Rhythm-Based Word Segmentation and its Relation to Speech-Brain Coherence in 9-month-old Infants

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Infants use rhythmic information as one of the important cues in word segmentation (Jusczyk et al., 1999). However, little is known about the neural mechanisms behind this sensitivity to rhythm. Neuronal oscillations in auditory cortex track the rhythm of the speech input, and synchronize with the incoming speech envelope (Giraud & Poeppel, 2012). In adults it has been found that this cortical tracking makes speech processing easier (Cason & Schön, 2012). Cortical tracking of the speech envelope is also present in infants, especially when listening to infant-directed speech (Kalashnikova et al., 2018).

The current study aims to gain insight into the functional relevance of cortical tracking of speech in infants for word segmentation. The following questions are investigated: Does the rhythm of the speech signal influence infants' ability to segment words from continuous speech? Does speech-brain coherence differ between rhythmic and non-rhythmic speech? How is this neural sensitivity to speech rhythm related to word segmentation?

To answer these questions, 65 monolingual Dutch 9-month-old infants participated in a two-session experiment (one rhythmic and one non-rhythmic session) during which EEG-data was collected. Each session consisted of 20 blocks, with each block containing a familiarization phase of eight sentences and a test phase of four words. The eight sentences each contained a repetition of a bi-syllabic low-frequent word with a strong/weak stress-pattern. In the test phase the familiarized target word and an unfamiliar word were presented each two times in isolation. To increase rhythmicity all sentences consisted of thirteen syllables with alternating strong/weak syllables. Stimuli were recorded with a metronome beating for every strong syllable, resulting in a stress rate of 1.6 Hz and a syllabic rate of ~3.2 Hz. For the non-rhythmic sentences the syllable duration was manipulated by speeding up or slowing down the speech across several syllables. The fragment with the target word was not adjusted, to make sure its duration remained the same between conditions.

Segmentation of the target words will be inferred by looking at the ERP word familiarity effect (Kooijman et al., 2005), comparing the ERPs evoked by the target words with the ERPs evoked by the unfamiliar words within the test phase. Speech-brain coherence during the familiarization phase will be assessed by looking at the consistency of the phase difference between the EEG signal and the speech amplitude envelope. We will specifically assess the frequencies of 3.2 Hz (syllabic rate) and 1.6 Hz (stress rate). It is expected that infants show enhanced word segmentation ability and have a stronger speech-brain coherence in rhythmic compared to non-rhythmic speech. Additionally, it is expected that infants will show enhanced word segmentation when there is higher neural sensitivity to rhythm, especially for the stress rate. The results of the study will be presented at the meeting. The outcome will inform about the functional relevance of the cortical tracking of speech for word segmentation in infants.