.

Key Tasks



Figures A and B sourced from Coffey et al. (2016) depicting the frequency-following response (A) and the relationship between the AoS of music training and the f0 in the right auditory cortex (B).

Figure C sourced from Lizcano-Cortés et al. (2022) depicting the speech-to-speech synchronization.

Implications

Improve our knowledge of the long-term effects of music training on auditory-motor synchronization and on a possible transfer to language-related skills.

Improve our understanding of the maturational timeline for music and language-related cognitive skills.

Demonstrate the benefits of early training on behavior and brain networks implicated in music and language domains.

Long-term potential for the promotion of early education music programs.

References

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