

## PAPERS BASED ON MASTER'S THESES

### VOCALIZATIONS OF YOUNG DEAF CHILDREN

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#### Abstract

This paper concerns a research on the vocalizations of three young deaf children in interaction with three teachers in a bilingual playgroup, using Sign Language of the Netherlands as well as spoken Dutch. The type of vowels and consonants, the syllable structure, and the production of spoken words demonstrate that the children used mostly sounds with neutral articulation and a good view of the lips. Vocalizations with one or two syllables are produced, as well as some spoken words. The development of the vocalizations of one child is followed for the period of one year. It appeared that the vowel production remained similar while consonant production diversified with age. Finally, the effect of bilingual language input has been evaluated. In the age period studied, the children did not differ in their vocalizations in relation to the teachers language input.

#### 1. Introduction

A lot of research has focussed on the vocalizations of deaf and hearing impaired children. Research is mainly concerned with two aspects of development of vocalizations. Firstly, the onset of canonical babbling, and secondly the types of sounds composing the vocalizations.

The first aspect marks the age at which the child starts to produce adultlike series of syllables which are thought to function as phonetic building blocks for spoken words (Oller & Eilers, 1988). Oller, Eilers, Bull & Carney (1985) found that a deaf child did not enter the canonical babbling stage before the age of 8 to 13 months in contrast to normally hearing children. The deaf child remained in the precanonical stage much longer. Comparison of the vocalizations of the deaf child and the normally hearing children, all in a comparable babbling stage, showed that all children produced similar vocalizations. So, hearing loss has an age effect with regard to the onset of the different stages, but not with regard to the quality of the vocalizations in these stages (Oller et al., 1985). In another study Oller and Eilers (1988) found that normally hearing children enter the canonical babbling stage when they are between 6 and 10 months old. In deaf children this stage starts only between 11 and 25 months. Hearing loss has a severe effect on the vocal development of children.

The second aspect studied in development of vocalizations is concerned with the influence of hearing impairment on the production of different types of sounds. Stoel-Gammon and Otomo (1986) found that, at the age of 8 months, hearing impaired

children produce fewer different types of consonants than normally hearing children. With age the number of different types of consonants increased in normally hearing children, while for the hearing impaired children the number remained constant or even decreased. A later study of Stoel-Gammon (1988), comparing normally hearing children and hearing impaired children, shows that the latter produce more labial consonants, more nasals, glides, and fricatives, and fewer alveolars, and plosives. It is clear that a hearing loss has a considerable influence on the development of speech in deaf and hearing impaired children.

During a traineeship of the first author (partially under supervision of the second author) at the Dutch Foundation for the Deaf and Hard of Hearing Child in Amsterdam we studied the vocalizations of three deaf children. One morning per week these children participated in a bilingual playgroup organized by the Foundation. The policy in the playgroup was adhering the principle of 'one person-one language' thus the children will learn that a specific person may use one language while another person uses another language. One deaf teacher uses Sign Language of the Netherlands (SLN), a normally hearing teacher speaks Signed Dutch (SD), while the speech therapist in the playgroup speaks Dutch only (D). The group of 10 to 12 children consists of deaf, hearing impaired, and a few normally hearing children. Explicit language training is not given since the childrens 'enjoying language use' is prerequisite.

## 2. The purpose

The purpose of the study on the development of vocalizations of young deaf children in the bilingual playgroup which is reported here was triple:

1. An investigation of vowels and consonants in the spontaneous vocalizations, the syllable structures used, and the occurrence of spoken words.
2. An investigation of developmental changes in the vocalizations per child.
3. An evaluation of the principle 'one person-one language'.

## 3. Subjects

We have used videorecordings of three girls, selected because of characteristics of their audiograms. The children have no developmental problems that might be of influence upon the ability to produce vocalizations.

Child A is born in October 1992 and had meningitis when 1;5 years old which evoked a profound loss of perception. She is provided with a hearing aid. Audiologic examination shows reactions only for 250 Hz and 500 Hz amplified to 100 dB. According to the parents she never reacts upon any sound. This child's videorecordings were made in the age period from 1;8 to 2;8 years.

Child B is born in December 1990 and she is born deaf. She is equipped with two hearing aids behind the ear. Videorecordings were made in the age period from 2;8 to 3;6 years.

Child C is born in August 1991 and reacted insufficiently upon the standard Ewing test around 9 months, administered at the Youth Health Care System in the Netherlands. Her first audiological examination was done when child C was 18 months old, and then a profound loss of perception was detected. She is equipped with two hearing aids behind the ear just as child B. Videorecordings were made in the age period from 2;5 to 3;4 years.

## 4. Hypotheses

Surveying literature, some hypotheses can be formulated.

1. No results on types of vowels in deaf children's vocalizations are reported in literature. We assumed that principles of consonantal development apply equally to vowels. Likely, vowels with a neutral position of the tongue will occur: the central vowels /uu/, /u/, the /ə/, and /aa/, the front vowel /e/, and the back vowel /a/. Vowels which combine a neutral tongue position with an obvious lip rounding or spreading such as the front vowel /ie/ and the back vowel /oe/ are expected to be produced as well.

2. In view of Stoel-Gammon's research (1988) we can expect that deaf children will produce proportionally more labial nasals, fricatives, and glides than other consonants especially the /m/, /w/, /f/, and /v/. They will also use the laryngeal /h/ frequently.

3. Similarly, Stoel-Gammon's study (1988) leads us to the hypothesis that alveolar plosives (/t/ and /d/) will not be produced quite often.

4. According to Oller and Eilers (1988) study it is expected that the children in our study, because of their ages, will produce canonical babbling sounds (CV- or CVC-like structures).

5. Since we study the children over some time we expect that the children will start to produce variegated babbling sounds.

6. Trainers of deaf children often report the occurrence of spoken words in this age period. Likely, the children in this study will start to produce one or more spoken words as well.

7. Stoel-Gammon and Otomo (1986) and Stoel-Gammon (1988) reports justify the following expectations about the development of vocalizations. The number of vocalizations will increase, while the number of different types of vowels and consonants will decrease. Mostly central vowels will be produced, and more labials than velars and alveolars. In general, vowels will occur more often than consonants. The children are expected to use simple syllable structures, yet occasionally some longer and complex structures will be produced.

8. As to the principle of 'one person-one language' we expect that the children receiving SLN will use more signs than vocalizations, whereas the children receiving spoken Dutch will produce more vocalizations than signs. When language input is Signed Dutch, the children may produce equal numbers of signs and vocalizations, possibly even parallel.

## 5. Material used for data collection

The material consists of videorecordings of the three children. Some were already made before we started our study, and some were made during the period of the traineeship. It is important to notice that the videorecordings are not made for the purpose of this study. They are in principle meant for the parents and other teachers to give an every day impression of the play group. The recordings are made in the play group focussing on all children at a time, and thus a lot of background noise is registered as well.

For this study only fragments of the recordings of the three children are used when sound production and view of the child's mouth was not hindered.

## 6. Definitions

The following definitions are used in this paper.

- Interaction:* Interaction is present between the child in focus and a partner when we noticed any form of contact, such as gaze or touch. Any contact with the partner just before or after a vocalization of the child resulted in the conclusion that the vocalization was directed at the partner.
- Utterance:* Sounds are considered to be one utterance when produced during one breath period.
- Vocalization:* All sounds of the children are considered to be vocalizations except vegetative sounds, and laughing for example. Notice the difference between utterance and vocalization.
- Syllable:* A syllable may consist of at least one vowel and/or consonant. Syllables can be produced by means of interruption of voicing, by means of articulatory movements, or a combination of both. Pitch variation may occur during one syllable.
- Word:* A vocalization is considered to be a word when it has a (near) adult form and is used in a plausible context. This definition equals the one given by De Boysson-Bardies and Vihman (1991).

## 7. Results

### 7.1 Types of vowels and consonants

As the number of videorecordings and their durations were different for the three children, results are given in percentages instead of absolute numbers of vocalizations. Figures 1a and 1b give an overview of the types of vowels and consonants in the vocalizations of all three children. Child A produced a total of 66 vocalizations with 110 vowels and 55 consonants. Child B produced 47 vocalizations with 79 vowels and 73 consonants, and child C 126 vocalizations with 165 vowels and 61 consonants.

Child A uses mostly front vowels, mainly /e/ and /ie/. She uses less the central vowels, and the ones she did use were mainly /u/ or the schwa (/ə/). The back vowels occurred least of all, and of those she produced the /a/ mainly.

Child B uses many central vowels, especially /u/ or the /ə/. She uses less the front vowels, mainly /e/, while she produces the back vowels, mainly /a/, sporadic.

Child C also uses mostly the central vowels, mainly /aa/. Only few front and back vowels are produced, mainly /e/ and /a/ respectively.

As to the types of consonants, it appears that child A uses most of the time the plosives /p/ and /b/. She produces less semi-vowels (mainly /w/). Fricatives and nasals occurred seldomly, and mainly /h/ and /m/ were produced then.

Of the nasals, child B produced many times /m/. Fricatives occurred not as often, and mainly the /h/. Semi-vowels and plosives were few, restricted to /j/, and /p/, /b/ respectively.

Child C uses mostly fricatives, mainly /h/, some plosives (/p/ and /b/), and rarely semi-vowels (/w/) and nasals (/m/).

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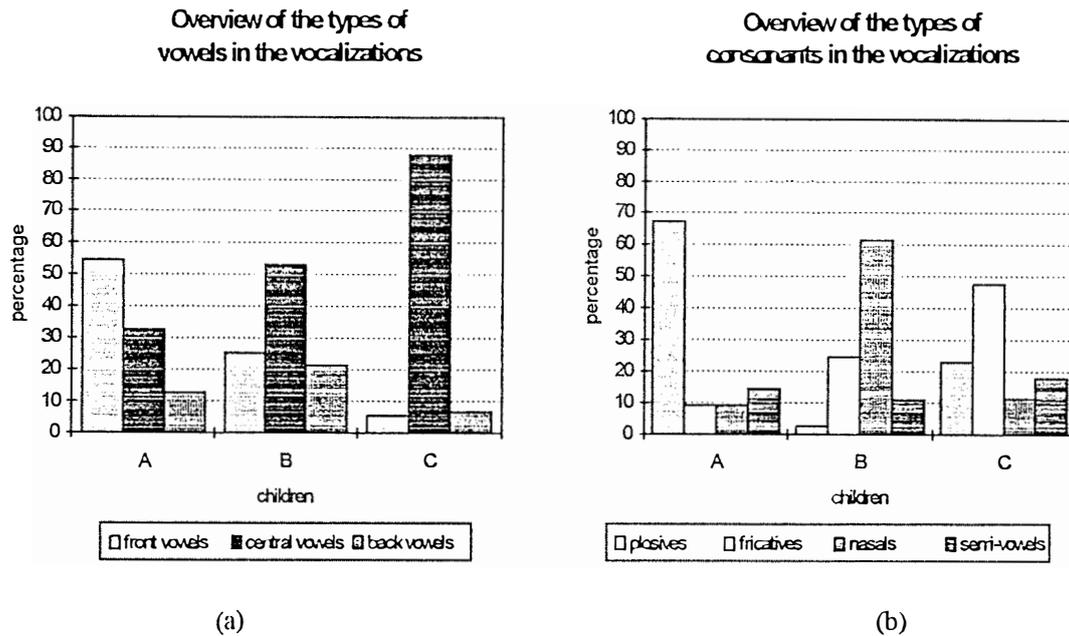


Figure 1 (a and b). Overview of the percentages of the types of vowels (a) and the types of consonants (b) in the vocalizations of three deaf children.

## 7.2 Syllable structure and spoken words

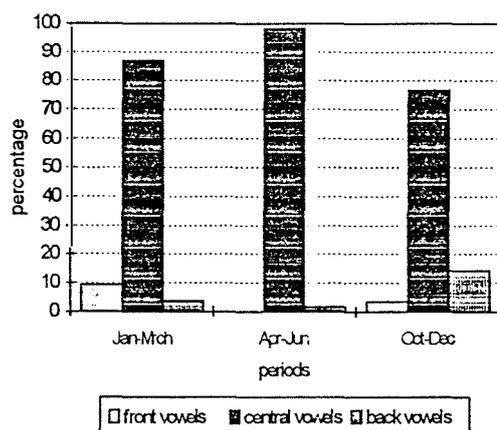
For every vocalization syllable structure was analyzed as well as the length in terms of number of syllables in one breath period. Most vocalizations consisted of only one or two syllables with V, CV, VCV, and CVCV combinations. The longest vocalization of child A had six syllables, of child B five syllables, and of child C four syllables.

All three children were found to produce at least one spoken word. Child A said 'eten' (to eat) at the age of 2;6 years. Child B produced the word 'mama' (mummy) when she was 3;6 years old. Child C used the word 'bal' (ball) at the age of 3;4 years.

## 7.3 Developments of the vocalizations

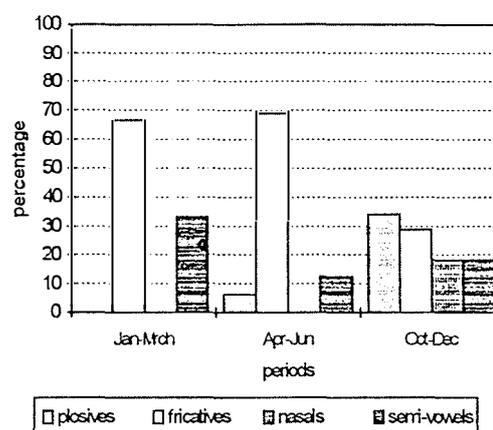
The development of speech production could only be followed for child C. The videorecordings in which she figured were regularly spread over a period of one year. That period has been divided in three periods: January to March, April to June, and October to December. No recordings were made during the summer holidays, as the play group then is closed. Figures 2a and 2b give the types of vowels and consonants that occurred in the vocalizations of child C in these three periods. In the first period (Jan. - March) she produced 40 vocalizations with 54 vowels and 9 consonants. In the second period (Apr. - Jun.) we counted 41 vocalizations with 55 vowels and 16 consonants, and in the third period (Oct. - Dec.) the numbers were 45 vocalizations with 56 vowels and 38 consonants.

Overview of the types of vowels in the vocalizations of child C during the three periods



(a)

Overview of the types of consonants in the vocalizations of child C during the three periods



(b)

Figure 2 (a and b). Overview of the percentages of the types of vowels (a) and the types of consonants (b) in the vocalizations of child C during the three periods.

It is clear that child C produces during all three periods about equal numbers of vowels, mainly the central vowel /aa/. In the second period the front vowel /e/ disappears but is produced again in the third period. The number of back vowels (mainly /a/ and /o/) decreases also in the second period to increase again in the third period. Comparing the first and the third period, the number of consonants is multiplied by four in the third period. Child C also produces more different types of consonants. The first period is mainly characterized by the production of the fricative /h/ and a small number of semi-vowels (mainly /w/). During the second period the number of fricatives is higher than in the first period, and the first plosives (mainly /p/ and /b/) occur. In the third period all kinds of consonants are produced in approximately the same numbers. Then the plosives are mainly /p/ and /b/, the fricative /h/, the nasal /m/, and the semi-vowel /w/.

With regard to the syllable structure and the number of syllables per vocalization, we found that child C produces mainly one syllable vocalizations of the type V during all three periods. The number of vocalizations with two and three syllables increases gradually over the three periods.

#### 7.4 Bilingual language input

In order to evaluate the principle 'one person-one language' we looked for a relation between the vocalizations of a child and the language used by interaction partner.

In the period between the first recording (April 1993) and the last one (June 1995) several deaf and hearing teachers participated subsequently in the play group. It is for sure that all teachers have their own style of using a language, be it SLN, Signed Dutch, or spoken Dutch. Therefore, we could not relate the vocalizations of the children to a certain language input, and decided to look for relations with the different teachers of the play group.

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### Overview of the percentages of the vocalizations related to the interaction partners

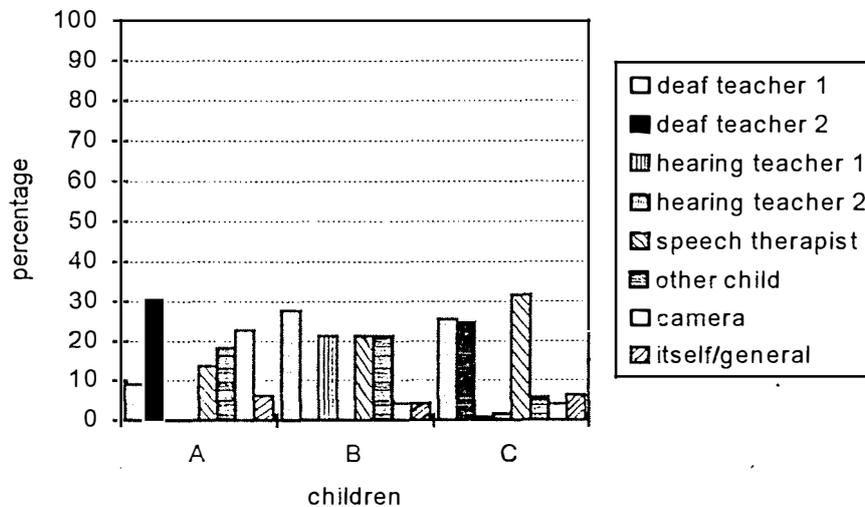


Figure 3. Overview of the percentages of the vocalizations of three deaf children in relation to the different teachers of the play group.

In figure 3 the percentages of vocalizations of the children directed at the different teachers are given. In general all children vocalized mostly in interaction with the deaf teachers and with the speech therapist. Additional categories for interactional situations are given, such as vocalizations directed at 'other child', 'camera', and 'itself/general'. In these latter cases the child did not receive a specific language input, yet child vocalizations occurred in these situations quite often. Possibly we must interpret these as training situations for vocalizing.

## 8. Discussion

Like we expected, the children indeed produced mostly the central vowels /uu/, /u/ or the /ə/ and the /aa/, the front vowel /e/, and the back vowel /a/. The front vowel /ie/ as well as the back vowel /oe/ were produced not often, with exception of child A for the front vowel /ie/.

With regard to the consonants, the children produced many labial sounds, especially the plosives /p/ and /b/, the nasal /m/, and the semi-vowel /w/. The laryngeal /h/ occurred frequently too. The fricatives /f/ and /v/ were produced hardly ever. Child B and child C produced some alveolars /t/ and /d/, while these were used frequently by child A.

Child A's repertoire of vowels and consonants differed from that of the other two children. The relatively long period of normal hearing of child A may be one explanation for this difference. Possibly, an additional explanation is that this child profits more from the presence of the speech therapist in the play group, since she has experienced sound input.

The differences found between the hypothesized sound productions and the actually found ones may be explained by the fact that certain sounds are not produced that often in the recorded situations, are still too difficult to be produced by these children, have less visual cues, or do not occur very often in speech in general.

As to the stages in speech development, we found that all three children produced canonical babbling sounds, although child A and C continued to use syllable structures from a previous stage, namely only V. The children also demonstrated aspects of the variegated babbling stage.

We expected that the children would start to produce spoken words, and so they did. The three children have used one spoken word each. However, no conclusions may be drawn about (delayed) speech development and the (low) number of words. The videorecordings made in the play group only give a fragmentary view on the children's vocalizations in general. Research of the development of (speech) sound production in young deaf children needs a more systematic manner of data collection than this inventory study.

The development in the production of vocalizations over a longer period of time could only be studied in child C, who figured in videorecordings over a period of about a year. She produces mainly central vowels and labial consonants, uses simple syllable structures although longer, and more complex ones did occur occasionally. In the age period studied the number of vocalizations did not increase, and the variation in types of vowels and consonants did not change. This can be explained by the fact that when only little variation is present, a decrease is not likely.

With regard to the principle 'one person-one language' an obvious difference between the teachers and the number of vocalizations directed at them is not found. Several explanations can be given for this unexpected finding. Firstly, it is possible that the children will make a distinction in language use towards the teachers only at an older age when no longer participating in the play group. Secondly, the children may not be, or only partially, conscious of their early vocalizations. We may assume that this consciousness is present when they produce spoken words, yet in this study they only have produced one word each. A third possible explanation is an unnoticed difference between, for the children visible, mouth movements and visually similar speech sound productions of the adults. The ongoing activities in the play group, the interaction styles of the teachers, and the fragments of videorecordings provide other explanations. Furthermore, the children's development in SLN is disregarded in this study, so nothing can be concluded about their signing to the deaf teachers for example.

## 9. Conclusions

The front vowels /ie/ and /e/, the central vowels /u/ or schwa (/ə/), and /aa/, as well as the back vowel /a/ were the most frequently produced vowels. These vowels are characterized by an unrounded articulation and a neutral position of the tongue.

A similar finding applies to the consonants: the types used have visual cues for the lip movements and a neutral position of the tongue as well. The places of articulation of the plosives, fricatives, nasals, and semivowels are bilabial, labiodental, palatal, and laryngeal.

The syllable structure of vocalizations is mostly one or two syllables of the V, CV, VCV, and CVCV types.

All three children have spoken one word in the age period studied and vocalizations usually occurred during interactions with both deaf teachers and the

speech therapist. It remains unclear if the principle 'one person-one language' applies for children of this age.

With regard to a developmental change in the vocalizations of one child the following can be stated. The number and types of vowels, mostly central ones, does not change, while the number and different types of consonants, mostly plosives and fricatives, increases. Vocalizations consist mainly of one or two syllables, although some longer and more complex syllable structures were found.

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