Methodological questions in studying phonological acquisition

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Why a talk on methods?

- Technology has changed, but have we?
  - 1960s-70s: cheap portable technology for making audio recordings
  - 1990s: inexpensive digital technology for recording and analysis.
- We continue to rely on transcription of elicited single words in studies of phonological acquisition and in clinical assessment of phonological disorder.

Outline of talk

- Data collection
  - Lexical factors and consonant accuracy:
    - word length
    - consonant-vowel sequence frequency
    - word familiarity
- Data analysis
  - Problems with transcription:
    - Dual purposes of transcription
    - Native-speaker filter
    - Covert contrast
- Alternative methods of analysis to consider

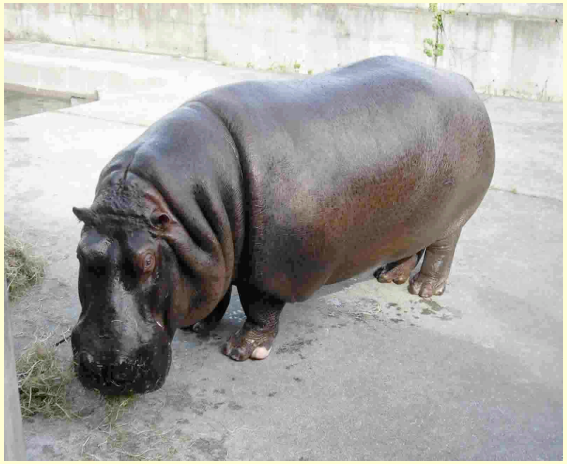
The παιδολογος project:
Cross-linguistic research on phonological acquisition

- Acquisition of word-initial lingual obstruents across 4 languages — Cantonese, English, Greek, and Japanese.
- Participants:
  - 45 2- and 3-year olds, 25 4-, and 5-year-olds, 20 adults for each language.
- All data recorded in each country with a native speaker as the experimenter.
- 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).

Examples of stimuli

English

Greek



Japanese

Cantonese

Analysis

- Transcription
  - Trained native-speaker phonetician
  - Initial consonants transcribed as correct or incorrect
  - Errors transcribed as:
    - Within-inventory substitutions
      - /kha:55thoN55phi:n35/ (*cartoon*)– /t/ for /k/
    - Outside-inventory substitution
      - /kjalo/ (*another*) – /t[illegible]/ (Korean tensed affricate) for /kj/
    - Intermediate between two sounds
      - *tube* – /tj/ or /kj/
    - Distortion
      - *gumdrops*
    - Deletion

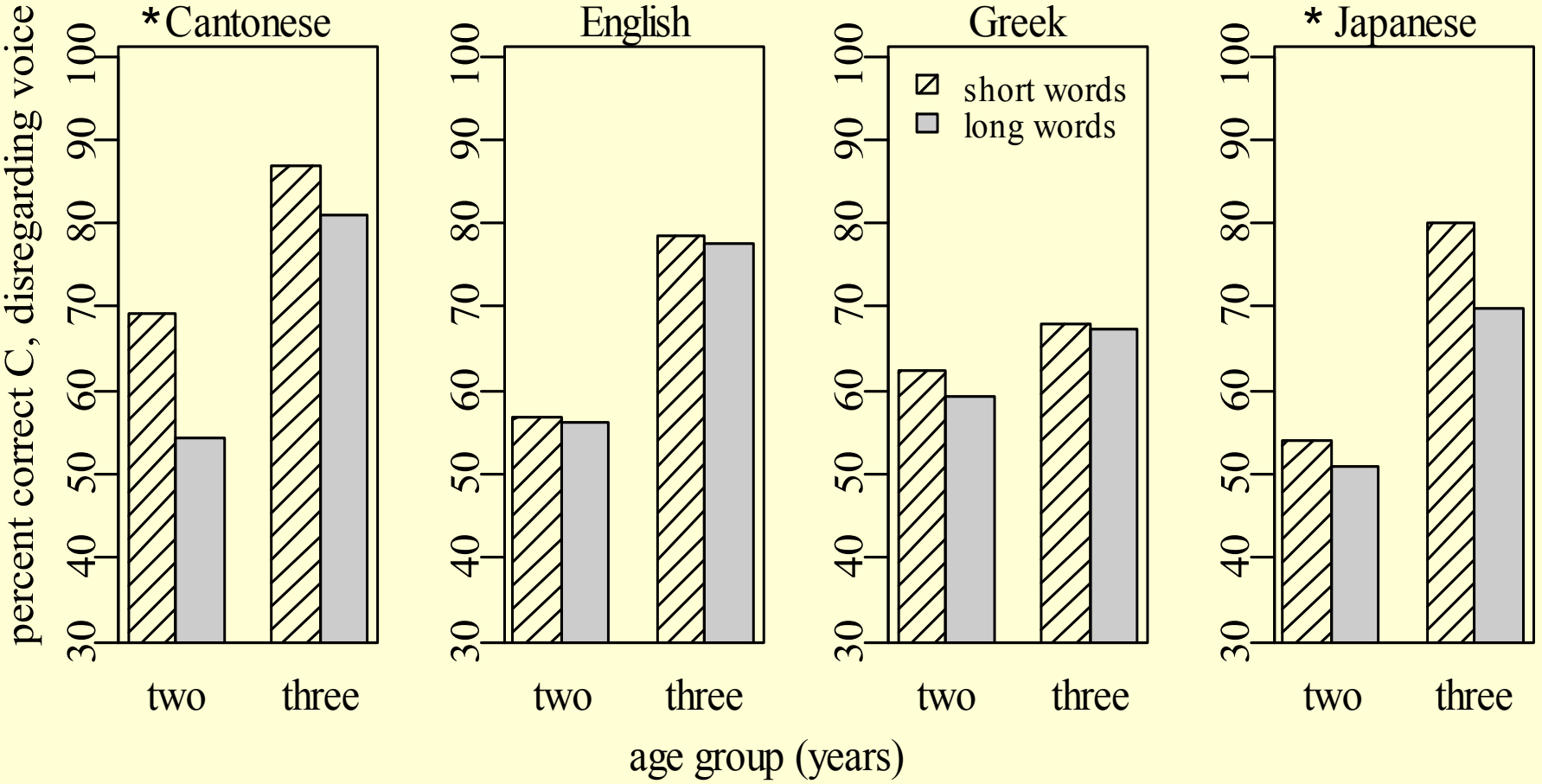
Data elicitation questions

- How do lexical factors influence production accuracy?
- Examined three factors:
  - Word length
  - Phonotactic probability
  - Word familiarity

Effect of lexical factors on consonant accuracy

- Problem:
  - Difficult to control for lexical factors in picture-naming tasks when we want words to be both pictureable and known to young children.
- Definitions of short and long words across languages:
  - *Short* words
    - English and Cantonese: monosyllabic
    - Greek and Japanese: disyllabic
  - *Long* words
    - English and Cantonese: polysyllabic
    - Greek and Japanese: trisyllabic or longer

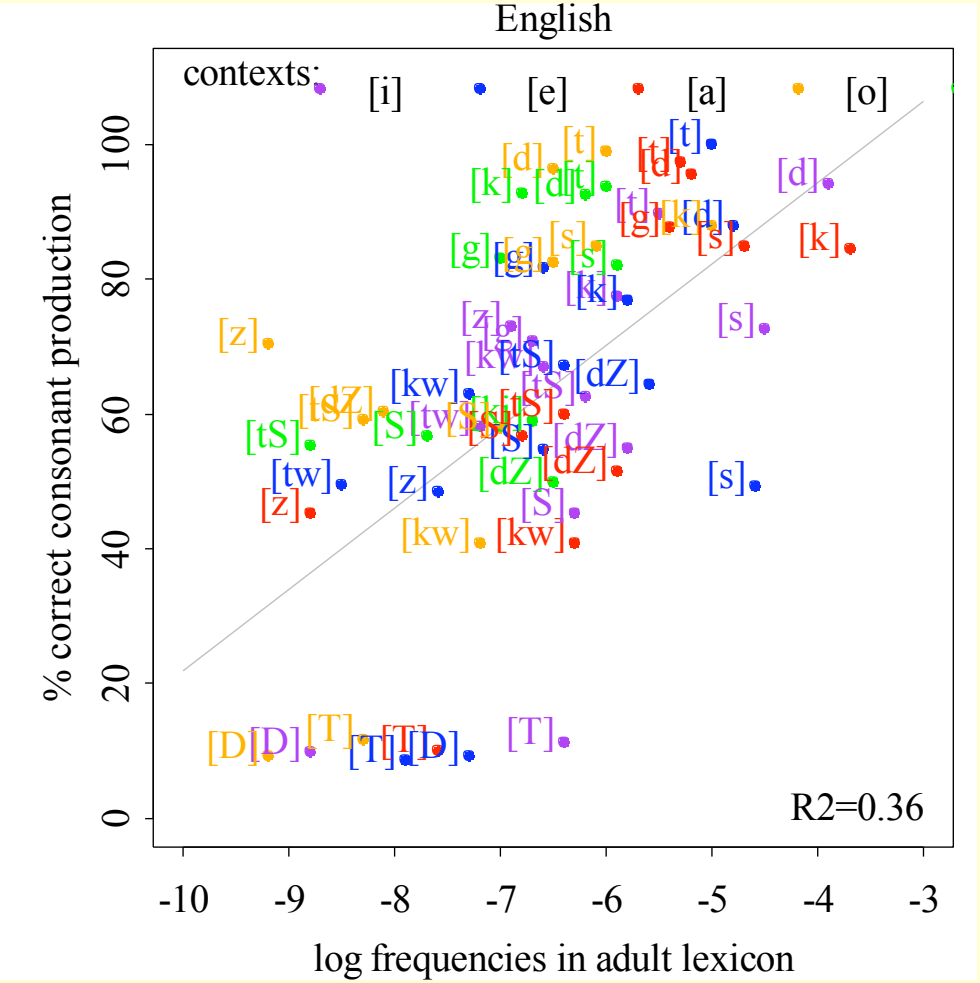
Results: Effect of word length on word-initial consonant accuracy



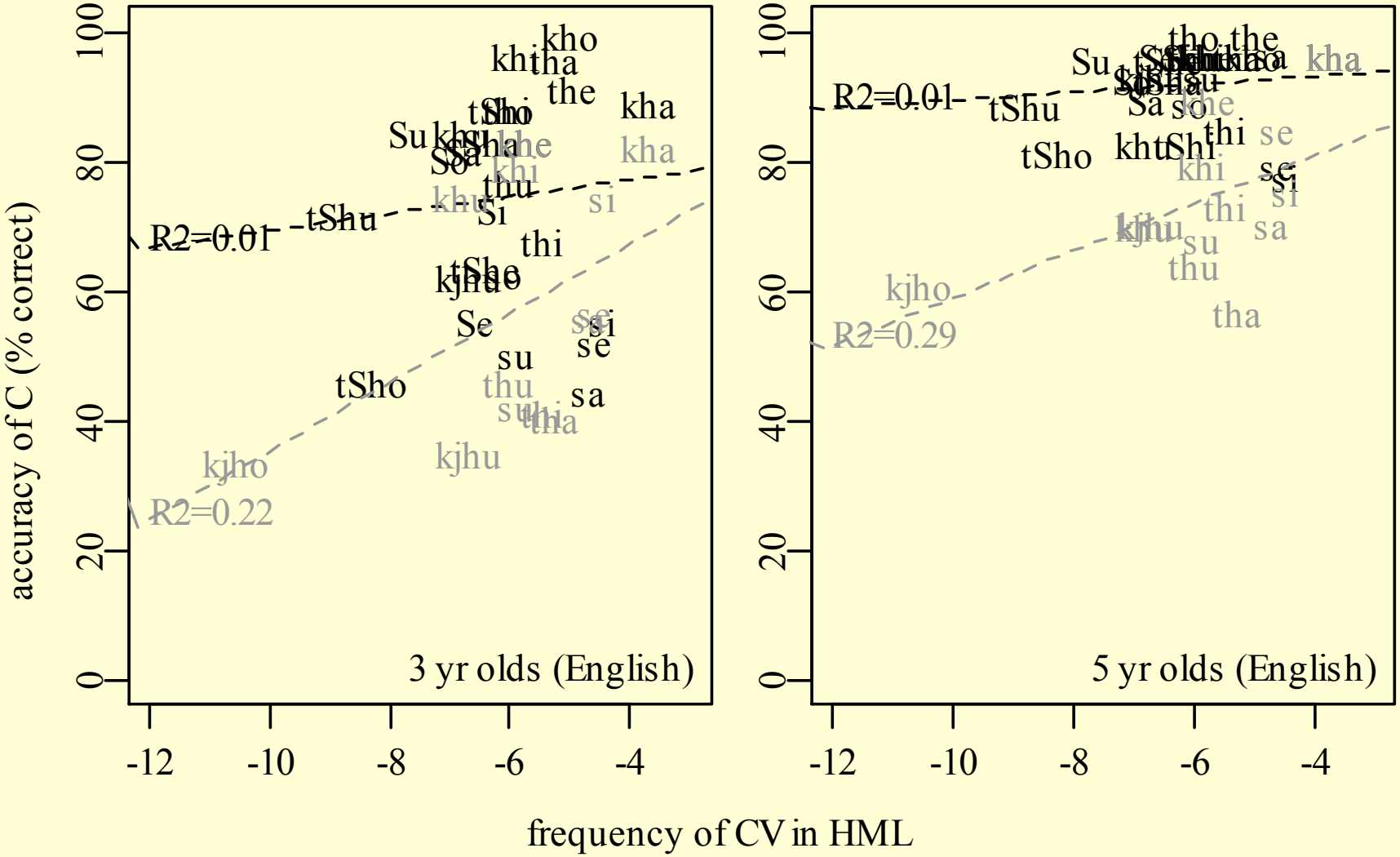
*Significant effect of word length on accuracy in Cantonese and Japanese, but not in English and Greek.

Effect of consonant-vowel sequence frequency on word-initial consonant accuracy

Log frequency accounts for more than 1/3 of the variability in production accuracy in English. Effect is smaller in other three languages.



Results: Effect of word familiarity on consonant accuracy



Summary

- Lexical factors influence word-initial consonant accuracy.
- What can we do?
  - Use nonwords instead of real words as stimuli in experiments and clinical assessment
  - Elicit consonants in more than a single wordform
  - Control wordforms for properties such as word length, stress pattern (where relevant), and so on.

Data analysis questions

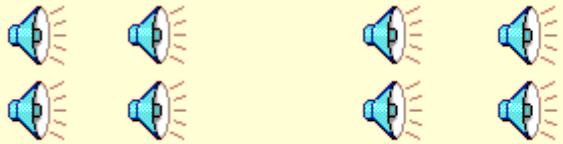
- What about our reliance on transcription?
- Dual purposes of transcription:
  - Phonemic: Is the child's production correct or incorrect?
  - Phonetic: Error analysis – what sound did the child produce?
  - Aren't these two purposes contradictory?

Dual purposes of transcription

- Phonemic purpose: Is production correct or incorrect?
  - Requires a fairly naïve transcriber.
  - Transcriber should not look at spectrogram, etc.
  - Transcriber should not transcribe too much of any one child (because of accomodation).
- Phonetic purpose: What sound did the child produce?
  - Transcriber should be a trained phonetician
  - Transcriber should examine spectrogram, etc.
  - Problems:
    - Transcription is too language-specific for this purpose.
    - Transcription is categorical, but the child's production may not fit clearly within a phoneme category.

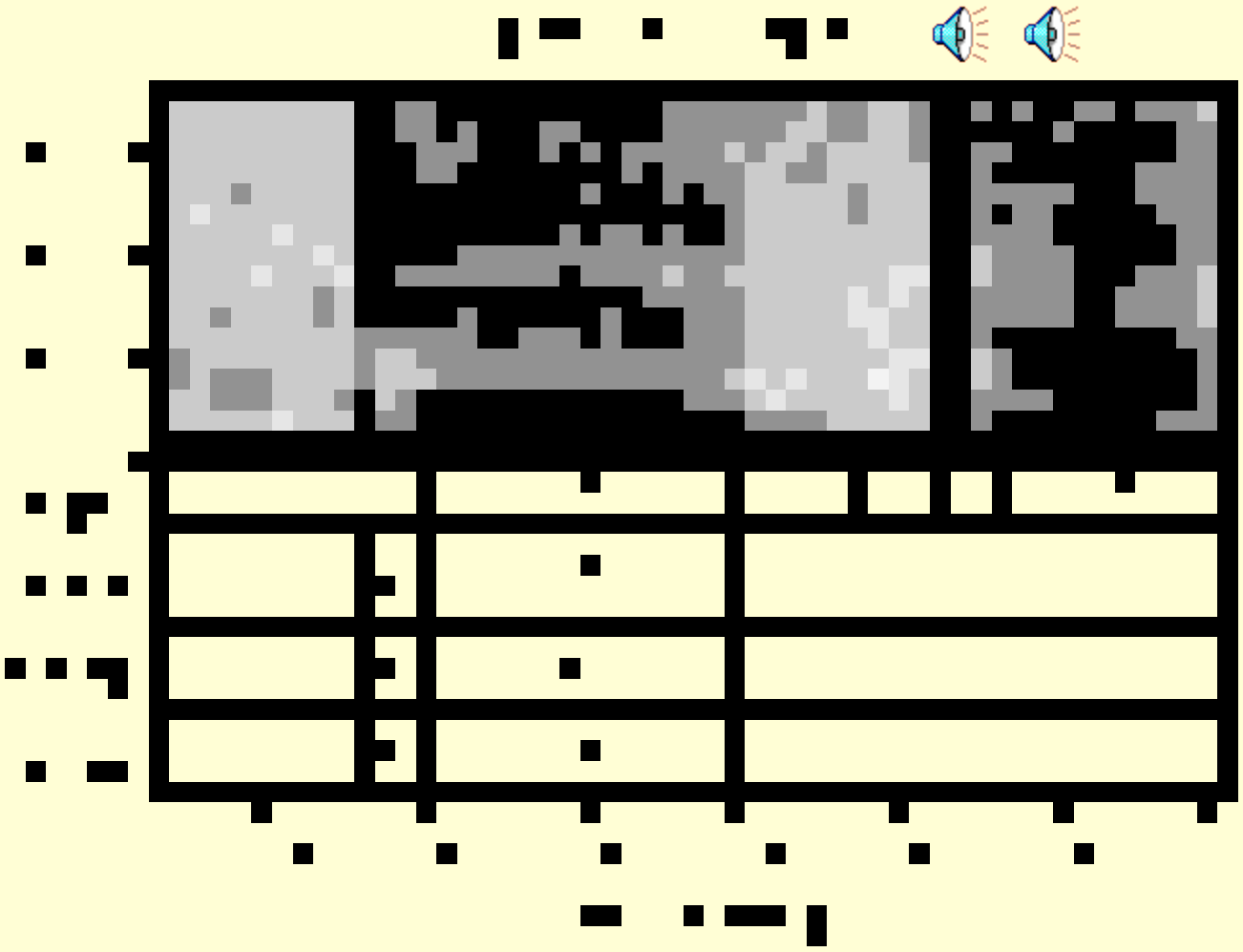
Systematic differences across languages: /s/ in English and Greek

- /s/ before back vowels in Greek (no /s/ vs. /ʃ/ contrast) vs. English



- In short, /s/ before back vowels in Greek sounds /ʃ/-like to English speakers' ears.

Systematic differences across languages: front /k/ in Greek vs English vs Japanese



For /k/ (=[k^{j}] or [c]) before front vowels in Greek:

- Greek speakers mostly hear okay /k/
- English speakers mostly hear /t/ substitution
- Japanese mostly hear /t[ɕ]/ substitution

Systematic differences across languages: /s/ in English and Japanese

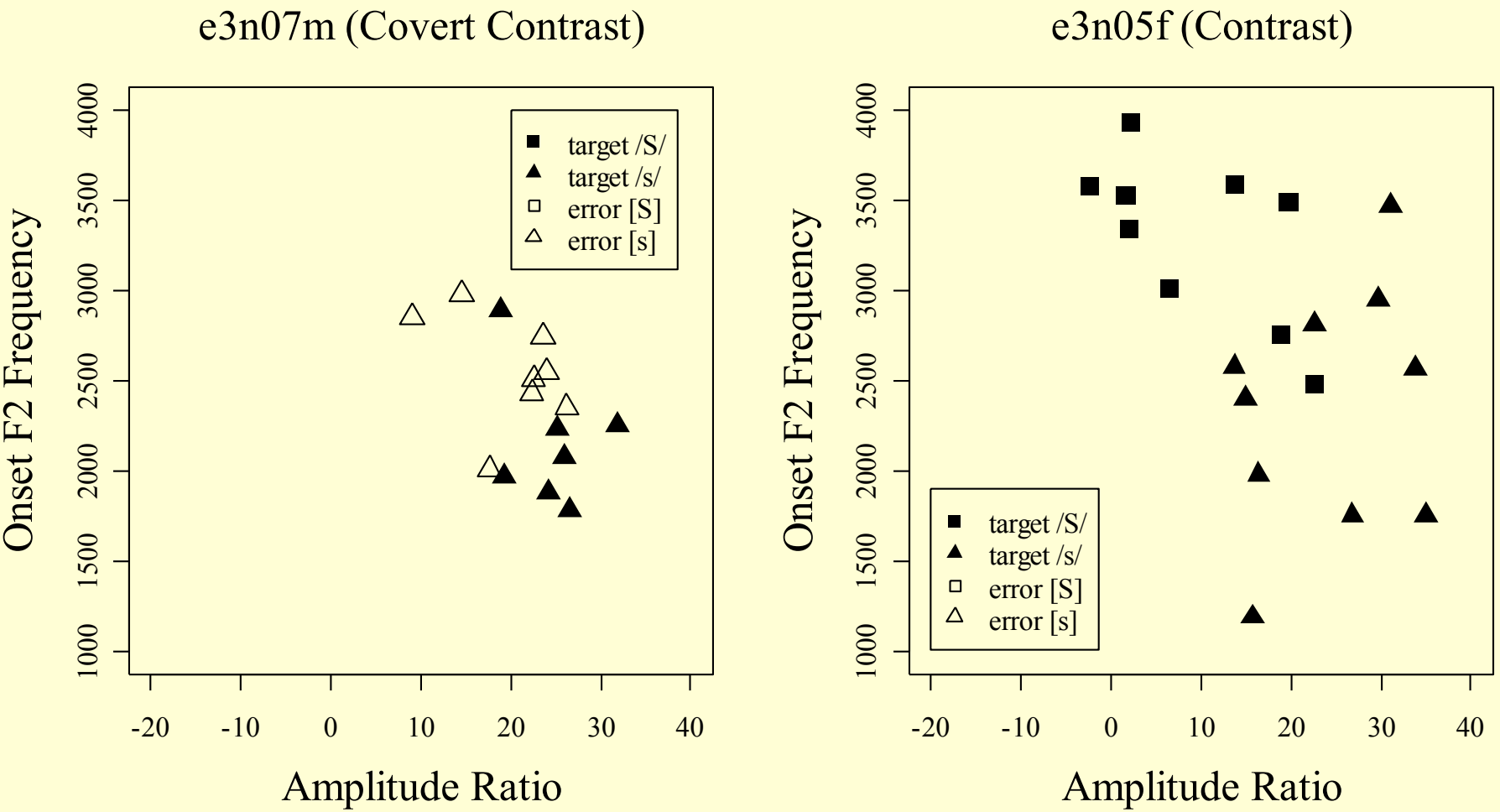
- Target in /senaka/ coded as an /ɯ/ for /s/ substitution by Japanese speaker, but as okay /s/ by English speakers.
- Same pattern of responses for j3n15f <sensei>

- Japanese speakers generally accept fewer productions of /s/ as correct than do English speakers, despite common 2-way contrast.

Covert contrast

- Definition: A perceptually indistinguishable, but statistically significant acoustic difference between two sounds.
- Contrast and covert contrast in English
  - two-way contrast in place of articulation between a coronal alveolar /s/ and a coronal postalveolar /ʃ/.
  - /s/ for /ʃ/ for errors are common
- Contrast and covert contrast in Japanese
  - two-way contrast in tongue posture between a coronal alveolar /s/ and an alveolo-palatal /ɕ/
  - /ɕ/ for /s/ errors are common.

Covert contrast



From Li & Edwards (2006).

Trained phoneticians vs. naïve listeners

- Perception experiment with adult English and Japanese listeners.
- Stimuli:
  - Correct adult and child productions of English /s/ and /ʃ/ and of Japanese /s/ and /ɕ/ in edited CV sequences
  - English /s/ for /ʃ/ substitutions and Japanese /ɕ/ for /s/ substitutions.
- Speeded response task:
  - Adult listeners listened to all CV's in two conditions, once to answer the question, "Is it an /s/" and once to answer "Is it an /ʃ/ (or /ɕ/)?"
- Reaction times and accuracy (relative to native speaker-transcriber) calculated for each token across both conditions.

Results: Evidence for gradience of perception

- Judgments of multiple naïve listeners uncovered gradience in listeners' judgments of children's phonetic accuracy.
- Transcriber judged sound as correct:
  - 85% of the time, English listeners agreed with transcriber for /S/
  - 74% of the time, Japanese listeners agree with transcriber for /ɕ/.
- Transcriber judged sound as incorrect:
  - 94% of the time, English listeners agreed with transcriber for /s/
  - 64% of the time, Japanese listeners agreed with transcriber for /s/.
- Note: inter-rater reliability between two native-speaker transcribers was 89% for Japanese and 90% for English.

Conclusion: We need to augment transcription with a 3-pronged approach

- Transcription by trained native speaker-phonetician
- Acoustic analysis
- Judgments by multiple naïve listeners