Title: Investigating awareness of linguistic structure with auditory speech entrainment

Presenting Author: Rodika Sokoliuk

Author(s): Rodika Sokoliuk, Centre for Human Brain Health (CHBH), School of Psychology, University of Birmingham, UK, Giulio Degano, Centre for Human Brain Health (CHBH), School of Psychology, University of Birmingham, UK, Uta Noppeney, Centre for Human Brain Health (CHBH), School of Psychology, University of Birmingham, UK

Abstract:

Rhythmic sounds “entrain” auditory brain regions (Regan, 1982), measurable as peaks in the EEG/MEG power spectrum. Listening to speech also makes our brain follow the speaker’s rhythm and, if we understand the language, we know which words build a sentence based on their semantic information. Previous MEG/EEG studies showed that this semantic information leads to cortical entrainment without any acoustic cues (Ding et al., 2016, 2017). In these studies, a stream of mono-syllabic 250ms-long words, which either built meaningful sentences (e.g. cold-homes-need-heat) or scrambled sequences (e.g. rain-fast-wear-scene) provoked acoustic entrainment at the word rate. However, sentential entrainment was only observed for meaningful sentences, reflecting comprehension of the sentential structure. This paradigm may therefore be of particular use in behaviourally unresponsive patients with prolonged disorders of consciousness (PODOC), who could show remaining capacities of conscious awareness as revealed by previous neuroimaging studies; the degree to which they understand instructions and the length of their attentional range is although uncertain. In all previous studies, participants were informed about the sentential structure within the stimulus. We therefore tested whether sentential entrainment could be observed in 48 naive participants. One half of participants performed a detection task, identifying words in the auditory stream while the other half was passively listening. Crucially, we found prior knowledge about stimulus structure is not necessary to independently learn and subsequently report the sentence structure, or for the EEG to show sentential entrainment. Furthermore, increased attention did not boost entrainment at the word or sentence rate, suggesting the sentence structure popping-out without task demands. Our results thus suggest this paradigm being a suitable low cognitive-demand marker of awareness in PODOC. We are currently completing a longitudinal study of the paradigm’s diagnostic and prognostic utility in coma and PODOC, and will present preliminary results alongside our healthy control studies above.