Early prosodic boundary perception: innate biases in preterm newborns

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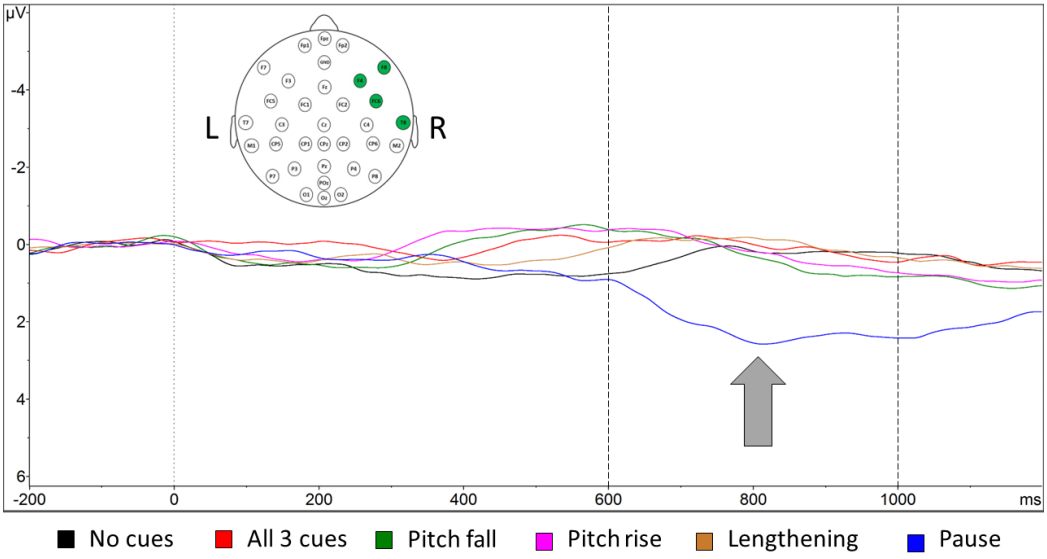
Segmenting continuous speech into meaningful linguistic units is an important first step for newborns acquiring language. The prosodic structure of speech assists in this task. Major speech units, e.g. Intonational Phrases (IPs), are marked by three types of prosodic cues: pitch change, pre-boundary syllable lengthening, and pauses. Although infants can process prosodic structure early on, the underlying mechanisms remain unclear. We hypothesise that infants initially rely on innate perceptual biases to process IP boundaries, namely, physiologically-motivated or cross-species perceptual mechanisms, e.g., the Respiratory Code (RC) and the Iambic-Trochaic-Law (ITL). According to the RC, high pitch is associated with phrase beginnings and low pitch with phrase endings, with pauses between phrases. According to the ITL, lengthened and low-pitched elements occur phrase-finally.

We presented 40 clinically-stable preterm newborns (28-33 weeks of gestation, Dutch-speaking parents) with utterances containing or lacking an IP boundary ([Moni and Lilli and Manu] vs. [Moni and Lilli] [and Manu]), within one week after birth. Boundaries were marked by either one cue or all cues. We measured the EEG component indexing boundary processing, the Closure Positive Shift (CPS), in each condition. We predict that, despite minimal prenatal and postnatal language exposure, preterm newborns can process IP boundaries using the individual cues, based on biologically-motivated principles.

Linear mixed effects modelling shows the CPS was elicited only in the pause condition in the right-frontotemporal region ($p < 0.001$). This implies newborns initially process major prosodic boundaries based on pauses, partially supporting our hypothesis. Associations between prosodic boundaries and other cues may be developed via input-driven learning.

Figure 1

ERP waveforms for frontotemporal electrodes on the right hemisphere, timelocked to the onset of the preboundary syllable.



Note:

Typically, CPS is a positive (downward-facing) deflection observed on frontal electrodes between 500-800ms after detecting a prosodic boundary. This response may be delayed in preterm newborns due to incomplete myelination of the brain (e.g. 600-1000ms, indicated by dashed lines). The gray arrow indicates the CPS, elicited when the boundary in the name sequences is marked by (only) a pause.