

Electrophysiological correlates of intonational phrase perception in infancy and childhood: How necessary is syntactic knowledge?

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In the course of acquiring their first language, infants decompose continuous speech into relevant structural units such as clauses and words. Gleitman & Wanner (1982) have suggested, within the framework of *prosodic bootstrapping*, that infants approach this segmentation problem by exploiting acoustic information in the speech signal which correlates with the occurrence of syntactically significant phrase boundaries, i.e., intonational phrase (IPh) boundaries. Here we report on the use of event-related brain potentials (ERPs) to investigate the emergence of IPh processing in young children. Specifically, we focused on an electrophysiological component referred to as the *Closure Positive Shift* (CPS), which is known to signal the online processing of IPh boundaries in adults (Steinhauer, Alter, & Friederici, 1999).

We explored the relationship between IPh processing and the emergence of syntactic knowledge in children for the following age groups: 5 months, 21 months, and 36 months. For the age of 5-6 months, behavioral studies have described an evolving sensitivity to prosodic boundary markers (e.g., Jusczyk et al., 1992). Regarding syntactic abilities, ERP studies have reported a developmental shift between 24 and 32 months for the processing of phrase structure violations (e.g., Oberecker & Friederici, 2006). Thus, children at the age of 21 months have not yet passed this developmental stage, while children at 36 months do.

The three groups of children listened to prosodically correct sentences, which either consisted of one IPh (no IPh boundary) or two IPhs (one IPh boundary). Additionally, another group of 5-month-olds was tested with sentences where the pause at the IPh boundary had been deleted and the IPh was only marked by a change in pitch and a lengthening of the pre-pause syllable.

Five-month-old infants showed no CPS in response to IPh boundaries. Instead, they provided an obligatory response following the IPh boundary, which disappeared when no pause was present. This suggests the infants are sensitive to pauses in sentences. We hypothesize that this is a necessary precursor for the processing of prosodic phrase boundaries.

Of the three age groups tested, only the 36-month-old children provided a CPS in response to the IPh boundary. The comparison across age groups suggests that IPh processing, as indicated by the CPS, does not emerge until some knowledge of syntactic phrase structure has been established. We suggest two alternative explanations.

First, the adult CPS may reflect syntactic structuring abilities in addition to prosodic processing. We think this is an unlikely explanation, since the CPS is also observed in hummed sentences, which preserve the normal intonational contour but lack all lexical/semantic and syntactic information (Pannekamp et al., 2005).

Second, the CPS of young children may reflect an interaction between the processing of prosodic and syntactic information during phrase boundary perception.

In sum, the combined data suggest that syntax and prosody interact in early speech learning. Infants initially rely on acoustic aspects of prosodic information to build up basic structural knowledge, but later acquired knowledge is employed to reinforce the perception of the different structural units in the speech input.

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