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CONSONANTS IN SPONTANEOUS SPEECH OF FIVE DANISH CHILDREN WITH OPERATED CLEFT PALATE - AN IMPRESSIONISTIC ANALYSIS

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This paper examines consonants in spontaneous speech of five 4-5 year old Danish children with persisting speech problems after primary cleft palate surgery. Based on phonetic transcriptions from video-recordings the phonetic and phonological behaviour is described for each child and related to the target norm. The findings are discussed in the light of strategies in cleft palate speech. Furthermore, some aspects of universal and language dependent characteristics in cleft palate speech are treated.

I. INTRODUCTION

Both from clinical experience and from the literature, "cleft palate speech" appears to be clearly different from other forms of pathological speech (see, e.g., Bzoch et al. 1984, Edwards 1980, Morley 1970), even though the consequences of congenital cleft palate for communication are so varied, that Morris (1979) states that "it is difficult if not downright impossible, to describe meaningfully "cleft palate speech"" (p. 193).

Congenital cleft palate may, even when surgically repaired, impair the velopharyngeal function, but also the function of the tongue tip and blade which - for reasons as yet only partly explainable - may have reduced sensibility (Edwards 1980) and dyscoordinated mobility (Fletcher 1978, Shelton 1979).

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Dental and occlusal anatomical abnormalities also represent hazards to speech production for the cleft palate population, but in spite of comprehensive research on this subject, no clear conclusions as to cause and effect have been drawn (Starr 1979).

Fluctuating conductive hearing-impairment should also be mentioned as a probable cause of deviating sound production. Finally, it has been shown in several studies that congenital cleft palate may be accompanied by delayed language development (see, e.g., Fox et al. 1978, Clifford and Clifford 1979, Pannbacker 1975). The characteristics are mainly expressive in character and may include all aspects of language.

To avoid misunderstandings in the following, it should be stressed that in describing the consequences of cleft palate for communication, we are talking about conditions after primary surgical repair, that is after the closure of the cleft. Most of the children have no communication problems after primary repair, but some children go on having more or less serious speech and language disorders.

II. BACKGROUND AND PURPOSE OF THE STUDY

The main purpose of this study is to describe how speech characteristics arising from the cleft palate interfere with consonants in spontaneous speech of some Danish children. The phonetic and phonological consequences of this interference will be described.

The existing studies of speech sound production in children with cleft palate are based on tests, not on spontaneous speech - with Lynch et al. (1983) as an exception. Sound production in spontaneous speech shows greater variation than in speech elicited from tests, and because great variation in sound production is sometimes characteristic for individuals with cleft palate, spontaneous speech seems more suited to reveal the true extent of this variation.

Further, most of the existing studies of cleft palate speech are frequency studies, for instance such that deal with the frequency of correct or deviant pronunciation of a given phoneme, or the frequency of certain categories of deviations (see, e.g., Moll 1968, Fletcher 1978, Van Demark 1974). There are very few phonetic descriptions of cleft palate speech, although this is a necessary basis for describing how a cleft palate speaker deviates phonetically and phonologically from a target norm. Such descriptions are important for the following reasons: Firstly, the phonetic and phonological competence of the speaker play an important part in the communicative problems caused by the cleft palate. Secondly, it is possible to classify the speech in categories that are based on well-defined phonetic and phonological criteria.[1] Van Erp (1984) performed a phonetic transcription of Dutch cleft palate speakers, but their deviant sound production is, also in this study, presented in terms of non-phonetic error categories. Finally, the vast majority of studies of cleft palate speech are based on American English speaking individuals. But one cannot implicitly assume that what is true about cleft palate speech in speakers of one language - for example American English - will necessarily be true about cleft palate speakers of other languages.

For these various reasons we found it relevant to look at the phonetic and phonological consequences that arise from cleft palate in the spontaneous speech of some Danish children.

III. METHOD

A. SUBJECTS AND EXPERIMENTAL SET-UP

The East Danish population of individuals with cleft palate consists of approximately 35 births per year, not including submucous clefts of the palate, or cleft lip only. About two thirds of these come from the greater Copenhagen area.

For this study we needed children of the same age, with normal intelligence, normal hearing, with no accompanying defects, but with speech defects, including some with glottal stop articulation. Also, for practical reasons they should live in the Copenhagen area. All these preconditions - along with parents who did not want to participate - reduced the number of potential children considerably. It should be added that two of the children previously had had periods of medically well-treated middle ear problems, but their hearing was normal at the time of recording. Due to the small number of subjects it was not possible to differentiate as to sex and type of cleft. Clinical information about the five children with repaired cleft palate are given in figure 1. Notice that two of the children have a normal velopharyngeal function.

A video film of about 30 minutes was made of each child in play with a parent, sitting at a small felt-covered table, so that at least the front of the child's, and 3/4 of the parent's face and upper torso could be viewed on the film. The toys were supplied both by the parents and the experimenters, but had to be "quiet" toys, to get a good sound recording for the phonetic analysis. All the children chose long periods of drawing and talking about this activity.

B. PHONETIC TRANSCRIPTION

The verbal communication between parent and child was transcribed orthographically. Furthermore, a narrow segmental transcription of the child's speech was performed in the IPA system supplemented by some ad hoc symbols.[2] The transcription was undertaken by a trained phonetician (BH) and discussed with

Child	Age	Sex	Cleft type	Age at primary palatal repair	IQ*	Hearing up to present age	Development of language	Velopharyngeal funct.	Hypernasality
I	5.0	M	lip/palate	22 months	normal	normal	delayed	sufficient	none
II	4.10	M	palate	22 "	normal	normal	normal	insufficient	mild
III	4.9	M	lip/palate	22 "	normal	well-treated fluctuating	normal	insufficient	severe
IV	4.2	F	palate	22 "	normal	normal	normal	insufficient	moderate
V	5.2	M	palate	22 "	normal	well-treated fluctuating	slightly delayed	sufficient	none

*) *Tested with Leiter, a non-verbal intelligence test, by the psychologists C. Lowe Nielsen and W. Cohn, two of the authors of the appendix to the present paper.*

Figure 1

Clinical information about the five Danish children included in the study and who have speech problems after primary cleft palate surgery.

a speech pathologist (KB) who, unlike the phonetician, has specialized in cleft palate. Since segmental transcription is extremely time consuming, we had to confine the number of transcribers and transcriptions to just one, in spite of the fact that transcriptions made by more transcribers show inter- as well as intra-transcriber variation (Vieregge 1985a). However, since the transcription was based on video recordings including visual as well as auditory information, the transcription task was somewhat facilitated. Theoretical and practical aspects of transcription are thoroughly treated in Vieregge (1985b).

Based on the phonetic transcription the speech of each child is analyzed with regard to the interference of the speech characteristics from cleft palate with normal Danish. Two types of interference are considered, namely interference with the sound realization of the phonemes, and with the number of phonemes. Interference with realization causes pronunciation to deviate more or less from the target norm, which does not necessarily damage intelligibility seriously, if the phonemes are still identifiable. Contrarily, interference reducing the number of phonemes - which occurs when it is not possible to distinguish between two or more phonemes - is in principle always damaging to intelligibility, as it may cause words to be pronounced identically that are distinguished in the norm language.

C. SPEECH MATERIAL

The sounds analyzed are limited to consonants. The Danish consonant system and its phonetic realization in syllable initial position preceding a full vowel are shown at the top of figure 3, while syllable final position is seen in figure 4. It is apparent that the initial system is the more differentiated one. However, final /*v j r*/ are excluded since they are realized as true semivowels forming part of diphthongs - and /*r*/ may even disappear in this position. Notice that in Danish both of the stop series are unvoiced. They are separated by a difference mainly in aspiration, so that /*ptk*/ are aspirated, /*bdg*/ unaspirated, but they only contrast in (absolute) initial position in syllables containing a full vowel. However, the main difference between /*t*/ and /*d*/ is one of affrication rather than aspiration. In other positions with stops only the unaspirated series /*bdg*/ occur. Notice also that the Danish *r*-sound is [ʁ], i.e. pronounced with the posterior part of the tongue.

In speakers who suffer from velopharyngeal insufficiency it is primarily the obstruents (= pressure consonants) that are distorted, due to the fact that the intra-oral pressure demanded for production of these sounds cannot be established. Also, these sounds may be disturbed by nasal friction. Contrarily, the oral sonorant sounds are usually normally produced, except for hypernasality, which is less disturbing to the communication. Nevertheless, only the vowels are excluded from the analysis besides final /*v j r*/, since consonants classified as sonorants may be affected by other distortions than nasalization.

Consonants are described in the following positions: 1. Single consonant in syllable initial position preceding a full vowel (ex.: *penge, Jakob*). 2. Single consonant in word final position (ex.: *Jakob*) (i.e. in syllable final position before word boundary), and 3. two-consonant clusters in syllable initial position preceding a full vowel (ex.: *sparke, puslespil*). The type of clusters in the present material includes the following combinations: *s* + unaspirated stop[3] (ex.: *stor*), stop + voiced consonant (ex.: *pjat, blå*), fricative + voiced consonant (ex.: *flaske*). Note that not all possible Danish combinations of consonants occur in the speech material. Some utterances or single words are left out because of uncertainty of their semantic content and/or because the pronunciation was impossible to transcribe meaningfully. You have to know both what is being said and how it is said to be able to compare the pronunciation with the target norm.

Table I

The table shows how many intended single consonants and consonant clusters are included in the description of the five cleft palate children. For comparison also a normal child (N) is included. CV = single consonant in syllable initial position preceding a full vowel, VC+ = single consonant in word final position, and CCV = two-consonant cluster in syllable initial position preceding a full vowel.

CHILD	CV	VC+	CCV
I	530	100	38
II	329	92	31
III	305	157	50
IV	421	127	51
V	809	216	45
N	693	222	61

In table I is shown how many intended consonants and consonant clusters are included in the description of each child. No study has been published about the frequency of occurrence of different sounds used in Danish spontaneous speech - neither for children nor for adults. To get an impression of any possible difference from the norm in cleft palate children in this regard, we video-taped a normal five year old girl in the same play situation as the cleft palate children. It will be seen that there is a good deal of variation among the children. Child V's output is by far the largest, even though only 3/4 of his utterances have been included. N's output comes second, but taking into account that nothing had to be left out due to unintelligibility, it seems safe to conclude that the normal child does not differ from the five cleft palate children.

To the left in figure 2 is shown the frequency of a given intended consonant or consonant cluster in percent of the total number of intended consonants, averaged over the five children with cleft palate. To the right is shown the same data for child N. Some consonants and consonant clusters seem to appear relatively more frequently than others, but no fundamental difference is found in the frequency of the various consonants and consonant clusters between N and the children with cleft palate. This difference in frequency is partly due to the fact that some specific sounds appear in particles and inflections which are frequent in spontaneous speech. If the consonant frequency is calculated from appearance in different words, the frequency of some consonants and clusters is reduced (especially initial */d j/*, final */n ɖ⁴/* and initial */s+k/*). The number of words with initial consonant appears to be sufficient to give a comprehensive description of the variation in pronunciation for each consonant. The occurrence of words with intended final consonants and initial consonant clusters, however, may for certain consonants and consonant clusters be limited to one word - or none. Half an hour's spontaneous speech at play with a parent, therefore, is not enough to get a sample in which the number of all possible consonants and clusters is sufficient. On the other hand, the normal speech sample from child N suggests that the less frequent single consonants and consonant clusters are the same for normal as for cleft palate children of the same age.

As the phonetic/phonological conditions in normal 4-5 year old children are equal to those of adults as far as the consonant material analysed in this study is concerned (excepting a very few consonant clusters), the phonetic/phonological conditions in the five cleft palate children will be compared to normal adult language.

IV. RESULTS

In figures 3 and 4 - below the normal consonant system and its realization - is shown the realization(s) most frequently used by each child for a given phoneme, called the primary variant(s). For each child is also shown how often the primary variant(s) is/are used in relation to other variants.

Encircling of the phonetic symbol indicates that the primary variant(s) is/are in accordance with the norm. In figure 5 is shown in outline the realizations of the consonant clusters for each child.

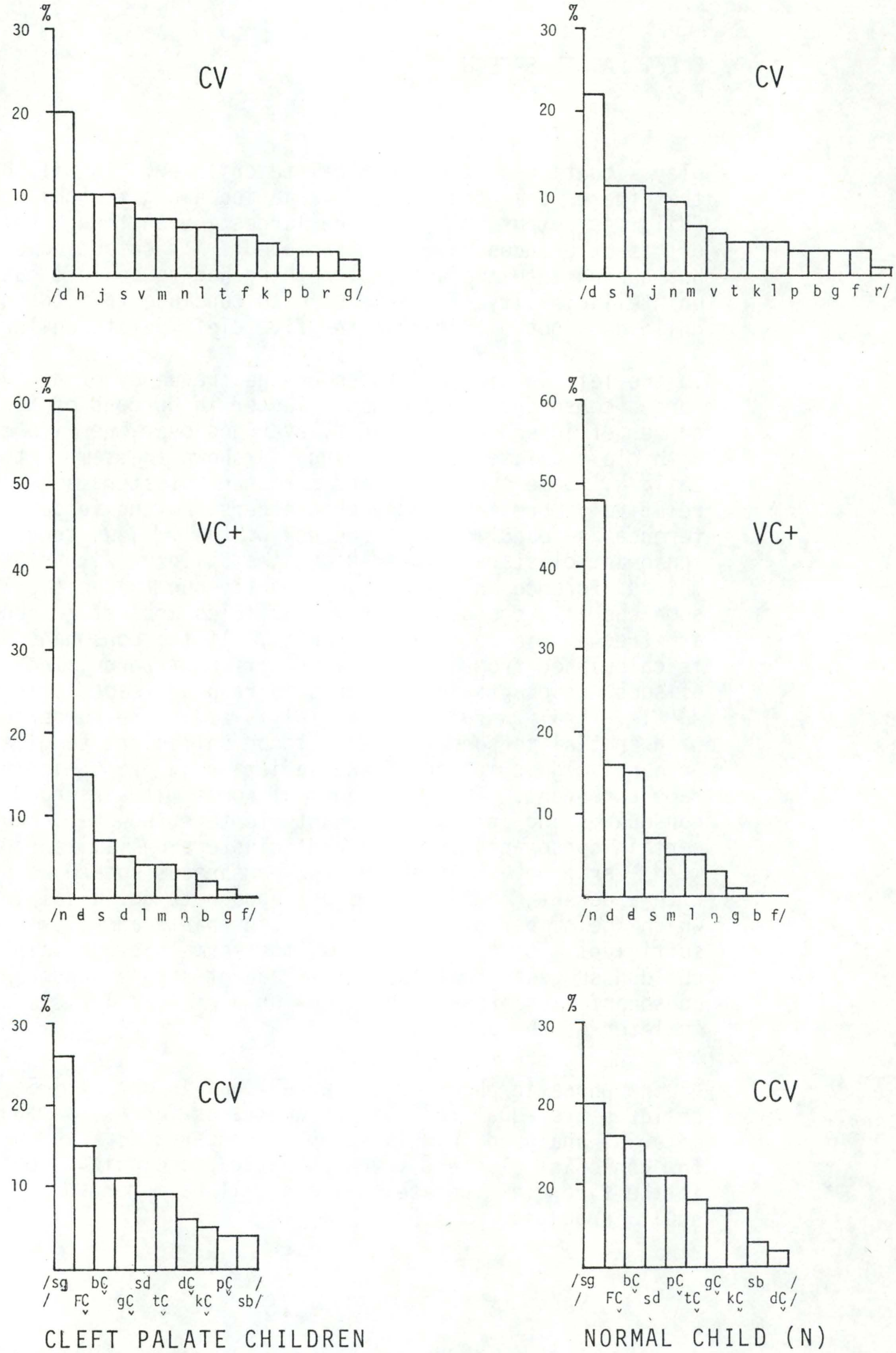

Figure 2

The figure shows the frequency of a given intended consonant or consonant cluster in percent of the total number of intended consonants. To the left data averaged over the five cleft palate children are indicated, and to the right the data for a normal child (N) is shown. The consonants and consonant clusters are shown with decreasing frequency. CV = single consonant in syllable initial position preceding a full vowel, VC+ = single consonant in word final position, and CCV = two-consonant cluster in syllable initial position preceding a full vowel. C̬ = voiced consonant, F = fricative (≠ /h/).

THE DANISH CONSONANT SYSTEM AND ITS REALIZATION -

IN SYLLABLE INITIAL POSITION PRECEDING A FULL VOWEL

PHONEMES	/ p	t	k	b	d	g	f	s	h	v	l	r	j	m	n /
REALIZATION	[b̥ʰ	d̥ˢ	g̊ʰ	b̥	d̥	g̊	f	s	h	v	l	ʁ	j	m	n]
<u>Child I</u>															
Primary variant(s)	[b̥ʰ	ʔ	ʔ	b̥	ʔ	ʔ	ʔ	ʔ/h	h	v	l	h	j	m	n]
Frequency (%)	*94*	*90*	*75*	*82*	*82*	*80*	*95*	*50/ 43*	*100*	*78*	*91*	*75*	*89*	*100*	*57*
<u>Child II</u>															
Primary variant(s)	[*F*	*F*	ʔ/ʔʰ	ʔm̥	ʔn̥	ʔ	f	ṡ/ṅ̥	h	ṽ	l̃	ʁ̃	j̃	m	n]
Frequency (%)	*71*	*45*	*44/ 31*	*100*	*68*	*56*	*75*	*24/ 22*	*91*	*74*	*75*	*50*	*97*	*100*	*100*
<u>Child III</u>															
Primary variant(s)	[b̥ʰ	ṅ̥/d̥ʰ	ŋ̊	b̥/m	n/d̥	n	f/ḟ	ṡ̥	h	ṽ	l̃	ʁ̃	j̃	m	n]
Frequency (%)	*43*	*30/ 25*	*36*	*46/ 31*	*56/ 21*	*44*	*44/ 32*	*38*	*100*	*76*	*70*	*75*	*100*	*100*	*100*
<u>Child IV</u>															
Primary variant(s)	[m	h	h	m	n/ʔ	h/ʔ	h	h/ʔ	h	ṽ	l̃	ʁ̃	j̃	m	n]
Frequency (%)	*71*	*56*	*67*	*91*	*60/ 14*	*27/ 27*	*86*	*71/ 29*	*89*	*58*	*83*	*43*	*99*	*94*	*93*
<u>Child V</u>															
Primary variant(s)	[b̥ʰ	d̥ʰ	h	b̥	d̥	d̥	f	s	h	v	l	ʁ	j	m	n]
Frequency (%)	*71*	*100*	*68*	*100*	*97*	*94*	*98*	*99*	*100*	*98*	*98*	*100*	*95*	*98*	*93*

Figure 3

At the top of the figure is shown the Danish consonant system and its realization for consonants in syllable initial position preceding a full vowel. Below, the primary realizations - primary variants - used by each child are indicated. Also, the frequency of occurrence for each variant is shown (in %). Encircling of the phonetic symbol indicates that the primary variant is in accordance with the target norm. [˙] *means 'nasal friction'. As to child II, no primary variant can be decided for /pt/; instead the frequency of variants produced with any kind of friction is indicated, symbolized by* [*F*]. *As to child III, /k/ and /g/ are in no case correctly produced, but the deviating realizations can be explained by assimilation. With child IV the interdental realization of /n d l/ is included in the frequency of occurrence.*

Child I

1. Single consonant.

INITIAL: Child I's realization of stops and fricatives is dominated by glottal stops [ʔ]. Only the bilabial stops are - with a few exceptions - pronounced according to the norm, and never as [ʔ]. Notice also that */f/* is realized as [ʔ], whereas */s/* is realized almost equally frequently as [ʔ] and as [h]. */h/* is correctly produced, but [h] is also the frequent pronunciation of */r/*. The remaining voiced consonants are usually pronounced according to the norm. Moreover, Child I in nearly all cases adds an [h] in front of word initial vowels, a position where */h/* occurs in the normal language, so that this "addition" of [h] may cause confusion of words.

FINAL: In this position child I does not use glottal stop. He shows a clear tendency to deletion of the nasal consonants */n/* and */ŋ/*, and of unvoiced consonants, while the phonetic realization of the remaining three phonemes is normal in most cases.

2. Initial clusters.
With a few exceptions all clusters are reduced to single consonants (≈100%). The most frequent pronunciation is [ʔ] (about 60%), */b/* + sonorant consonant being an evident exception as it is always realized as either [b̥ʰ] or [b̥]. It cannot be decided, however, if these manifestations can be generalized as valid for bilabial stop + sonorant consonant, since */p/* + sonorant consonant does not occur in the sample. But it is clear that his realization of stop + sonorant consonant cannot simply be described as identical with the realization of the stop as single consonant, because */b/* as single consonant is realized solely as [b̥].

It should be added, too, that child I has a number of assimilations of word initial consonants, both progressive and regressive (ex.: *v*[m]*armere*, *n*[l]*emlig*, *larmer l*[m]*idt*, *læse n*[l]*ogen*). Also, the way in which child I treats the Danish stød is worth a comment. Danish stød is considered a prosodic phenomenon with the syllable as its domain: if the vowel is long, the stød will appear at the end of the vowel; if the vowel is short, it appears on the following voiced consonant. In child I's sample 67 words should be produced with stød, but he only uses stød in 10% of these words. In most of the cases, where stød should have occurred on the vowel, it is omitted while keeping the vowel long (ex.: *sol* [soːˀl]→[ʔoːl], *træ* [d̥ʁɛːˀ]→[ʔɛː]). In the remaining cases with stød on the vowel, child I uses a short vowel. In the words occurring in the sample, where stød should have been on the voiced consonant, he sometimes lengthens the preceding vowel (ex.: *hånd* [hʌnˀ]→[hʌːn]), but more often the stød is just omitted.

As can be seen from the diagram in figure 1, child I's language development is delayed (in morphology and syntax). The assimilations, the problem with stød, and the addition of word initial [h] is probably also due to the language retardation.

THE DANISH CONSONANT SYSTEM AND ITS REALIZATION -

IN SYLLABLE FINAL POSITION

PHONEMES	/b	d	g	f	s	l	đ	m	n	ŋ/
REALIZATION	[b̥	d̥	g̊	f	s	l	đ	m	n	ŋ]
Child I										
Primary variant(s)	[	0			0	l	đ	m	n/0	0]
Frequency (%)	÷	100	÷	÷	100	89	90	67	45/ 35	80
Child II										
Primary variant(s)	[ʔm̩		0		s	l̃	đ̃	m	n	]
Frequency (%)	50	÷	50	÷	50	100	100	100	95	÷
Child III										
Primary variant(s)	[b̥	0/d̥		ḟ	s*/ṡ	l̃	đ̃	m	n	ŋ]
Frequency (%)	67	43/ 29	÷	100	33/ 33	100	100	100	93	100
Child IV										
Primary variant(s)	[b*	0			h*/0	l̃	đ̃	m	n	ŋ]
Frequency (%)	100	100	÷	÷	67/ 33	100	97	86	76	100
Child V										
Primary variant(s)	[	d̥/0			s	l	đ/0	m	n	ŋ]
Frequency (%)	÷	50/ 42	÷	÷	73	100	65/ 35	75	88	83

Figure 4

At the top of the figure is shown the Danish consonant system and its realization for consonants in syllable final position. Final /v j r/ are excluded since they are realized as true semivowels forming part of diphthongs - and /r/ may even disappear. Below, the primary realizations - primary variants - used by each child are indicated. Also, the frequency of occurrence is shown (in %). Notice that only consonants in syllable final position before word boundary are included. Encircling of the phonetic symbol indicates that the primary variant is in accordance with the target norm. As to child IV, the interdental realization of /l n/ is included in the frequency of occurrence.
0 in the row of phonetic symbols means 'omission of consonant', while ÷ in the row of frequency of occurrence indicates that the intended sound occurs only once or not at all with a given child. [˙] means 'nasal friction' and [$_*$] 'weak articulation'. The symbol đ is used for the 'soft d', which is a voiced approximant with a slight raising of the front and back of the tongue.

Also, as child I's velopharyngeal function is normal, his comprehensive and persisting use of glottal stop may be reinforced by his language delay, even though a status of the total East Danish cleft palate population born 1970-1978 (N = 293), shows no significant relationship between language delay and the use of glottal stop. In any case, the consequence of his dominant use of [ʔ] and [h], and of the frequent omission of final consonants is that both the phonetic realization and the number of phonemes deviate considerably from the norm.

Child II

1. Single consonant.

INITIAL: Child II also uses glottal stop, mainly for the stop consonants. The glottal stops, however, in most cases are articulated in combination with the correct supraglottal place of articulation. Only the velar stops are most frequently realized as a simple glottal stop. Also, child II is characteristic in that he shows a large variation in his realization of stops, except for */b/*, which is always realized as [ʔm͜]. For */p t/* the variation is so great that the occurrence of the different variants is too small to decide which is the primary variant for these stops. But there is a clear tendency to maintain a distinctive difference between aspirated and unaspirated stops, friction of some kind being frequent in the manifestation of */ptk/*.

/s/ also has many variants, but there are two primary variants, namely the nasal fricative [n̥̈] and *s* with audible nasal emission, that is with nasal friction [s̈][5]. The remaining */s/*-variants generally have a weaker and more diffuse friction noise, but the place of articulation for all of them - including the primary variants - is dental/alveolar. */h/* and */f/* and the voiced consonants are mostly correct, except that the oral voiced consonants are nasalized.

FINAL: In child II is also found omission of final stop consonant - but the occurrence of words with final consonants is very limited. It is noticeable, though, that final */b/* may be pronounced as a combination of bilabial and glottal stop, just as bilabial stops in initial position. */s/* is realized either as a 'weak s', that is as a weak and diffuse s-friction [s̭][5], or with evident nasal friction [s̈]. The voiced consonants* are pronounced normally, except for nasalization of the oral consonants.

2. Initial clusters.
There is a clear tendency for child II to realize clusters of two consonants as a combination of two consonants (67%), often in the way they are realized as single consonants - and thus with great variation (ex.: *blir* [ʔm͜ĩ], *smadre* [n̥̈m]). */s+n/*, though, is always reduced to [n̥̈], which can be described as omission of */n/*, since [n̥̈] is a frequent realization of */s/* (ex.: *snakke* [n̥̈]). This is possibly not to be explained as a simple omission but as a process in which */n/* is assimilated

Child I

Main pattern:	/CC/ > [C]	(100%)
example:	/CC/ > [ʔ]	(60%)
Systematic exception:	/bC/ > [b̥ʰ] or [b̥]	

Child II

Main pattern:	/CC/ > [CC]	(67%)
example:	/bl/ > [ʔ͜mĩ]	
Systematic exception:	/sn/ > [ṅ̥]	

Child III

Main pattern:	/CC/ > [CC]	(70%)
example:	/tr/ > [ṅ̥ʁ̃]	
Systematic exception:	/sb/ > [ṁ̥]	

Child IV

Main pattern:		
if C_1 = fricative	$/C_1C/$ > [C]	(90%)
example:	$/C_1C/$ > [h]	(88%)
if C_1 = stop	$/C_1C/$ > [C]	(65%) (≠ [h] (73%))
example:	/gr/ > [ʁ̥⁻]	

Child V

Main pattern:	/CC/ > [C] / [CC]	depending on cluster type
examples:	/sg/ > [s]	
	/sd/ > [d̥]	
	/bl/ > [b̥l]	
	/sn/ > [sn]	

Figure 5

The figure shows in outline the realization of two-consonant clusters in syllable initial position preceding a full vowel. C = consonant, [˙] = nasal friction.

to */s/* with regard to voicing and friction - that is, the two consonants become identical ([ṅ̥n]→[ṅ̥ṅ̥]) after which one of them is omitted. Moreover, assimilation of place of articulation can explain that */s+g/* as a cluster is often realized as [ṅ̥ʔn̮] because */d/* as a single consonant - but never */g/* - is realized as [ʔn̮] (ex.: *skal* [ṅ̥ʔn̮]).

Thus, child II's pronunciation of consonants deviates considerably from the target norm, while the decrease in number of phonemes is limited. His language development is normal, so that his consonant problems appear to be a direct consequence of his cleft palate, that is, of his insufficient velopharyngeal function.

Child III

1. Single consonant.
Glottal stop does not occur in child III (except three times sporadically).

INITIAL: Child III's realization of stops is often correct, least frequently for the velar stops, as they are nearly always assimilated to the surrounding consonants in place of articulation and/or nasality. The realizations are furthermore characterized by the use of voiced nasal consonants and unvoiced nasal consonants with nasal friction (i.e. nasal fricative), but other variants occur as well. Even though several of the variants deviate from the norm, there is a clear tendency in child III to try to maintain a distinctive difference between aspirated and unaspirated stops, as the voiced nasal consonants are the dominant realization of the unaspirated stops, while the unvoiced nasal consonants are dominant for the aspirated ones. The pronunciation of */f/* is often correct, but */f/* accompanied by nasal friction also occurs ([ḟ]). The primary variant for */s/* is *s* + nasal friction alias [ṡ]. There is, however, great variation in the pronunciation of the fricatives */f/* and */s/*, although the place of articulation is nearly always correct. The voiced consonants are usually correctly produced - except for nasalization of the oral consonants. It should be added that child III shows examples of correct manifestation of all consonants (except */s/*) in spite of evident hypernasality.

FINAL: For child III omission of final consonants is limited to */d/*, as */b/* is never omitted (no occurrence of words with final */g/*). */b/* and */d/* - when not omitted - are often correctly produced. */f/* is most frequently produced with accompanying nasal friction, [ḟ], whereas */s/* is realized either with accompanying nasal friction, [ṡ], or as weak, diffuse *s*-friction alias [s̽]. The voiced consonants are pronounced according to the target norm, except for nasalization of the oral consonants.

2. Initial clusters.
Child III mostly realizes clusters of two consonants as a cluster (about 70%), often consisting of consonants the way they are realized as single consonants (*trapperne* [ṅ̥ʁ̃], *fjernsyn* [ḟj̃]). Omission of consonants is most frequent in */s+b/*,

most often pronounced as [m̥]. This can be explained as a process in which */s/* - often as a single consonant realized as [n̥] - is assimilated in place of articulation, after which */b̥/* is omitted.

Finally, both progressive and regressive assimilation occurs in child III's speech, most frequently "fronting" of the velars accompanied by assimilation of nasality (*g*[n]*år* *d*[n]*e*, *hende* *g*[n]*år*).

As the correct pronunciation of consonants in child III's speech are quite often among his variants, and as omission of final consonants also in clusters is limited, his pronunciation of consonants and the number of phonemes are found to be only moderately deviating from the norm - judged by the primary variants.

Child IV

1. Single consonant

INITIAL: Child IV's realization of stops and fricatives is dominated by the nasal consonants [m] for */p/* and */b/*, and [n] for */d/*, and by [h] for the remaining stops and for the fricatives. Glottal stop is also relatively frequent for */d/*, */g/* and */s/*. [h] and [ʔ] occur sporadically for nearly all the voiced consonants, and even */h/* may be realized as [ʔ]. Voiced consonants are usually correctly produced, though, except for nasalization of the oral consonants. It should be mentioned, too, that child IV shows a rather large variation in her realization of alveolar and velar stops.

FINAL: In child IV's sample there are not many occurrences either with intended final stop or fricative. But in the very limited material */d/* is always omitted, whereas */b/* is realized as a very 'weak *b*', actually only a very loose constriction (*/g/* occurs only once - correctly produced). */s/* is also realized as a very weak and diffuse friction, [h̽]. */n/* too may be omitted, but otherwise the remaining voiced final consonants are usually correct, except for nasalization of the oral consonants.

2. Initial clusters.
If the first consonant is a fricative, child IV mostly reduces the cluster to single consonant (90%), but only */s+g/* occurs more than a few times. The realization is usually [h], but [ʔ] also occurs. As */s/* and */g/* as single consonants are both realized as [h] and [ʔ], it cannot be decided if the realization of */s+g/* should be described as omission of */s/* or of */g/*. An argument in favour of the stop being omitted would be that */s+d/* is realized as [h] - in the few occurrences found - and that */d/* as a single consonant seldom is realized as [h]. If the first consonant is a stop, the frequency of reduction to a single consonant decreases (65%). Only */b/* and */d/* + a sonorant consonant occur more than a few times. With */b/* the realization shows great variation, but mostly it is pronounced either as single [m] or followed by a sonorant consonant (ex.: *bruge* [m] or [mʁ̃]). With */g/* the cluster is most frequently

reduced to a single consonant. In all but one case the sonorant is */r/*, mostly realized as a retracted uvular unvoiced fricative [ʁ̥⁻]. As the production of single */r/* in the target norm may be very close to an unvoiced uvular fricative, child IV's pronunciation of */g+r/* is not as deviating as it may appear.

It should be mentioned that child IV speaks with a very low intensity, and that her speech is frequently interrupted by superficial inspiration. Her comprehensive use of nasal consonants, [h] and - to a lesser degree - [ʔ], means that both pronunciation and number of phonemes deviate considerably from the norm. Also, her [n], which is the realization of */n/* and frequently also of */d/*, is in many cases produced with interdental articulation. This also applies to */l/*. Child IV's use of glottal stop is noticeable, as it occurs also sporadically for sonorant consonants and */h/*. This will be discussed later.

As she shows no language delay, her consonant problems may be considered due to her cleft palate.

Child V

1. Single consonant.

INITIAL: In child V's sample only few, sporadic deviances from the norm occur, except for the velars */k/* and */g/*, which are realized as [h] and [d̥], respectively. As his velopharyngeal function is normal, [h̊] for */k/* may be a reminiscence of an earlier insufficiency. His "fronting" of */g/*, however, may be seen as a symptom of his slight language delay, and it is possible that also the [h] for */k/* is related to the language delay.

FINAL: The pronunciation is usually correct, but omissions do occur for nearly all types of consonants.

2. Initial clusters.
Child V's clusters are realized both as single consonants and as clusters, depending on cluster type. However, his treatment of clusters is common for children with developmental language delay as illustrated by the following examples: *grusgrav* [ʁ], *skal* [s], *stor* [d̥], *svært* [f]. The reduction in the last example can be described as a process where */v/* is assimilated to */s/* with regard to voicing, and then */s/* is omitted.

Also, child V uses many assimilations in his speech. Assimilations over a distance are regressive, while contact assimilations are mainly progressive (*k*[f]*om til at få*, *d*[b̥]*em*, *fars k*[s]*ammerater*).

It may be concluded that in child V's speech the interference with both realization and number of phonemes is very limited. Furthermore, it is supposed that his slight consonant problems are due to his mild language delay rather than to a reminiscence from his velopharyngeal insufficiency.

V. DISCUSSION

The results presented above show that the five children differ in their phonetic as well as in their phonological behaviour. In this section the results are considered in a more general aspect concerning strategies in cleft palate speech. Also, some aspects on universal versus language specific characteristics in cleft palate speech are treated.

A. STRATEGIES IN CLEFT PALATE SPEECH

Speech characteristics associated with cleft palate relate primarily to the insufficient velopharyngeal function, but also dyscoordinated mobility due to reduced sensibility in the anterior part of the tongue must be considered.

Velopharyngeal insufficiency results in abnormal pronunciation of different origins. If the abnormal pronunciation is a consequence of insufficient velopharyngeal valve function only, with the glottal and supraglottal articulations being normal, the resulting abnormal pronunciation of the speech is unavoidable and thus passive in nature. This may be considered as the "laisser faire" strategy or the <u>passive strategy</u> in cleft palate speech. Contrarily, if the speaker attempts to reduce unavoidable consequences of his or her handicap, the abnormal pronunciation is due to an active behaviour. There are two techniques of reduction, and these may be considered as the <u>active strategies</u> in cleft palate speech. Below is described how the physiological characteristics related to each strategy affect various types of sounds. Next, the five children are discussed according to this description. It should be pointed out, that in the present description the speech characteristics are considered from a causal point of view rather than a symptomatic one dealing with the consequences for the sound production, as is the case in most other descriptions.

The consequences of the <u>passive strategy</u> depend on the vocal tract configuration, i.e. on the type of speech sound to which it is applied. In the description of these consequences the velopharyngeal insufficiency is supposed to prevent any considerable increase in the intraoral pressure, and the glottal and supraglottal articulations are as in the target sound except for the velopharyngeal behaviour.

The oral <u>non-pressure</u> sounds (also including vowels) are <u>voiced</u> and thus realized as the nasalized cognates of the intended sounds. If intended voiced fricatives are realized as voiced, not only are they nasalized, but the conditions for friction are also reduced, resulting in a more or less non-fricative realization. In this context Ohala (1975) should be mentioned because he questions the existence of friction noise in speech sounds categorized as nasal voiced fricatives. As to the <u>stops intended to be voiced</u>, the passive strategy results in nasalization; in other words, these stops are realized as (voiced) nasal consonants.

A special category comprises unvoiced stops produced with a state of the vocal folds which results in voicing when airflow passes between them. This is the case in Danish (unvoiced) unaspirated stops. Since a blockage of the airflow is impossible in case of a velopharyngeal leakage, the Danish unaspirated stops will be voiced with the passive strategy. The only means to devoice these stops are to abduct the vocal folds - or to make a glottal closure - and then the strategy is no longer purely passive. Thus, the consequence of the velopharyngeal insufficiency is that the Danish unaspirated stops are realized as nasal consonants with the passive strategy. Voicing and devoicing in Danish stops - which is a more complicated matter than appears from the present description - is discussed in Hutters (1985).

Unvoiced sounds produced with a high rate of airflow presuppose abduction of the vocal folds. This category comprises fricatives and aspirated stops. The velopharyngeal leakage results in nasal emission of air, but due to the high rate of airflow they are produced with audible nasal emission of air, i.e. with nasal friction. Thus, the unvoiced fricatives are produced as a combination of oral and nasal friction (or, in case of turbulence, with nasal snort), one of them being the more dominating one. The aspirated stops will be realized as unvoiced nasal consonants with more or less nasal friction (or snort).

Thus, a characteristic feature of the passive strategy is nasalization and nasal friction. In the present description it is supposed that any considerable increase in intraoral pressure is prevented by the leakage of air through the velopharynx. However, in a speaker who sticks to the passive strategy, the resistence to the air may in fact be sufficient for production of consonants that are more similar to the intended pressure consonants than appears from the present description. The better pressure conditions - for a given vocal tract configuration - may be due not only to a less open velopharyngeal passage but also to the conditions in the nasopharynx and in the nasal airway. These factors, of course, also influence the degree of nasalization.

There are two active strategies that cleft palate speakers may utilize in order to reduce the unavoidable consequences of the organic handicap. One strategy is to compensate for some or all of the pressure consonants normally produced at, or in front of the velopharyngeal valve, by making constrictions appropriate to consonants produced posterior to the valve. Thus, the place of articulation is changed to an area in the vocal tract where obstruction to the airflow is possible in spite of the velopharyngeal leakage. Thus, by definition, the compensatory strategy only applies to pressure consonants. The other types of sounds are normally realized by means of the passive strategy. The compensatory sounds are primarily glottal stops and pharyngeal fricatives. However, Trost (1981), Lawrence and Phillips (1975) and Phillips and Kent (1984) also find pharyngeal stops in individuals with cleft palate. This finding is interesting, since with normal speakers it is assumed that it is not possible to establish a closure between the posterior pharyngeal wall and the tongue root, which explains why pharyngeal stops have not been registered as speech sounds.

The other active strategy is to mask or camouflage the unavoidable consequences of the organic handicap by means of weak articulation resulting in weak sound production. This strategy may apply to all types of sounds. Included in this strategy of weak sound production is the use of [h] for obstruents, since [h] is a weak sound. Thus, the use of this sound should not be considered a consequence of the other active strategy, where the place of articulation is posterior to the velopharyngeal valve in order to produce an effective blocking or constriction of the air, even though [h] is normally classified as a glottal fricative. Also, the pharyngeal and nasal alea constriction may be considered part of the active camouflage strategy, as it is an attempt to reduce nasal emission of air. Paradoxically, the nasal alea constriction may result in a more audible nasal emission.

A common realization of /*s*/ and other sibilant fricatives is a "nasal fricative", i.e. an unvoiced nasal consonant with friction. There may be two explanatory reasons for this realization. One is that the speaker wants to produce a more audible friction noise. If so, the strategy is of the compensatory active type. However, in this case the change in articulation is better described as a change in manner of articulation, that is an oral versus a nasal fricative, rather than in place of articulation. Another reason could be a reduced sensibility and dyscoordinated mobility of the tongue tip and blade which may result in articulation with the front of the tongue rather than with the tongue tip and blade. Since the production of sibilants is very demanding on tongue articulation, the speaker with tongue problems may "choose" the much simpler closing tongue gesture required for the nasal fricative. Notice that a nasal fricative may also be a consequence of the passive strategy, but in this case it is an abnormal production of dental/alveolar stops.

Further, a common consequence of the reduced sensibility and dyscoordinated mobility of the tongue tip and blade, resulting in articulation with the front of the tongue, is that dental/alveolar consonants are produced as palatal or prepalatal consonants. This tendency to articulation with the front of the tongue may also explain the paradox that the same consonants may be produced with interdental articulation - provided that the interdental articulation is considered a consequence of the front of the tongue articulating against the teeth and the alveolar ridge.

Only children who suffer from a persisting velopharyngeal insufficiency need to "choose" a strategy for their speech production. Thus, only the children II, III, and IV answer to this description. However, they differ as to "choice" of strategy, which appears from the realization of the pressure consonants.

Both child II and child IV use active strategies. As to child II, glottal stop is used for the stops - frequently articulated in combination with the correct supraglottal articulation - while /*s*/ is produced either as a nasal fricative or as an *s* with nasal friction. Thus, child II's realization of the pressure consonants is dominated by the active compensatory strategy. Child IV's realization of these consonants is dominated by [h] and weak sound production, which are characteristics of the active camouflage strategy. However, the pronunciation of some of her stops is dominated by nasal consonants produced with the correct place of articulation. This feature of nasal consonants may be explained by the overall weak articulation including the abduction of the vocal folds. That is, as explained above, if a laryngeal devoicing mechanism is not introduced simultaneously with the supraglottal closure, the intended stop consonant is realized as a voiced nasal consonant due to the velopharyngeal leakage. Of course, the production of nasal consonants instead of oral stops may also result from the passive strategy. However, with the purely passive strategy stops which in normal speech are articulated with a considerable abduction of the vocal folds should not be realized as voiced nasal consonants. Thus, if passive, her /*p*/ should be realized as [m̥̊] rather than [m].

Also, it is surprising that glottal stop occurs spontaneously in her speech in spite of her camouflage strategy. However, based on a more detailed analysis of her use of glottal stop, it appears that this sound only occurs in word initial position, i.e. at a word boundary, no matter whether the word in the target norm has a consonant (or consonants) in this position, or whether it starts with a vowel.[6] In the latter case it functions obviously as a 'hard' attack, that is as a non-phonemic sound, whereas the former case may be interpreted as a 'hard' attack with omission of the word initial consonant rather than as a phonemic compensatory glottal stop. One argument in favour of the non-phonemic interpretation of her glottal stops is that if phonemic, it must be accepted that they are used for non-pressure as well as for pressure consonants. Thus, her use of glottal stop does not seem to be compensatory in nature. Also, it should be recalled that child IV shows interdental articulation, probably due to a vacillating use of the tip and blade of the tongue as described above.

In child III's speech the fricatives are realized with nasal friction, while the aspirated and unaspirated stops are realized as unvoiced nasal consonants and voiced nasal consonants, respectively. Thus, child III's pressure consonants are dominated by the passive realization - when they are not correctly produced.

The children I and V have normal velopharyngeal function. Nevertheless, child I's speech is dominated by glottal stops instead of normal pressure consonants. Thus, what was former an active strategy, intended to compensate for a velopharyngeal insufficiency, has now become a habit.

In the speech of child V, as stated above, the very few abnormal consonant realizations are probably due to his slight language delay rather than to a former velopharyngeal insufficiency. Thus, a description according to strategies is irrelevant for child V.

Child I exemplifies the well-known fact that glottal stop - and other compensatory sounds - is a very ingrained habit even after the velopharyngeal function is no longer insufficient. Henningsson and Isberg (1985) have demonstrated that in speakers with good or moderate velopharyngeal activity and with persistent use of glottal stops, the velopharyngeal activity is considerably reduced during pronunciation of these glottal stops. The explanation seems to be that since sounds produced below the velopharyngeal valve are not impaired by a velopharyngeal leakage, the speaker may not establish a closed velopharyngeal port during these sounds. This opening, which is harmless to the production of glottal stops, may spread to the surrounding oral sounds and thus give a false impression of organically caused velopharyngeal insufficiency. That is, the apparently harmless habit may turn into a very speech-impairing habit. In child I there is no apparent velopharyngeal insufficiency in his speech, so that even if there may be reduced velopharyngeal activity during his glottal stop production, it is of no consequence to his sound production. One may wonder if the apparent velopharyngeal insufficiency in child II, who also employs compensatory glottal stops, may be secondary to a reduced velopharyngeal activity in the glottal stops spreading to the surrounding sounds, and thus complicating the diagnosis of organic versus non-organic causes of his persisting "cleft palate speech".

In normal speech the same connection between glottality and the velopharyngeal mechanism has been observed, namely that the velopharyngeal port may be opened or closed during production of glottal stop and [h] according to the context (Ohala 1972). This optional velopharyngeal leakage has been proposed to explain that nasal vowels - which are normally developed from a context of nasal consonants - may develop from oral vowels preceded by a glottal stop and [h] (Matisoff 1975). From this it may be worthwhile to examine [h] in cleft palate speakers with good or moderate velopharyngeal activity to see if the velopharyngeal behaviour is the same as with the glottal stop.

In conclusion, due to the origin of the passive strategy, speakers suffering from velopharyngeal insufficiency will always show characteristics related to this strategy in their speech. Consequently, the passive strategy can actually not be "chosen". What the speaker can choose is to supplement his/her passive cleft palate speech with some of the characteristics from the active strategies, even though we talk about "choice of strategies" including the passive one. So, it appears that cleft palate speech may contain characteristics from several strategies with some characteristics being the more dominant ones. On the other hand, due to the antagonistic nature of the two active strategies, they are supposed to be mutually exclusive, even if they, though probably mistakenly, seem to occur simultaneously as seen in child IV. As appears from the preceding discussion this description - including its basis and implications - seems to be profitable to the description of cleft palate speech and its varieties.

B. UNIVERSAL AND LANGUAGE SPECIFIC CHARACTERISTICS IN CLEFT PALATE SPEECH

Characteristics that originate directly from the organic conditions of the speech production apparatus are by definition universal rather than language dependent. As described above, the strategies in cleft palate speech are related to the organic conditions; thus, the strategies per se must be considered universal. Also, within the pressure consonants, differences according to place and manner of articulation have been reported. As to place of articulation, the labial stops are more frequently produced according to or closer to the target norm than stops produced with the tongue. This may be explained by the greater demands in the production of lingual sounds. Within the lingual stops it is further reported that those normally produced with the tip and blade of the tongue are more frequently distorted than are stops produced with more posterior parts of the tongue. These differences may be explained by the reduced tongue tip/blade sensibility observed in some cleft palate speakers. The tongue problems may also explain that sibilant fricatives are observed to be more frequently produced in an abnormal way than stop consonants. These differences as to place and manner of articulation, provided that they originate from the organic conditions, should be observed in cleft palate speakers irrespective of language, and thus be universal in nature. But due to the very restricted amount of data in the literature stemming from other languages than English, our knowledge is only fragmentary in this area. Only the observation that labial stops are more frequently normally produced does occur in the present material (see figure 3), which may be accidental and due to the very restricted number of children. One obvious feature originating from the tongue problem is the interdental articulation occurring in child IV.

Contrarily, since languages differ as to their sounds and sound structure, the consequences for communication induced by the passive strategy will also differ from language to language. Thus, the unavoidable phonetic and phonological difficulties that cleft palate speakers may have are evidently language dependent. However, the question is whether some of these speakers show language dependent reactions to the passively conditioned characteristics. For instance, why do some cleft palate speakers stick primarily to the passive "laisser faire" strategy, whereas others supplement it with one or the other active strategy? Theoretically it could be that the sound structure of the speaker's language is decisive for the choice of strategy(ies), and if so, the choice is by definition language dependent. It is a well-known fact that all strategies occur in one and the same language, as also appears from our Danish children. But what we do not know is whether one strategy is more dominant in some languages than in others. For instance, it may be hypothesized that the active compensatory strategy is less frequent in languages which include the compensatory sounds in their sound system. These pharyngeal and glottal sounds have a distinctive function in many languages, but unfortunately, the data available in the literature do not permit any suggestions concerning this question. In the appendix following the present paper a psychological aspect is considered to be a conceivable part of the answer to the question of choice of strategy.

Another question relates to the fact that the phonetic output of cleft palate strategies normally have more or less severe consequences for the target phonological system of the speaker. This aspect of cleft palate speech is obvious in our Danish material. Do cleft palate speakers react to these phonological consequences? Our Danish material illustrates that the phenomenon seems to exist as it appears from child I and his treatment of the stød and glottal stop. After some general comments on glottal stop, this will be described in the following.

Like other sounds occurring in speech, glottal stop can be described with regard to production and to function. Its production is normally described as e.g. by Bergendahl and Fex (1977): *"the vocal folds are pressed forcibly together and separated with a plosive sound by the increased subglottal pressure"* (p. 17). However, this description seems to apply to a forceful realization of glottal stop. For glottal stop - as for all other sounds in speech - the force of articulation depends on factors like overall level of speech intensity, position, and stress. In our material on cleft palate speech it has been observed that perceptually clear glottal stops may in fact be produced without a true closure of the glottis, since weak and irregular voicing appears in the microphone curve. But this needs further examination.

As to the function of glottal stop, it may be phonemic or nonphonemic. When phonemic, glottal stop has a distinctive function, which is found in many languages. When non-phonemic, it occurs before a word initial vowel, and its function may be to signal a boundary or a feature of emphatic speech. Non-linguistic terms for these non-phonemic glottal stops are "hard attack" or "phonatory glottal stop" (Bergendahl and Fex, 1977). The phonemic use of glottal stop does not exist in Danish, whereas the non-phonemic one is optional.

In cleft palate speech the compensatory glottal stop has by definition a phonemic function, but of course the non-phonemic function will also be present if it occurs in the target speech norm. However, compensatory glottal stop used by Danish cleft palate speakers may be perceived as a Danish stød, since this sound is perceptually fairly similar to a non-forceful glottal stop. And as a stød at the surface level has a phonemic function, there are risks of phonological mistakes. This may be the reason why child I, who uses the phonemic compensatory glottal stop, in most cases either omits the stød or signals it in a deviant manner: because stød in his speech will be understood as a compensatory glottal stop by the listener, it cannot be used also for the stød of the norm language. Furthermore, it is interesting that the non-phonemic function of glottal stop is also avoided in child I's speech, probably in order to avoid confusion with his phonemic use of the glottal stop. However, the [h] that he inserts before a word initial vowel may be interpreted as a different initiation of phonation, namely the 'soft' attack. Furthermore, his [h] instead of [ʁ] may be interpreted as a different initiation of phonation, namely the 'soft' attack with omission of /*r*/ rather than as the phonemic realization of /*r*/. The 'soft' attack [h] is probably understood as the phonemic /*h*/ by the listener. But the number of potential mistakes are in fact much less with [h] than with glottal stop, since [h] is the realization of only one phoneme, whereas the glottal stop is used for many phonemes in the target norm.

It should be added that the literature on language development delay in Danish speakers does not mention stød as a problem, and nor did any of the children with compensatory glottal stop from the 1970-78 status have any problems with stød, which fits very well with the fact that prosodic phenomena are less exposed to be a speech problem than segments. Thus, child I is certainly not representative of the population. However, his treatment of stød illustrates that it seems worthwhile to investigate the question whether cleft palate speakers react to the phonological consequence imposed by the cleft palate strategies. But again, due to want of phonetic and phonological descriptions of cleft palate speech in individuals, one cannot hypothesize which conditions will cause such reactions and how frequent the phenomenon is.

In conclusion, it has been pointed out that some characteristics in cleft palate speech may be observed in all cleft palate speakers, while others depend on the speaker's language. However, it has also become clear that phonetic descriptions of cleft palate speech with speakers of different languages are necessary prerequisites to the solution of the problem of universal and language dependent characteristics in cleft palate speech.

VI. CONCLUDING REMARKS

As quoted from Morris (1979) in the introduction, it may be considered impossible to make meaningful descriptions of cleft palate speech due to the great inter-individual variation in the cleft palate population. However, it seems meaningful to us to describe cleft palate speakers according to the origin and type of their deviating speech production. And such descriptions are useful for the assessment and treatment of these persons.

In practice there are three options for a person with persisting speech problems after primary palatal surgery: extra surgery, treatment with pharyngeal opturator, and speech therapy, sometimes in connection with the two first mentioned options. The advice as to which option to choose rests mainly on impressionistic analyses - as does also much research on cleft palate speech - partly due to the fact that it does not involve much equipment. However, a precondition for impressionistic analysis - in practice as well as in research - is a substantial knowledge about physiological, aerodynamic, and acoustic aspects of cleft palate speech to be related to the impressionistic percept. Many studies on physiological and aerodynamic aspects have been performed, while the number of acoustic studies is rather limited (see, e.g., Philips and Kent 1984). However, many questions as to the nature of the deviant types of speech production described are still unanswered. And other questions concerning cleft palate speech need further research such as the communicative consequences and the question of language dependency. Also, there remain the complications from the psycho-social constitution and background of each individual, and research in this field is evidently needed as well.

VII. NOTES

1. The categories "distortion", "substitution", "omission", and "addition" used to describe language development, are frequently used also in connection with cleft palate speech (excepting "addition"). These categories are ambiguously defined as to phonetic and phonological criteria.

2. A transcription system especially designed for cleft palate speech has been proposed by Vieregge & Jansen (1981).

3. Aspirated stop does not occur after *s*, in spite of the spelling *'ptk'*.

4. The symbol *đ* is used for the "soft *d*", which is a voiced approximant with a slight raising of the front and back of the tongue, and thus without any true constriction of the vocal tract. There is no symbol for this sound in the IPA-system.

5. [˚] indicates nasal friction, [$_{*}$] that the sound is weak. These symbols are not included in the IPA-system.

6. For this purpose, syllable initial consonants preceding also a non-full vowel have been examined.

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APPENDIX

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A characteristic feature of cleft palate speech is the tendency to retract the articulation of obstruents normally produced in front,of to a place below the velopharyngeal valve as a compensatory obstruction of the airflow, resulting in glottal stops and pharyngeal fricatives. This deviant pronunciation is often very damaging to intelligibility - because each of the compensatory sounds is often used as realization of several phonemes, whereby the number of contrasting sounds is reduced. Also, this type of deviant pronunciation has proved very difficult to correct, even after surgical normalization of the velopharyngeal mechanism (see, e.g., Bzoch 1979). In the status mentioned above of all individuals with cleft palate from East Denmark, born during the period 1970-78 (N=293), about 10% were found to use glottal stop articulation in their speech at three years of age, and this was only reduced to 7% at six years of age, in spite of logopedic intervention. It would therefore be essential to be able to predict which infants are likely to use compensatory sounds so that prophylactic intervention could be initiated. And since glottal babbling before surgical closure of the palate is sometimes observed (Olson 1965, Henningsson 1981), this intervention could be initiated very early.

From clinical experience we venture the hypothesis that these children have certain features in common: extrovert personality, eagerness to communicate and to be noticed socially, and earlier initiation of language than usual for most cleft palate infants. It was therefore relevant to see if the children in this study who are using glottal stops show features in their communication behaviour which differ from the children who use other "strategies".

From the video-recordings used in the phonetic analysis the communicative interaction between parent and cleft palate child was analyzed. It must be stressed, however, that because of the very limited number of children in the study and also because of the limitations in which the experimental setting was created (see p. 3), the results should only be viewed as a guideline for more comprehensive studies.

The method used for this pilot study is descriptive and derives from an etiological frame of reference (Blurton Jones 1979, Nielsen and Damholt 1982). The first phase consists of describing interaction between the child and parent through a rough analysis of the video recordings. Throughout this phase we did not operate with any specific hypothesis. The

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second phase of the analysis required a detailed description of specific elements in the parent-child interaction, and how these elements interact and influence each other. This requires a frame by frame analysis which could not be carried out in this study.

It was not possible, from the rough analysis alone, to determine any definite impressions of the children's behaviour or character, since the experimental setting limited free and natural interaction between the parent and the child. However, it was observed that the children using glottal stops seemed to use their voice more accompanied by gestures, when they lacked words, and they also used more onomatopoeia than the other children.

On the basis of the observations of parent-child interaction a hypothesis could be formulated: The children with glottal stops are exposed to greater expectation regarding their communicative competence than the children who do not use glottal stops.

Communicative competence is defined as the child's knowledge of and ability to use language (Hymes 1971). Thus, it can be considered as a process involving interaction between impressive and expressive language.

An attempt to verify the above hypothesis was made by examining the dialogue between parent and child. A categorization similar to Newport et al.'s (1977) method of scoring Mother's speech into sentence types was used. The sentence types are the following:

Sentence types	
Declarative	You can sing a song.
yes-no question	Can you sing a song?
Imperative	Sing a song.
Wh-question	What can you sing?
Deixis	That's a dog.

Thus, the first fifty utterances of each dialogue in the study were categorized in order to study the differences in the ways in which the parents communicated with their children. In figure 6 is shown examples from the dialogues.

In example 1 the parent's sentence types are the following: yes-no questions - declarative - deixis, in the parent's first utterance. In example 2 the following combination is seen: imperative - declarative - yes-no questions - imperative - imperative, all in the parent's first utterance. In examples 3 and 4 the parents only use one sentence type for each utterance.

The demand on the child to understand the message seems to be greater in ex. 1 and 2 than in 3 and 4. The frequency of the parent's use of successive sentences of different structure for the first 50 parent utterances in each recording was found to be: child I: 36%, II: 36%, III: 6%, IV: 2%, and V: 8%. These results show a significant difference in the ways in which parents communicate with their children. This shows that the parents of child I and child II seem to have greater expectations of their children's communicative competence than the other parents.

Child I and child II were the same children who showed predominant use of phonemic glottal stops in their speech. From clinical and parent information it appears that child I and child II used sentences several months earlier than the other children in the study, and that they used glottal babbling. According to the linguistic analysis child IV used glottal stops as well but in an atypical manner (see p.20).

The observations and the analysis carried out by the psychologists have led to many new questions concerning the communicative behaviour of children with glottal stops, as well as their parents' behaviour. Therefore, before any definite conclusions can be made concerning the findings in this study, further studies must be conducted.

It would be essential to study how parents of children with glottal stop communicate with their children during the years of language acquisition. The parents of children who use glottal stop may also have a significant role in their child's habit, since they may expect the child to understand their long and complicated sentences. They may also expect that their child has the ability to communicate with other, nonlinguistic forms of vocal utterance, such as onomatopoeia and sounds accompanying gestures.

Perhaps better insight into this process could show how a child's communicative competence can influence his/her parents' communicative behaviour. Such a study could also include a closer examination of whether a child's eagerness to speak is expressed when he/she first begins using words and sentences, and also whether the language acquisition occurs at a different rate than in other children with cleft palate. Finally, the parents' expectations of their child's communicative competence could be studied through interviews, observations, and analyses of their communication.

To be able to study these suggestions properly, the experimental conditions should be different from those of the present pilot study, which was primarily set up for the linguistic analysis. A study of this kind should include a detailed analysis of the children's spontaneous communication and behaviour in a more natural setting, with an emphasis placed on the behaviour occurring during the communicative dialogue. The number of children should be sufficient, including a control group of normal children and their parents.

The children should be as young as 1-2 years, which is the period in which glottal stops may change from a non-phonemic status in babbling into a phonematic function in emerging language. Also, the rate of language acquisition should be studied. A follow-up study some years later could perhaps be compared to the results of the present observations on 4-5 year old children.

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Ex. 1

P: Make flowers? - But it's not yellow all of it - they are green.

C: Where's green - oh yes, green

P: Yes, green to begin with - and then a red flower

C: Oh yes - green

P: hmm, a green one like that, and then a red flower - now you're making it wrong

Ex. 2

P: I think you ought to take your boots off - you're not sitting very comfortably, are you? - Yes, boots off - and put them next to you

C: Look, a little watermill

P: Oh yes, it's just like the one we just saw on TV about water - what can you use water for - can you remember?

Ex. 3

P: Look here

C: A hat

P: What's that?

C: Some clothes

P: What is it getting to drink?

C: milk

Ex. 4

P: What are you going to draw first?

C: I'm drawing a house

P: First a house, yes, and then you make the wall

C: This is inside, and that's outside

P: Hm-m

Figure 6

The figure shows examples from the child-parent dialogues (in translation). P = parent, C = child.