

Benefits of music when learning a foreign language: a classroom neural tracking study

Anna M. Czepiel*, Christina M. Vanden Bosch der Nederlanden
Department of Psychology, University of Toronto Mississauga

Contact: a.czepiel@utoronto.ca

Introduction

Language learning improves when words put to song[1,2], perhaps due to rhythmic predictability & enjoyment[3]

Behavioural effects consistent with evidence that brain tracks words more strongly in song[4], especially in familiar songs[5]

Effects not yet directly related together, and only conducted in **controlled lab settings; limiting generalizability**

Current study:

- Can **song aid learning** in uni **classroom with live interaction**?
- Does the neural tracking in the brain support **language learning**?

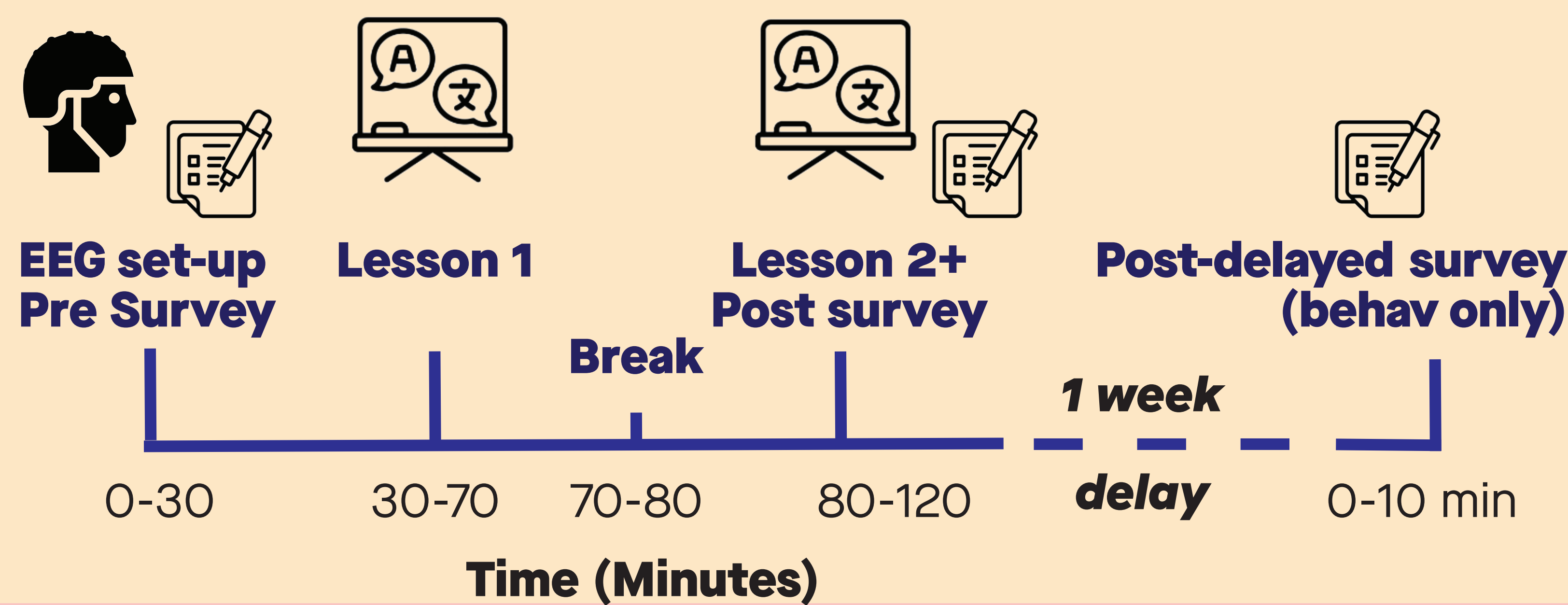
Method

Participants: Groups of 3-6 university students (plus 1 teacher)
N=16 (goal=32), age mean=18.87, sd=0.99, 18-21, N Female=12

Materials:

- Introductory (German) language course: **4 topics**, each **8 target words**

Design: Within-subjects, topics presented by live instructor in
(1) Speech, (2) Song (familiar melodies, 7-pnt rating: M=5.5, SD=2.17)
→ Conditions counter-balanced



Measures:

- Learning of target words: recognition, recall, & comprehension
- Engagement, focus, mind-wandering, enjoyment (7-pnt scale)
- Positive And Negative Affect Scale (**PANAS**)[6]
- Inclusion of Self in Other (**IOS**)[7]

Mobile EEG

- mBrainTrain SMARTING PRO (32-chan, sample rate: 500 Hz)
- Zoom H3-VR 360° 4-chan audio, Owl Meeting camera, 360° video
- Synchronised via lab streaming layer (LSL)
- EEGLAB/Fieldtrip[8,9] in MATLAB for preprocessing and analysis

References

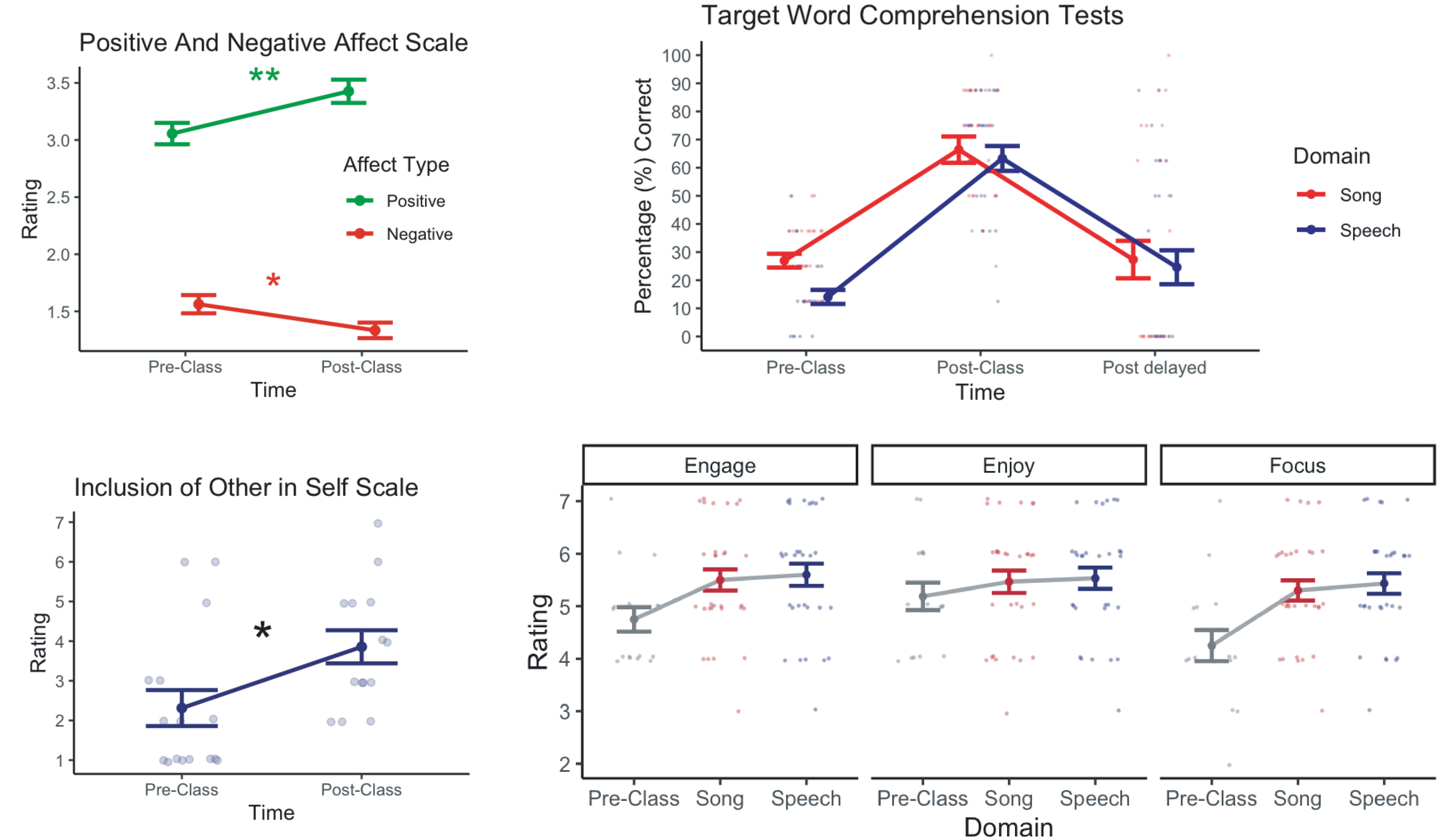
- [1] Ma, W., Bowers, L., Behrend, D., Margulis, E. H., Thompson, W. F. (2024), *Q. J. Exp Psychol*
[2] Ludke, K. M., Ferreira, F., & Overy, K. (2014). *Memory & Cognition*
[3] Fiveash, A., Ferreri, L., Bouwer, F. L., ... & Tillmann, B. (2023), *Neurosci. & Biobehav. Rev.*

- [4] Vanden Bosch der Nederlanden, C. M., Joanisse, M. F., Grahn, J. A. (2020), *NeuroImage*
[5] Vanden Bosch der Nederlanden, Joanisse, M. F., Grahn, J. A., Snijders, T. M., Schoffelen, J-M. (2022), *NeuroImage*
[6] Watson, D., & Clark, L. A. (1994). The PANAS-X: Manual for the positive and negative affect schedule-expanded form.
[7] Aron, A., Aron, E. N., & Smollan, D. (1992). *J. Pers. Soc. Psychol.*

- [8] Oostevend, R., Fries, P., Maris, E., & Schoffelen, J. M. (2011), *Comput. Intell. & Neurosci.*
[9] Crosse, M. J., Di Liberto, G. M., Bednar, A., & Lalor, E., (2016), *Front. Hum Neurosci.*
[10] Dikker, S., Wan, L., Davidesco, I., Kaggen, L., Oostrik, M., McClintock, J., ... & Poeppel, D. (2017), *Curr. Biol.*
[11] Chabin, T., Gabriel, D., Comte, A., Haffen, E., Moulin, T., & Pazart, L. (2022), *Ann. N. Y. Acad. Sci.*

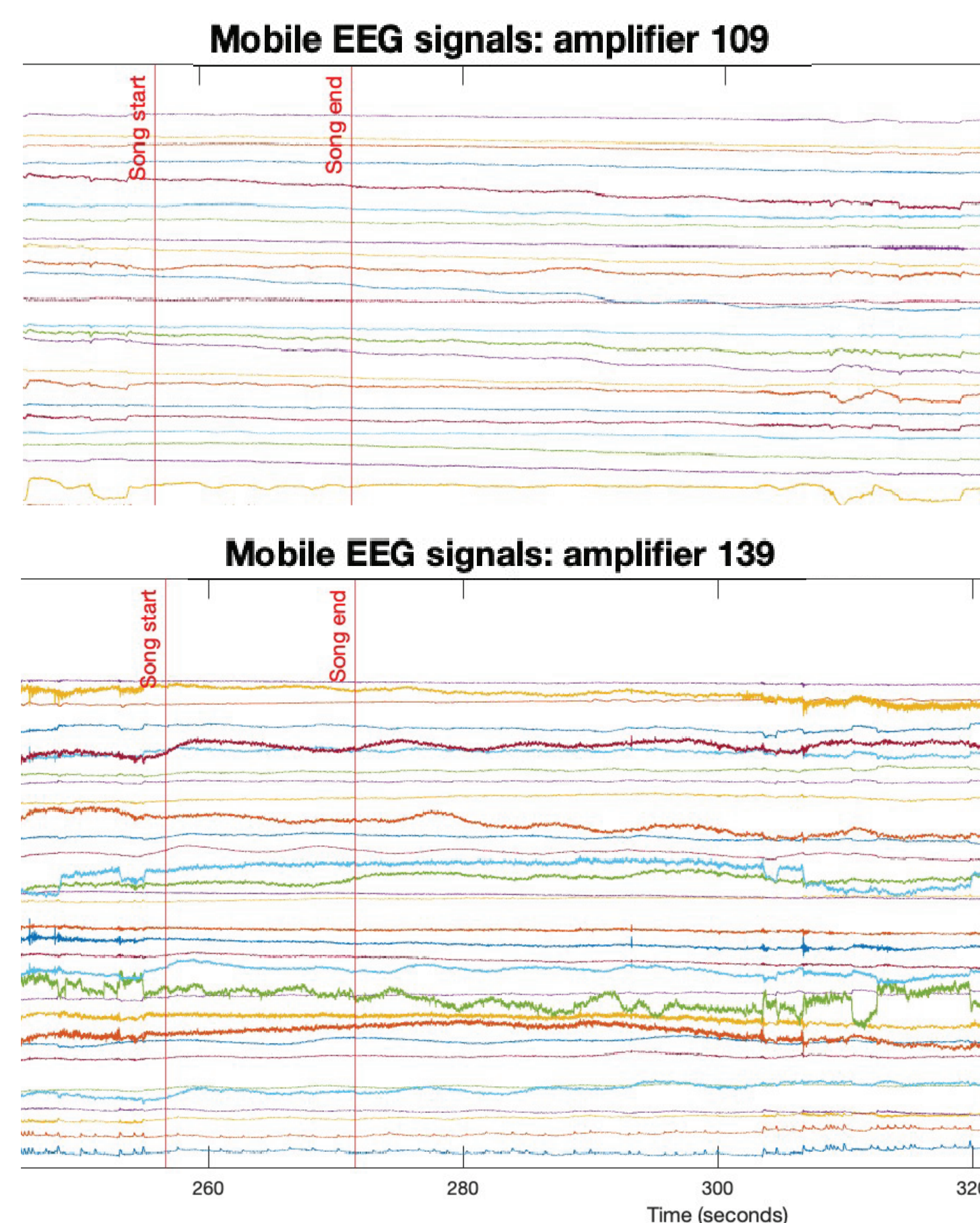
Preliminary Behavioural results

- Learning best occurred immediately after lesson: **song nominally better**
- **Class was enjoyable** (increased positive **PANAS**, enjoyment, focus) & increased social connectedness



Neural Tracking analysis

We expect **higher neural tracking** (mTRF[9], phase coherence[4,5]) in **song & related to learning**



Outlook and implications

- Learning occurred, with certain **song benefits**
- Despite challenges of **naturalistic design**, clear social interaction benefits[10,11]
- Future plans: developmental study with children
- Start of **mobile eeGTA consortium** (LAMA lab, BEAT lab, TEMPO lab, SMART lab, Auditory Aging lab)

Acknowledgements

- mBrainTrain SMARTING PRO generously provided by Björn Herrmann & SMART lab.
- 360° camera generously provided by APPLY Lab & FUKUDA Lab at UTM
- German lessons curated by Suzanne Schafer in collaboration with CVBDN & AMC