How a cross-linguistic study of phonological development can inform clinical practice

ASHA, 2011

Jan R. Edwards, Mary E. Beckman, and Benjamin Munson

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A complex web of collaborators

- Edwards
  - Todd
  - Arbisi-Kelm
  - Syrika
- Munson
  - Urberg-Carlson
  - Li
- Beckman
  - Chung
  - Kong
  - Holliday
  - Yoneyama

ASHA Annual Convention (Nov. 17, 2011)
A complex web of collaborators

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A complex web of collaborators
Why you should stay

The million dollar question:

How is a study of phonological acquisition across languages informative for clinical practice in the United States?
Our original motivation

• Do children learn **sounds** or do they learn **sounds in words**?
What did we learn?

• Children learn sounds in words.

What else did we learn?

• We can’t rely only on transcription because:
  • There are language-specific differences in perception.
  • All incorrect productions are not the same.
  • All correct productions are not the same.
  • Children are learning more than simply how to produce speech sounds correctly.
Methods

– **Languages**: English, Cantonese, Greek, Japanese, (Korean, Mandarin)

– **Target consonants**: word-initial lingual obstruents

– **Procedure**: Auditory word-repetition task

– **Participants**: 100 2- to 5-year olds for each language.

– **Analysis**:
  • Transcription
  • Acoustics
  • Naïve speaker perception
Example stimuli for /k/ in English

- kaytush
- key
- coffee
- cutting
- cougar
- coat
- quick
Example stimuli for /k/ in Japanese

[kumi]  [kibi]  [kuruma]
[kemono]  [keki]  [kumi]  [kuruma]
[ku:ri]  [kaba]  [koara]

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Result 1: Children learn sounds in words
Result 1: Children learn sounds in words
Result 2: Language-specificity in perception

- Cross-linguistic differences in phoneme frequency do not explain all language-specific patterns.

- Sibilant fricative contrast in Japanese acquired later than similar contrast in English, although phoneme frequencies are similar (Li et al., 2010).
Result 2: Language-specificity in perception
Result 2: Language-specificity in perception

- Why is /s/ produced with such low accuracy by Japanese-speaking 2- and 3- year olds?
- Why is /s/ produced with such high accuracy by English-speaking 2- and 3- year olds?
Result 2: Language-specificity in perception

- **English:**
  - /s/ is mastered earlier than /ʃ/
  - [s] is substituted for /ʃ/  
    
    shoe  safe

- **Japanese:**
  - /ʃ/ is mastered earlier than /s/
  - [ʃ] is substituted for /s/  
    
    Shukurimu “cream puff”  semi “cicada”
Result 2: Language-specificity in perception

- **Question:**
  - Are there differences in how adult native speakers of English and Japanese perceive children’s /s/ and /ʃ/ productions?

- **Participants:**
  - English speakers (Minneapolis, MN)
  - Japanese speakers (Tokyo, Japan)

- **Stimuli:**
  - CV sequences
  - Correct productions of /s/ and /ʃ/ and prototypical substitutions of children in each language.

- **Task:** Is it an /s/? Is it an /ʃ/?
Result 2: Language-specificity in perception

- **English listeners**: Larger acceptable range for /s/
- **Japanese listeners**: Larger acceptable range for /ʃ/
Result 3: All incorrect productions are not the same

Problems with transcription.

1. Depends on listener’s experience and expectations.
2. Children do not progress
directly and categorically from
incorrect to correct productions.
   – All incorrect productions are not the same.
   – All correct productions are not the same.
**Result 3: All incorrect productions are not the same**

<table>
<thead>
<tr>
<th></th>
<th>Japanese- versus English-speaking</th>
<th>centroid (Hz)</th>
<th>F2 onset (Hz)</th>
<th>st. dev. (Hz)</th>
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<tbody>
<tr>
<td></td>
<td>Li (2008)</td>
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Li (2008)
Result 3: All incorrect productions are not the same

–Transcription analysis: We observed many intermediate productions.

–**English:** [k] or [g]
  [f] or [θ]

–**Greek:** [k] or [t]
  [s] or [θ]
Result 3: All incorrect productions are not the same

• **Question:**
  – Can naïve listeners reliably categorize productions as intermediate between /s/ and /θ/ (Schellinger et al., 2008)?

• **Participants:**
  – naïve adult listeners

• **Method:** Visual analog scaling

The “s” sound

The “th” sound

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Result 3: All incorrect productions are not the same

• Stimuli:
  – 200 CV sequences.
    • correct /s/
    • [s] for /θ/
    • intermediate: closer to [s] than [θ]
    • Intermediate: closer to [θ] than [s]
    • [θ] for /s/
    • correct /θ/
Result 3: All incorrect productions are not the same
Result 3: All incorrect productions are not the same

Speech-language pathologists do it better! (Munson, Johnson, & Edwards, 2010)

Their responses better differentiate among transcription categories

They don't have as strong a bias to label sounds as 's'

They have superior intra-rater reliability
Result 4: All correct productions are not the same

Holliday et al., 2010
Result 4: All correct productions are not the same

• **Question:**
  – Do naïve listeners rate productions from children with steep slopes differently than productions from children with shallow slopes (Sovinski, 2011)?

• **Participants:**
  – naïve adult listeners

• **Method: Direct magnitude estimation**

  ![Diagram of Good “s” and Bad “s”]
Result 4: All correct productions are not the same
Result 5: There’s more to phonological development than phonemes

• Speech sounds encode at least two kinds of information:
  – Lexical information
  – Socio-indexical information
Result 5: There’s more to phonological development than phonemes

Mandarin has two post-alveolar fricatives:
- /ɕ/ (“she”)
- /ʂ/ (“shr”)

- Onset F2 frequency (y-axis):
  - Differentiates /ɕ/ and /ʂ/
- Centroid frequency (x-axis):
  - Used for socio-indexical coding for /ɕ/.

Li & Kong, 2008

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Result 5: There’s more to phonological development than phonemes

- Difference between /ç/ and /ɻ/ is greater for women than for men.
  - Without fem. accent:
  - With fem. accent:
Result 5: There’s more to phonological development than phonemes

Development of Gender-marked Phonetic Variant in Mandarin

Boy:  
Girl w/o F.A.  
Girl w/F.A.

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Edwards 34
Result 5: There’s more to phonological development than phonemes

Children learn to mark their gender through phonetic variation.

3-7-year-old boys with phonological disorder were rated to sound less boy-like than age peers.

Munson & Baylis, 2007
What did we learn?

1. Children learn sounds in words.

What else did we learn?

- We can’t rely only on transcription because:
  2. There are language-specific differences in perception.
  3. All incorrect productions are not the same.
  4. All correct productions are not the same.
  5. Children are learning more than simply how to produce speech sounds correctly.
Back to the million dollar question

How can these results inform clinical practice???
Levels of knowledge about speech sounds

categorical phonological knowledge

[t]onset

front[k]onset

stressed[i] back[k]onset

stressed[u] trochee

words

{key} {tuna} {cougar}

language-specific phonetic detail

man's <key> man's <tuna> man's <cougar>

socio-indexical knowledge

Buffalo gay adult NYC female

gay male child people

Ben Marie Aunt Jan

girls' <cougar>

voices

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Edwards 38
How can these results inform clinical practice?

- **Result 1**: Children learn sounds in words.
- Need to consider the words a child knows as well as the sounds he/she knows.
- Children with phonological disorders have smaller vocabularies than their typically developing peers.
How can these results inform clinical practice?

• **Result 2:** We can’t rely only on transcription:
  – There are language-specific differences in perception.

• Transcription is influenced by listeners’ linguistic experience (and expectations).
How can these results inform clinical practice?

• **Result 3-4:** We can’t rely only on transcription:
  
  – All incorrect productions are not the same.
  – All correct productions are not the same.
How can these results inform clinical practice?

• **Result 5:** We can’t rely only on transcription:
  – There’s more to phonological development than phonemes.

• Some language disorders characterized by difficulties understanding social cues.
• Many social cues are signaled by sociophonetic features.
How can these results inform clinical practice?

• How can we supplement transcription?

• Clinicians are good at hearing intermediate productions.

• VAS and DME are not difficult to use in clinical practice.
Acknowledgments

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• Participation of the children and cooperation from their parents

For all of which, a heartfelt:

谢谢  thank you  ευχαριστώ πολύ  ありがとう