

# WHY DO ADULTS VARY IN HOW CATEGORICALLY THEY RATE THE ACCURACY OF CHILDREN'S SPEECH?

Eden Kaiser<sup>1</sup>, Benjamin Munson<sup>2</sup>, Fangfang Li<sup>3,4</sup>, Jeffrey Holliday<sup>4</sup>, Mary E. Beckman<sup>4</sup>, Jan Edwards<sup>5</sup>, and Sarah Schellinger<sup>2,5</sup>

<sup>1</sup>Program in Linguistics, University of Minnesota; <sup>2</sup>Department of Speech-Language-Hearing Sciences, University of Minnesota; <sup>3</sup>Department of Psychology, University of Lethbridge; <sup>4</sup>Department of Linguistics, Ohio State University; <sup>5</sup>Department of Communicative Disorders, University of Wisconsin-Madison

## Background

### Children acquire speech sounds gradually

- Phonetically transcribed speech samples suggest that speech sounds are acquired discontinuously (e.g., Smith 1973)
- However, instrumental studies show that acquisition is in fact gradual (e.g., Macken & Barton, 1980; Edwards, Gibbon, & Fourakis, 1997; Li, Beckman, & Edwards, 2008)
- Phonetic transcription, the most common analysis tool used to study phonological acquisition, limits the degree to which speech sounds can be represented continuously

### Most assessment tools elicit categorical judgments

- Clinical assessments and experimental research on phonological development often use broad transcriptions made by native speakers
  - Easier, simpler, and faster than the alternatives
  - Based on the assumption that people can't perceive within-category distinctions
- These transcriptions don't allow tracking of children's gradual acquisition of speech sounds
- This poster is part of a larger set of experiments examining novel methods for measuring children's speech production

### People can perceive fine phonetic detail in children's speech

- Many people can perceive fine differences in sounds' acoustic characteristics within categories (e.g., Kong, 2009; Munson, Li, Yoneyama, Hall, Beckman, Edwards, & Sunawatari, 2008; Urberg Carlson, Munson, & Kaiser, 2009; Urberg Carlson, Kaiser, & Munson, 2008)
- Most people use fine phonetic detail within categories to identify attributes about a speaker, such as age, social class, gender, sexuality, social group identification, and mood (Crocker & Munson, 2006; Drager, 2008; Munson, McDonald, DeBoe, & White, 2006; Smith, Munson & Hall, 2008)

## Motivation for the current study

### In Munson, Kaiser, and Urberg Carlson (2008), adults judged the accuracy of Japanese- and English-acquiring children's speech

- Participants listened to two- to five-year-old children's and adults' CV productions of /s/ and a postalveolar sibilant fricative (/ʃ/ or /ç/)
- They rated how "s-like" or "sh-like" each sound was by clicking on a double-headed arrow anchored with "the 's' sound" and "the 'sh' sound" at either end
- They indicated their judgments on a visual analog scale (VAS), similar to the one in Figure 3

### Two different types of response patterns emerged

- Categoricity of response was assessed by logit functions predicting click location from fricatives' M1, as illustrated in Figures 1 and 2 (shallower slopes = less categorical)
- Some participants utilized all points on the VAS line for their responses (Figure 1)
- Others grouped responses around discrete locations on the line (Figure 2)
- This led to the question: why are some more categorical than others?

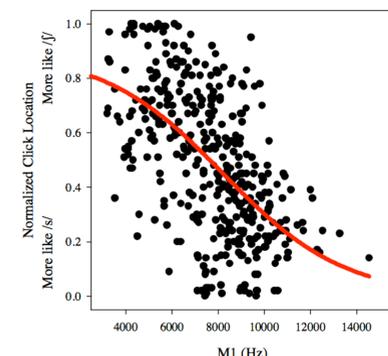


Figure 1: The second-most continuous responder on /s/-/ʃ/ discrimination judgments (slope = -0.000144)

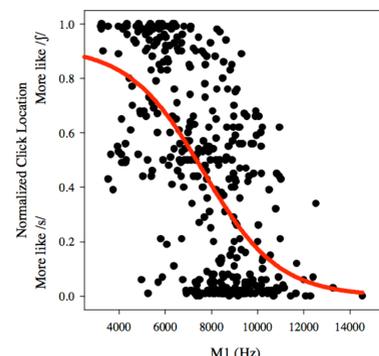


Figure 2: The most (realistically) categorical responder on /s/-/ʃ/ discrimination judgments (slope = -0.000301)

## Why are some adults more categorical and some more continuous when they rate children's speech?

### Some hypotheses:

- Differences in overall response strategies: individuals tend to respond similarly across tasks
- Differences in processing speed (see Munson, Kaiser, & Urberg Carlson, 2008)
- Differences in attention to indexical information

### Munson, Kaiser, and Urberg Carlson (2008) concluded that the second hypothesis cannot explain these response patterns

- We hypothesized that listeners would be more categorical when there was a long delay between the presentation of the stimulus and the response than when the response was immediate
- We enforced one-, two-, and three-second delays between presentation of the stimulus and elicitation of the response
- Fine phonetic detail in children's speech was perceived equally well across different task-delay conditions; the categoricity of responses didn't change
- This reflects the kinds of delays that occur in real-world assessment of children's speech

### So we created an experiment to test the third hypothesis

- Indexical variables, like gender, are conveyed through fine phonetic detail within categories.
- Hence, we predict that people will be more continuous when they attend to indexical information than when attending to categorical linguistic information
- To encourage *categorical* responses we interleaved forced-choice vowel identification questions between the /s/-/θ/ judgments; vowels were embedded in CV syllables
- To encourage *continuous* responses we interleaved sex-identification judgments between the /s/-/θ/ judgments

## Procedure

### The experiment consisted of three blocks; the first and last were randomized between subjects

- Lexical (categorical) task: /s/-/θ/ judgments alternating with vowel identification (vowels were embedded in CV syllables)
- Short distractor task: judging emotion of speaker based on distorted signals
- Indexical (continuous) task: /s/-/θ/ judgments alternating with judgments of speaker sex (see Figures 3 and 4)

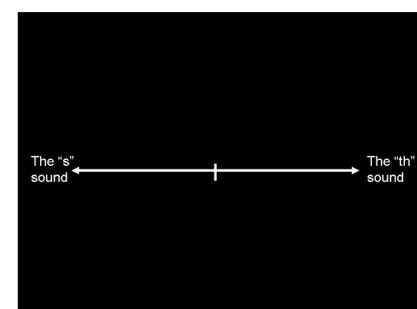


Figure 3: VAS rating screen for /s/-/θ/

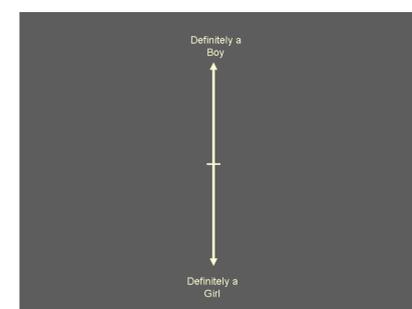


Figure 4: VAS rating screen for gender

### We used the same stimuli that were used in Schellinger, Edwards, Munson, and Beckman (2008) to examine adults' ratings of children's /s/-/θ/ productions

- Stimuli were two- to five-year olds' productions of target /s/ and /θ/ in CV syllables
- Stimuli were randomly assigned to the first and last blocks
- We counterbalanced the assignment of stimuli to condition

## Results

### No significant difference was found between the two conditions

- Relative intensity was used as a predictor for VAS click locations on the /s/-/θ/ continuum (see Figure 5)
- Figure 6 is scatterplot of the subjects' /s/-/θ/ slopes in the two blocks
- A Wilcoxon Signed-Ranks test showed no significant difference between the two conditions, Lexical and Indexical ( $z = -0.114$ ,  $p = 0.91$ )
- The median slope for the Lexical condition ("Vowel Blocks") was -6.11
- The median slope for the Indexical condition ("Gender Blocks") was -6.96

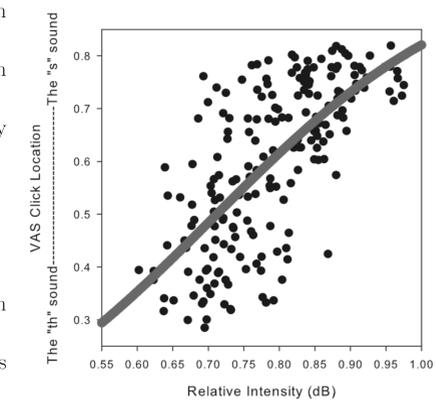


Figure 5: /s/-/θ/ judgments pooled across the two conditions

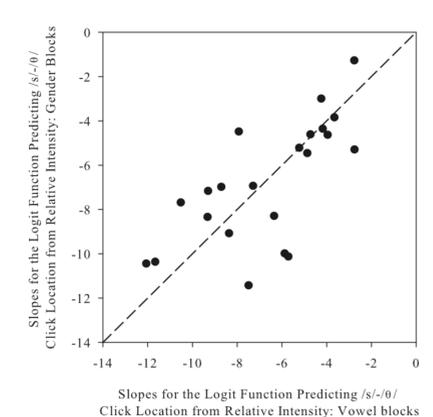


Figure 6: Comparison of slopes between the two conditions

## Conclusions and future work

### People are consistent across different types of tasks in rating children's speech

- We tested whether people would respond categorically to fricatives if they are made to pay more attention to categorical aspects of the stimuli (like the identity of phonemes), and conversely, whether people would respond continuously to fricatives if they are made to pay more attention to indexical information like speaker gender
- This didn't happen, so we can conclude that differences in attention to indexical information (the third hypothesis) cannot explain why some adults are more categorical and others more continuous when they rate the accuracy of children's speech
- People's ability to perceive fine phonetic detail in productions is robust across different tasks

### Future work

- Test the first hypothesis
- Continue to refine our measure of categoricity of response
- Explore other factors that will predict VAS ratings on the /s/-/θ/ continuum; maybe relative intensity isn't the best predictor for all listeners

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