

From Babbling to First Words: Acoustic Analysis of Two German Infants

Britta Lintfert
University of Stuttgart, Germany, Britta.Lintfert@ims.uni-stuttgart.de

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Abstract

How do infants learn to produce the sound patterns of their native language? This paper is a short report on work in progress. Our aim is to develop an exemplar-based model for the first-language acquisition of the correlates of stress in German. Before the onset of meaningful speech, infants are sensitive to the frequency of occurrence of the sound patterns in the ambient language, and they are able to encode this information in the representation of these patterns (Jusczyk et al.:1994, Curtin, Mintz & Christiansen: inpress). Curtin, Mintz and Christiansen showed that already after several months of exposure to the target language patterns, infants represent stressed and unstressed syllables in a different way. Their experiments suggest that stress information in the ambient language not only shapes the representational landscape used by infants in segmentation, but that this information is also encoded in the representations of parsed sequences. This findings supports the possibility that stressed syllables are differentially represented from their unstressed counterparts and gives evidence for an exemplar theory of representations (Goldinger:1998), in which details from the input are retained in memory for each token. But how and when do infants learn to produce these different representations? Babies already seem to have a sufficient sampling of exemplars to make language-specific generalizations about the distribution of values in the auditory dimensions of the phonetic space (Beckman:2003), and babbling is one key mechanism that permits babies to discover and produce the patterned structure of the ambient language (Boysson-Bardies:1999, Vihman/Velleman:2000).

To develop an exemplar-based model of the acquisition of contrastive stress in German we analyze the effects of stress on its main acoustic correlates, i.e. on fundamental frequency, on duration and on the quality of different vowels in German. We aim to evaluate at which time they are able to produce stress and how they realize it. Our hypothesis is that children adopt the features that their parents use to indicate stress and produce stress in the same way as their parents do.

To test this hypothesis we started a longitudinal study two years ago and have collected speech data from 2 children with a starting age of 5 months. The data were collected as part of a larger investigation of children's acquisition of stress in German. The two infants were audio-recorded every 6--8 weeks starting at the age of 5 months, when first CV-syllable productions occur, at their homes in regular play situations with the parents. Before the recordings started the parents were instructed how to use the recording equipment. No person unfamiliar to the child needs to be present during the recordings. During a recording session one parent plays with the child, later on at the word stage reading a picture book, and introduces special picture names and encourages the child to repeat it, and later, when the picture names are known to the child, to use them spontaneously. The parents are recorded as well. The recordings are made with high-quality wireless microphones. This is necessary to ensure that, first, especially the younger children are not aware of the microphone; second, that the distance between the microphone and the mouth is constant during the entire session;

and third, that high-quality recordings are obtained, which can be analyzed acoustically using standard speech analysis tools.

Recordings and analysis are separated in three parts of development: babbling phase, meaningful speech and repeated words. We used the "Mean Babble Level" for measuring the prelinguistic vocal development (Stoel-Gammon:1989, Smith et al.:1989). The intonation pattern would be first perceptually analyzed and categorized into five categories (RISING, FALLING, RISE-FALL, FALL-RISE, LEVEL) (Whalen et al.:1991) and then compared with the fundamental frequency from the early, middle and late portion of each syllable. We also made acoustical analysis; fundamental frequency, F0 slopes, F1, F2, intensity, duration, final syllable lengthening in reduplicated babbling are examined to investigate whether the children adopt the parental strategies in the production of words. We report initial results on the examined acoustic correlates of the first 3 years of language acquisition.

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