Learning paths in phonology
Evidence from the CLPF database

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Introduction

• Many phenomena have been investigated in isolation

  • Acquisition of PoA
  • Acquisition of MoA
  • Acquisition of syllable structure
  • etc.

• Variation in development both in time and pathways for each of the phenomena

• But are these connected?
Outline

- Introduction

- Target language: Dutch
  - Syllables, Manner of Articulation, Sonority

- Child language: developmental paths
  - MoA, Clusters, Syllables

- Discussion and Conclusions
Different learning paths: examples

• Consonant clusters

• All children start reducing clusters typically to the least sonorant consonant
  • Example: /blum/ > [bum]

• The next step varies for different children:

• Some children produce the cluster correctly (end state): /blum/ > [blum]
Different learning paths: examples

- But some children have intermediate steps
  - CG: /blum/ > [bjum] (max contrast within onset)
  - [C-Son]_{PoA}: /blum/ > /buum/
  - L: /blum/ > [lum]
  - CvL: /blum/ > [bəlum]

- All roads lead to Rome
Questions

• Is the pathway chosen dependent on other developments?

• Do children who have PoA harmony within clusters also have more harmony otherwise in their system?

• Do children who chose a maximal contrast in onset clusters also show evidence for maximal contrasts in the development of other parts of the system?

• Do children who have L as an in-between-strategy also show more deletion as a solution for ‘difficult’ sound sequences?

• We have started investigating these questions related to MoA, syllable structure and word prosody, where dependency relations are likely to occur.
MoA, Sonority, syllable structure

• Sonority Sequencing Principle: P > F > N > L > G > V

• Onsets: preferably least sonorous

• Rhymes: preferably most sonorous

• Ideal syllable: CV: Plosive - Vowel

• Syllable contact law:
  • C.C: some sonority distance is preferred (required in many languages) (Cson.Cobst), although Dutch also allows CVCo\textsubscript{obst}.Co\textsubscript{obst}V (pasta, klooster)
  • Word endings: contact law not applicable; extra position for coronal obstruents
GOING DUTCH

Syllables and MoA Target language
Manner of articulation

Dutch allows:

• Plosives (P): p b t d k
• Fricatives (F): f v s z χ
• Nasals (N): m n ŋ
• Liquids (L): l r
• Glides (G): j ʋ
Syllables

• Onsets: (s)(C\text{obst})(L)

• Rhymes: VV, V(V)C_{son}, V(V)C_{obst}, V(V)C_{son}C_{obst}
  
  • Nucleus: maximally two positions: VV or VC_{son}
  
  • Coda: one position
  
  • Rhymes minimally are bi positional (*CV)

• Extrasyllabic position: in word-final position rhymes may be followed by an appendix with (one or two) coronal obstruents
Words

• The majority of words in Dutch consist of one or two syllables

• Most disyllabic words are trochaic
All data come from the CLPF Database

- Data from 12 Dutch children (6 in Groningen, 6 in Leiden)

- Aged between 1;0 and 2;0 at the start of a one-year-period of data collection

- Recordings bi-monthly at the children’s homes (30-45 min)
Manner of Articulation

**Method:**

(a) Onsets in isolation

(b) Codas in isolation

(c) **Word patterns:** Selection of monosyllabic CVC- and trochaic CVCV-nouns resulted in 2122 CVC and 1030 CVCV words

• Every consonant was coded for its **MoA:** P (stop), F (fricative), N (nasal), L (liquid), G (glide)

**Only the ‘youngest’ children:** Elke, Jarmo, Robin, Tom, Eva and Noortje
Developmental paths of word onsets

Based on all word-initial onsets (including CV words)
Essentially only based on stressed syllables
Markedness in onsets (MoA)

Least marked stop and least marked sonorant

Where $u = \text{unmarked}$, $m = \text{marked}$
Perception

- In word learning and word comprehension tasks it seems indeed that plosives are the default (unmarked; unspecified) MoA

- A MP from unmarked stop to marked fricative is not noticed
  - boom ‘tree’ produced as ‘voom’ is not noticed (equal looking times)

- A MP from marked fricative to unmarked stop is noticed
  - vis ‘fish’ produced as ‘bis’ is noticed (shorter looking times to picture)

- Currently we are testing MP from stop to nasal and vice versa.
Perception methods
Markedness in representation (Perception)

• Explanation:

• Only marked features are present in the UR

• All features are perceived (in SR): features must be mapped onto UR

• Mismatch between perceived and stored features excludes the word for recognition.

• Mismatches only possible with marked features. Unmarked features are not present, and hence always lead to a No Mismatch.
Markedness in representation (Production)

• Only marked features are present in the UR

• Children may delete marked features, resulting in less marked productions, but do not often add features (more marked representations)

• Hence, fricatives may be produced as stops, but not vice versa.
Order of acquisition of Manner of Articulation in word offsets

- Final position: all children start with a (default) obstruent
- For some children this is the stop, but many prefer a fricative in word final position.
  - Those children show the typical error pattern: plosives produced as fricatives. They all usually produce plosives as well, but PVF is more frequent
- Example: Elke’s first recording session
  - 15 target plosives realized as fricatives (7), plosives (5), deleted (3)
  - 9 target fricatives: all realized as fricatives
Why obstruents? Against typology?

• All children first have obstruents, and only later nasals

• Universality? Many languages have restrictions as to what can occur in postvocalic position. Usually, if a language allows obstruents, it also allows sonorants, but not vice versa.

• Why obstruents acquired early for Dutch?
  • Very frequent in CVC words.
  • Difference between consonants in branching nucleus (always sonorants), and consonants in codas (can be both)

• Codas are acquired first

• Branching nuclei are acquired later (with VL contrasts)
Rhyme structure

Rhyme
  /\  
Nucleus
   \ /
    V Son

Rhyme
  /\  
Nucleus
   \ /
    V Coda
CVC Word patterns

• Predominantly PVF words in the early stages for PVF targets and PVP targets. Markedness? No MoA contrast yet: obstruents are plosive in onsets and fricatives in codas (complementary distribution; allophones): OVO

• At this stage unfaithful manners are observed: target nasals and liquids may be produced as obstruents. Later unfaithfulness becomes rare

• Some children have a subsequent stage in which the two C’s of the word have the same MoA: one MoA per word for Consonants

  • Example: Elke’s second stage: FVF > NVN > PVP

• Subsequently, different MoA features appear in her words: PVF and PVP: Faithful productions of both stops and fricatives.

• Some children introduce MoA contrast first in initial position; others in final position (Noortje en Robin)
Some children start introducing contrasts in offsets

- Initial position remains fixed; final position varies

<table>
<thead>
<tr>
<th></th>
<th>C2=stop</th>
<th>C2=fricative</th>
<th>C2=nasal</th>
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<tr>
<td>C1=C2</td>
<td>PVP</td>
<td>PVF</td>
<td>PVN</td>
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<tr>
<td>C1=stop</td>
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<tr>
<td>C1=nasal</td>
<td>NVP</td>
<td>NVF</td>
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Noortje and Robin
Some children start introducing contrasts in onsets

- Final position remains fixed; initial position varies

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Order of acquisition of MoA

- Most children acquire MoA contrast in initial position before they acquire the contrast in final position.

- Noortje and Robin introduce the contrast in final position.
Onset Clusters

• Two types

• Clusters obeying the sonority sequencing hierarchy (Obstruent - Sonorant)

• Clusters disobeying the sonority sequencing hierarchy (s- Obstruent)
Onset clusters (1): Obstruent - Sonorant

- Dutch allows the following onset clusters:

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>b</th>
<th>t</th>
<th>d</th>
<th>k</th>
<th>f</th>
<th>v</th>
<th>s</th>
<th>z</th>
<th>x</th>
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Onset clusters (2): /s/+obstruent

Dutch allows the following combinations:

<table>
<thead>
<tr>
<th>c1</th>
<th>c2</th>
<th>s</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>(r/l)</td>
<td>x</td>
</tr>
<tr>
<td>t</td>
<td>(r)</td>
<td>x</td>
</tr>
<tr>
<td>k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
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<td></td>
</tr>
<tr>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>(r)</td>
<td>x</td>
</tr>
</tbody>
</table>

Generalizations:

- /s/ plus voiceless stop
- If stop can be followed by a sonorant, this can be combined with /s/
- /k/ is replaced by /χ/ (historical change)
- /sχl/ is not allowed
Two pathways for onset clusters
Some data (Robin): Obstruent-Sonorant

- plukken ‘pick’
  - [pykə] (1;10.20)
    - [pœkə] (2;03.21)
- slapen ‘sleep’
  - [patə] (1;7.26)
  - [sapeə] (2;04.28)

- brood ‘bread’
  - [pot] (1;08.09)
  - [bot] (2;03.21)
Some data (Robin): /s/-Obstruent

- schoen ‘shoe’
  - [pum] (1;7.12)
  - [sɔnə] (1;10.06)
- stoel ‘chair’
  - [tu] (1;08.09)
  - [stu] (2;03.21)
- speeltuin ‘playground’
  - [pitœyn] (1;11.06)
  - [speltœyn] (2;03.21)
Complex offsets

- Two types
  - Sonorant-Obstruent
    - hand, eend, etc.
  - Obstruent-Obstruent
    - kast, dicht, etc.
Offset clusters

- Two possible acquisition orders:

  - NC > - CC
    - Robin, Noortje, Catootje, Tirza and Eva
  - CC > - NC
    - Leonie, Tom, Jarmo and Elke

- Here, there seems to be a lot of variation. Why?
Rhymes

• Some children allow all sonorants to occur in nucleus: for example Jarmo.

  • Compensatory lengthening: If liquid is deleted, the vowel is often lengthened or diphthongized

  • Sonorants are acquired late, and are dependent on vowel length acquisition

• But some children do not, such as Robin: nasals seem part of coda (not nucleus). Robin acquires nasals early in coda position

• Also word medial N.C clusters are acquired early by Robin

• These children seem to end up with different syllable structures
Coda clusters

• **Robin and Noortje** acquire ‘coda’ clusters earlier than onset clusters
  - -NC > -CC > sC-

• Leonie, Tom, Jarmo and Elke acquire onset clusters (CL-) before ‘coda’ clusters
  - CL- > -CC > -NC

• Catootje, Tirza and Eva also have final clusters before initial clusters
  - -NC > -CC > CL- > sC-
Correlations?

• Is it the case that children who introduce MoA in initial position have initial clusters before final clusters?

• And do children who introduce contrast in final position have final clusters first?

• Preliminary analysis suggests this, but exact analysis depends on
  • whether you take all child’s production into account (including unfaithful productions)
  • focus on first faithful realizations
Noortje and Robin

- Add MoA contrast in word-final position first

- Have final clusters before initial clusters

They also:

- Have N-Obstruent before Obstruent-obstruent clusters in final position

- Have s-Obstruent clusters before Obstruent-Liquid-clusters

- What do these facts have in common? Are they related?
Beyond CV

• Noortje and Robin seem to build on a stable, more or less fixed CV pattern to which new structure is added

• CV + C, where MoA contrast are introduced in the final C
  
  • Giving rise to a onset-nucleus-coda syllable

• When final clusters are introduced, the peripheral consonant is in the appendix

• After the final appendix has been acquired, this seems to trigger the development of word initial s + CV cluster: where the appendix is at the word beginning
Discussion

• In general, the following generalization holds: if a child has sC- clusters then s/he also has final consonant clusters

• What do sC-clusters and final consonant clusters have in common?
  
  • extrasyllabic position: knowledge of extrasyllabic position enhances the acquisition of sC-clusters

  • sC- and CL- acquisition not related

  • CL- acquisition not related to final cluster acquisition

• Correlation with morphology? Too few cases in database

• Correlation with initial unstressed syllables? Not clear
Many questions:
- How can we exploit longitudinal databases/Phonbank to find correlations among different phenomena?
- How many data/children do we need to discover possible learning paths?
- Or do we use the database to build hypotheses and test them experimentally?

Thank you!