Consonant Harmonies and Acquisition of Natural Classes

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INTRODUCTION
Consonant harmony (CH): definition

• Relatively theory neutral definition from Hansson (2010):

  Any assimilatory effect of one consonant on another consonant, or assimilatory co-occurrence restriction holding between two consonants, where:

  a. the two consonants can be separated by a string of segmental material consisting of at the very least a vowel; and
  b. intervening segments, in particular vowels, are not audibly affected by the assimilating property.

<table>
<thead>
<tr>
<th>Adult language</th>
<th>Child language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ineseño Chumash (McCarthy, 2007)</td>
<td>Jul - 01;10 (Yamaguchi et al., 2015)</td>
</tr>
<tr>
<td>/ha-s-xintila/ [hasxintila] ‘his gentile’</td>
<td>/ʒu/ [zu] ‘play’</td>
</tr>
<tr>
<td>/ha-s-xintila-waf/ [haxintilawaf] ‘his former gentile’</td>
<td>/ʒənə/ [nunu] ‘knee’</td>
</tr>
</tbody>
</table>
CH: Typology (from Hansson 2010)

• CH – Place of Articulation
  • CH seems to exist only between two consonants sharing the same major Place of Articulation: Labial, Coronal, Dorsal

• CH – Manner of Articulation
  • CH Stop-Fricative (extremely rare)
  • CH Nasal-Oral (mainly in Bantu languages)
  • CH Lateral-Rhotic (rare)

• CH – Directionality
  • Regressive in the vast majority of cases

• CH – Prosodic structure
  • « ...consonant harmony never interacts with prosodic factors. For example, consonant harmony is never affected by stress, syllable weight or segmental length, and is never confined to prosodically-defined domains such as the foot. » (p. 137)
CH: Language acquisition

• CH – Place of Articulation
  – All type attested (frequent)

• CH – Manner of Articulation
  – All type attested (less frequent to rare)

• CH – Directionality
  – For Place of Articulation: in general regressive (Pater, 1997; Rose, 2000; Gerlach 2010) or bidirectional

• CH – Prosodic structure
  – For Place of articulation: Prosody can play a role (Rose et dos Santos, 2006; Gerlach 2010)
CH: Language acquisition

  - Clara’s regressive Labial harmony pattern

<table>
<thead>
<tr>
<th>Form</th>
<th>Word</th>
<th>IPA target</th>
<th>Child’s output</th>
<th>Age</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>CVCV</td>
<td>chapeau</td>
<td>[ʃapo]</td>
<td>[pæpo]</td>
<td>1;07.06</td>
</tr>
<tr>
<td></td>
<td>CVC</td>
<td>table</td>
<td>[tab]</td>
<td>[tæb]</td>
<td>1;10.04</td>
</tr>
<tr>
<td>b.</td>
<td>CVCV</td>
<td>café</td>
<td>[kafe]</td>
<td>[pəfe]</td>
<td>1;10.04</td>
</tr>
<tr>
<td></td>
<td>CVC</td>
<td>cube</td>
<td>[kʏb]</td>
<td>[kyb]</td>
<td>1;09.29</td>
</tr>
</tbody>
</table>
CH: Language acquisition

• CH does not seem to be a universal phenomenon (Stoel-Gammon & Stemberger 1994)
  – Some children seem to not produce CH

• Pater & Werle (2003) proposed the same constraint family for taking into account all types of CH: AGREE

• Pater (2002) proposed generalizations for CH of place of articulation

• Nothing is said about CH of manner of articulation (scarce phenomenon)
Acquisition of Natural Classes

• The study of the acquisition of natural classes needs:
  • Longitudinal data
  • To take into account the prosodic position of the segment (onset, coda,...)
  • To select words whose structure restricts the occurrence of possible phonological processes:
    • Assimilation: *train* /tuʁɛ̃/ → *[kʁɛ̃]* ‘train’
    • Harmony: *cadeau* /kaʁo/ → *[kako]* ‘gift’
CH and Natural Classes

• To the best of our knowledge no studies on CH have combined ALL the following methodological criteria:
  • Restriction on the word under scrutiny based on their phonological structure
  • Combined the study of CH with the acquisition of natural classes
  • Using quantitative data for studies on CH AND on acquisition of natural classes
  • Study more than one child
<table>
<thead>
<tr>
<th>References</th>
<th>Collecte</th>
<th>Language</th>
<th># children</th>
<th># HC</th>
<th>Selection</th>
<th>Seg. Acqu.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vihman (1978)</td>
<td>Mixed (several sources)</td>
<td>6 languages</td>
<td>13</td>
<td>347</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Berg (1992)</td>
<td>Diary</td>
<td>German</td>
<td>1</td>
<td>65</td>
<td>No</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Goad (1997)</td>
<td>Diary (Smith, 1973)</td>
<td>English</td>
<td>1</td>
<td>?</td>
<td>No</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Pater (1997)</td>
<td>Diary (Compton et al., 1977)</td>
<td>English</td>
<td>2</td>
<td>73</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Berg et al. (2000)</td>
<td>Diary (Deville, 1891)</td>
<td>French</td>
<td>1</td>
<td>37</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pater et al. (2003)</td>
<td>Diary (Compton et al., 1977)</td>
<td>English</td>
<td>1</td>
<td>400</td>
<td>Stops C1(C)V1(C)C2(C)(V)(C)</td>
<td>No</td>
</tr>
<tr>
<td>Gormley (2003)</td>
<td>Recordings - Induced prod.</td>
<td>English</td>
<td>1</td>
<td>5</td>
<td>(same word)</td>
<td>No</td>
</tr>
<tr>
<td>Rose et al. (2006)</td>
<td>Recordings – Spontaneous prod.</td>
<td>French</td>
<td>2</td>
<td>317</td>
<td>2 consonants in the same foot or not</td>
<td>Yes</td>
</tr>
</tbody>
</table>
RESEARCH QUESTIONS
Goal:
To combine the study of CH with the acquisition of the consonant system by children → less unexplained variation

Question:
In child production, are all instances of CH part of the same phenomenon?
Hypothesis

At least, two types of CH

- ‘Filling’ CH: Harmonized consonants belong to natural classes which are \textit{in the process of being acquired} by the child

- ‘Uniformizing’ CH: Consonants are harmonized because they belong to a different (but already acquired) \textit{natural class} than other consonants in the same word
Hypothesis: Filling CH

- Filling CH: harmony trigger = an acquired natural class; harmony target = a natural class in the process of being acquired
  - Linked with the natural class acquisition process in the child’s phonological system (paradigmatic axis)
  - No preferred direction for CH
Hypothesis: Uniformizing CH

• Uniformizing CH: 2 different natural classes (which are already acquired) in the same target word
  – Linked with the acquisition of a sequence of 2 different natural classes in the same word (syntagmatic axis)
  – CH feature determined by the harmonizing natural class position → direction always regressive
  – These natural classes are already acquired by the child
METHODOLOGY
Participants

• 4 monolingual French speaking children from the French project PREMS (ANR n°11-BSH2-0009)

• Longitudinal study: 1h video recording at home of parent-child interaction, every two weeks

• Transcription: Phon

<table>
<thead>
<tr>
<th></th>
<th>Emm (F)</th>
<th>Bap (M)</th>
<th>Est (M)</th>
<th>Jul (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session start</strong></td>
<td>01:00.08</td>
<td>01:00.27</td>
<td>01:01.03</td>
<td>01:03.01</td>
</tr>
<tr>
<td><strong>Session end</strong></td>
<td>02:01.08</td>
<td>02:00.12</td>
<td>02:00.24</td>
<td>02:00.28</td>
</tr>
<tr>
<td><strong># sessions</strong></td>
<td>29</td>
<td>24</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td><strong># utterances</strong></td>
<td>4513</td>
<td>4730</td>
<td>1478</td>
<td>3768</td>
</tr>
</tbody>
</table>
Natural class

Natural classes studied :

• Manner of Articulation (MoA):
  – Stop: /p, t, k, b, d, g/
  – Fricative: /f, s, ʃ, v, z, ʒ/
  – Nasal : /m, n, ɲ/

• Place of Articulation (PoA):
  – Labial : /p, b, f, v, m/
  – Coronal : /t, d, s, z, ʃ, ʒ/
  – Dorsal : /k, g/
Word selection

• For the acquisition of natural classes:
  – CV words
  – \( C_1 \) in \( C_1 V C_2 (V) \) where \( C_1 \) and \( C_2 \) share the same natural class

• For CH:
  – Only 2 syllable words when there is a CH between the 2 onsets:

\[
\begin{align*}
  C_1 & \quad V \quad C_2 \quad V
\end{align*}
\]

• Harmonized CVC words were excluded → same prosodic position comparison
Data

• Acquisition of natural classes
  • Number of target consonants: 26252

• CH
  • Number of CH: 556
    • 214 CH of MoA
    • 342 CH of PoA
RESULTS
Acquisition of natural classes

• For all children in onset of $C_1VC_2(V)$ words (where $C_1$ and $C_2$ share the same natural class)
  
  • MoA
    • Stop and Nasal acquired first
    • Fricative acquired later

  • PoA
    • Labial and Coronal acquired first
    • Dorsal acquired later
CH data overview

• MoA (214 CH)
  • 51% of $C_1VC_2V$ words are harmonized (*less target, more frequent*)
  • 72% are regressive CH

• PoA (342 CH)
  • 35% of $C_1VC_2V$ words are harmonized (*more target, less frequent*)
  • 83% are regressive CH

• Directionality results differ when the natural classes at play are taken into account
Filling CH: MoA

- Filling CH occurs when one CH in the word is in the process of being acquired
  - In our case: Fricative
  - Regressive
  - Progressive

<table>
<thead>
<tr>
<th>Target</th>
<th>Fri-Fri</th>
<th>Stop-Stop</th>
<th>Nas-Nas</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri-Stop</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>2</td>
</tr>
<tr>
<td>Fri-Nas</td>
<td>33%</td>
<td>0%</td>
<td>67%</td>
<td>3</td>
</tr>
<tr>
<td>Stop-Fri</td>
<td>6%</td>
<td>94%</td>
<td>0%</td>
<td>31</td>
</tr>
<tr>
<td>Nas-Fri</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Filling CH: PoA

- Filling CH occurs when one CH in the word is in the process of being acquired
- In our case: Dorsal
- Regressive
- Progressive

<table>
<thead>
<tr>
<th>Target</th>
<th>Dor-Dor</th>
<th>Lab-Lab</th>
<th>Cor-Cor</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dor-Lab</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>Dor-Cor</td>
<td>11%</td>
<td>0%</td>
<td>89%</td>
<td>125</td>
</tr>
<tr>
<td>Lab-Dor</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>3</td>
</tr>
<tr>
<td>Cor-Dor</td>
<td>40%</td>
<td>0%</td>
<td>60%</td>
<td>5</td>
</tr>
</tbody>
</table>
Uniformizing CH: MoA

- Uniformizing CH occurs when two different and already acquired natural classes are present in the word
  - In our case: Nasal and Stop
  - Regressive

<table>
<thead>
<tr>
<th>Target</th>
<th>Productions</th>
<th>Nas-Nas</th>
<th>Stop-Stop</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nas-Stop</td>
<td>0%</td>
<td></td>
<td>100%</td>
<td>91</td>
</tr>
<tr>
<td>Stop-Nas</td>
<td>97%</td>
<td></td>
<td>3%</td>
<td>37</td>
</tr>
</tbody>
</table>
Uniformizing CH: PoA

• Uniformizing CH occurs when two different and already acquired natural classes are present in the word
  • In our case: Labial and Coronal
  • Regressive

<table>
<thead>
<tr>
<th>Target</th>
<th>Productions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cor-Cor</td>
</tr>
<tr>
<td>Cor-Lab</td>
<td>5%</td>
</tr>
<tr>
<td>Lab-Cor</td>
<td>72%</td>
</tr>
</tbody>
</table>
Results: summary

• Two types of CH occurring at one point in time (e.g. 1;06)
  • When one natural class is not acquired, it is replaced by the natural class of the other consonant → Filling CH
    • Directionality determined by the position of the consonant whose natural class is not yet fully acquired
    • Here: Fricative and Dorsal are in the process of being acquired
  • When the natural classes of the two consonants are already acquired, before the child masters the production of a sequence of two different consonants → Uniformizing CH
    • Directionality is regressive like in adult language
    • Here: Stop and Nasal / Labial and Coronal
Methodological issues

• Avoid putting apples and oranges together:
  • Limit the number of possible other processes than the one at stake
  • Strict criteria for word inclusion in the study
  • Knowledge of the development of the child’s phonological system taking into account prosodic position

• Less data to analyze but emergence of (quite) clear patterns
  • CH of MoA more frequent than CH of PoA
  • Directionality depends on the acquisition or not of the natural classes of the target word → progressive CH are not exceptions
Future directions

• to strengthen the hypothesis
  – Need data from more children
  – Add CVC words in the analysis (different prosodic structure)
    ▪ Final consonant development
    ▪ Predictions: find filling and uniformizing CH as well
  – Duplicate the study with another language (English?)
• Compare closely uniformizing CH with adult CH (regressive or anticipatory CH)
References


Thank you for your attention!

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