Contrast and covert contrast in the acquisition of /s/ and /ʃ/ in English and Japanese

Fangfang Li*; Jan Edwardsº
* Ohio State University, cathy@ling.osu.edu; ºUniversity of Wisconsin-Madison, jedwards2@wisc.edu

Résumé: Cet article examine des productions de /s/ et de /ʃ / chez 20 enfants acquérant l'anglais et 20 enfant acquérant le japonais. Nous avons observé des types d'erreurs inverses pour ces deux groupes, un résultat qui a été vérifié par des transcriptions et des analyses acoustiques. De plus, 5 enfants anglophones et 2 enfants japanophones ont montré un « covert contrast » (contraste câché), le contraste étant porté par un aspect auquel les adultes ne prêtent pas attention.

This paper examines productions of /s/ and /ʃ/ in English- and Japanese-acquiring children. These sibilant fricatives are interesting because they are often mastered late despite being common across languages (Jakobson 1968, Templin 1957, among others), and English and Japanese are particularly interesting languages in which to study them, for two reasons. First, opposite error patterns have been observed. In English, /s/ is typically mastered before /ʃ/ and [s] is reported to substitute for target /ʃ/ (e.g., Prather et al, 1975). By contrast, in Japanese, /s/ is mastered much later than /ʃ/, and [ʃ] and [tʃ] are typically reported substitutions (e.g., Nakanishi, Owada, & Fujita, 1972). Second, Tsurutani (2004) found evidence suggesting covert contrast[1] in substitutions of [ʃ] for target /s/ in five Japanese-acquiring children, and our impression of [s] for target /ʃ/ substitutions that we have heard leads us to expect covert contrast in some English-acquiring children, too.

The productions we studied were words beginning with /s/ and /ʃ/ taken from recordings for each language of five adults, ten 2-year-olds, and ten 3-year-olds engaged in a word-repetition task. All productions were transcribed by a native speaker, and the transcription results agreed with earlier studies for the most part. Of the 20 English-speaking children, all but two produced /s/ correctly, whereas only half produced /ʃ/ correctly. Moreover, no /s/ errors were substitutions of [ʃ], whereas all /ʃ/ errors were substitutions of [s]. By contrast, only seven of the Japanese-acquiring children produced /s/ correctly, as compared to ten who produced /ʃ/ correctly. Meanwhile, most errors for /ʃ/ were substitutions of manner (e.g., [tʃ] or [c]), with only one child substituting [s], whereas errors for /s/ typically involved place in addition to (or instead of) manner. Many children substituted [tʃ] or [c] for /s/, and one child consistently substituted [ʃ].

We measured six acoustic parameters that have been shown to distinguish sibilants in several languages, in order to address two sets of questions. First, what parameters distinguish /s/ from /ʃ/? Do these parameters pattern the same way across the two languages and are patterns consistent between child and adult speakers? Second, for children who do not produce a perceptible contrast between /s/ and /ʃ/, is there acoustic evidence of covert contrast? If so, are the same parameters involved in covert contrast across children and across languages?

One result observed in the adults' productions for both languages was that each of the six parameters showed a significant difference between the contrasting sibilants although the size of the effect varied. Another notable cross-language similarity was that, for children who were transcribed as producing a contrast, the most reliable acoustic parameters were the first and third spectral moments and/or the highest amplitude spectral peak frequencies during the fricative itself. These measures are illustrated in Figure 1, which plots skewness against centroid

[1] Covert contrast refers to statistically significant acoustic differences between productions of contrasting phonemes that are transcribed identically, as in Macken & Barton's (1980) study of VOT differences between target /b, d, g/ and substitutions of [b, d, g] for target /p, t, k/ in English-acquiring two-year-olds.

frequencies for productions of English /s/ vs. /ʃ/ by a three-year old (on the left) and by an adult (on the right). While the /s/ and /ʃ/ are better separated in the adult's productions, the child's productions also show a clearer separation than plots of the other measures for this child. This result suggests that adult listeners of both languages may primarily rely on the cues of energy concentration in categorizing children's productions of sibilant fricatives.

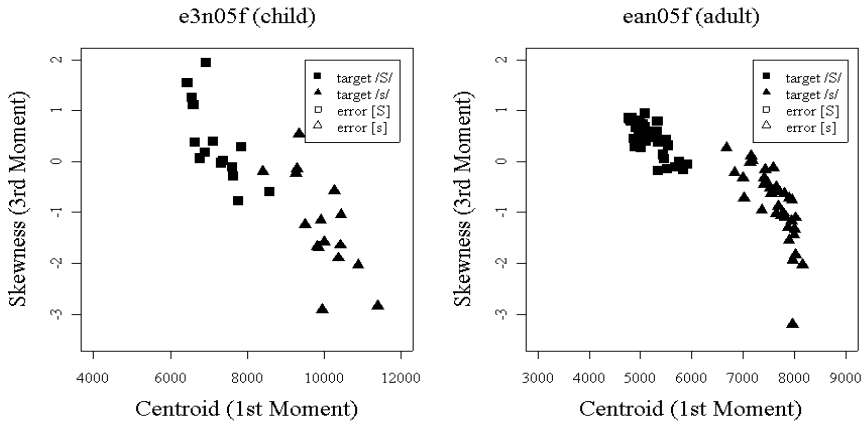

Figure 1. Comparison of productions of /s/ vs. /ʃ/ between an English three-year old and an adult

One notable cross-language difference was the greater differentiation between /s/ and /ʃ/ in adult productions for English as compared to Japanese for all six parameters. This greater differentiation probably reflects the secondary feature of rounding that makes the English /ʃ/-/s/ place contrast especially robust, whereas Japanese /ʃ/ is not rounded and it primarily contrasts with /s/ in palatalization (Toda & Honda, 2003).

The acoustic measurements also showed that five English-acquiring children and two Japanese-acquiring children had a covert contrast between /s/ and /ʃ/. Within each language, different children used different acoustic parameters in covert contrast. Most of the children made a covert contrast in aspects that adults do not attend to. For example, one English-speaking child had significantly different F2 frequencies at the onset of the following vowel, whereas another had significant differences in energy in this band in the fricative itself.

In summary, the two sibilants show language specific as well as language-general patterns. Although both languages differentiate the sibilants by similar acoustic means, the English contrast seems more robust. Also, although both sibilants are mastered late in both languages, /s/ seems to be particularly late in Japanese-acquiring children. Both cross-language differences seem to be related to language-specific patterns in fine-grained phonetic details that are better captured in acoustic analyses than in transcription.

References

JAKOBSON, R. (1968). *Child language, aphasia, and phonological universals*. The Hague: Mouton.

NAKANISHI, Y., OWAD, K. & FUJITA, N. (1972). Articulation test and its result. [In Japanese.] In *Report of the Research Institute for the Education of Exceptional Children, Tokyo Gakugei University*, 1: 1-41.

MACKEN, M. A. & BARTON, D. (1980). The acquisition of the voicing contrast in English: A study of voice onset time in word-initial stop consonants. *Journal of Child Language*, 7, 41-74.

PRATHER, E., HEDRICK, D. & KERN, D. (1975). Articulation development in children aged two to four years. *Journal of Speech and Hearing Disorders*, 53, 179-191.

TEMPLIN, M. C. (1957). Certain language skills in children: their development and interrelationships. *Institute of child welfare monographs*, 26. University of Minnesota Press, Minneapolis.

TODA, M. & HONDA, K. (2003) "An MRI-based cross-linguistic study of sibilant fricatives." *Proc. Annual meeting of the Phonetic Society of Japan*, Osaka (Japan), September 27-28.

TSURUTANI, C. (2004). Acquisition of Yo-on (Japanese contracted sounds) in L1 and L2 phonology in Japanese Second Language Acquisition, *Journal of Second Language*, l(3). 27-48