Phonological specificity of vowels and consonants in 20-month-olds’ word representations

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Background
• Infants discriminate phonetic contrasts already before 4 months of age (e.g., Eimas, Siqueland, Jusczyk, & Vigorito, 1971).
• Discriminate both native and nonnative contrasts from the beginning.
• Sensitivity to nonnative contrasts decline around 12 months (Werker & Tees, 1984).
• Sensitivity to native contrasts increases around 12 months.

Discrimination of Hindi and Salish by English-learning infants

6-8 mo. Discriminate contrasts in both languages
8-10 mo. Half of the infants could discriminate
10-12 mo. Few could discriminate (Werker, 1989)

Discrimination of the English /r/-/l/ distinction: Sensitivity increases for American infants but decreases for Japanese infants between 6-12 mo. (Kuhl et al., 2006)

Background
• High capability of perceiving native phonetic distinctions at around 1 year.
• At this time word learning begins.
• Word learning requires encoding of sound for later recognition.
• Expect infants to encode the sound pattern of words accurately because of their perceptual abilities at 1 year of age.

Background
• BUT an early report indicated that at around 1 year, infants confuse minimal pairs (Shvachkin, 1973).
• They could discriminate.
• …but could not associate the right word with a referent.
• Access to phonetic detail hampered by word-object association.

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Background

- The effect of word-object association on perception shown again later in habituation-switch task (Stager & Werker, 1997)
- 14-month-olds were taught novel “words”:
  - very different word pair: *Lif – Neem*
  - minimal pair: *Bih – Dih*
- In test phase, infants noticed word-object switch for *Lif-Neem* pair, but not *Bih-Dih*
- But infants could discriminate *Bih-Dih*

Background

- Reduced phonological sensitivity at 14 mo. when associating words with objects?
  - i.e., words phonologically underspecified?
- Only novel words
- Sensitivity to mispronunciations of well-known words at 14 mo. shown with switch task (Fennel & Werker, 2003) and inter-modal preferential looking task or IPL (Swingley & Aslin, 2002)

Background

- Sensitivity to phonological detail of well-known words at 18-23 months (Swingley & Aslin, 2000)
- “Recovery” of sensitivity to phonological detail of novel words at 17-20 months (Werker et al. 2002)

<table>
<thead>
<tr>
<th></th>
<th>Well-known</th>
<th>Novel</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 mo.</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>20 mo.</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

Background

- The just-reviewed studies examined sensitivity to consonants
- But vowels might have either stronger or weaker representation than consonants
  - *Weaker*: Vowels constrain lexical access less than consonants in adults (Cutler et al., 2000)
- More or less detail for vowels than consonants in early word representations?

Background

- Conflicting results
  - 20-month-olds showed sensitivity to mispronunciations in the consonant but not the vowel in novel words (Nazzi, 2005)
  - 15 to 24-month-olds sensitive to mispronunciations in both vowels and consonants in well-known words (Mani & Plunkett, 2007)
This study

Tested sensitivity to vowel and consonant mispronunciations in well-known words using IPL

Purpose

• To pit sensitivity to vowel mispronunciations against consonant mispronunciations to determine if vowels constrain lexical access less than do consonants
• To examine sensitivity to consonant mispronunciations in the first vs. last consonant in CVC words

Methods

Participants

• Thirty-two 19 to 21-month-olds – 16 each in experiment 1 and 2
• All were healthy full-term infants born to native speakers of Danish

Methods – Exp. 1

Auditory stimuli

• Four correctly pronounced (CP) and four mispronounced (MP) Danish CVC
• MP words differed from the correct words in either the initial consonant or the vowel.
• Each MP stimulus could be “reconstructed” to two of the correct words by changing the vowel or initial consonant

Example of MP trial

<table>
<thead>
<tr>
<th>Consonant target</th>
<th>Vowel target</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Kat”</td>
<td>“Sut”</td>
</tr>
<tr>
<td>Change vowel</td>
<td>Change consonant</td>
</tr>
</tbody>
</table>

Methods – Exp. 1

Table 1. Auditory stimuli, which were either correctly pronounced or mispronounced

<table>
<thead>
<tr>
<th></th>
<th>Danish</th>
<th>IPA</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>sut</td>
<td>/s/</td>
<td>“pacifier”</td>
</tr>
<tr>
<td>kat</td>
<td>kæt</td>
<td>/kæ/</td>
<td>“cat”</td>
</tr>
<tr>
<td>bil</td>
<td>bi:l</td>
<td>/bi:l/</td>
<td>“car”</td>
</tr>
<tr>
<td>fjal</td>
<td>fju:l</td>
<td>/fju:l/</td>
<td>“bird”</td>
</tr>
<tr>
<td>Mispronounced</td>
<td>sut</td>
<td>/s/</td>
<td>“pacifier”</td>
</tr>
<tr>
<td>kut</td>
<td>kæut</td>
<td>/kæut/</td>
<td>“cat”</td>
</tr>
<tr>
<td>bul</td>
<td>bu:l</td>
<td>/bu:l/</td>
<td>“car”</td>
</tr>
<tr>
<td>fjl</td>
<td>fju:l</td>
<td>/fju:l/</td>
<td>“bird”</td>
</tr>
</tbody>
</table>

Methods – Exp. 1

Procedure

• Infant sits on parents lap in dim booth
• On each trial, two pics shown for 5000 ms
• At 2250 ms, word stimulus (CP or MP) is presented in carrier sentence: Se, en ___
• Offline examination of picture fixation after word stimulus, frame by frame from video recordings (show video)
• Observation window: 1500 ms
Methods – Exp. 1

Procedure

• In CP trials, the picture named by the auditory stimulus was the target
• In MP trials, both pictures were possible targets. Auditory stimulus e.g., *kut*
  – Consonant target: Kat-picture (correct consonant, wrong vowel)
  – Vowel target: Sut-picture (correct vowel wrong consonant)

Preference for looking at the consonant target in MP trials = consonants constrain lexical access more than vowels (weaker specification of vowels)
• Preference for looking at the vowel target = vowels constrain lexical access more than consonants
• 16 test trials (8 CP, 8 MP)

Results – Exp. 1

Difference score (looking time at target minus distractor in MP trials) shows target preference in CP trials
Small positive difference score in MP trials (looking time a consonant target minus vowel target), not signific. different from 0
Non-significant preference for consonant target

Discussion
• Preference for target in CP trials = experiment works
• Non-significant preference for consonant target = no evidence that consonants and vowels differ in constraining lexical access
• Does not suggest a difference in specificity for vowels and consonants in well-known word representations at 20 months

Methods Exp. 2

Examined sensitivity to mispronunciation in vowel vs. *final* consonant in CVC words

Stimuli
• Four CP words and four MP words, analogous to experiment 1 stimuli
• Each MP stimulus could be reconstructed to two CP stimuli, e.g., *Kot*
  – Consonant target: Kat-picture
  – Vowel target: Kop-picture

Results – Exp. 2

Difference score (looking time at target minus distractor in MP trials) shows target preference in CP trials
Small negative difference score in MP trials (looking time a consonant target minus vowel target), not signific. different from 0
Non-significant preference for vowel target
Discussion

• Non-significant preference for vowel target
  = no evidence that consonants and vowels differ in constraining lexical access
• Does not suggest a difference in specificity for vowels and consonants in well-known words at 20 months
  – Supports Mani & Plunkett (2007)

Interpretation problem

• Under specification of both vowels and consonants in well-known words at 20 mo. is unlikely
  – evidence of substantial detail for vowels and consonants in English infants aged 14-15 mo.
  – if both vowel and final consonant are underspecified, it should be hard to tell \textit{kat} from \textit{kop} in CP trials
• Convinced?

Discussion

• Possible effect of position of mispronunciations

Diagram:

- Initial consonant vs. vowel
- Final consonant vs. vowel

• Could this effect solve interpretation problem?
• If the effect of position of mispronunciation is significant, how could both vowels and consonants be underspecified?

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Conclusion

• Vowels and consonants do not differ in constraining lexical access to well-known words at 20 months
• Suggests that vowels are as phonologically well-specified as consonants are in word representations at 20 months
• Future: difference between vowels and consonant specificity at 14 months?

Thank you!

• Presentation will soon be available from
  – www.andershojen.dk
  – www.sdu.dk/cfb
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References


