Speech perception in young multilinguals

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L3 workshop 2017
Outline

- Speech perception in multilinguals
  - Models of L2 speech perception
  - Overview of research

- Study
  - Aims
  - Methods
  - Results
  - Conclusion
Models of L2 speech perception

- Perceptual Assimilation Model (PAM, PAM-L2)
  
  Best 1995, Best & Tyler 2007

- L2 sounds may be assimilated into L1 phonological space => as good/acceptable/deviant exemplars of L1 category

- Different assimilation patterns:
  - TC – 2 L2 phones to two different L1 categories
  - CG - 2 L2 phones to one L1 category (but one is better exemplar)
  - SC - 2 L2 phones to one L1 category (equally good/bad exemplars)
  - UC – uncategorised assimilation
Speech perception by multilinguals?

- PAM does not make any predictions
- Are L3/Ln categories assimilated to L1 or L2 categories in multilinguals?
- Will phonological categories from multiple languages help distinguish between two similar L3/Ln categories?
Overview of previous L3 perception studies (1)

- Studies on L3 perception rather scarce

- Kopečková 2013, 2015
  - cross-linguistic vowel identification task
  - child participants
  - Polish: L1, English: L2 or L3
  - basic mechanism of equivalence classification for both L2 and L3 learners
  - gradual change in perceptual sensitivity
Overview of previous L3 perception studies (2)

- Cabrelli Amaro 2013, 2016
  - word-final vowel reduction in L3 BP and L2 Spanish
  - naturalness preference task
  - Phonological Permeability Hypothesis not supported

- Onishi 2016
  - perception of Japanese contrasts by L3 and L2 learners
  - L1 Korean/L2 English/L3 Japanese vs. L1 English/L2 Japanese
  - AXB discrimination task
  - increase in perceptual sensitivity with L2 phonological acquisition (claimed multilingual advantage)
Multilingual advantage for perception

- Multilinguals deal better with cross-linguistic interference
  (Bartolotti & Marian 2012)

- Advantage for perception of novel contrasts
  (e.g. Antoniou et al., 2015; Enomoto, 1994; Tremblay & Sabourin, 2012)

- No difference between monolinguals and bilinguals acquiring novel contrasts
  (e.g. Díaz, 2011; Gabriel et al., 2014; Patihis et al., 2015)

- Conflicting outcomes possibly due to differences in:
  - cross-linguistic similarity,
  - bilingual dominance and proficiency,
  - specific vs. global advantage
Previous related research

- Kopečková, Marecka, Wrembel, Gut, 2016, IJM
  
  "Interactions between three phonological subsystems of young multilinguals: the influence of language status"

  - **Vowel production** in L3 Polish by child participants

  - **L1**: German, **L2**: English

  - Heritage speakers vs. foreign language learners

  - Complex patterns, individual variation
Aims of the study

- To investigate perceptual categorisation of L3 sounds
- To trace possible facilitation effect of multilingualism
- To explore differences in the vowel and sibilant inventories of the three languages tested

<table>
<thead>
<tr>
<th>German</th>
<th>English</th>
<th>Polish</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 vowels</td>
<td>12 vowels</td>
<td>6 vowels</td>
</tr>
<tr>
<td>/i-/ɪ/, /u-/ʊ/</td>
<td>/i-/ɪ/, /u-/ʊ/</td>
<td>no vowel length distinction</td>
</tr>
<tr>
<td>/s z ŋ tʃ tʃ ts/</td>
<td>/s z ʒ tʃ dʒ/</td>
<td>/s z ɕ z ʂ z ʐ tʃ dʒ tɕ dʑ tʃ dʒ/</td>
</tr>
</tbody>
</table>
Research questions

- **RQ1**: Do L3 speakers distinguish L3 vowels and sibilants?

- **RQ2**: Are L3/Ln vowels and sibilants assimilated to L1 or L2 categories?

**Hypotheses:**

- **H1**: Problems distinguishing L3 Polish sibilants (not occurring in L1 German or L2 English)

- **H2**: No problem distinguishing L3 Polish vowels (L1 and L2 being vocalic)
Participants

- 10 participants growing up in Berlin (9 for the vowel perception)
- 5 male, 5 female (4 male in the vowel perception task)
- aged 14
- enrolled in Polish classes for 10 months
- L2: English, L3/Ln: French or Latin
- 3 German speakers (grew up as monolinguals)
- 7 heritage speakers (at least one Polish parent, grew up with two or more home languages)
Perceptual task 1: vowels

- **Cross-linguistic categorical discrimination**
  (cf. Fox, Flege and Munro 1995, Cebrian 2015)
  - indicate (dis)similarity on 7-point Likert scale
  - minimal pairs within L3 and across other languages:
    - L3 – L3, L3 – L1, L3 – L2
  - vowels: 6 Polish, 9 English, 9 German
  - 55 trials in 2 blocks, randomised
  - bVt context, e.g.

<table>
<thead>
<tr>
<th>L3 Polish</th>
<th>L2 English</th>
<th>L1 German</th>
</tr>
</thead>
<tbody>
<tr>
<td>byt</td>
<td>bit</td>
<td>Bitt</td>
</tr>
<tr>
<td>beat</td>
<td></td>
<td>Bütt</td>
</tr>
</tbody>
</table>
Perceptual task 2: sibilants

**AX discrimination task**

- tokens presented auditorily in monosyllable /Xan/
- 4 sibilant pairs selected
  

- ISI: 300 ms
- (4 same pairs + 4 different) x 2 repetitions = 16 trials
- in random order
- reaction time (RT) task in E-prime
Results: vowel perception (1)

- 2 x 4 ANOVA (group x type of vowel comparison)
- **Group**: German vs. heritage speakers
- **Type**:
  - Polish & Polish vowels (same)
  - Polish & Polish vowels (different)
  - Polish & English vowels
  - Polish & German vowels
- **Significant effect of vowel comparison type**
  \[ F(3,21) = 26.14, \ p < .001, \text{ eta squared } = 0.59 \]
- **No effect of group, no interaction** between group and vowel comparison
Results: vowel perception (2)

- **Polish vs Polish vowels**  
  (same): $M = 1.59$, $SD = 0.50$

- **Polish vs English vowels:**  
  $M = 2.73$, $SD = 0.65$

- **Polish vs German vowels:**  
  $M = 2.80$, $SD = 0.68$

- **Polish vs Polish vowels**  
  (different):  
  $M = 4.22$, $SD = 1.26$
Results: vowel perception (3)

- Polish vs Polish vowels (same)

< Polish vs Polish vowels (different)

\[(t(8) = -7.66, \, p < .001, \, d = -2.55)\]

Big differences

\[M = 4.22\] on PL vs PL (different) vs \[M = 1.59\] on PL vs PL (same)

BUT

greater variability on

PL vs PL (different)

\[(SD = 1.26)\]
Results: vowel perception (4)

- **Polish same < Polish vs English**
  
  \( t(8) = -4.64, p < .05, d = -1.55 \)

  but

  **Polish different > Polish vs English**

  \( t(8) = 4.38, p < .05, d = 1.46 \).

- **Polish same < Polish vs German**

  \( t(8) = -4.86, p < .01, d = -1.61 \).

  but

  **Polish different > Polish vs German**

  \( t(8) = 4.18, p < .05, d = 1.39 \)
Results: vowel perception (5)

- Polish vs English < Polish vs German
  \((t(8)= 5.53, \ p<.01, \ d = 1.84)\)

- English vowels were consistently rated as more similar to Polish than German vowels
  
  BUT
  
  the actual difference between German and English is very small:
  
  Polish vs English vowels: 
  \(M = 2.73, \ SD = 0.65\)
  Polish vs German vowels: 
  \(M = 2.80, \ SD = 0.68\)
Results: individual vowels
Results: sibilants

- perception of different sibilant pairs highly accurate
- discrimination accuracy:
  ż-ź (92.50%) > dż-dż (85.00%) > sz-ś (81.25%) > cz-ć (73.75%)
- difference between cz-ć & ż-ź statistically significant (Mann-Whitney U test with Bonferroni corrections, \( p < 0.01 \))
- RT: no statistically significant differences
  sz-ś (M = 157.23 ms, SD = 347.23) > cz-ć (M = 242.75 ms, SD = 454.11) > dż-dż (M = 285.00 ms, SD = 399.39) > ż-ź (M = 413.77 ms, SD = 1298.73).
- no effect of group, no interaction between group and sibilant type
### Results: individual differences

**d' score**  
(through sibilant types)  

<table>
<thead>
<tr>
<th>Subject</th>
<th>d' Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>HeritPol07</td>
<td>1.277</td>
</tr>
<tr>
<td>GerMono10</td>
<td>1.552</td>
</tr>
<tr>
<td>GerMono05</td>
<td>1.622</td>
</tr>
<tr>
<td>HeritPol06</td>
<td>1.887</td>
</tr>
<tr>
<td>GerMono09</td>
<td>2.229</td>
</tr>
<tr>
<td>HeritPol01</td>
<td>2.229</td>
</tr>
<tr>
<td>HeritPol03</td>
<td>2.229</td>
</tr>
<tr>
<td>HeritPol04</td>
<td>2.367</td>
</tr>
<tr>
<td>HeritPol02</td>
<td>2.73</td>
</tr>
<tr>
<td>HeritPol08</td>
<td>4.645</td>
</tr>
</tbody>
</table>

**Mean distances (vowel types)**

<table>
<thead>
<tr>
<th></th>
<th>Polish vs Polish (same)</th>
<th>Polish vs Polish (different)</th>
<th>Polish vs German</th>
<th>Polish vs English</th>
</tr>
</thead>
<tbody>
<tr>
<td>German monolingual1</td>
<td>1.67</td>
<td>3.00</td>
<td>2.14</td>
<td>2.08</td>
</tr>
<tr>
<td>German monolingual2</td>
<td>1.50</td>
<td>4.33</td>
<td>3.31</td>
<td>3.29</td>
</tr>
<tr>
<td>German monolingual3</td>
<td>1.33</td>
<td>5.67</td>
<td>3.10</td>
<td>3.05</td>
</tr>
<tr>
<td>Heritage speaker 1</td>
<td>2.50</td>
<td>6.00</td>
<td>2.60</td>
<td>2.53</td>
</tr>
<tr>
<td>Heritage speaker 2</td>
<td>1.83</td>
<td>3.67</td>
<td>3.34</td>
<td>3.23</td>
</tr>
<tr>
<td>Heritage speaker 3</td>
<td>1.17</td>
<td>4.33</td>
<td>3.55</td>
<td>3.43</td>
</tr>
<tr>
<td>Heritage speaker 4</td>
<td>1.00</td>
<td>2.33</td>
<td>1.49</td>
<td>1.47</td>
</tr>
<tr>
<td>Heritage speaker 5</td>
<td>2.17</td>
<td>5.33</td>
<td>3.23</td>
<td>3.13</td>
</tr>
<tr>
<td>Heritage speaker 6</td>
<td>1.17</td>
<td>3.33</td>
<td>2.44</td>
<td>2.38</td>
</tr>
</tbody>
</table>

**NB.** excellent discrimination $>3.0$,  
lack of discrimination $<1.0$.  

![Image](image-url)
Discussion: vowel perception (1)

• Different **Polish vowel types** perceived as highly **distinct** (although greater SD than for other comparisons)

• Different **tokens of the same Polish vowel** perceived as the **same**

• English and German ’equivalents’ perceived as similar but not the same as Polish vowels

=> **developed categorical perception for Polish vowels**

• German vowels perceived as less similar to Polish than English, but the difference is small

=> **possibly L2 effect**
Discussion: vowel perception (2)

• No group effect – heritage speakers not different from the German learners of Polish (but v. small group)

• Categorical perception different for different vowel types:
  – Polish and English *bet* or *bot* perceived as very similar
  – Polish *bit* and English *beat* also perceived as similar
  – Polish *but* and German *buht* perceived as very dissimilar
Discussion: sibilant perception

- Different Polish sibilant pairs perceived with **high discrimination accuracy** $\Rightarrow$ task effects?
  
  (short ISI, tapping auditory sensory ability rather than categorization processing?)

- The highest the accuracy of sibilant discrimination the lowest the reaction time

- No group effect – heritage speakers not different from the German speakers (but v. small groups)
Discussion: vowel and sibilant perception

- Results partly contradict PAM’s prediction that two similar sounds in the target language and non-existent in the L1 should be assimilated to this L1 category.
- In general the L3 child learners clearly distinguished between the tested Polish vowels and sibilants, respectively, and did not seem to assimilate them to L1 categories.
- More assimilation to L2 than L1 vowel categories (although the difference is very small).
Conclusions

- **RQ 1:** Do L3 speakers distinguish L3 Polish vowels and sibilants?
  - YES

- **RQ 2:** Are L3/Ln vowels and sibilants assimilated to L1 or L2 categories?
  - Rather to L2

- **Hypothesis 1:** Problems distinguishing L3 Polish sibilants
  - NO

- **Hypothesis 2:** No problem distinguishing L3 Polish vowels
  - YES
Conclusions

- **Future work**
  - Longitudinal study to trace development in L3 perception
  - Both cross-linguistic dissimilation and identification tasks
  - Mirror groups
    - L3 Pol/L2 Eng/L1 Ger vs.
    - L3 Ger/L2 Eng/L1 Pol
THANK YOU


References (2)


# Perception task 1 - stimuli

<table>
<thead>
<tr>
<th>POLISH L3</th>
<th>ENGLISH L2</th>
<th>GERMAN L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>bet</td>
<td>bet</td>
<td>Bett</td>
</tr>
<tr>
<td>bat</td>
<td>bat</td>
<td>Bad</td>
</tr>
<tr>
<td>bit</td>
<td>beat</td>
<td>Biet</td>
</tr>
<tr>
<td>byt</td>
<td>bit</td>
<td>Bitt</td>
</tr>
<tr>
<td>but</td>
<td>boot</td>
<td>Buht</td>
</tr>
<tr>
<td>bot</td>
<td>bott</td>
<td>Bott</td>
</tr>
</tbody>
</table>
Vowel systems

English (Roach 2006)

Polish (Jassem 2003)

German (Mangold 2005)