Exploring relationships between speech understanding and auditory ERPs

Tess K. Koerner, Leslie Grush, Brandon M. Madsen, Curtis J. Billings VA RR&D National Center for Rehabilitative Auditory Research, VA Portland Healthcare System, Portland, OR

Understanding speech in background noise is difficult for many individuals. Factors such as age, hearing sensitivity, and cognitive processing abilities likely contribute to the variability in performance often observed across individuals. Electrophysiological measures are ideal for assessing speech perception in complex listening environments as they allow for an examination of the effects of various factors on neural response timing and magnitude along the auditory pathway. Examining relationships between various neural and behavioral measures can provide valuable information about neural mechanisms underlying speech-in-noise perception. This work used auditory event-related potentials and behavioral measures to explore relationships between electrophysiological responses, cognitive processing abilities, and speech-in-noise perception across a group of 10 older, hearing impaired participants. Speech-evoked P3 responses were elicited to consonant-vowel syllables in a complex oddball paradigm. The P3 auditory event-related potential is thought to reflect attentional and cognitive processes related to auditory perception, and therefore serves as a useful measure for exploring variability in speech-in-noise perception in older, hearing impaired listeners. Participants also completed several speech perception tests and cognitive measures. Relationships between the P3 response and these behavioral measures were analyzed. Data from work examining the effects of age and hearing impairment on various neural and behavioral measures of speech perception in noise will also be discussed. This work has strong practical implications for the use of electrophysiological responses in the assessment of communication abilities in clinical populations by confirming that auditory event-related potentials are possible predictors of speech-in-noise perception across individuals with hearing impairment.

Funding Sources: VA Advanced Fellowship to TKK; United States (U.S.) National Institutes of Health (NIHNIDCD: DC15240) to CJB; Department of Veterans Affairs (VA-RR&D: 5IK2RX000714) to CJB.

Measuring Distress in Hearing

Lars Rogenmoser Laboratory of Integrative Neuroscience and Cognition Georgetown University Medical Center, Washington, DC, USA

Among many things, hearing is essential for making music. Life-long professional musicians becoming impaired in playing music (e.g., due to hearing loss, tinnitus) experience a severe loss of quality of life which is of high public importance. Quantifying impairment-related issues using EEG can be straightforward to some degree (e.g., ABR), whereas capturing the affective perspective is not. In my talk, I will focus on this aspect, discussing an N400 paradigm to measure distress in hearing. In particular, I will present findings from a special population representing a bend point in auditory performance, namely musicians with absolute pitch.

Funding source: Swiss National Science Foundation

Does lip reading make speech comprehension easier for everyone? Electrophysiological evidence on inter-individual differences in younger and older adults

Nathalie Giroud[1,2,3] & Natalie A. Phillips[1,2,3,4]

[1] Centre for Research in Human Development, Department of Psychology, Concordia University, Montréal,
Québec, Canada
[2] Centre for Research on Brain, Language, and Music, Montréal, Québec, Canada
[3] Canadian Consortium on Neurodegeneration in Aging, Team 17, Canada
[4] Lady Davis Institute for Medical Research, Jewish General Hospital, Montréal, Québec, Canada

For older adults, speech comprehension represents a strong load on working memory (WM) because of the need to rapidly process auditory cues while maintaining relevant information. The presence of visual cues (i.e., lip movements) during speech processing has been shown to enhance speech comprehension. However, the relation between audiovisual speech processing and WM remains unclear. In this EEG study, we investigated the extent to which interindividual differences in audiovisual speech processing may be explained by WM in younger (N=32) and older adults (N=16). The N400 was recorded time-locked to the last word of high and low predictable sentences. The semantic context (SC) effect was quantified as the difference in the N400 magnitude evoked by low minus high predictable sentences and assessed separately for an auditory-only (AO) and an audiovisual condition (AV). Furthermore, cortical sources of the SC effect were estimated using sLORETA. All individuals showed an earlier SC effect in the AV compared to the AO condition, highlighting faster integration of unpredictable words. Additionally, we found a stronger SE effect in the AV compared to the AO condition, but only in individuals with high WM. In low WM individuals, we found stronger right precuneus activity in the AV condition reflecting higher processing load during multisensory integration. Our data suggest that only a high WM allows to use visual speech cues to create predictions about the end of a sentence. We therefore argue that individual differences in WM may relate to qualitatively different aspects of the audiovisual benefit during speech comprehension.

Funding sources: NG: Early Postdoc Mobility Swiss National Science Foundation, NP: Canadian Institutes of Health Research (Grant MOP-97808)

Word learning as a promising tool for assessing auditory-related disorders and cognitive dysfunctions

Stefan Elmer Division Neuropsychology (Auditory Research Group Zurich, ARGZ), Institute of Psychology, University of Zurich, Switzerland

Word learning constitutes a multifaceted task that requires the dynamic interplay between perceptual and cognitive functions. In my talk, I will propose different word learning tasks as promising tools for assessing auditory-related disorders, learning disabilities, and mnemonic dysfunctions across the lifespan. In particular, I will present EEG data on word segmentation and word-meaning learning in different populations, including children, adults, elderly as well as musicians. Furthermore, I will emphasize how different EEG parameters (i.e., event-related potentials, frequency-based analyses, and source-based functional connectivity) can be used in a fruitful manner for diagnostic purposes and for predicting training outcome.