Cross-linguistic prosodic differences and their effects on the interpretation of error patterns in child speech

Timothy Arbisi-Kelm
University of Wisconsin, Madison
Mary E. Beckman
Ohio State University

Special thanks to the following…

Principal Investigator: Jan Edwards (University of Wisconsin-Madison)
Lab members: Hyunju Chung, Junko Davis, Eunjong Kong, Fangfang Li, Sarah Schellinger, Asimina Syrika, Peggy Wong
Funding sources: NIH traineeship to first author, and NIDCD grant 02932 to Jan Edwards (PI)

Cross-linguistic phonological differences: inventory of autosegmental content specifications

- Focus is often on differences in phoneme inventories:
  - e.g., English has /s/ and /ʃ/, while Greek has only /s/.
- Or on differences in phonotactic constraints:
  - */tu/ in Cantonese
  - */kjo/ in English
  - */si/ in Japanese

Cross-linguistic prosodic differences (1)

But languages also differ dramatically in terms of prosodic structure:

- Phrasal shapes
  - English, Greek: pitch shapes ("accents") from intonation linked to metrically prominent lexical stresses
  - Japanese: phrasal pitch shapes where "accents" are lexical tones; phrasing and pitch range manipulation, but no "stress"
  - Cantonese: intonation-phrase-final tones appended after lexical tone on last syllable

Cross-linguistic prosodic differences (2)

- Word shape
  - English: primarily 1-2 syllables, trochaic bias (Hayes 1980; Halle & Vergnaud 1987)
  - Greek: trisyllabic stress window aligned to end of word; iambs as common as trochees (Joseph & Philippaki-Warburton, 1987)
  - Japanese: predominantly 2-3 syllables, no stress, contrastive vowel and consonant length
  - Cantonese: predominantly monosyllabic, with each syllable equally prominent, specified for tone

Cross-linguistic prosodic differences (2)

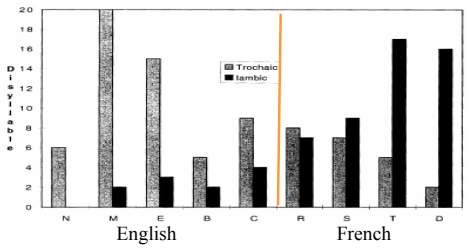
- Syllable reduction:
  - English /ə/ and Greek /i, u/ can delete in metrically weak syllables that cannot align to pitch accents — e.g. *po*tato, /çiˈmonas/ 'winter', but not /ˈçilja/ 'lips'
  - Japanese: high vowel devoicing or deletion constrained by vowel length rather than by metrical strength
  - Cantonese: "syllable fusion"= consonant and vowel lenition and even deletion, but with preservation of lexical tone (Wong 2004, 2006)

Prosody in language acquisition

- Native language prosody is one of the earliest aspects of language that children learn:
  - Distinguish correct vs. incorrect pause placement in clauses at 6 mos. (Jusczyk, Hirsch-Pasek et al., 1992)
  - English-speaking babies show preference for trochaic vs. iambic words at 9 mos. (Jusczyk et al., 1999)

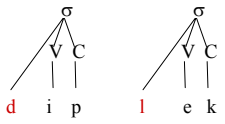
The influence of ambient language on late babbling

English-acquiring babies (13-20 mos) produced only recognizable trochees, while the French-speaking babies produced recognizable iambs Vihman, DePaolis, & Davis (1998) .



Prosodic evidence in speech errors and disfluencies

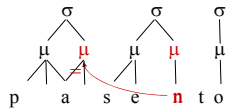
- English speech errors (e.g., Shattuck-Hufnagel 1987; Fromkin 1973; Dell 1985) often exchange consonant gestures at foot beginnings.



'deep lake' → 'leep dake'

Alignment evidence in speech errors and disfluencies: Metrical structures are language specific

- Japanese errors (Kubozono 1989) suggest an affinity between analogous mora positions in different syllables, regardless of the gestural content licensed by the position.



paasento→ pansento

1) **We would predict, therefore, that native language prosody also shapes children's production of one-word utterances.**
2) **Focus of this talk: consider how language-specific prosodic organization constrains segmental errors in children acquiring a first language.**

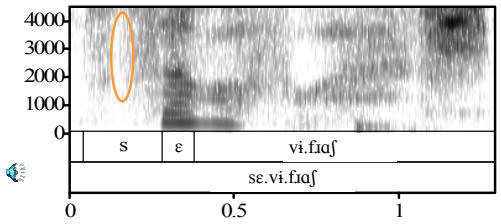
The παιδολογος project — cross-linguistic research on phonological acquisition

- Comparing word-initial lingual obstruents in real words and nonwords across Cantonese, English, Greek, and Japanese.
- Languages chosen because all have a rich inventory of lingual obstruents, as well as salient prosodic differences.
- Participants (20 2-5 yr-old children for each language) completed a word-repetition task, presented with both audio and visual stimuli.

Analysis — transcription by native-speaker phonetician

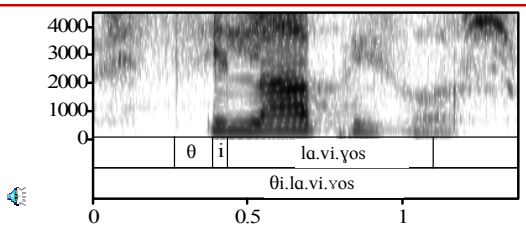
- Initial consonants transcribed as:
  - 1 (correct and fluent)
  - 0 (incorrect in place and/or manner)
  - V (correct except for voicing/aspiration)
  - E ("Effortful"; reserved for fricatives and affricates)
- Also coded:
  - "Split CV" (pause/resyllabification between consonant and vowel)
  - Devoicing

"E" for "effortful"



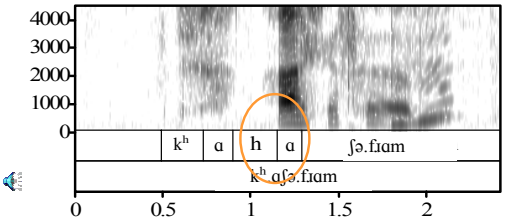
- Analogous to adult stuttering — a disfluency arising from the demands of coordinating a difficult consonant constriction (e.g., tongue tip for [s]) with:
  - respiratory system for utterance initiation
  - laryngeal posture and subglottal pressure for initial syllable
  - tongue body coordination for "following" vowel

Metrical conditions for "E" in Greek



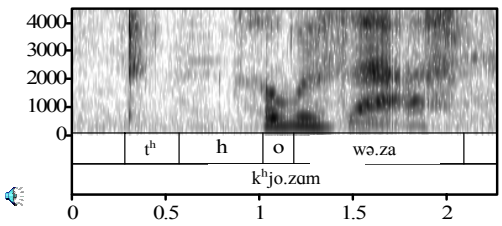
- Cases of "E" for fricatives most frequent in four-syllable nonwords.
- Greek has a "three-syllable window" for stress; therefore four-syllable forms necessarily have word-initial unstressed syllables.
- Child seems to focus more effort on getting non-initial stressed syllable right.

"Split CV"



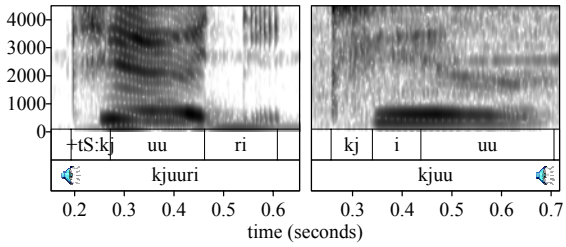
- "split CV": disfluency after a plosive release, especially when stop glottal gesture repeated.
- "split CV" suggests struggle with coordinating a precise lingual gesture with the following vowel.
- Percept is insertion of epenthetic vowel.

Autosegmental/Metrical conditions for "split CV"



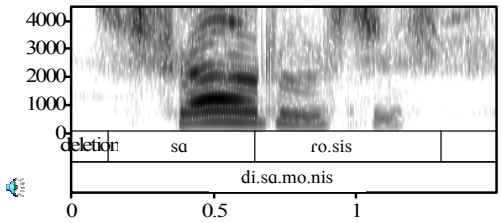
- In English, such "split CV" cases are often seen when child is attempting the particularly complex gestural configuration of the "palatalized velar" (or /k/ before /ɻu/ diphthong).
- Often there is also a stereotypical /t/ for /k/ substitution.

Different metrical resolution for /kʲ/ in Japanese



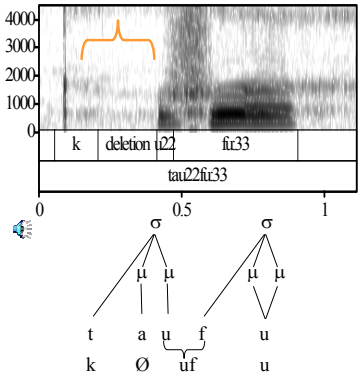
In Japanese, the more common resolution of the difficulty of this gestural configuration is to substitute an alveolopalatal (cf. also Tsurutani, 2004).

Metrical conditions for syllable deletion



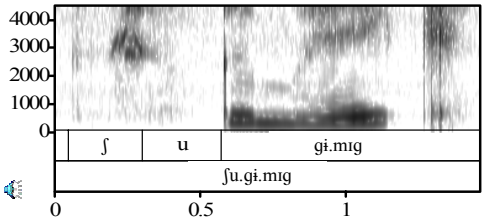
- Greek word-initial unstressed syllables in 4-syllable forms were often deleted, so that the word began with the stressed second syllable.
- Compare this with the "trochaic bias" of English, where initial unstressed syllables are deleted also in disyllabic and trisyllabic forms (e.g., /ˈnæ.nə/ for *banana*).

Vowel devoicing in Cantonese equals syllable fusion



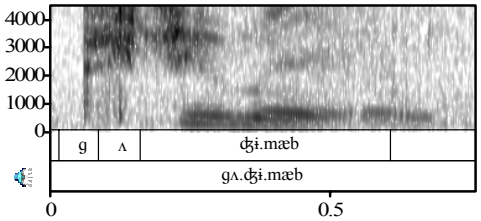
- Cantonese syllable fusion: vowel deletion can occur without tone loss.
- Devoicing of vowel targets first part of syllable nucleus, leaving space to realize tone.

Devoicing in English, too!



- Devoicing in English should only occur in unstressed syllables, which were not used in our elicitation protocol.
- But we did see cases of devoiced syllables, as another kind of "E" with difficult sibilant fricatives

Or is it all in the ear of the adult perceiver?



- So what do we do when speech errors "break the rules"?
  - Interpretation 1 (TAK, listening to "stress"): "Residual cues to stress (e.g., high intensity of consonant burst and alternation with weak following vowel) preserves the syllable count."
  - Interpretation 2 (MEB listening to tone pattern): "This is English, so the syllable is deleted and the stress shifts to the following syllable."

Conclusion and Future Directions

- As children acquire the ambient spoken language, they must learn the metrical structures as well as the inventory of autosegmental content specifications.
- Children's speech errors are therefore highly constrained by the prosodic structure of the ambient language.

- Future work:
  - statistical analysis of all error patterns
  - perception tests to address variation in prosodic structure licensing in complex errors

Thank you!