

The development of segment inventories

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Summary

In this talk, we argue in favour of a traditional, Jakobsonian view of segment acquisition (acquisition of features) based on data from the CLPF database and using a constraint-based framework.

1 The issue

- (1)
 - a. { p, t, k } →
 - b. { p, t, k, b, d, g } →
 - c. { p, t, k, b, d, g, f, s, x, v, z, ʃ }
- (2)
 - a. Feature-based: children learn feature by feature; frequent and infrequent sounds are acquired around the same time if they are in the same natural class
 - b. Segment-based: children learn more frequent sounds first; natural class behaviour is unexpected or epiphenomenal
 - c. Word-based: children initially use all kinds of segments, provided they occur in frequent words; sounds spread through the lexicon
- (3) Restrictions
 - a. We did not (yet) consider the target sounds
 - b. We disregarded the glides /j/ and /w/, since it is unclear whether to regard them as part of the consonantal system
 - c. Similarly, we disregarded /ʃ/, /ʔ/ and /h/, of which the place in the segment inventory is unclear
 - d. We ordered the remaining segments on Guttman scales

(4) The data: Child 2

Ch	Dh	b	d	t	h	p	m	s	z	n	f	w	k	X	l	x	R	j	S	v
2	52 9	3	7	5	4	2														
2	54 0	3	6	7	2		2													
2	55 4	4	8	4	2				5											
2	56 7	5	1	7		2		3											2	
2	58 8	1	1	1		3	5	3	5					2						
2	60 2	5		9	2	1	2	4												
2	61 5	5	5	1		2	2	4		4	6	3								
2	62 9	1	1	11		9		3		2	5	2								
2	64 3	6	1	9	2	6	6	2	4	1	6	6	4	3			2			2
2	71 5	1	1	2	2	3	1	2	3	9	2	7	3							
2	76 6	3	1	3	1	3	1	1		1	2	8				2				
2	78 5	6	8	2	2	8	8	1		1	2	1	2							4
2	81 7	2	1	1	1	8	1	2		4	1	8	1	4	4	2	2			
2	83 0	8	3	4	5	2	2	8	2	1	3	3	5	1	3			8		2
		4	0	0	2	4	2	3		8	4	2	2	8	4					

Ch	Dh	s	t	p	m	n	k	r	R	X	f	l	N	S
2	52 9	6	1	3										
2	54 0	3	1	4	1	2							1	
2	55 4	6	5	2	2	4	1							
2	56 7	7	6		2	7								
2	58 8	1	4	4	5	9								
2	60 2	8	6	1	1	4						1		
2	61 5	11	1	1	2	7								
2	62 9	6	1	2	1	11					1			
2	64 3	4	5	1	9	62	2	11	1	8	4	2	1	
2	71 5	1	1	4	6	20	1	9	7	4			1	
2	76 6	2	2	6	4	24	8	1			6			
2	78 5	2	1		2	30	1	2	4	6	4			
2	81 7	3	1		2	20	8	1	2	2	2	2	2	
2	83 0	8	6	2	1	10	2	2	1	1	1	8	4	4

(5) Frequency (from the Joost van de Weijer Corpus)

Onsets	Offsets
j = 10,6	n = 10,3
m = 10,6	t = 10,1
d = 9,6	r = 6,9
h = 7,2	m = 6,1
n = 6,9	s = 5,3
z = 5,6	k = 2,9
b = 5,4	x = 2,9
w = 4,4	p = 2,3
k = 4	l = 2,2
x = 3,6	nt = 1
v = 2,1	j = 0,5
l = 2	f = 0,4
p = 1,4	xt = 0,4
t = 1,3	st = 0,5

- (6) Frequency would predict the following order:
 $j, m > d > h > n > z > b > w > k > x > v > l > p > t$
- (7) The word-based approach
- Target onset /l/ is [h] or [s] up until 2;2.27. In subsequent recordings target words starting with /l/ are produced with onset [l] (100% correct): *leeuw, lift, lezen, lepel, leertjes, lopen, lekker, luier, laarzen* etc.
 - Target onset [m]. Is [m] only in three fossilized forms: *mamma, mij, meer*, [b] or [p] otherwise up until 1;11.20. In subsequent recording all target words starting with /m/ are produced with onset [m] (100% correct): *mag, mee, mooi, mannetje*.
 - Target onset /f/ ([v]). Is produced [s] or [z] up until 1;8.10. In subsequent recording we find [f] onsets for all target words starting with /v/, like *vallen, vis, vogel*.
 - Target onset /x/ is produced [s] and later [f] up until 2;1.25. In subsequent recording we find 100% [x] productions for target words with onset /x/: *grote, gegeten, ga, gek, glijbaan*.

2 A feature-based analysis

- (8) An important reason why a feature-based analysis seems to fail, is that we find gaps: natural classes are not always learned as a whole.
- (9) Example: Beers (1996)
- inventory 1: { p, m, t, n, j }
 acquired features: [consonantal], [sonorant], [labial] [coronal]
 problem: how do we distinguish /j/ and /n/?
 - inventory 2: { p, m, t, n, j, k }
 acquired feature: [dorsal]
 problem: no [ŋ] in inventory
 - inventory 3: { p, m, t, n, j, k, s, x, h }
 acquired feature: [continuant]
 problem: no [f] in inventory
- (10) Two types of fcc (Itô, Mester and Padgett 1994):
- *[F,G]: No segment has both F and G
 - [F]⊃[G]: If a segment has F, it also has G
- (11) Only the following constraints seem necessary:
- General:** *[nasal,velar], *[velar,voice], *[continuant,voice], [continuant]⊃[coronal], *[continuant,velar]

b. **Onset:** [continuant]⊃[labial], [nasal]⊃[labial], [labial]⊃[nasal]

c. **Coda:** [velar]⊃[continuant]

(12) Example: Child 2 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[voice] [labial], [coronal]	-	{ b, p, t, d }	529
2.	[nasal]	i. [nasal]⊃[labial]	{ b, p, t, d, m }	540
3.	[continuant]	ii. [continuant]⊃[coronal]	{ b, p, t, d, m, s, z }	554
4.	-	Revoke i. Revoke ii. (Assuming w=v)	{ b, p, t, d, m, n, s, z, f, v }	615
5.	[velar]	iii. *[voice,velar]	{ b, p, t, d, m, n, s, z, f, v, k, x }	643
6.	[lateral]	-	{ b, p, t, d, m, n, s, z, f, v, k, x, l }	766
7.	[rhotic]	-	{ b, p, t, d, m, n, s, z, f, v, k, x, l, r }	817

(13) Example: Child 2 / Coda

	Features	Constraints	Predicted inventory	Day
1.	[labial],[coronal] [continuant]	a. *[continuant, Place]	{ p, t, s }	529
2.	[nasal]	-	{ p, t, s, n, m }	540
3.	[velar] [rhotic]	Revoke a. b. *[nasal,velar]	{ p, t, s, n, m, x, f, k, r }	643
4.	[lateral]	Revoke b.	{ p, t, s, n, m, x, f, k, r, ŋ, l }	817

(14) Example: Child 10 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[labial] [continuant]	a. *[continuant,Place]	{ p, s }	777
2.	[velar], [coronal] [nasal]	Revoke a.	{ p, s, k, t, f, x, n, m, ŋ }	915
3.	[lateral]	-	{ p, s, k, t, f, x, n, m, ŋ, l }	1065

(15) Example: Child 4 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[labial], [coronal], [velar] [continuant] [nasal]	a. [velar]⊃[continuant]	{ p, t, f, s, x, m, n }	497
2.	[rhotic]		{ p, t, f, s, x, m, n, r }	590
3.	-	Revoke a. b. *[nasal,velar]	{ p, t, f, s, x, m, n, r, k }	643
4.	-	Revoke b.	{ p, t, f, s, x, m, n, r, k, ŋ }	703

(16) Example: Child 7 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[coronal]	-	{ t }	392
2.	[labial] [nasal] [continuant]	a. [nasal]⊃[labial] b. [labial]⊃[nasal]	{ t, m, s }	429
3.	-	Revoke b.	{ t, m, s, p, f }	460
4.	[velar]	Revoke a. c. (✗)inexpressible constraint against /k/)	{ t, m, n, s, p, f, ŋ, x }	524
5.	[lateral]		{ t, m, n, s, p, f, ŋ, x, k, l }	537

(17) Example: Child 8 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[labial], [velar]	-	{ p, k }	517
2.	[continuant]	a. *[continuant,Place]	{ p, k, s }	572
3.	[coronal] [lateral]	-	{ p, k, s, t, l }	590
4.	[nasal]	b. [nasal]⊃[labial] -	{ p, k, s, t, l, m }	608
5.	-	Revoke a.	{ p, k, s, t, l, m, f, x }	636
6.	-	Revoke b.	{ p, k, s, t, l, m, f, x, n, ŋ }	649

(18) Example: Child 9 / Onset

	Features	Constraints	Predicted inventory	Day
1.	[voice] [labial], [coronal]	-	{ p, b, t, d }	569
2.	[velar] [nasal]	i. *[velar,voice] ii. [nasal]⊃[labial]	{ p, b, t, d, k, m }	583
3.		Revoke ii. iii. *[nasal,velar]	{ p, b, t, d, k, m, n }	639
4.	[continuant]	iv. *[continuant,velar] vii. *[continuant,voice]	{ p, b, t, d, k, m, s, f }	691
5.	[lateral]	-	{ p, b, t, d, k, m, s, f, l }	741
6.	-	Revoke iv.	{ p, b, t, d, k, m, s, f, l, x }	846

3 Discussion / conclusion

- A feature-based analysis of acquisition of segment inventories seems feasible, if supplemented with a restrictive theory of fcc
- However, we still need to find out what determines the order in which features are acquired
- Variation might still be due to relative input frequency
- We also need to consider the relevance of the target words

(Slides: <http://www.vanoostendorp.nl/pdf/tin2007.pdf>)