Input and interaction in deaf families
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In this chapter we will start to look in more detail at the linguistic structure of input and output. We will look at the use of deictic and representational symbols in section 7.1, and at the use of nouns versus verbs in section 7.2. In section 7.3 we discuss the variability in the signed and spoken lexicons, and section 7.4 focuses on the occurrence of lexical equivalents. Section 7.5 summarizes the results from this chapter.

7.1 Deictic and representational symbols

7.1.1 Deictic and representational symbols in the input

The aim of the first analysis is to establish whether or not the children are offered combinations of representational symbols both in SLN and in Dutch. Only these utterances provide syntactic information about the languages used (see section 2.3.1). From the results on the different use of language (section 5.3.1) we now know that the mothers offer many simultaneous utterances (SC) alongside SLN and Dutch. We also now know that some of these utterances are supplementary in semantic content (see 6.3.1). The status of combinations of representational signs and representational words with different semantic content is, however, unclear. Here we will investigate how deictic and representational symbols are used and combined in SLN, NL and SC input (see section 3.3, question 14A).

Method

We distinguish the following two categories, based on categories used by Goldin-Meadow and Mylander (1990) and adaptations of these by Iverson et al. (1994) and by Heim (1994):

*deictic*:

- signs and words that derive their meaning completely from the situational context in which they are used (i.e., personal, possessive and demonstrative pronouns and demonstrative adjectives and locative expressions)

*representational*:

- signs or words that represent specific referents; their basic semantic content does not change appreciably with the context (i.e., nouns, verbs, adjectives, adverbs, closed-class words)
We selected all analyzable utterances plus Points alone for this analysis¹ (see also Chapter 4, Figure 4.11).

Procedures

Points to parts of the body are not considered to be deictic (following Ahlgren 1990:170) and are coded as representational, except when the point to a body part is the reply to the question "Where is your ...?" (e.g. nose). In this case the answer "POINTnose" is interpreted as meaning here and the Point is counted as a deictic. The word zo 'so' when occurring alone is considered to be deictic when the mother is demonstrating the child how to perform an action. For instance, how to put a Duplo-doll into the seat of a Duplo-car, and simultaneously saying zo meaning 'this is the way to do it' (following Heim 1994). YES and NO (head nods and headshakes) are considered to be representational symbols.² Deictic words will be discussed if and when they occur.

Deictic signs are abbreviated to DS, deictic words to DW, representational signs to RS and representational words to RW, representational symbols in general as R. Per session we categorized the linguistic utterances of the mothers, excluding minors and unintelligible utterances as follows in three main categories:

• Deictic Signs (DS) (i.e. Points alone), Deictic Words (DW), and Deictic Sign(s) with one Representational symbol (D/R)

An utterance consists of one (or more) Point(s), which can refer to a person, an object or a location; or it consists of a deictic word (1). Also utterances consisting of one (or more) Point(s) or one or more deictic word(s) with one Representational symbol (signed or spoken) (2).

(1) POINTtobookcase (there)

or

that (that [one])

(2) POINTpicture RABBIT (this is a rabbit)

or

RABBIT (this rabbit)

this

¹ see Appendix to Chapter 7, Tables A7.1, page 272 and for the children A7.6, page 273

² In SLN, as well as in other sign languages (see Coerts 1992), head nods and head shakes can function as bound morphemes, and as such should perhaps not be always considered as separate representational symbols. However, we decided to follow Iverson et al.’s definition (1994), which included head nods and head shakes as representational symbols, for reasons of comparison.
• Representational symbol (R)

An utterance consists of one representational sign (3), or one representational word (4), or one representational sign combined with one representational word with the same semantic content (5).

(3) RABBIT  (a rabbit)

(4) good  (well done)

(5) CLEVER  (clever you!)

clever

• Combinations of representational symbols

An utterance consists of a combination of at least two representational signs (6) or two representational words (7), with or without additional deictic symbols. If an utterance consists of a combination of two signs, and one word is uttered simultaneously (or vice versa) only the two-symbol combination is considered. Sometimes two (or more) representational signs occur simultaneously with a two (or more) word combination in one utterance (8) (with the same semantic content). In that case both combinations are counted.

(6) POINT train TRAIN LONG  (that train is long)  RS+RS

(7) doll sleep  (the doll is sleeping)  RW+RW

(8) BOOK TAKE POINT book (take that book)  RS / RW

book take

In this analysis we did not consider separately utterances such as described in example (9). These were already counted in Chapter 6 as supplementary utterances (ss). The signed and spoken parts were analyzed separately here and in the case of (9) would fall both under R.

(9) HUG  ([he is so] sweet [you must] hug [him])

sweet

Results

In all the linguistic input we looked for combinations of representational signs (RS+RS) as evidence for SLN syntax in the input and for combinations of representational words (RW+RW) as evidence for Dutch syntax. Category RS+RW consists of combinations of signs plus combinations of words in SC utterances, and is interpreted as syntactic SLN and syntactic Dutch in combination in a SC context.
Lexical issues in input and output

Mother of Carla  
Mother of Laura  
Mother of Mark

D/R = deictic symbol, alone or combined with one representational symbol  
R = one representational symbol  
RS+RS = combination of ≥ 2 representational signs  
RW+RW = combination of ≥ 2 representational words  
RS+RW = combination of ≥ 1 representational sign(s) and ≥ 1 representational word(s)

Figures 7.1a and 7.1b INPUT DC and HC: Combinations of deictic and representational symbols of the mothers with the hearing children
Figures 7.1a and 7.1b\(^3\) show the categories as described above, offered by the deaf mothers at the different points in time to the deaf and to the hearing children respectively. We shall discuss the results per category.

The deaf mothers proportionally use category D/R significantly\(^4\) more often with the deaf children than with the hearing children except at age 3;0. Lock, Young, Service and Chander (1990:49) found that hearing mothers' use of pointing gestures with hearing children increases (compared to previous months) around 7 months, 10 months and 13 months. After this there is a steady decrease until 24 months as pointing gestures are steadily replaced by spoken words. This seems also to be the case with the mothers of the hearing children (less so with Alex), but not with the deaf children. This difference may be due to the functions of pointing gestures in sign languages, where they can be personal, possessive and demonstrative pronouns. This function is structurally different from the complementary function they perform in spoken language. The fact that there is more use of deictic signs with the deaf children suggests that from the start the mothers are incorporating deictic gestures in a different way into their linguistic input compared to their use with the hearing children. We will discuss the use of deictic signs further in section 9.7.

This category also includes utterances consisting of a deictic word with or without a representational symbol. We found that the deaf mothers use deictic words only with the hearing children\(^5\), and then only rarely. We will come back to this in Chapter 9, where we will discuss the use of different word-types by the mothers.

Category R utterances (one representational sign or word) are used at all ages with all children. They occur in the input to Jonas (H) and Sander (H) less often compared to the input of the other mothers. The mothers of Carla (D) and Laura (D) seem to use this category less over time.

The combinations of representational signs (RS+RS) or words (RW+RW) reflect the degree of SLN and NL syntax in the input according to the definitions of Caselli and Volterra (1990). The RS/RW category (multiple signs and multiple words combined) is present in the input to all children at all ages. It can be seen that the total number of combinations is greater with the hearing children than with the deaf children. This is probably related to a greater use of deictic signs plus representational signs as a linguistic form with the deaf children. For most children the proportion of combinations in the input increases over time. Mark (D) and Jonas (H) are the exceptions.

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\(^3\) see Appendix to Chapter 7, Tables A7.2, page 272 and Table A7.4, page 273 for the raw data and percentages

\(^4\) see Appendix to Chapter 7, A.7.5 for Chi-square values per age, page 273

\(^5\) see Appendix to Chapter 7, Table A7.2 for information on deictic words in the input, page 272
In Figure 7.1a we see that the deaf mothers offer the deaf children mainly sign and sign combinations, or sign and word combinations but only small percentages of word and word combinations (range is 0-13%). Most of the Dutch syntax in the input on the basis of which the children might start producing combinations in Dutch themselves is thus offered in a SC context. In section 5.1 we saw that the deaf children receive little Dutch only as a separate language; here we see that they do have evidence for Dutch syntax from the SC input. The hearing children are offered mainly word and word combinations, and sign and word combinations. Most of the sign combinations are thus offered to the children in a SC context. We do not know at this point whether evidence in SC enables the hearing children to acquire SLN or the deaf children to acquire NL.

Summarizing the section above we can say that the input of the mothers clearly meets the requirements for input formulated by Caselli and Volterra (1990), namely that a truly linguistic system must be offered to children for them to be able to acquire a language. SLN input to the deaf children and NL input to the hearing children is present in the form of combinations, and should enable the children to acquire these languages. However, syntactic NL input to the deaf children and syntactic SLN input to the hearing children is mostly offered in a SC context. These RS+RW combinations form on average 19% of the total input to the deaf children, and 25% to the hearing children. We will need to study the syntactic structure of these combinations in order to establish whether they follow SLN or NL grammatical rules or not (Chapter 9). A further question is whether they can serve as input for grammatical structure and for what system.

7.1.2 The children: from prelinguistic to linguistic symbols
In section 5.3.2 we described how the prelinguistic utterances of the children, i.e. movements and vocalizations, decrease or disappear, as the children grow older. Movements were produced mainly by Carla (D) and Sander (H) at age 1;6. All children showed a decrease in vocalizations, although Carla (D) and Alex (H) produced more vocalizations for a longer period than the other children did. We suggested this might be related to a possibly later development of representational words. In this section we will look in more detail at the first occurrence of representational signs and words in the output of the deaf and hearing children and discuss the relation between the production of movements and vocalizations and the development of the signed and spoken lexicons.

The data on first representational signs and words presented in Table 7.1 come from diary entries made by the mother of Laura (D) and Mark (D), and for Jonas (H) and Alex (H) from a previous study (Blankenstijn and van den Bogaerde 1989). Sander's (H) data are collected by means of a rapid-scanning session of the available videotapes. We found representational signs and words in the 1;6 session of Carla (D); however, since we have no information of her output before this age, we do not know whether these are the first occurrences or not.
Deictic and representational symbols

Table 7.1 OUTPUT DC+HC: First representational symbols of the children

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>Children</th>
<th>first representational sign at age:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
<td>Carla</td>
<td>(&lt;1,6)*</td>
</tr>
<tr>
<td></td>
<td>Laura</td>
<td>0;10</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>0;10</td>
</tr>
<tr>
<td>Hearing Children</td>
<td>Jonas</td>
<td>1;2</td>
</tr>
<tr>
<td></td>
<td>Alex</td>
<td>1;0</td>
</tr>
<tr>
<td></td>
<td>Sander</td>
<td>1;0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>first representational word at age:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Hearing Children</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

* we have no information of Carla before this age

Laura (D) produces a few MOV's at ages 1;0 and 1;6, and her first representational sign is reported by her mother to have already occurred at 0;10. Mark's first sign is reported to have occurred at the same age, but contrary to his sister he does not produce any MOV's during the filming sessions. Jonas (H) produces one movement at 1;6 and 2;0, and his first sign occurs around age 1;2. Alex (H), who made no MOV's, produces his first sign at age 1;0, but his production of representational signs shows a different development from that of the other two hearing children (see also later sections). The fact that he produces no movements may be related to the fact that his sign production does not really start to develop within the period of this study. Sander produces some movements at ages 1;0 and 1;6, and his first sign occurs at the age of 1;0. We see thus that after the first signs appear in the output of the children, movements tend to disappear a few months later.

Vocalizations are produced often by Laura (D) at age 2;0 and by Mark (D) at age 1;6 after which ages vocalizations decrease in their output. Both children produce their first words around 1;6. Although we cannot make an evaluation of the early language production of Carla, we know that from age 1;6 up to age 2;6 she produces significantly more vocalizations than Laura and Mark. In section 5.3.2 we saw that Carla produces more SC utterances than the other two deaf children. We will see whether there is a relationship for the deaf children between the number of vocalizations and the later production of representational words (see section 7.3). Jonas (H) and Sander's (H) vocalizations decrease after 1;0, around which age their first words appear. For Alex, who produces his first word around 11 months, the
number of vocalizations also decrease but they continue to occur more frequently in his output than in the output of Jonas and Sander. We will see later whether or not this has an influence on his development of spoken language.

In sum we find that as the children start producing representational signs and words, the production of movements and vocalizations decreases. The function of vocalizations may be different for the deaf than for the hearing children. With the hearing children vocalizations are decreasingly produced as they are replaced by words. With the deaf children it may be the case that they produce more vocalizations over a longer period of time. Firstly because according to our definitions the sounds they produce are not easily identifiable as 'words' yet, and secondly, because they need more practice than hearing children in order to produce recognizable words. It may be that the more they vocalize, the more practice they get and the more words they will eventually produce. In Chapter 9 we will return to these questions.

7.1.3 Deictic and representational symbols in the output
Pointing gestures (deictic signs) can be expected in young children from approximately 10 months (see for instance Bates, Camaioni and Volterra 1975; Zinober and Martlew 1985; Volterra and Ertling 1990). Deictic words appear at different ages in Dutch (Boland and Kuiken 1998:44); for a further discussion of deictic words we refer to Chapter 9.

The first representational signs and words are reported to occur around the first birthday (Bonvillain and Folven 1993, Clark 1993, Volterra and Iverson 1995). Caselli and Volterra (1990) say that before children combine two representational symbols, they combine a pointing gesture with a representational symbol (either signed or spoken) (see also Chapter 2). Whether or not children combine two representational signs and/or two representational words, which is considered to be the beginning of syntax is dependent on the input. Only on the basis of a full language model can children acquire that language. This means that, when children are offered a sign language, the expected development is as follows:

1) \[ DS < RS < DS+RS < RS+RS \]
   \( DS = \) deictic sign
   \( RS = \) representational sign

This representation does not imply that whenever a new element or combination is acquired, the element(s) or combination(s) already acquired cannot co-occur with the new ones; in fact, these do not disappear in the language production.

If children are offered a spoken language, the expected sequence of development is:

2) \[ RW \]
   \[ DS+RW < RW+RW \]

   \( RW = \) representational word
If children are offered both a sign language and a spoken language (separately or simultaneously) the children will produce the combinations described in 1) and 2) but also combinations in the two different modes (Prinz and Prinz 1979, 1981; Griffith 1985, 1990):

\[
\begin{align*}
\text{RS, RW} & < \text{RS+RS} \\
\text{DS/RS} & \text{RW+RW} \\
\text{DS/RW} & \text{RS+RW}
\end{align*}
\]

The RS+RW combinations remain intriguing, since we do not know to which linguistic system they belong. They may be evidence for SLN for Dutch or for a separate system. Based on the input that we described in Chapter 5 we predict that the children in our study will produce deictic and representational symbols in the sequence described in 3) (see question 14B in section 3.3.)

**Results**

Figures 7.IIa and 7.IIb\(^6\) show the percentages for the different categories in the analyzable utterances (plus category 'points alone', see Figure 4.II), of the deaf and hearing children respectively over the five points in time. At age 1;0 we have no data from Carla (D) and Mark (D) does not produce analyzable utterances at this age.

As can be seen in Figures 7.IIa the deaf children produce a large proportion of deictic signs at all points in time (range 38-79%) - even at age 3;0 deictic signs (with or without a representational symbol) occur in 40% of the output. The hearing children (see Figures 7.IIb) produce category D/R far less frequently, even though deictic words are included in this category. These are produced by the hearing children only\(^7\), mostly from age 1;6 on by Jonas and Alex. Sander produces one deictic word at age 1;0. Contrary to deictic signs, the linguistic status of deictic words is known. We will come back to this aspect in Chapter 9.

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\(^6\) see Appendix to Chapter 7, Tables A7.7-A7.12, pages 274-275

\(^7\) see Appendix to Chapter 7, Table A7.7, page 274
Lexical issues in input and output

Figures 7.11a and 7.11b OUTPUT DC and HC: Combinations of deictic and representational symbols of the deaf and hearing children
Single representational symbols are produced at all ages too by all children, but their number decreases. RS+RS combinations (i.e. SLN syntax) are produced by Laura (D) and Mark (D) from age 1;6 and by Carla (D) from age 2;0. Their input contained many RS+RS combinations (either in SLN or in SC), which enables the children to produce SLN combinations. Jonas (H) and Sander (H) produce sign combinations from age 2;0 on. Even though their input did not contain much SLN (i.e. signs only) (section 5.3.1), apparently the many multiple sign and multiple word combinations (RS+RW) in SC provide much information about RS+RS combinations. These occurred in the input to Jonas in the range of 11-54%, and to Sander between 9-53%. Alex' (H) input of RS+RS combinations almost only occurred in a SC context, but overall was less (range 7-21%) compared to the input to Jonas and Sander. Perhaps this explains why Alex is only starting to produce RS+RS combinations at age 3;0.

None of the children produce multiple sign and multiple word combinations at these ages.

The deaf children produce no RW+RW combinations at all, that is no Dutch syntax. So even though RW+RW combinations were present, mainly in the SC input offered to the deaf children (see section 7.1.1), the deaf children produce no Dutch syntax themselves.

All hearing children from age 1;6 (Jonas) or age 2;0 (Sander and Alex) produce RW+RW combinations. However, they do not produce multiple word combinations simultaneously with sign combinations, which were present substantially in their input. When we compare the output of the deaf children to that of the hearing children we see that the deaf children in general use more points proportionally (either alone or in combination with one representational symbol) than the hearing children. This was also the case in the input (see section 7.1.1). The hearing children combine representational symbols from the same age on as the deaf children (between 1;6 and 2;0) but they produce a greater proportion. This reflects their input also.

Summarizing the results we can say that in our recordings the children produce representational single sign or word utterances before or at the same time that they start using deictic signs. We have no evidence whether deictic signs were produced before representational signs since the first representational signs were already produced before the first recording. We cannot support or disprove Caselli and Volterra (1990). They claim that children produce deictic signs before representational signs. They also claim that D/R combinations occur before R+R combinations. All children in this study with the exception of Laura (D) did produce D/R combinations before combined R+R symbols.

The deaf children combine representational signs and are thus beginning to produce SLN syntax. They produce no Dutch syntax. This is not consistent with the input
they receive. Apparently the spoken or mouthed words in SC utterances (input) cannot serve as uptake for them probably due to access difficulties.

The three hearing children produce NL syntax, and Jonas and Sander also combine representational signs, i.e. use syntactic SLN. Alex, however, produces mainly Dutch combinations, and only at 3;0 begins to combine representational signs. This means that of the six children, only Jonas and Sander show bilingual syntactic skills in their language production.

7.2 Verbs and nouns

7.2.1 Nouns versus verbs in the input

The development of the use of the verbal system of a given language conveys important information on the language acquisition process of a child. In preparation for this discussion in Chapter 9 we will discuss the input and output of verbs versus nouns.

As discussed before, verbs are crucial for acquiring the core syntax. But we have also seen that languages differ in their noun bias and that this language specific bias is reflected in the preponderance of nouns in the early production of children (section 1.3.2). We are therefore interested to know how often nouns are used relative to verbs in the signed and spoken input of the mothers and the output of the children (see research question 15, section 3.3).

Method

We counted all nouns and verbs (copulas, auxiliaries and main verbs) in the signed and spoken analyzable utterances of the deaf mothers. We established the ratio as follows: the total number of noun tokens is divided by the total number of noun plus verb tokens (N/(N+V)) (see also Tardif et al. 1996). For BSL nouns and verbs are discussed by Sutton-Spence and Woll (1999:108-110) and for ASL the noun-verb distinction has been described by Supalla and Newport (1978). The latter found the following.

In ASL, the distinction between nouns and verbs and much of the inflectional apparatus of the language appears in the nature of movement of the sign. (Supalla and Newport 1978:93)

The difference between nominal forms and verbal forms in SLN has not been studied yet in detail. Therefore it is sometimes difficult to make the distinction (see section 4.4.3 and Koenen, Bloem and Janssen 1993). Signs were categorized as verbs also on the basis of semantic and contextual information. We looked at all nouns and verbs produced in SLN and in NL, as well as at the signed and spoken nouns and verbs in SC utterances at the session where the children were aged 2;0.
We chose this age to make a comparison possible with data presented in other research in several languages (see also section 1.3.2).

**Results**

In Table 7.2 we present the ratios for signed and spoken noun tokens versus verb tokens in the input of the mothers at age 2;0 of the children.\(^8\)

**Table 7.2** INPUT DC+HC: Noun Ratio (tokens) in SLN, NL and SC input of the deaf mothers at age 2;0 of the children (\(N/(N+V)\))

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Mothers</th>
<th>SLN</th>
<th>NL</th>
<th>signed SC</th>
<th>spoken SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf</td>
<td>Mother of Carla</td>
<td>(0)</td>
<td>-</td>
<td>.79</td>
<td>.75</td>
</tr>
<tr>
<td>Children</td>
<td>Mother of Laura</td>
<td>.05</td>
<td>(0)</td>
<td>.42</td>
<td>.38</td>
</tr>
<tr>
<td></td>
<td>Mother of Mark</td>
<td>.08</td>
<td>-</td>
<td>.34</td>
<td>.39</td>
</tr>
<tr>
<td>Hearing</td>
<td>Mother of Jonas</td>
<td>(1)</td>
<td>.60</td>
<td>.51</td>
<td>.53</td>
</tr>
<tr>
<td>Children</td>
<td>Mother of Alex</td>
<td>(.67)</td>
<td>.27</td>
<td>.59</td>
<td>.54</td>
</tr>
<tr>
<td></td>
<td>Mother of Sander</td>
<td>(.33)</td>
<td>.50</td>
<td>.81</td>
<td>.61</td>
</tr>
</tbody>
</table>

\(-\) no utterances in this language mode

\(\) these are based on very small numbers

In the SLN input to the deaf children at age 2;0 the noun ratio is very low. Carla's mother produces 4 verbs and no nouns. The mother of Laura and Mark also offers more verbs than nouns (20 and 11 respectively). The noun ratios shown in Table 7.2 in the SLN input to the hearing children is slightly misleading, because Jonas' mother only produces one noun and no verb, Alex' mother 2 nouns and 1 verb, and the mother of Sander 1 noun and 2 verbs. On the basis of these figures we cannot draw any conclusions and we will not further discuss this input.

In the NL input to the deaf children 3 verbs are produced by the mother of Carla, and no nouns are presented at all to any of them. We will not further discuss the NL input to the deaf children. In the NL input to Jonas (H) and Sander (H) we see a noun ratio which is comparable to the noun ratio found in the Gillis and Verlinden study (1988:30, see also section 1.3.2), which was .66. We see a much lower noun ratio in NL with Alex (also compared to the spoken noun ratio in SC), which is comparable to noun ratios found by Tardif et al. (1996) for English and Mandarin.

The signed and spoken noun ratios in the SC input to the deaf children show a difference between Carla's mother and the mother of Laura and Mark. The noun ratios are much higher in the SC input to Carla. This might be related to the fact her mother uses labeling utterances more and for a longer period (Chapter 8). However, for all three mothers the noun ratios of the signed parts of SC are comparable to the noun ratios in the spoken parts of SC. The SC input to Sander (H) has a high signed noun ratio, and this is clearly higher than the signed noun ratios offered to Jonas.

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\(^8\) see Table A7.13 in Appendix to Chapter 7 for full details, page 275
Lexical issues in input and output

(H) and Alex (H). The spoken noun ratios are similar in the input to the hearing children, and are also comparable to the noun ratio found in Dutch input by Gillis and Verlinden (1988). When we compare the noun ratios in the SC input to the deaf children with that to the hearing children we see that Carla's (D) and Sander's (H) mothers have a higher signed noun ratio than the mothers of Jonas (H) and Alex (H) and a much higher ratio than the mother of Laura (D) and Mark (D).

With Laura (D) and Mark (D) verbs seem to occur more often than with the other children. There is no clear preponderance for nouns with Jonas (H) and Alex (H), although the mothers offer more nouns than English, Italian and Mandarin speaking mothers do. The input to Carla (D) and Sander (H) contains more nouns (both signed and spoken) than verbs. If input is a decisive factor in creating a noun bias in the early vocabularies of the children, we would expect Carla (D) and Sander (H) to produce a high noun ratio, Laura (D) and Mark (D) a low noun ratio, and in Jonas (H) and Alex (H) no clear preference either for nouns or for verbs. We will discuss this further in the next section.

7.2.2 Nouns versus verbs in the output

The same method was followed as for the input. We present in Table 7.3 the noun ratios of the children in our study at age 2;0. Before discussing the results we want to point out that the noun ratios of the children are sometimes based on a very small number of utterances, and must be interpreted with care.9

Carla's (D) produces verbs in SLN only, but still her signed noun ratio is high. Her mother's SLN input also contained more verbs than nouns (see Table 7.2). Laura (D) produces slightly more verbs (n=4) than nouns (n=2) in SLN, Mark (D) only three verbs and no nouns. This is similar to their input (more verbs than nouns in SLN). From the ratios for Dutch and SC we can see that Carla (D) uses only spoken nouns. Laura (D) and Mark (D) do not produce any spoken nouns or verbs yet in NL or in SC.

| Table 7.3 OUTPUT DC and HC: Noun Ratio (tokens) in SLN, NL and SC in the output of the deaf and hearing children at age 2;0 |
|---|---|---|---|---|
| OUTPUT | Children | SLN | NL | signed SC | spoken SC |
| Deaf Children | Carla | .89 | 1 | 1 | 1 |
| | Laura | .33 | - | - | - |
| | Mark | 0 | - | - | - |
| Hearing Children | Jonas | .40 | .60 | .29 | .68 |
| | Alex | - | .81 | 1 | .71 |
| | Sander | .82 | .90 | .89 | .78 |

(-) means no utterances in this language mode

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9 see Appendix to Chapter 7, Table A7.14 for details, page 275
Jonas (H) signed noun ratio is much lower in SC than in SLN, and both are lower than the spoken noun ratios. Compared to his mother his signed noun ratio is lower, i.e. proportionally he uses more signed verbs than she does. His spoken noun ratio is similar in NL and SC, and resembles that of his mother's. Alex (H) produces no SLN at all and only nouns in the signed parts of SC. He has a high noun ratio both in NL and in the spoken parts of SC. His output does not resemble the input of his mother. Sander (H) has a high noun ratio in all language modes, and his signed noun ratio in SC is the only ratio that resembles his mother's. In general the hearing children show a much higher spoken noun ratio than their mothers, except Jonas for signs both in SLN and SC. The noun ratios for NL and spoken parts of SC of Alex and Sander are the same or higher than the one found for Maarten (.80) in the Gillis and Verlinden study (1988).

We can conclude that we have found some evidence for a direct influence from the input of the mothers on the production of nouns by the children, but then on an individual basis. Carla (D) and Sander (H) met our expectations for a high noun ratio, and Laura (D) and Mark (D) for a low ratio. Jonas (H) and Alex (H) were expected to show no preponderance for nouns on the basis of their input. However, both Jonas and Alex have a high noun ratio for spoken nouns, and Alex also for signed nouns. Jonas' lower noun ratio for signs is contrary to expectations, and not consistent with his input.

In Chapter 9 we will take a look at the development of the verbal system in the language output of the children, where we might find more facts that might explain the paucity of verbs in the output of the children.

In the next section another lexical aspect, variability in the signed and spoken lexicons of the mothers, is discussed and compared in the interaction with the deaf and with the hearing children.

7.3 Variability in signed and spoken vocabulary

As described in Chapters 1 and 2 the lexical richness of the languages in the input is important for vocabulary development of the children. We want to describe the variability in vocabulary in signs and words, measured in proportion of different types in the input of the mothers and in the output of the children (see research question 16, section 3.3).

Method

As the mothers use mainly SLN and SC with the deaf children, and NL and SC with the hearing children, we decided not to look at the vocabularies per language but per modality, i.e. we looked at all the signs produced in either SLN or SC, and all the words produced in either NL or SC.

In many acquisition studies the TTR (Type-Token Ratio) is used to measure lexical development in children or to measure lexical variability in the input (Templin
Lexical issues in input and output

1957; Cross 1977; Fletcher 1985). Recently, however, doubts have been expressed about the TTR as an adequate measure (Richards 1987; van Hout and Vermeer 1988; Richards and Malvern 1997, Malvern and Richards 1999)). Van Hout and Vermeer remark that there are different independent problems in producing a valid measure (1988:119) among others length of text, type of text, word categories and developmental phase of the child.

Despite these restrictions in the use of TTR measures we decided to use this measure. Further research is necessary to develop an adequate measure of the vocabulary (see Richards and Malvern 1997). The number of different types is calculated as follows: the number of (signed or spoken) types of a sample is divided by the total number of (signed or spoken) tokens. We only present data if at least a hundred tokens are produced.

Firstly we investigate the richness of the signed and spoken vocabulary that is offered to the children through the TTR. Secondly, we are interested in the variety in the vocabularies that are offered to the children at the different points in time. For instance is it the case that the children are offered the same words over and over again in each session? In order to gain insight into the variability we measured the number and percentages of repeated sign types and word types across all sessions. Thirdly, we take a brief look at the cumulative vocabulary of the children over time.

Procedures

Regarding the type of text we believe that the different samples are comparable, even though the toys that are used may differ within the free play situation (but see chapter 4, Bacchini et al. 1995). Since word categories are different in SLN and Dutch we decided to not make a word category analysis (e.g. content words versus function words) at this point (see section 9.7 for a discussion of these sign or word classes).

Word types were defined as follows (adapted from Templin 1957:160; Miller 1981:42; and Fletcher 1985:42 in Richards 1987:204)

1) Compound nouns count as one word
2) Expressions functioning as a single unanalyzed unit (e.g. dank je wel 'thank you' or tante Gerda 'aunt Gerda') are counted as one word
3) Inflections and bound morphemes do not count as separate words. Inflected and non-inflected forms of the same stem count as a single type (e.g. gaat 'goes' and gaan 'go', or ik 'I' and mij 'me').
4) Demonstrative pronouns (e.g. deze, die, dat 'this/these' 'that/those' are counted as one type.

For sign types the same rules apply, with a few clarifications:

1) Classifiers used in verbs are not counted separately. For example: JIJ Ccl-OPDOENstok 'YOU Ccl-PUT-ONstick' (put it [the ring] on the stick) or Bcl-OPDOENsuikerpot 'Bcl-PUT-ONsugarbowl', (put it [the lid] on the sugarbowl). The type PUT-ON, meaning 'to put something on something', is counted once.
Variability in signed and spoken vocabulary

2) All Points are ignored as a type, whether they are POINTto-object, POINTto-person or POINTto-location.

3) Inflections do not count as separate types. Inflected verbs and verbs in citation form count as a single type (e.g. 1KIJKEN2 'I look at you' and KIJKEN 'look', or candy-in-bookPAKKEN1 'I take the candy-in-the-book' and PAKKEN 'take'.

For the second analysis we consider the variety of the vocabulary over time by calculating the number of repeated types used at the five points in time in the following manner:

- The sign and word types produced in the first session of a particular mother-child dyad are considered to form the basic lexicon of the mother or the child.
- In each consecutive session we looked at the number of repeated types (i.e. types occurring in more than one session) produced by the mother or the child in relation to the total number of types.

The third analysis concerns the cumulative vocabulary in signs and words of the children during the sessions. From the second session onwards (age 1;6) we counted the number of new signs and words in the vocabularies of the children, including the signs and words produced in the preceding session(s). The cumulative vocabulary of the children is of course based on the five sessions of 10 minutes of interaction, and does not give a picture of their full vocabulary.

7.3.1 Variability in the input

The TTR for signs in the input of the deaf mothers ranges between .21 and .46, with a median of .35. No significant difference is found for the number of sign types of each mother at the different points in time or per age group. Furthermore the richness of the sign vocabulary offered to the deaf children is similar to that offered to the hearing children. We can conclude that across time the lexical richness of the sign vocabulary remains more or less the same, whereas we would have expected it to increase.

We measured the number and percentages of repeated sign types across all sessions. These signed data are presented in Table 7.4.

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10 see Appendix to Chapter 7, Tables A7.15 and A7.16 for details, pages 275-276
11 see Appendix to Chapter 7, Table A7.17, page 276
12 see Appendix to Chapter 7, Table A7.18, page 276
13 see Appendix to Chapter 7, Table A7.19 for details, page 276
Table 7.4 INPUT DC+HC: Number and (%) of repeated sign types and total number of signs of the mothers, pooled over time

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Mothers</th>
<th>repeated sign types</th>
<th>total number of sign types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
<td>Mother of Carla</td>
<td>48 (19)</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>Mother of Laura</td>
<td>51 (18)</td>
<td>290</td>
</tr>
<tr>
<td></td>
<td>Mother of Mark</td>
<td>54 (21)</td>
<td>255</td>
</tr>
<tr>
<td>Hearing Children</td>
<td>Mother of Jonas</td>
<td>51 (20)</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td>Mother of Alex</td>
<td>58 (23)</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>Mother of Sander</td>
<td>69 (24)</td>
<td>290</td>
</tr>
</tbody>
</table>

Table 7.4 shows that the percentages of repeated sign types are more or less the same in the input to the deaf and hearing children. We can conclude that the variety in the sign vocabulary of the mothers is the same with the deaf and with the hearing children. In quantity and quality (related to variety) there is no difference in the input. Considering the fact that in section 5.2 (Figures 5Ia-f) we found that the deaf mothers use mainly SLN and SC with the deaf children, but NL and SC (and some SLN) with the hearing children, this is surprising. We would have expected more signs with the deaf children than with the hearing children on the basis of these findings. This finding suggests a similar lexical use of signs in Simultaneous Communication, even though we found that the use of the two channels is different with the deaf and with the hearing children in terms of propositions (see section 6.3).

The range for the TTR for words in the input of the deaf mothers is between .23 and .61 (median .37). In general we find that per mother the TTR does not change significantly over time, except for the mother of Mark (D) ($\chi^2=16.14$, df=4, $p<0.005$), who produces fewer word types at age 2;0.15 We did find a significant difference in the TTR between the deaf mothers at ages 1;0 and 1;6.

Also, the input offered to the deaf children differs significantly from that offered to the hearing children at ages 1;0, 1;6 and 2;6. This indicates that at those ages the deaf children are offered a more varied word lexicon in comparison to the hearing children.

14 see Appendix to Chapter 7, Tables A7.20 and A7.21 for details, page 277
15 see Appendix to Chapter 7, Table A7.22 for Chi-square values per mother across time, page 277
16 see Appendix to Chapter 7, Table A7.23 for Chi-square values for all mothers per age group, page 277
17 $1;0 : \chi^2 =15.26$, corrected for df=1, $p<0.001$
   $1;6 : \chi^2 =10.64$, corrected for df=1, $p<0.005$
   $2;6 : \chi^2 =14.95$, corrected for df=1, $p<0.001$
In Table 7.5 we present the data for the repeated word types.\textsuperscript{18}

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Mothers</th>
<th>repeated word types</th>
<th>total number of types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
<td>Mother of Carla</td>
<td>56 (22)</td>
<td>263</td>
</tr>
<tr>
<td></td>
<td>Mother of Laura</td>
<td>49 (19)</td>
<td>253</td>
</tr>
<tr>
<td></td>
<td>Mother of Mark</td>
<td>63 (27)</td>
<td>230</td>
</tr>
<tr>
<td>Hearing</td>
<td>Mother of Jonas</td>
<td>91 (25)</td>
<td>367</td>
</tr>
<tr>
<td>Children</td>
<td>Mother of Alex</td>
<td>102 (28)</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td>Mother of Sander</td>
<td>129 (29)</td>
<td>448</td>
</tr>
</tbody>
</table>

The percentages of repeated word types are not significantly different ($\chi^2 = 0.27$, corrected for df=1, p$\leq$0.001) in the input to the deaf and to the hearing children. But the total number of word types is different ($\chi^2 = 95.75$, corrected for df=1, p$\leq$0.001). The deaf children are offered fewer words. In our opinion the difference in quantity of words offered to the deaf children carries more weight than the fact that they are offered a more varied spoken lexicon. The spoken words are offered mainly in a signed environment (see section 6.3) which may reduce the focus on the words. Furthermore, the percentages of spoken words that were actually seen by the children were not very high (see section 6.1.1). Also, the fact that more types are offered implies that the words are repeated less often. Whether or not this lessens the chance for the children to acquire those words will be discussed in the next section.

In sum we can conclude that the sign lexicon that is offered to the deaf and to the hearing children is similar in size and in variety. From the results presented in section 7.1.1 where we discussed the use of representational signs in combinations, we know that these signs are offered to the deaf children in either a SLN or a SC context, whereas the hearing children see most of the signs in SC utterances. This difference may have its influence on the actual acquisition of vocabulary by the deaf and the hearing children. The hearing children may consider signs to be always connected to spoken words, since they encounter them by themselves less often. We will look into this aspect in sections 7.3.2. and 7.4.

In contrast to the sign lexicon the word lexicon offered to the hearing children is significantly larger than that offered to the deaf children. And even though the spoken input to the deaf children seems to be more varied, this fact probably does

\textsuperscript{18} see Appendix to chapter 7, Table A7.24 for individual data, page 278
outweigh the importance of the smaller size of the vocabulary. The deaf children simply encounter fewer words during interaction than the hearing children do.

7.3.2 Variability in the output
The same method was used with the children as with the mothers as described in the section above. Furthermore we look at the cumulative vocabulary of the children over time.

Results
In Table 7.6 the TTR for signs are presented. We give the data of those sessions where the children produce more than 100 tokens. The hearing children produce fewer than 100 tokens in each recording (except Sander at age 2;6) and therefore their data are not presented in Table 7.6.

<table>
<thead>
<tr>
<th>Deaf children</th>
<th>2;6</th>
<th>3;0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carla</td>
<td>.45</td>
<td>.58</td>
</tr>
<tr>
<td>Laura</td>
<td>.40</td>
<td>.35</td>
</tr>
<tr>
<td>Mark</td>
<td>.35</td>
<td>.42</td>
</tr>
</tbody>
</table>

*fewer than 100 tokens

Carla has a higher TTR at age 3;0 than Laura and Mark. We cannot compare her TTR to earlier ages, because she did not produce 100 tokens in earlier sessions. Laura and Mark show a significant change over time in the number of sign types.20 Around age 2;6 their sign vocabularies seem to level out, indicating that the higher number of sign types in earlier sessions may very well fall within the period of the 'vocabulary spurt'.

We prorated the tokens of the children to a hundred tokens, in order to be able to compare them. The children differ significantly from each other at most ages.21 These differences can be attributed to individual variation and not to hearing status, since we found no statistically significant differences between the deaf children and the hearing children as groups.

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19 see Appendix to Chapter 7, Table A7.25 for the raw data, page 278
20 see Appendix to Chapter 7, Table A7.26 for Chi-square values across time, page 278
21 see Appendix to Chapter 7, Table A7.27 for Chi-square values at different ages, page 278
Variability in signed and spoken vocabulary

Next we will look at the total number of sign types and the repeated sign types in Table 7.7 in order to gain insight into the variety of the children's vocabularies as we did for the mothers.

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>Children</th>
<th>repeated signs types</th>
<th>total number of sign types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf</td>
<td>Carla</td>
<td>22 (19)</td>
<td>119</td>
</tr>
<tr>
<td>Children</td>
<td>Laura</td>
<td>7 (7)</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>22 (20)</td>
<td>110</td>
</tr>
<tr>
<td>Hearing</td>
<td>Jonas</td>
<td>9 (13)</td>
<td>72</td>
</tr>
<tr>
<td>Children</td>
<td>Alex</td>
<td>2 (11)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Sander</td>
<td>16 (13)</td>
<td>120</td>
</tr>
</tbody>
</table>

The percentages of repeated sign types differ significantly for the children individually ($\chi^2 = 21.6$, df=5, $p<0.001$), but not for the deaf and the hearing children as a group ($\chi^2 = 1.82$, corrected for df=1, $p<0.001$). Carla and Mark (D) repeat more sign types in general than the hearing children, and show the same percentages as their mother. Laura has a very low percentage of repeated sign types, lower than the other children and also lower than her mother. This is of course related to the fact that her amount of language during the sessions is small until age 2;6 (see section 5.1.3). The hearing children repeat fewer signs (mean 12%) than their mothers (mean 23%).

The deaf children produce an equal number of total sign types, but the hearing children differ significantly from each other ($\chi^2=74.4$, df=2, $p<0.001$) and also from the deaf children ($\chi^2=26.22$, corrected for df=1, $p<0.001$).

In sum then Carla (D), Laura (D), Mark (D) and Sander (H) produce significantly more sign types than Jonas (H) and Alex (H), although the variety in the sign vocabularies shows individual differences. Laura displays a greater variety than the other children, which may be partly explained by the smaller amount of language she produces until age 2;6 (section 5.1.3).

In Table 7.8 we present the TTR for words for the hearing children.23 We give the data of those sessions where the children produce more than 100 tokens. The deaf children produce fewer than 100 tokens in each recording and are thus not represented in Table 7.8.

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22 see for the data per session Appendix to Chapter 7, Table A7.28, page 279
23 see Appendix to Chapter 7, Table A7.29 for the raw data, page 279
Table 7.8 OUTPUT HC: TTR for words

<table>
<thead>
<tr>
<th>Hearing children</th>
<th>2.6</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jonas</td>
<td>.45</td>
<td>.34</td>
</tr>
<tr>
<td>Alex</td>
<td>.30</td>
<td>.39</td>
</tr>
<tr>
<td>Sander</td>
<td>.54</td>
<td>.52</td>
</tr>
</tbody>
</table>

Jonas (H) shows a significant change in the word TTR, whereas Alex and Sander do not.\(^{24}\)

A comparison of the children per age reveals (with tokens prorated to 100) that the children differ significantly\(^{25}\) from each other, especially so at ages 1;0 and age 2;0, and that significant group differences\(^{26}\) (deaf versus hearing) occur at ages 1;0, 1;6, and 2;6. We can conclude that the hearing children seem to develop according to expectation, but that the deaf children considerably lag behind in their spoken language development. This is of course to be expected because of their low access to the spoken language.

Table 7.9\(^{27}\) shows the numbers of repeated and total word types.

Table 7.9 OUTPUT DC+HC: Number and (%) of repeated word types and total number of word types of the children

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>Children</th>
<th>repeated word types</th>
<th>total number of word types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
<td>Carla</td>
<td>3 (9)</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Laura</td>
<td>3 (18)</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>0 (0)</td>
<td>6</td>
</tr>
<tr>
<td>Hearing Children</td>
<td>Jonas</td>
<td>48 (23)</td>
<td>209</td>
</tr>
<tr>
<td></td>
<td>Alex</td>
<td>32 (25)</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>Sander</td>
<td>42 (21)</td>
<td>203</td>
</tr>
</tbody>
</table>

The children are significantly different in the percentage of repeated word types individually \((\chi^2=28.99, df=5, p<0.001)\) but not per group \((\chi^2=3.56, corrected for df=1, p<0.001)\). Laura (D) has the same percentage of repeated types as her mother, but Carla and Mark show a much lower percentage than their mothers. The hearing children resemble each other and also their mothers for percentage of repeated word types.

\(^{24}\) see Appendix to Chapter 7, Table A7.30 for Chi-square values across time, page 279
\(^{25}\) see Appendix to Chapter 7, Tables A7.31 for Chi-square values per age, page 279
\(^{26}\) see Appendix to Chapter 7, Tables A7.32 for comparison of DC and HC, page 280
\(^{27}\) see Appendix to Chapter 7, Table A7.33 for full details, page 280
The difference in the total number of word types is statistically significant, per individual child ($\chi^2 = 437.9$, df=5, $p \leq 0.001$) as well as per group ($\chi^2 = 390.46$, corrected for df=1, $p \leq 0.001$). Mark (D) has significantly fewer word types than Laura does ($\chi^2 = 19.72$, df=2, $p \leq 0.001$). She in turn has fewer types than Carla. Carla has the largest spoken vocabulary, as predicted in section 7.1.2 on the basis of her vocalizations. Alex (H) produces fewer types than Jonas and Sander ($\chi^2 = 23.3$, df=2, $p \leq 0.001$), which may also be connected to the fact that he continues to produce vocalizations up to a later age than the other two hearing children.

Huttenlocher et al. (1991) found that amount of maternal talk during their observation period was the best predictor of children's growth in vocabulary (in Snow 1994:9) in a monolingual situation. Our findings seem to support their conclusion only in part, this being a multilingual situation. The mothers offered the deaf and hearing children a sign vocabulary, which was similar in terms of quantity of vocabulary (see section 7.3.1). The output of the children shows differences. The deaf children Carla, Laura and Mark, and Sander, who is hearing, have a similar sign vocabulary in size (see above) although the variety in their vocabularies differs. But Jonas' (H) and Alex' (H) sign vocabularies are much smaller, despite the similar input. They focus more on Dutch in terms of language choice (see section 5.3.2). This is reflected in the development of their sign lexicon and is not a result of the lexical input.

The mothers offer the deaf children fewer word types than the hearing children, although the variability of the vocabularies is comparable (see above). This is reflected strongly in the output of the children. As expected, the deaf children produce significantly fewer word types than the hearing children, with big individual differences in the variety of their word lexicons. The fact that the deaf children produce fewer words is of course also related to their hearing status - the acquisition of a spoken language by deaf children is always problematic (Mogford 1988; Beers and Baker 1997) and shows great differences in ultimate success rate.

Finally we will examine very briefly, the cumulative sign and word vocabularies of the deaf and hearing children in 10 minutes of interaction over the five points in time (Figures 7.IIIa and 7.IIIb respectively).28
The sign vocabularies of Laura and Mark increase the most at age 1;6, and Carla's (D) at age 2;0. We consider those points in time as the period in which they have their 'vocabulary spurt' (Clark 1993:27). Jonas (H) and Alex (H) also show the largest increase in their sign vocabularies at age 1;6 (although Alex produces only a few signs) and Sander (H) at 2;0. At age 3;0, the three deaf children and Sander have similar sign vocabularies in terms of age; Jonas' is a little smaller and Alex only has 18 signs (based on 10 minutes of interaction).
Variability in signed and spoken vocabulary

Figure 7.IIb OUTPUT: Cumulative word vocabulary (in types) of the deaf and hearing children based on 10 minutes of interaction

The increase in word types is very gradual with the deaf children. Carla has a slightly larger vocabulary than Laura and Mark at age 3;0. This may be due to a more proficient use by Carla of her residual hearing, although according to the audiometric tests she has no better hearing than Laura or Mark (see section 4.1). The input of Carla's mother is probably important here. She predominantly offers Carla SC with use of voice (see section 6.1.1), which may stimulate the use of voice and the use of spoken elements in Carla's output.

Hearing children acquiring their first language show a vocabulary spurt at around 1;6 when they have acquired 50 words (Ingram 1989). If there is a comparable spurt in a second language or in bilingual acquisition, then we must assume that the spurt has yet to come for the deaf children.

Alex' word vocabulary increases the most at age 2;0, although his development slows down after this age in comparison to Jonas and Sander. These two hearing children are expanding their word vocabularies quickly and consistently. We thus find that Alex lexical development somewhat lags behind that of the other two hearing children after age 2;0. Apparently it takes him longer to produce intelligible words, which is reflected in his higher production of vocalizations (see section 5.1.3).
We have shown that there is considerable variation in the size, the richness and the variety of the sign lexicons of the deaf and the hearing children at the different ages. The deaf children and Sander (H) seem to develop in a similar way with respect to vocabulary size. This is also reflected in their cumulative vocabulary. Jonas (H) has a smaller lexicon than the deaf children and Sander (H), and Alex (H) produces only a few sign types. Also with respect to variety (repeated types) there is individual variation. Laura shows slightly less repetition in her choice of signs. The hearing children resemble each other in percentage of repeated sign types. In section 7.3.1 we found that the sign lexicon offered to the deaf and hearing children was similar in size, richness and in variety. However, the signs are offered in SLN and SC contexts to the deaf children and mainly in SC context to the hearing children. This may explain the difference in lexicon of Jonas (H) and Alex (H), but does not explain why Sander's signed lexicon (H) resembles that of the deaf children. Input alone cannot explain the differences in the sign lexicons between Sander and the other two hearing children.

Concerning the word lexicons we found substantial differences between the deaf and the hearing children. The deaf children lag behind the hearing children in size, richness and in variety. Even though the mothers offer the deaf children far fewer words than the hearing children, the difference cannot be explained by input factors alone. The very fact that the deaf children have only visual access to the spoken words diminishes their chances of processing the words fully. The fact that the deaf children do not have full visual access to the word in the input (see Chapter 6) is also partly responsible for their slower development.

7.4 Lexical equivalence in input and output

As described in section 1.4.2 children initially may use words from different languages in one utterance. Whether or not this is a result of mixed input, or evidence that in the beginning there is no separation of language by the children is still under discussion. An indication that children are truly acquiring two languages is the use of lexical equivalents.

7.4.1 Lexical equivalence in the input

The languages that we are studying, SLN and NL, are produced in different modalities - SLN in the visual-gestural modality, and Dutch in the oral-auditive modality. Perhaps this modality difference gives the children enough evidence that two different languages are being used. Or does the fact that signs (e.g. *BOOM 'TREE') and words (e.g. *boom 'tree') can be produced simultaneously cloud the issue in any way? The fact that signs and words can be produced simultaneously may obscure the fact that Dutch and NL are two separate languages. There is also the possibility that through the simultaneous use of signs and words (SC) a third linguistic system is offered to the children (Romaine 1995, see sections 1.4.2 and 2.2). Such a third system could show characteristics of both languages, e.g. the
Lexical equivalence in input and output

syntactic structure of the one and the lexicon of the other language. An analysis was carried out to find out whether or not the children are indeed offered evidence for SLN, NL and possibly SC as a third system, and whether they show evidence for these languages in their output (see research question 17 in section 3.3).

Method
In order to look for lexical equivalents in the input we distinguished the following categories of language use which shows a contrast between languages:

1) SLN versus NL (e.g. 'TREE' and 'tree')
2) SLN (versus SC, e.g. 'TREE' and 'TREE/tree')
3) NL (versus SC, e.g. 'tree' and 'TREE/tree')

Procedures
1) Evidence for SLN and NL
In this category are included all sign and word types that refer to the same concept and furthermore, that occur without a simultaneously spoken or signed equivalent. Those sign and word types never occur simultaneously but do appear signed only and spoken or mouthed only (Figure 7.IV).

The underlined signs and words in the following utterances are the targeted items:

(10) \begin{tabular}{ll}
\textbf{BOOM} & \textbf{HOOG} \\
\textit{TREE} & \textit{HIGH} \\
\end{tabular} \hspace{1cm} \text{(SLN utterance)}

(11) \begin{tabular}{ll}
\textit{wat een mooie boom} & \textit{what a nice tree} \\
\end{tabular} \hspace{1cm} \text{(NL utterance)}

If both examples occur in the input, the child will have encountered evidence for SLN and NL labels for the concept [tree]. If the concept were expressed only by a sign type occurring in a signed utterance or, vice versa, only by a word type in a spoken utterance, that would not per se be evidence for SLN and NL to exist as two separate linguistic systems.

2) Evidence for SLN
Lexical issues in input and output

Signs sometimes occurring alone and sometimes co-occurring with a word (with the same meaning) are evidence for SLN (see Figure 7.5).

Example (12) and (13) illustrate this situation:

(12) \textit{BOOM} \textit{HOOG} \textit{TREE} \textit{HIGH} \quad \text{(SLN utterance)}

(13) \textit{POINTboom} \textit{BOOM} \textit{dat is boom} \textit{treedree} \textit{that is tree} \quad \text{(SC utterance)}

The fact that the sign also occurs by itself gives support for the existence of SLN as a separate language.

3) Evidence for NL
Words sometimes occurring alone and sometimes co-occurring with a sign (with the same meaning) are evidence for NL (see Figure 7.6).
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(14) \[ \text{dat is een boom} \] (NL utterance)
that is a tree

(15) \[ \text{POINTplaatje BOOM} \] (SC utterance)
\[ \text{dat is een boom} \]
POINTpicture TREE
that is a tree

If the situations depicted in Figures 7.V and 7.VI both occur in the input (i.e., a sign occurs alone and sometimes together with a word which also appears by itself) then this might be lexical evidence for the child that there are two linguistic systems: SLN and NL, and perhaps a third, SC.

No evidence
If for instance the sign \textit{BOOM 'TREE'} occurs \textit{only} in the signed utterance \textit{BOOM HOOG 'TREE TALL'} and an utterance like example (11) \textit{wat een mooie boom 'what a nice tree'} is never offered, the child will encounter only evidence for SLN and not for NL for the concept [tree]; there is no lexical equivalent in NL. The sign and the word for a certain concept both have to occur but separately for the child to find lexical evidence for SLN and NL as separate languages.

There are also signs and words that occur \textit{only} simultaneously. These combinations offer no evidence to the child as to the existence of SLN and NL as different languages.

Results
The results are shown in Table 7.10. The percentages in the last column headed 'No evidence' refer to those lexical items that are only signed alone (and never spoken) or spoken alone (and never signed) or always simultaneously signed and spoken. The percentages in this column represent the lowest percentages occurring at any of the five points in time for a particular mother.\textsuperscript{29} Signs and words of this category offer no evidence that SLN and NL are separate languages.

\textsuperscript{29} see Appendix to Chapter 7, Tables A7.36 - A7.41, pages 281-282
Although we do find some lexical equivalents for SLN and NL the percentages are very small. More evidence for SLN is found with the deaf children than with the hearing children. NL evidence is presented more to the hearing children than to the deaf children. In our samples the bulk of the lexical symbols produced by the mothers occur without there being a lexical equivalent in one of the other modes. This means that on a lexical basis there is hardly any evidence in the input of the deaf mothers that they are producing SLN or Dutch as a separate system. As mentioned above, the modality difference may offer the children a clue that two languages are being used simultaneously, at least lexically. A further analysis of the structure of the SC input may reveal morphosyntactic evidence for its existence as a separate system. This will be discussed in Chapter 9.

7.4.2 Lexical equivalence in the output
We present the data on lexical equivalents in SLN and NL in the output of the children in Table 7.11.30

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>Children</th>
<th>Evidence for SLN and NL</th>
<th>Evidence for SLN</th>
<th>Evidence for NL</th>
<th>No evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf</td>
<td>Carla</td>
<td>10</td>
<td>8</td>
<td>3</td>
<td>83</td>
</tr>
<tr>
<td>Children</td>
<td>Laura</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>93</td>
</tr>
<tr>
<td>Hearing</td>
<td>Jonas</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>84</td>
</tr>
<tr>
<td>Children</td>
<td>Alex</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Sander</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>87</td>
</tr>
</tbody>
</table>

NB: the percentages shown are of the highest occurrence in all points in time; therefore the percentages do not add up to 100%

see Appendix to Chapter 7, Tables A7.42 - A7.47 for full details, page 282-283
Although the deaf mothers hardly provide any lexical equivalents in SLN and Dutch (see Table 7.10), Carla shows that for 10% of her sign vocabulary she also produces spoken lexical equivalents. This provides some evidence that she is separating SLN from NL. However, Laura and Mark do not show this awareness (no equivalents in SLN and NL), although all three deaf children show some evidence of SLN being a separate language in contrast to SC. This is comparable to the input they were offered. The deaf children show no awareness that NL is a separate language, even though there was some evidence in their input. Jonas (H) and Sander (H) show some evidence that they perceive SLN and NL as separate languages. Their output reflects the input of their mothers - although there is not much lexical evidence in the input, it is maybe enough for Jonas and Sander to conclude that there are two systems. To what extent the Simultaneous Communication of the children is a system in itself will be discussed in Chapter 9.

On the basis of lexical equivalents the other children show little evidence that they are aware that SLN and NL are separate languages. The modality difference therefore in the input in itself does not appear to provide the children with a clue that different channels are being used for different languages.

7.5 Summary

The analysis of deictic and representational signs and words showed that a considerable use of deictic signs with a representational sign or word were used in the input. This decreased in time with the hearing children but remained important in the input to the deaf children. In general representational signs in combination were increasingly offered, although these were mostly offered in a SC context with the hearing children. Words are increasingly offered in combination to the hearing children; word combinations were mainly offered in SC to the deaf children. In the children movements and vocalizations start to disappear after the first sign and word respectively appear. The first representational signs were already being produced before the beginning of the study as were the first words of the hearing children. The deaf children produced their first words around 1;6. All the children increase their production of combinations of representational signs over time, but there is variation between the children in the amounts. The hearing children increase their production of word combinations; the deaf children do not yet produce word combinations.

When the representational signs were analyzed in terms of the dominance of nouns in relationship to verbs at two years of age, a complex picture emerges. The mothers showed a strong preference for nouns in Dutch similar to the input in hearing families. In SC and SLN there was individual variation. Laura and Mark's mother showed far less noun dominance; Jonas' and Alex' mothers showed a moderate dominance and Sander's and Carla's mothers had a strong dominance. It is not clear how this variation can be explained. It is possible that where the other uses voice
(all except Laura's and Mark's mother) that Dutch exerts an influence on this aspect of language. The children show a similar variation at age two years in their output. The input showed an expected amount of lexical variety (TTR) in signs and this does not change over time; the variety in words increased at age 1;6 but was constant after that. Only Jonas showed a change in the variety of his lexical production. The other children were constant but there was considerable individual variation. The children showed a vocabulary spurt in signs around two years of age. Word development was more steady.

The vocabulary was also analyzed to see if there was much lexical equivalence between languages, which might be an indication to the children that they are learning separate languages. There were not many equivalents in the input, and also not in the output of the children. There are several areas here where the input apparently influences the children's production. The children reflect the amounts of combinations types offered to them on the whole in their output. The deaf children produce combinations in signs, not in words, and the hearing children produce combinations in words and signs as in the input. Alex received less input of sign combinations and does not produce them until 3;0, later than the other two hearing children. The hearing children do however receive most examples of sign combinations in SC but they produce them in SLN; clearly the SC input serves as a model for SLN. The children also in general reflect their individual mother's level of preference for nouns. The variety of vocabulary was similar in signs for the deaf and hearing children, yet the children showed different rates of acquisition. Sander showed the greatest increase amongst the hearing children, which again reflects his greater orientation to signing despite the similarity of his input to that of the other mothers. The small amount of lexical equivalence in the input is also reflected in the output. The children appear not to split simultaneous combinations of signs and words, but acquire these combinations as combinations.

Again there are considerable differences between the deaf and hearing children; some of these are a result of the input, others not. The combination of deictic sign (Point) and representational sign or word was still being commonly used with the deaf children at age 3;0, whereas with the hearing children it had decreased. The deaf children use this also more and the hearing children less. This is a reflection of the fact that the deictic sign is part of SLN, which as a language is offered more to the deaf children (see Chapter 5). The combination of Point and representational sign stays therefore as part of the language, whereas with the hearing children point combined with word disappears as the spoken input becomes more complex. The deaf children receive very few combinations of words in Dutch, as might be expected from the little Dutch input they receive; however they are offered more word combinations in SC. The hearing children do receive signed combinations, mainly in SC. This difference is reflected in their output. The hearing children receive in total more combinations of representational signs or words than the deaf children. This can be partly explained by the fact that Point combined with
representational signs remains common for the deaf children and is part of SLN. The two groups of children are not clearly different in the age at which they produce their first sign; they differ by six months though in the production of the first word. Six months is nevertheless a brief delay considering how inaccessible the input is to the deaf children.

There was no difference in the variety of lexicon offered in signs (TTR) to the deaf and hearing children. The spoken vocabulary offered to the deaf children showed more variety but was a great deal smaller than to the hearing children, as might be expected since they receive so little Dutch. The deaf children start to produce words later and their vocabulary grows more slowly, as a result of their input but also their hearing status. Two of the hearing children are slower in sign vocabulary. Sander is the exception since he seems to be more oriented to signing despite being hearing.