

**Transcriptional & acoustical methods for analyzing
young children’s gestural coordination patterns in sibilant fricatives**

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This gestural coordination required to produce /s, ʃ/ correctly is not native in young children, but instead must be learned during language acquisition. Indeed, large-scale normative studies of consonant acquisition have found that /s/ is not acquired in a majority of children until age three, and /ʃ/ is not acquired until age four (Sander 1972; Smit et al., 1990). Furthermore, some children struggle with the /s/–/ʃ/ contrast until age seven (Smit et al., 1990). This protracted acquisition make English /s, ʃ/ well-suited to the study of the development of speech gestural coordination in young children. The current presentation reports on transcriptional and acoustical methods that are under development for investigating young children’s coordination patterns in sibilant fricatives.

Attempted productions of /s/- or /ʃ/-initial English real words were recorded from two-through five-year-old children. These recordings were then transcribed phonetically by a trained phonetician, using an extensive symbol set that included non-English phonemes (e.g., the fricative [ɕ] and the affricate [t͡ɕ]), as well as a connective (:) to denote when a produced sound was intermediate between canonical sounds (e.g., [s:θ]). Furthermore, attempts in which the word-initial sibilant was produced as a sequence of sounds were transcribed as such (e.g., [θs]).

These transcriptions were then pooled into classes that reflect differences in articulatory gestural coordination: 1) *fortition* errors were those productions whose transcription included either a stop or an affricate, suggesting mis-coordination between the lingual or labial and mandibular gestures, which resulted in a full occlusion, rather than a constriction, in the oral tract; 2) *heterorganic* fricative errors comprised those productions transcribed as a sequence of fricatives; 3) *homorganic* fricative errors, where the transcription was either a canonical fricative or intermediate between two fricatives, suggesting proper coordination for producing and maintaining frication, but in a way that the turbulence noise is created at the wrong place in the oral tract; and 4) *phonetically* correct productions.

Figure 1 summarizes the proportion of each type of sibilant attempt for a talker, as a function of age group. These results suggest that heterorganic fricative errors are present in the youngest talkers, but are exceedingly rare in talkers that are 3;6 years;months or older. Fortition errors seemed to persist in all cohorts except the oldest. Finally, homorganic fricative errors were the most common error for each cohort and persisted even for the oldest children recorded, suggesting that children still struggle with articulating sibilants at the proper place, even once they have developed the requisite coordination for producing and maintaining the same quality of frication throughout the duration of the consonant.

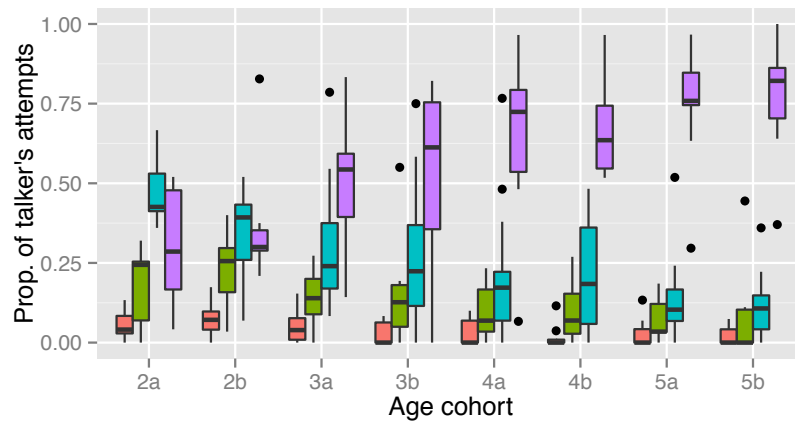


Figure 1: Proportion of a talker’s sibilant attempts that are heterorganic fricative errors (red), fortition errors (green), homorganic fricative errors (blue), and correct productions (purple).

A method for tracking changes in the spectral properties of fricative productions is also presented. This method allows one to track the development of sibilance across the time-course of the fricative, which is related to the coordination between forming the linguopalatal constriction and raising the lower incisors to create noise sources.