The Multilingual Mind: lecture series on multilingualism across disciplines

Winter Semester 2021/2022
Tuesdays, 17.00 - 18.30 CET
Online

02.11.2021

Sergio Soares (University of Konstanz)

Neurophysiological oscillatory correlates of heritage bilingualism

Abstract

Bilingualism can result in a more fine-tuned executive control system and in structural and functional brain adaptations (see for a review Pliatsikas, 2019). However, the effects of bilingualism studied through the lenses of neural oscillations remain understudied. Here, I will present findings from two projects of my dissertation's work, comprising resting state EEG (rs-EEG) and time-frequency representations (TFRs) data. Rs-EEG activity (frequency power) is related to various cognitive functions and can estimate neurological connectivity (mean coherence) between brain regions. As such, it has emerged in the past few years as a complementary neuroimaging methodological option to investigate the effects of languages in the brain (Bice et al., 2020; Prat et al., 2016). On the other hand, research using TFRs has shown that executive function tasks (e.g. Flanker task - FT) modulate power within theta and alpha frequency bands. These power modulations have been linked to a greater engagement of the executive control system (Cavanagh & Frank, 2014). Herein, we use brainwaves to investigate how individual differences in bilingual language experience may modulate neurocognitive oscillatory outcomes.

EEG data for both tasks were collected from heritage speakers (HSs) and late L2 learners. All participants completed the Language and Social Background Questionnaire (LSBQ; Anderson et al., 2018), which quantifies language exposure and crucially the division of usage in diverse variety of activities and settings in the participants' two languages over the lifespan. We hypothesized degree of active bilingualism would predict changes in frequency bands (mostly in alpha and beta bands) in both early and late bilinguals at both the rs-EEG (power and functional connectivity) and task-based EEG levels.

We found main effects of Age of L2/2L1 onset on *high beta* and *gamma* powers (i.e., earlier acquisition resulted in higher beta and gamma frequencies) and higher exposure/usage scores from the LSBQ of the non-societal language at home modulated mean coherence effects (functional brain connectivity) in *theta*, *alpha* and *gamma* frequencies for the rs-EEG data. Similarly, individual differences analyses from the FT revealed significant correlations between age, age of acquisition, and usage of the non-societal language at home with *alpha* and *beta* band activity for late bilinguals, whereas only age effects were found in early bilinguals. Furthermore, when correlating *alpha* power with reaction times, early bilinguals showed a negative correlation while later bilinguals show a positive correlation.

Results are in line with claims that bilingualism effects are not monolithic, but rather indicate adaptations towards differential brain recruitment to deal with the cognitive demands associated with variation in language experience.

References

Anderson, J. A., Mak, L., Chahi, A. K., & Bialystok, E. (2018). The language and social background questionnaire: Assessing degree of bilingualism in a diverse population. *Behavior Research Methods*, *50*(1), 250–263.

Bice, K., Yamasaki, B. L., & Prat, C. S. (2020). Bilingual Language Experience Shapes Resting-State Brain Rhythms. *Neurobiology of Language*, *1*(3), 288–318.

Pliatsikas, C. (2019). Multilingualism and brain plasticity. In *The handbook of the neuroscience of multilingualism* (In J. Schwieter (Ed.), pp. 230–251). Hoboken, NJ: Wiley-Blackwell.

Prat, C. S., Yamasaki, B. L., Kluender, R. A., & Stocco, A. (2016). Resting-state qEEG predicts rate of second language learning in adults. *Brain and Language*, *157*, 44–50.