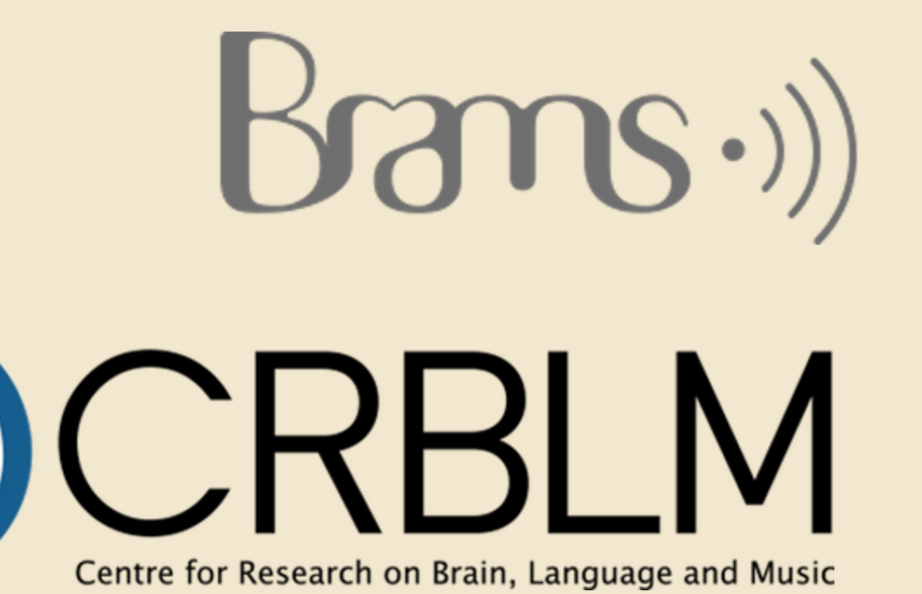


The sooner the better?



Sensitive periods and the effect of musical training

P. Berry, M. Psomas, J. Velez, E. Whittington & V.B. Penhune

What we want to know

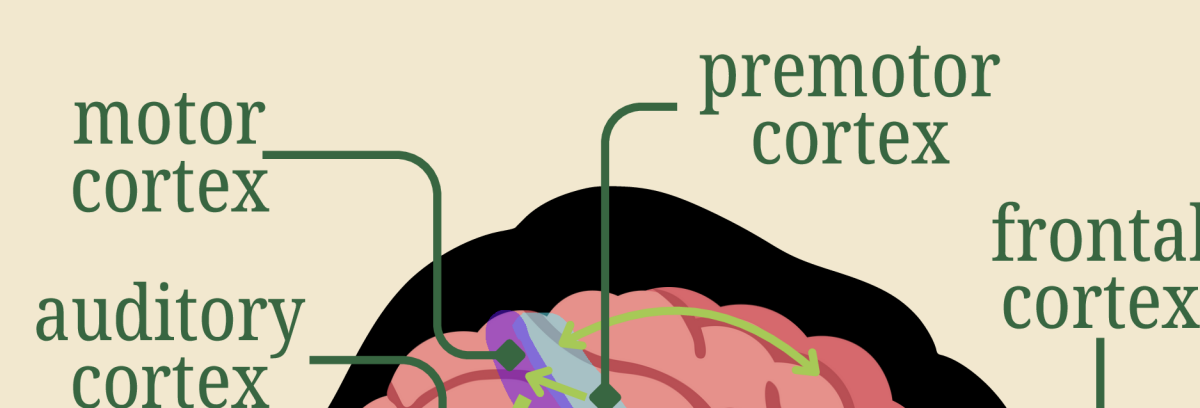
Does starting music training before age 7 impact musical abilities later in life? Does this experience transfer to other abilities?

Understanding how experience impacts musical skill sheds light on how the brain is shaped during development.

& why we care

Sensitive Periods

The interplay of genetic predispositions, exposure to specific experiences, and the window of development in which particular experiences occur leads to lasting neuroanatomical and behavioural changes¹.



Auditory Motor Synchronization

The interaction between auditory and motor systems in the brain is crucial to synchronize movements to sound, a skill that is relevant to music production and perception².



Developmental Windows

Auditory Cortex
1 - 5 years old³

Premotor Cortex
6-8 years old⁴

Corpus Callosum
6-8 years old⁵

Experimental Design

Musical Tasks

rhythm discrimination (MET)

melody discrimination (MET)

rhythm synchronization

beat alignment

Participants

- Participants divided into three groups: early-trained (< age 7), late-trained, and non-musicians
- Musicians must have at least 3 years of formal training and be currently practicing
- Seeking 105 participants, 35 per group

Other Tasks & Questionnaires

hearing in noise

frequency following response

statistical language learning

speech to speech synchronization

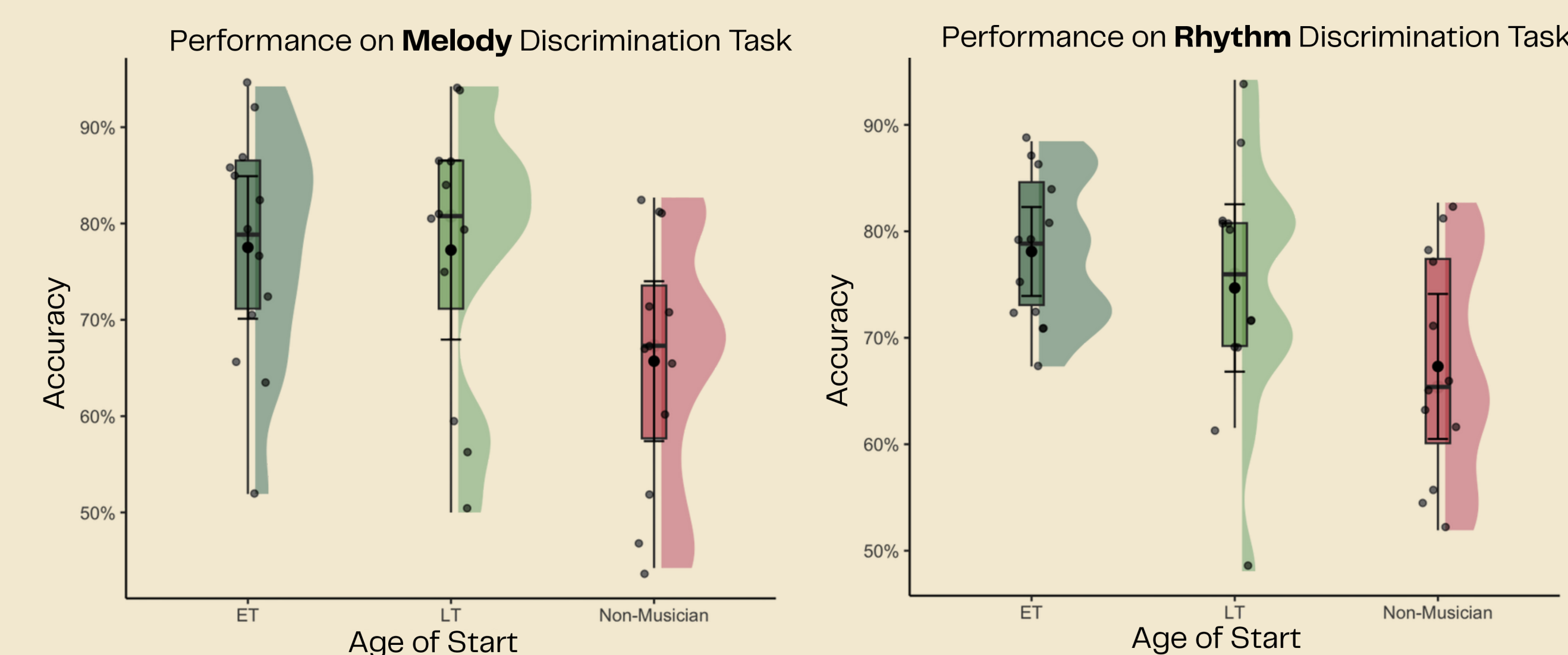
barcelona music reward questionnaire

musical experience questionnaire

WAIS

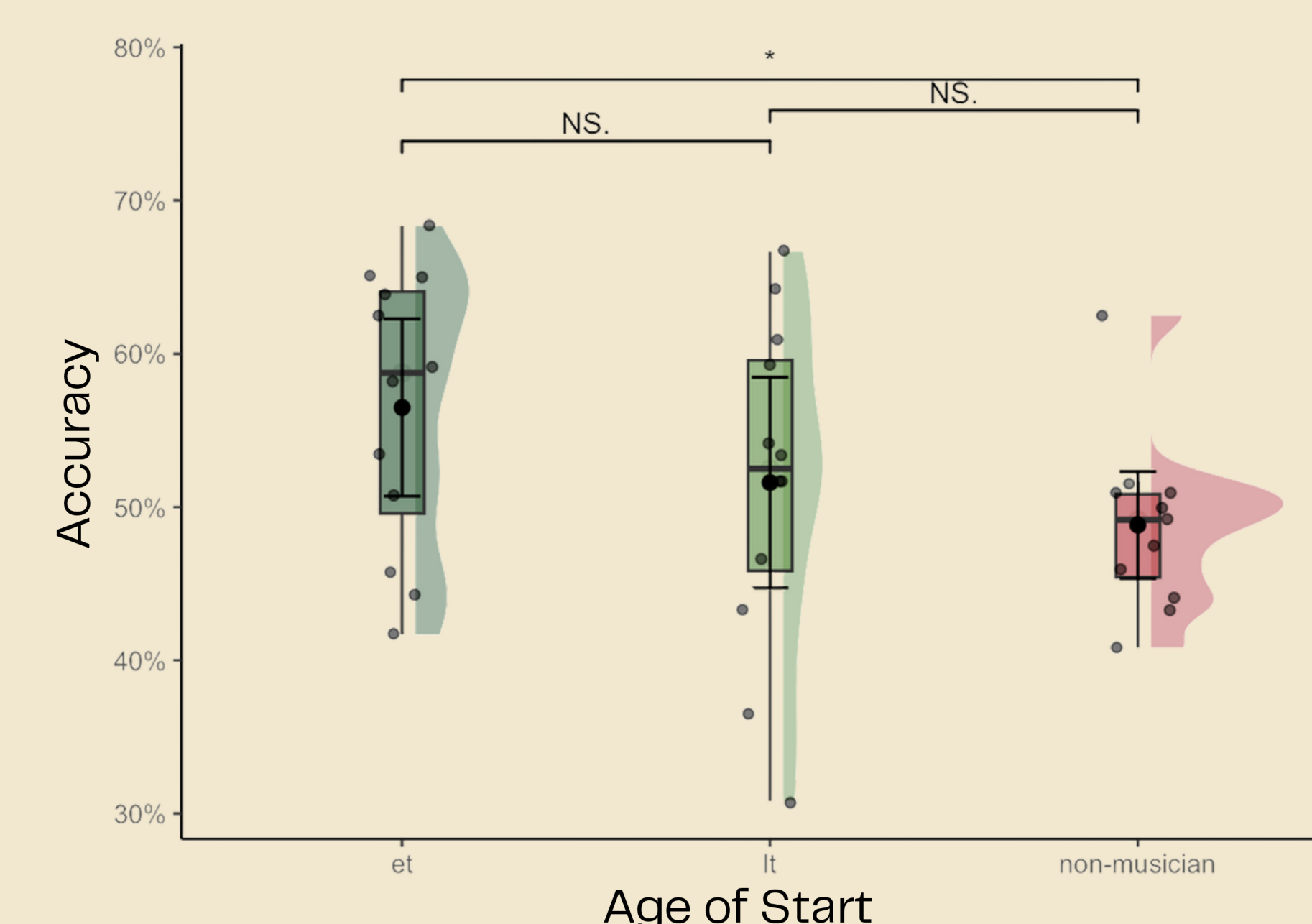
Preliminary Results

Performance on Musical Ear Test

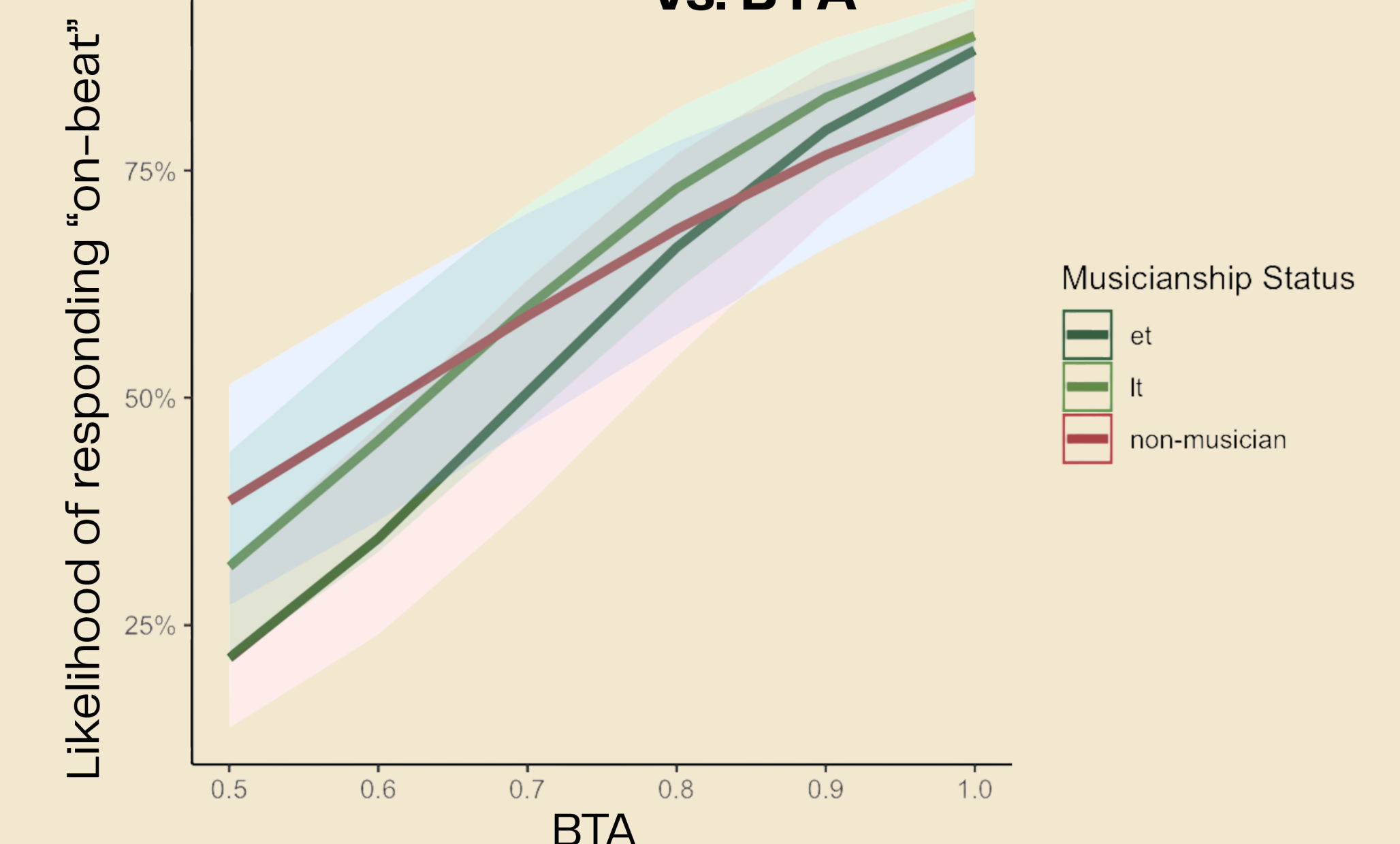


- n = 37
- Pilot data → convenience sample of Concordia psychology students
- Musical Ear Test shows differences between groups on rhythm but not melody task
- CA-BAT results indicate that ET musicians are more accurate when indicating if metronome is on/off beat
- ET less likely to respond "on-beat" at low BTA and more likely to respond "on-beat" at high BTA

CA-BAT Accuracy by Age of Start



Likelihood of Responding "On-Beat" vs. BTA



Discussion

- Pilot data indicates that tasks are performing as expected
- Is there a different mechanism driving performance on melody and rhythm tasks?
- Could there be different sensitive periods for different musical skills?
- Continue exploring relationship between music variables (years of experience, years of training, age of start) and performance on various musical tasks

Future Directions

- Continue testing with well defined musicianship groups
- Investigate relationships between age of start, statistical word learning, speech synchronization abilities, and hearing in noise
- Explore neural differences between groups via frequency following response (electroencephalography)

¹ Penhune, V. B. (2020). A gene-maturation-environment model for understanding sensitive period effects in musical training. *Current Opinion in Behavioral Sciences*, 36, 13-22. <https://doi.org/10.1016/j.cobeha.2020.05.011>

² Zatorre, R. J., Chen, J. L., & Penhune, V. B. (2007). When the brain plays music: auditory-motor interactions in music perception and production. *Nature Reviews: Neuroscience*, 8(7), 547-558.

³ Moore, J. K., & Guan, Y. L. (2001). Cytoarchitectural and axonal maturation in human auditory cortex. *Journal of the Association for Research in Otolaryngology: JARO*, 2(4), 297-311.

⁴ Giedd, J. N., Blumenthal, J., Jeffries, N. O., Castellanos, F. X., Liu, H., Zijdenbos, A., Paus, T., Evans, A. C., & Rapoport, J. L. (1999). Brain development during childhood and adolescence: a longitudinal MRI study. *Nature Neuroscience*, 2(10), 861-863.

⁵ Westerhausen, R., Luders, E., Specht, K., Orfe, S. H., Toga, A. W., Thompson, P. M., Helland, T., & Hugdahl, K. (2011). Structural and Functional Reorganization of the Corpus Callosum between the Age of 6 and 8 Years. *Cerebral Cortex*, 21(5), 1012-1017. <https://doi.org/10.1093/cercor/bhq165>