Cross-Linguistic Investigation of Phonological Acquisition:
Language-specific and language universal influences

*Jan Edwards and **Mary E. Beckman,
*University of Wisconsin-Madison, Madison, WI; **Ohio State University, Columbus, OH

INTRODUCTION AND RATIONALE

Language-universal versus language-specific influences on phonological acquisition

- How do we distinguish between language-universal and language-specific influences on phonological acquisition?
- Language-universal influences are generally thought to be related to constraints on production and perception – sounds and sound sequences that are easier to produce or perceive will be acquired earlier, regardless of the language that the child is learning.
- Language-specific influences have been hypothesized to be related to functional load or phoneme frequency, especially when a particular sound or sound sequence is acquired earlier in one language as compared to another language.

Language-universal influences on phonological acquisition

•Children learn some phonemes or phonemic contrasts in a similar order within and across languages because of constraints on production or perception. For example:
- •Stops are generally acquired before affricates, perhaps because the motor control demands are greater for an affricate than a stop (Kent, 1992).
- •Sibilant fricatives are generally acquired before non-sibilant fricatives, perhaps because it is more difficult to perceive a non-sibilant fricative (Jongman et al., 2000).

Language-specific influences on phonological acquisition

•There is growing evidence for language-specific influences on phonological acquisition, starting in the first year of life and continuing through childhood.

Infant speech perception:

•Infants lose some non-native consonant contrasts by about 10 months (Werker & Tees, 1984).

Infant babbling:

•Infant babbling is influenced by the frequencies of consonants, vowels, and prosodic shapes in the ambient language (de Boysson-Bardies et al., 1989; de Boysson-Bardies & Vihman, 1991).

Phoneme acquisition:

•French-acquiring children produce /l/ accurately before English-acquiring children (Chevrie-Miller & Lebreton, 1973).

•Japanese-acquiring children produce /ʃ/ accurately before /s/, while the reverse is true in English.

What accounts for language-specific influences on phonological acquisition?

Hypothesis:

•At least some cross-linguistic differences in consonant acquisition are related to differences in phoneme frequency and phoneme sequence frequency across languages.

Evidence for this claim:

•Within a language, children produce low-frequency phoneme sequences less accurately than high-frequency sequences (e.g., Edwards, Beckman, & Munson, 2004; Zamuner, Hammond, & Gerken, 2004).

•Across languages, some of the reported production differences might plausibly be related to frequency.
- •/l/ is produced accurately at a younger age in French than in English and /l/ is a higher-frequency phoneme in French.
- •/s/ is more frequent than post-alveolar /ʃ/ in English and is acquired earlier. By contrast, the post-alveolar fricatives /ʂ/ and /ɕ/ are more frequent than /s/ in Puthonghua and are acquired earlier.

The παιδολογος project:

CROSS-LINGUISTIC RESEARCH ON PHONOLOGICAL ACQUISITION

•It's necessary to examine phonological acquisition across languages in order to distinguish between language-specific and language-universal factors.

•We designed this project to examine the acquisition of word-initial lingual obstruents across 4 languages — Cantonese, English, Greek, and Japanese.

•Why these four languages?
- •All four languages have online lexicons.
- •All four languages have a rich inventory of lingual obstruents.
- •Sounds and sound sequences differ in frequency across these languages.
  - •/θ/ is very low-frequency and /s/ very high-frequency in English, whereas the two frequencies are more similar in Greek.
  - •/si/ is the highest frequency CV sequence in Greek, but unattested in Japanese.

PHONEME FREQUENCY INFORMATION

From online adult lexicons:

English: HML (Pisoni et al., 1985) — a list of about 19,000 word types from *Webster's Pocket Dictionary*.

Cantonese: Cantonese language portion of the *Segmentation Corpus* (Chan & Tang, 1999; Wong et al., 2002) — 33,000 transliterated words extracted from newspaper texts.

Greek: ILSP database (Gavrilidou et al., 1998) — a list of the 20,000 most frequent word types from newspaper texts.

Japanese: NTT database (Amano & Kondo, 1999) — 78,000 words from the *Sanseido* dictionary.

PILOT WORD REPETITION EXPERIMENT

Languages:
- •English, Greek, Japanese, Cantonese.
- •All data recorded in each country with a native speaker as the experimenter.

Participants:
- •About ten 2-year-olds and ten 3-year olds for each language.
- •All typically developing.

Stimuli:
- •Photographs of words beginning with target CV sequences and digitized recordings of each target word (spoken by female native speaker).

Procedure:
- •A picture and a digitized recording of each stimulus were presented simultaneously (word repetition task).

Analysis:
- •Native speaker transcribed all initial CV's.
- •Initial consonants were described as either correct, incorrect, or voicing-error-only.

TYPICAL ERROR PATTERNS IN DIFFERENT LANGUAGES

(Please listen to examples on laptop)

English
- •[t] for /k/ in /kek/ *cake*
- •[t] for /tʃ/ in /tʃɑpiŋ/ *chopping*
- •[s] for /θ/ in /θɑt/ *thought*
- •[s] for /ʃ/ in /ʃɪp/ *ship*

Greek
- •[k] for /t/ in /tokso/ (bow and arrow)
- •[k] for /ts/ in /tsepi/ (pocket)

Japanese
- •[k] for /t/ in /tamago/ (egg)
- •[ʃ] for /s/ in /suika/ (watermelon)

Cantonese
- •[t] for /k/ in /kʰa:^{55}tʰoŋ^{55}pʰi:n^{35}/ (cartoon)

EXAMPLES OF STIMULI

English /kɑfi/

Japanese /kaba/

Cantonese /kʰa:^{55}tʰoŋ^{55}pʰi:n^{35}/

Greek /karpuzi/

ANALYSES

1. We correlated CV frequencies across pairs of languages. If phonotactic probabilities are rooted in universal constraints on perception and production, then these correlations should be significant.
2. We correlated CV frequency with accuracy within each language. If the effects of universal constraints on phonotactic probability are modulated by specific-language experience — then there should be significant within-language correlations between frequency and accuracy.
3. We examined three specific comparisons across languages: a) the acquisition of /s/ versus /θ/ in English and Greek; b) the acquisition of /t/ versus /ts/ in Cantonese and Greek; and c) the acquisition on /t/ versus /tʃ/ in English and Japanese.
   - All three comparisons contrast an earlier-acquired sound with a later-acquired sound (stops are generally acquired before fricatives and sibilant fricatives before non-sibilant ones).
   - There are differences in relative frequency for all three comparisons across languages.

RESULTS

1. Five of the six correlations of CV frequencies across languages were not significant. The only significant correlation was between Greek and Japanese ($R2 = 0.15$, $p = 0.02$).
2. Two of the four correlations between CV frequency and CV accuracy were significant. CV frequency accounted for about one-third of the variance in consonant accuracy in English (see Fig. 1).
3. All three of the specific comparisons showed an effect of frequency on accuracy (see Fig. 2).

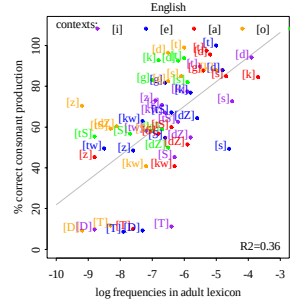

Figure 1. Consonant accuracy plotted against CV frequency for English (consonants are used as plotting symbols, with following vowel color-coded as shown on plot).

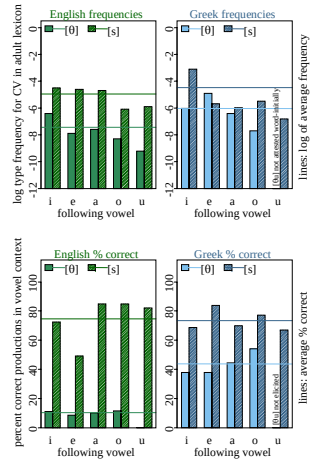

Figure 2. Log relative frequency (top plot) and percent correct (bottom) for English and Greek /s/ and /θ/ in different vowel contexts.

DISCUSSION AND CONCLUSIONS

•Language-universal factors influence phoneme acquisition in two ways:
- •Directly: Across languages, universal constraints imposed by constraints on perception and production predict which contrasts will be easy or difficult for the child to learn.
- •Indirectly: Within languages, universal principles of ease of perception and production tend to influence the lexicons of many languages through commonly attested sound changes.

•Phonological acquisition is a process mediated by the lexicon, which is the language learner's source of information about phoneme and phoneme sequence frequency in her language.