

BACKGROUND

1. Phonological categories and socio-indexical categories

- Speech sounds encode not only lexical information but also social identity such as gender, age, geographic origin, ethnicity, formality and so on (Kramarac, 1982; Labov 1990, 2001; Purnell, Idsardi & Baugh, 1999; Clopper & Pisoni, 2004).
- Gender-marked phonetic variants of phonological categories
 - Fricative and vowel production (shown by studies reviewed by Munson and Babel, 2007).
 - Stop productions (Swartz, 1992): shorter VOTs in males' stops in American English.
- Acquisition of lexical information and gender-marked variant
 - Whiteside (2001, 2004): girls' (5;8, 13;2) longer VOTs for aspirated stops (Sheffield, British English).
 - Docherty et al (2002), Foulkes & Docherty (2006): girls' (3;6) more use of pre-aspirated stops (Newcastle, British English).

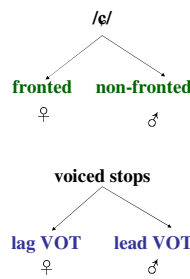
2. Gender-marked phonetic variant in Mandarin and Japanese

• Voiceless sibilant fricatives in Songyuan Mandarin Chinese

- Three-way contrast in Mandarin fricatives: dental/alveolar /s/ vs. alveopalatal /ç/ vs. retroflex /ʂ/.
- Feminine accent: fronted or dentalized /ç/ sound, in college-aged women, first found in the Beijing dialect (Cao 1986, 1987; Wu 1991).

• Stops in Tokyo Japanese

- Two-way contrast in stop voicing: voiced versus voiceless stop (Homma, 1980; Shimizu, 1989).
- Recently noted that VOT of the voiced stop category varies systematically with the speaker's age and gender (Takada, 2004).



QUESTIONS

1. What are the relevant acoustic measures to describe the phonetic variants associated with these social-indexical categories?

2. How does the acquisition of variants that reflect adult social-group membership interact with acquisition of lexical phonetic knowledge in the first language acquisition?

- When and how do children manifest these socially specific variants in adult-like manner in the course of phonological development?
- What kinds of linguistic constraints would affect the mastery of knowledge associated with speech sounds in the first language acquisition?

DATA & ACOUSTIC MEASURES

1. Subjects

- Recruited and recorded in Songyuan, China, and Tokyo, Japan.
- Adults (18-30): 10 females and 10 males for each language.
- Children (2;0-6;0): 10 children per age group, with sex balanced in each language.

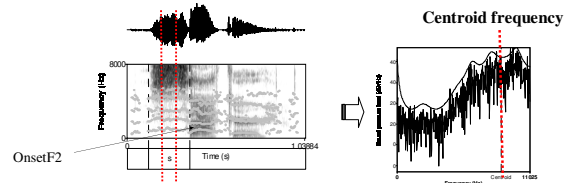
2. Materials (from the paidologos project <http://www.ling.ohio-state.edu/~edwards>)

- Word Repetition task.
- Stop- and fricative-initial followed by vowel /a, i, u, e, o/ in words familiar to children were elicited.
 - Mandarin fricatives: /s/ in /san/ "three" and /ç/ in /çi/ "west".
 - Japanese stops: /d/ in /daikon/ "radish" and /t/ in /tako/ "octopus".

3. Acoustic measures

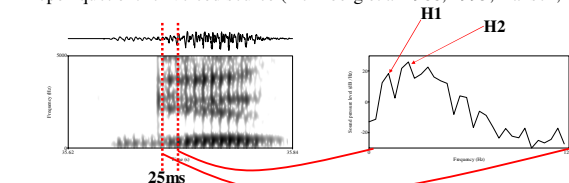
• Mandarin fricatives

- Centroid frequency: 1st moment in moment analysis; mean frequency over the fricative spectrum; negatively correlated with the length of the front cavity. Centroid measure is calculated over a 40ms window centered at the middle of the frication of the target fricatives.
- Onset F2 frequency for fricatives: the 2nd formant frequency of the vowel following the fricatives taken at the onset of the vowel.



• Japanese stops

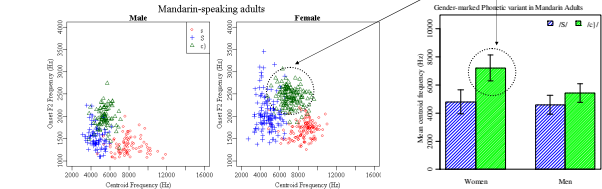
- VOT (Voice Onset Time: Lisker & Abramson 1964): An interval between the articulatory explosion and voicing onset.
- H1-H2: The amplitude difference between the first harmonic and the second harmonic measured at the following vocalic onset, breathiness measure, correlating with larger open quotient for voiced source (Holmberg et al 1988, 1995; Hanson, 1997; 1999).



RESULTS:

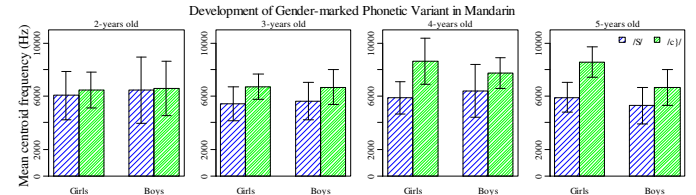
A. Voiceless sibilant fricatives in Mandarin

• Adults



- The two parameters together effectively describe the contrast in both genders.
- The /ç/ sound generally has higher onset F2 frequencies than the other two sounds.
- Centroid values of /ç/ relative to /s/ are higher for females than for males, suggesting a fronted constriction place; a two-way ANOVA shows a significant interaction between these phoneme categories & gender [F(2,22)= 6.8786, p<0.005].

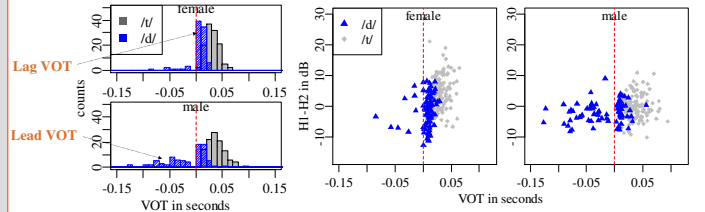
• Children



- Not much difference between the two genders at age 2 and 3.
- At age 4, girls start to show a tendency to front the /ç/ sound.
- By age 5, girls have a gender-marked pattern similar to that of female adults, with a significant category*gender interaction [F(2, 16)= 4.7672, p<0.02].

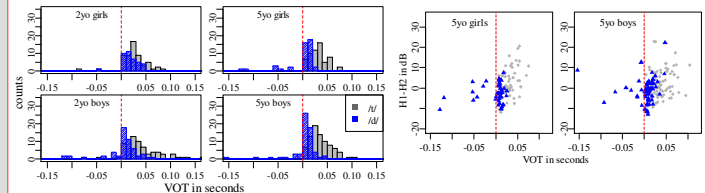
B. Stops in Japanese

• Adults



- Gender difference was found in the use of VOT for the two phoneme categories; ANOVA shows phoneme by gender interaction [F(1, 18)= 11.209, p<0.005].
- Lag VOT voiced stops were used by most of females.

• Children



- No clear gender-related difference in children's use of lag / lead VOT variants of voiced stops: phoneme*gender [F(1,10)= 0.0034, p= 0.955] in 5yos' productions.
- Both boys and girls tend to produce voiced stops with short lag VOT values, and very few pre-voiced tokens were found even in the oldest boys.

DISCUSSION

• Adult productions showed that ...

- in Mandarin, female variants of alveopalatal fricative can be acoustically characterized as having a higher centroid frequency.
 - in Japanese, female variants of voiced stops can be acoustically characterized by having short lag VOT values whereas male variants have lead values for VOT.
- The emergence of gender-marking variation might be constrained by the same maturational factors that govern the mastery of the lexical phonological contrast.
- Those Mandarin 4 or 5 year olds who exhibited extremely dentalized forms in fricative production for all three lexically contrasting categories.
 - By contrast, the Japanese children as a group might not have been able to show evidence of acquiring sociolinguistic markers associated with voiced stops, because the male-marking variant (voicing lead) is a difficult sound that is not mastered until age 6 cross-linguistically (Allen, 1985; Macken & Barton, 1980).

- Alternatively, the lag VOT variants of Japanese voiced stops in boys' speech could also be interpreted as a reflection of sound change in progress, where the voiceless-voiced contrast is becoming a lax-tense distinction. Recordings of older Japanese-speaking children's productions may help distinguish between these two interpretations.

ACKNOWLEDGEMENT

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