Phonological development in a child with cri du chat syndrome (CDCS)

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1. Introduction

1.1 CDCS and linguistic research

In this paper I present some findings from a pilot study of the phonetic and phonological development of a girl, H, suffering from a disorder called cri du chat syndrome (CDCS). H is now 8 years old.

CDCS is a genetic disorder resulting from loss of material from the short arm of chromosome five. Symptoms include delayed language development. However, at this point language development in persons with CDCS has only been described in very general (non-linguistic) terms. Three tendencies have been noted in the recent literature (cf. Cornish & Pigram 1996; Cornish & Munir 1998; Cornish, Bramble, Munir & Pigram 1999; Cornish, Cross, Green, Willatt and Bradshaw 1999): First, there is a discrepancy between chronological age and linguistic age in children with CDCS. Second, there is a discrepancy between their receptive and expressive linguistic abilities. Third, their articulation is characterized by omissions and substitutions. Unfortunately, no details are given in the literature concerning the articulation problems. Furthermore, there are few substantial discussions of the possible causes of these problems.

1.2 Questions

In general, H's linguistic development is in agreement with the findings just referred to. She understands spoken language relatively well. When she was three years old, and again when she was six, her comprehension of language was measured with *Reynell Developmental Language Scales* (Reynell 1983) and shown to be within the average range. By 7;2 she was tested with *Test of the reception of Grammar* (Bishop 1983) and by 7;4 with *Dansk impressiv morfologitest* (Grønborg & al. 1988), another test which measures grammatical comprehension. The results of these two tests also point to a language comprehension within the average range.

H's expressive language abilities are in many ways extremely poor. Her inventory of speech sounds, and the way she uses them are comparable to what can be seen in normally developing Norwegian-speaking children younger than two years. On closer inspection, however, her expressive abilities also show some rather complex patterns common to older children. To put it briefly, H's language gives clear evidence of an effort to express

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complicated concepts by means of an extremely poor phonology and syntax, cf. the utterances in (1):

(1)

la:	ikæ	upæ	o:tæ		(7;2;30)
klare	ikke	stoppe		gråte	
manage	not	stop	cry		
'I can't stop crying'					

uŋ	maŋæn	pi:tæ	on	(7;3;7)
vondt	magen	spise	sånn	
ache	tummy	eat	this	
'Eating this will give me a tummy ache'				

je:	ikæ	e:tæ	(7;1;12)
vet	ikke	lese	
know	not	read	
'I don't know		what to read'	

These utterances are difficult to understand for two reasons: First of all, only content words, no grammatical words, appear, unless you count the negation as a grammatical word. Secondly, the words that do appear are pronounced in a way which is very different from the pronunciation of the corresponding words in the target language. In other words, H has both considerable phonological problems and considerable grammatical problems. In this paper I focus on the phonological problem, more precisely on the development of H's consonant inventories and on the way she uses these consononants over a period of 2 1/2 years.[1] My data represent speech samples elicited from her at three different ages; 4;6, 5;9 and 7;0. I concentrate on what these data can tell us about the question stated in (2):

(2) What similarities and differences are there between H's speech and the speech of normally developing children?

I will try to answer to this question, and compare my answer to a set of characteristic properties of disordered phonologies in English-speaking

[1]I will not discuss H's vowels in any detail here, only note that her vowel inventories exhibit the following characteristics: (1) considerable variation; (2) a tendency to centralize vowels; (2) lack of [y].

Furthermore, I will not discuss tones. Although she appears to perceive tonal differences, there is no suggestion in my data that she makes any tone distinctions in her speech production.

children formulated by Stoel-Gammon (1991: 28), reproduced in (3). Children with a phonological disorder often have

(3)

- a restricted set of speech sounds
- limited word and syllable shapes
- persistence of error patterns
- chronological mismatches
- unusual error types
- extensive variability, but lack of progress

2. Consonant inventories

When H was 4;6 she had the inventory of consonants shown in (4):[2]

(4) **H's consonant inventory at 4;6**

p		k	
m	n	ŋ	
	l	j	h

We see that she had eight distinct consonants at this stage. This is a very small inventory, compared for example to the consonant system of the Norwegian dialect spoken in the Oslo area, with 23 consonants. Also in comparison with normally developing four-year old Norwegian-speaking children, her inventory at 4;6 is aberrant in at least the following four respects (cf. Simonsen 1990):

- there is no distinction between voiced and voiceless oral stops
- there is no distinction between aspirated and non-aspirated oral stops
- there are no fricatives
- there is no coronal oral stop

Consider next the inventory at 5;9, shown in (5):

(5) **H's consonant inventory at 5;9**

p	t	k	
m	n	ŋ	
	l	j	h

[2]The consonant inventories in (4) – (6) do not tell the whole story, as there is considerable variation in H's articulation of consonants. However, I have sinplified the data in order to focus on the size of her inventories.

This inventory differs from the one at 4;6 by the presence of a coronal stop. There is still no distinction between voiced and voiceless and between aspirated and non-aspirated oral stops. Nor are there any fricatives.

Finally, consider H's consonant inventory at 7;0, shown in (6):

(6) **H's consonant inventory at 7;0**

p	t	k	
m	n	ŋ	
	l	j	h

This inventory is identical to the one at 5;9: there are no voiced or aspirated stops, and no fricatives.

In sum, even when she was seven, H had a consonant inventory which in size but not in the consonants involved, can be compared to inventories of much younger normally developing Norwegian-speaking childen. Simonsen's (1990) study of the phonological development of three Norwegian-speaking children shows that by age two all three had acquired the distinction between voiced and voiceless oral stop consonants as well as fricatives. Thus, H's inventory at age seven is considerably less developed than the inventories seen in normally developing Norwegian-speaking two-year-olds.

If we look at the communicative capacity of inventories of this size in comparison with adult Norwegian, it is clear that the size is a serious obstacle to efficient communication[3]. On the other hand, during the 2 1/2 years I have followed the development of her speech, there has also been considerable progress in the way she uses the few consonants she does have. I will now look at two aspects of this development:

- Development of word and syllable shapes
- Development of strategies for approaching target words

3. Development of word and syllable structure

3.1 Number of syllables and accentuation

With respect to syllable shape and structure, H's words have the following general properties, listed in (7):

[3] However, the size in itself need not be an obstacle to efficient communication. Maddieson (1984) refers to languages with smaller consonant inventories than the ones in (4) - (6).

(7)

- With few exceptions her words have the same number of syllables as the target words.
- However, if the accented syllable is not word initial, all syllables to the left of it are omitted

The second property is illustrated by the words in table 1:

Table 1: Omission of syllables to the left of accented syllable		
H's pronunciation	*Target pronunciation*	*Meaning*
[ˈman]	[baˈna:n]	ʻbananaʼ
[ˈa]	[ɟiˈta:ɾ]	ʻguitarʼ
[ˈpi]	[pʰaɾaˈply:]	ʻumbrellaʼ

The pattern illustrated in table 1 is typical also of the speech of normally developing children around 2 years of age (cf. Ingram 1989:372).

3.2 Word and syllable shapes

In the speech of toddlers only a very restricted subset of all possible syllable shapes appears. Typical examples of monosyllables are V and CV, whereas CVCV is the most typical shape in bisyllabic words. If we take a look at H's words at 4;6 we see that they are in agreement with this tendency, cf. table 2:

Table 2: Syllable shapes at 4;6			
Monosyllabic words		*Bisyllabic words*	
CV	18	CV.CV	18
V	13	V.V	7
VC	1	V.CV	5
CVC	1	V.CVC	1

As for H's speech, a majority of her CVCV words were reduplicated at 4;6. Some examples are given in table 3:

Table 3: Reduplicated word at 4;6		
H's pronunciation	*Target pronunciation*	*Meaning*
[ˈpæ.pæ]	[ˈbɑ:.de]	'bathe'
[ˈmæ.mæ]	[ˈjɛlm]	'helmet'
[ˈmæ.mæ]	[ˈlu.mə]	'pocket'
[ˈpæ.pæ]	[ˈblom.stɻ]	'flowers'
[ˈkɔ.kɔ]	[klɔ.cə]	'clock'

Now remember that H's consonant inventory did not develop much from 4;6 to 5;9. But that does not mean that her phonological abilities didn't develop. First, the reduplicated words disappeared. Thus, a development seen in normally developing children at around two years, appeared in H's speech between 4;6 and 5;9. This development can be seen from table 4, which shows the reduplicated words from 4;6 together with the corresponding words at 5;9, where the only remaining reduplicated word is 'clock':

Table 4: Disappearance of reduplicated words between 4;6 and 5;9			
4;6	*5;9*	*Adult pronunciation*	*Meaning*
[ˈpæ.pæ]	[ˈpa.tæ]	[ˈbɑ:.də]	'bathe'
[ˈmæ.mæ]	[ˈæm]	[ˈjɛlm]	'helmet'
[ˈmæ.mæ]	[ˈo.me]	[ˈlu.mə]	'pocket'
[ˈpæ.pæ]	[ˈo.cæ]	[ˈblom.stɾ̩]	'flowers'
[ˈkɔ.kɔ]	[ˈkɔ.kɔ]	[ˈklo.cə]	'clock'

Second, there was development in the relative frequency of syllable shapes, as table 5 shows:

Table 5: Development of syllable shapes							
Monosyllabic words				*Bisyllabic words*			
	4;6	5;9	**7;0**		4;6	5;9	**7;0**
CV	18	4	**3**	CV.CV	18	14	**12**
V	13	13	**5**	V.V	7	3	**4**
VC	1	9	**16**	V.CV	5	18	**11**
CVC	1	4	**9**	V.CVC	1	–	**4**

By comparing the syllable shapes and their frequency at 5;9 with the corresponding parameters at 4;6 we see that the number of CV syllables decreased drastically, whereas the number of closed syllables increased. As for bisyllabic words, the number of CVCV-syllables decreased, and the number of V.CV-syllables increased.

To complete the picture of syllable shape development from 4;6 to 7;0 I have also included in table 5 frequencies of the various syllable shapes at 7;0. The most striking property of the syllable shapes at this stage is that the number of closed syllables was more than doubled in comparison with 5;9 (29 to 13). Furthermore, the most typical syllable shapes of early phonologies – CV, V and CV.CV – are drastically reduced, from 49 at 4;6,

through 31 at 5;9, to 20, at 7;0. In sum, whereas H's phonetic inventory is relatively unchanged from 4;6 to 7;0, the way she organizes these sounds into words is considerably changed.

4. Strategies for approaching target words

Simultaneously with the development in syllable shapes H's phonology also developed in another interesting way. This development concerns the way she approached target pronunciations – at 5;9 and 7 she used a strategy which was very different from the one she used at 4;6.

4.1 Articulatory patterns at 4;6

H's words at 4;6 exhibit some patterns which can be interpreted as phonological processes, e.g. consonant harmony, cf. table 4. However, when all the words at this stage are considered, there are several features which are difficult to interpret in terms of such processes.

In a study of eight normal German-speaking children between 0;7 and 2;0 Piske (1997) argues that early phonological organization is better interpreted in terms of what he calls articulatory patterns than in terms of for example substitutions or simplifications. In what follows I will try to show that the same is the case with H's words at 4;6. Unfortunately, Piske does not give the term articulation pattern a concise definition. However, he characterizes an articulatory pattern as a way of organizing phonological information that is based on perceptually salient features in the target words (see also Waterson 1971). The articulatory patterns are furthermore constrained by the child's immaturity in neuromotor control.

The idea that these articulation patterns form the basis for early phonological organization builds on several assumptions; the two most relevant for my project are given in (8):

(8)

a A few articulatory patterns determine the phonetic structure of the large majority of a child's first words

b As a result of (a) there are many homophonous forms in the child's lexicon.

Table 6 shows how 86% of H's words produced in the vocabulary test at 4;6 can be sorted into 8 articulatory patterns. The second column of the table shows the number of words that each pattern represents. The third column gives a brief description of each pattern. The third and fourth columns give examples, first of a selection of H's word, and then of the corresponding target words.

TABLE 6: ARTICULATORY PATTERNS AT 4;6				
	LEXICAL ITEMS	DESCRIPTION	EXAMPLES OF H'S WORDS	CORRESPONDING TARGET WORDS
1	8	([h] +) V[unrounded,high]	[ˈi] [ˈi], [ˈhi] [ˈi]	[ˈʃi:] 'ski' [ˈsi:v] name [ɑpɛl.ˈsi:n] 'orange'
2	10	([h] +) V[rounded]	[ˈhʉ] [ˈʉ] [ˈɵ] [ˈʊ] [ˈœ]	[ˈhʉn] 'dog' [ˈsku:] 'shoe' [ˈtʰo:g] 'train' [ˈjʉ:s] 'juice' [ˈsnø:] 'snow'
3a	10	C[nasal] + V	[ˈɲæ] [ˈmæ] [ˈnæ]	[ˈstæjn] 'stone' [ˈman] 'man' [ˈgrøn] 'green'
3b	8	Full or partial reduplication of (3a)	[ˈmœ.mœ] [ˈmæ.mœ]	[ˈlu.mə] 'pocket' [ˈjɛ.mə] 'at home'
4a	11	C[oral] + V	[ˈpi] [ˈpi] [ˈpæ] [ˈcæ]	[ˈbi:l] 'car' [ˈfly:] 'plane' [ˈbal] 'ball' [ˈçɛks] 'biscuit'
4b	12	Full or partial reduplication of (4a)	[ˈpæ.pə] [ˈpæ.pæ] [ˈcæ.cə] [ˈkɔ.kɔ]	[ˈbɑ:.də] 'take a bath' [ˈspɑ:.də] 'shovel' [ˈgɑ.fl̩] 'fork' [ˈcʰlɔ.cə] 'watch'
5	6	ˈV[rounded] . [æ]	[ˈʉ.æ] [ˈʊ.æ] [ˈɵ.æ]	[ˈcʰɾu:.nə] 'crown' [ˈlø:.ʊə] 'lion' [ˈso:.pə] 'soap'
6	5	ˈV[unrounded] . [æ]	[ˈi.æ] [ˈi.æ]	[ˈni.sə] 'gnome' [ˈʃi:.ʊə] 'slice of bread'
7	3	ˈV[non-high] . [læ]	[ˈə.læ] [ˈa.læ]	[ˈbɾi.lɾ̩] 'glasses' [ˈfjɛl] 'mountain'
8	3	[(ə)ɲæ]	[ˈə.ɲæ] [ˈɲ̩.æ] [ə.ˈɲæ]	[ˈpʰɛ.ɲə] 'coin' [ˈfiɲ.ɾ̩] 'finger' [ˈnœ.c̩l] 'key'

	11	Unsorted	[ˈhɥæ] [ˈmpæ.ʊæ] [ˈhæ.næ] [ˈpi.æ] [ˈmæl̥] [ˈnæj] [ˈpæ.mœ] [ˈæj] [ˈæj] [ˈʉː.pæ] [ˈhœ.næ]	[ˈhʉs.cə] ′swing′ [ˈbœ.tə] ′bucket′ [ˈhɑ.nɑ] name [ˈsy.c̩l] ′bike′ [ˈmɛlc] ′milk′ [ˈnæj] ′no′ [ˈtʰɾu.mə] ′drum′ [ˈflɑg] ′flag′ [ˈɛg] ′egg′ [ˈkʰɔp] ′cup′ [ˈtʰæj.nə] ′draw′

As I mentioned, one of the ideas behind the articulatory patterns is that they represent perceptually salient features of the target words that correspond to the patterns. The examples in table 6 clearly show that there are strong similarities between the various patterns and the target words. However, before I can show that these similarities originate in perceptually salient features of the target words, they are of course only hypotheses about such features.

4.2 Simplifications at 5;9 and 7;0

At 5;9 and 7;0 H appears to use a very different strategy from what she did at 4;6. We have seen that the word and syllable shapes become more varied, and many of her words have changed to the extent that an analysis in terms of simplifications instead of articulatory patterns seems to be more useful.

Some common simplifications in early child language are listed and illustrated in (9):

(9) **Simplification patterns**

- **Omission**: A sound is omitted in a word. Example: [ba] instead of [bal] for *ball* ’ball’, where the final [l] is omitted
- **Substitution**: One sound is substituted for another. Three common substitution patterns are:
  - **Fronting**. One sound replaces another with a more forward place of articulation: [tʰat] for [kʰat] *katt* ‘cat’.
  - **Backing:** One sound replaces another with a more backward place of articulation: [çɛg] for [ʃɛg] *skjegg* ‘beard’, where the [ç] replaces [ʃ] (from Bjerkan 1994:20).

  - **Stopping**: A stop consonant replaces a fricative consonant: [tʰitə] for [sitə] *sitte* 'sit' (from Simonsen 1990).
- **Cluster reduction**: A sequence of two or more consonants in a target word is reduced to one consonant, often one of the consonants of the cluster in the target word: [nø:man] instead of [snø:man] for *snømann* 'snowman' (from Bjerkan 1994:21), where the cluster [sn] is reduced to the single consonant [n]

The patterns in (9), and several others, are found in the speech of normally developing children. And, as we will see, several of them are also found in H's speech at 5;9 and 7. A general property of her omissions at 5;9 was that fricatives in target words, which, as we have seen, were not part of her inventory, were systematically omitted, both initially, medially and finally in words, cf. the words in table 7:

Table 7: Omissions of oral fricatives at 5;9		
H's pronunciation	*Adult pronunciation*	*Meaning*
[ˈi]	[ˈʂi:]	'ski'
[ˈi]	[ˈi:s]	'ice'
[ˈʉ]	[ˈjʉ:s]	'juice'
[ˈæc]	[ˈçɛcs]	'biscuit'

At 7;0 H replaces some of the fricatives word finally in the target words with stops. Two examples of this pattern of stopping are shown in table 8. Note that the word for 'shower' has both stopping and backing:

Table 8: Stopping of oral fricatives at 7;0		
H's pronunciation	*Adult pronunciation*	*Meaning*
[ˈit]	[ˈi:s]	'ice'
[ˈʉk]	[ˈdʉʂ]	'shower'

However, the word initial fricatives of target words were omitted also at 7;0.

At 5;9 and 7;0 there were also examples of cluster reductions, cf. table 9 and 10:

Table 9: Some cluster reductions at 5;9		
H's pronunciation	*Adult pronunciation*	*Meaning*
[ˈpɑ.tæ]	[ˈspa:.de]	'shovel'
[ˈpi.læ]	[ˈbɾil.ɾ̩]	'glasses'
[ˈko]	[ˈgɾo:]	'grey'
[ˈnø]	[ˈsnø:]	'snow'

Table 10: Some cluster reductions at 7;0		
H's pronunciation	*Adult pronunciation*	*Meaning*
[ˈpokŋ]	[ˈblomst]	'flower'
[ˈpo]	[ˈblo:]	'blue'
[ˈmi.læ]	[ˈsmi:.le]	'smile'
[ˈpi.tæ]	[ˈspi:.se]	'eat'

5. Conclusion

I return now to Stoel-Gammon's characteristics of disordered phonologies in (3), repeated as (10), to see how my data compares with these.

(10)

- A restricted set of speech sounds
- Limited word and syllable shapes
- Persistence of error patterns
- Chronological mismatches
- Unusual error types
- Extensive variability, but lack of progress

First, as I have demonstrated, H has a restricted set of consonants in the period I have looked at. Second, her speech is characterised by limited word and syllable shapes. However, it is also important to remember that her syllable shapes developed considerably from 4;6 to 7;0, cf. table 5. Third, there is a certain persistence of error patterns. For example, at all three stages, omission of initial consonants is a very common error. This is not a typical property of the word shapes of normally developing children.

Stoel-Gammon's fourth point is concerned with what is called chronological mismatches. A chronological mismatch within a phonological system is the presence of a property typical of more advanced systems in an otherwise delayed system. There is one chronological mismatch in H's development. As I have shown her consonant inventories are similar to those found in children younger than two years. However, the

presence of an [l] in all three inventories is typical of more advanced systems (cf. Dinnsen 1992).

The extensive omission of initial consonants in H's speech must be considered an unusual error type (Stoel-Gammon 1991:28). As I have noted CV and CVCV are typical early syllable shapes. When the repertoire of shapes is extended in languages like Norwegian and English this can happen via a gradual increase of syllable final consonants. On the other hand, omission of initial consonants would represent a regressive development.

The final point in Stoel-Gammon's list, extensive variability, but lack of progress, is not necessarily characteristic of H's phonology. I have not focused on variability here, but my data show that both vowels and consonants vary. On the other hand, as I have shown there is no doubt that there is progress. The most important difference is that she develops extremely slowly. The aspects of H's development which I have discussed, stretch over 30 months. Normal children start the same development somewhere around 18 months and acquire a considerably more complex phonology during the next 6 to 7 months.

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