Input and interaction in deaf families
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Citation for published version (APA):
van den Bogaerde, B. (2000). Input and interaction in deaf families Utrecht: IFOTT/LOT

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Download date: 13 Dec 2018
6 LANGUAGE ACCESSIBILITY

In section 6.1 we show how accessible the input offered by the deaf mothers is. In section 6.2 we look at the accessibility of the language production of the children for their mothers. This analysis will indicate whether or not the children are aware of the fact that their mother is deaf and therefore needs to have visual access both to the signed and to the spoken utterances. In section 6.3 we discuss how the mothers and children use the two modalities in terms of semantic content and the effect thereof on the accessibility of the content of the language production. We look at the relationship of the quantity of input and the attention-giving development of the children in section 6.4. Section 6.5 is a summary of this chapter.

6.1 Input and accessibility

In Chapter 5 we showed that the mothers offer their children SLN, NL and SC. However, as described in section 2.2, offering a language is not enough. That language must be accessible for the child in order for the child to be able to acquire it. This means for the deaf children that they must have visual access, both to signed and to spoken input. The hearing children can hear the spoken language, at least if it is produced with voice, but must also have visual access to sign language.

Research question 5 was formulated to see how much of the input is accessible to the children (see section 3.2). Furthermore we want to establish who is responsible for the accessibility of the input, in other words how do the mothers take care that the children have access to their signed and spoken input? Do the children contribute as well? (research questions 6, 7 and 8 in section 3.2).

Method

All signs and words are coded as 'seen' (+) or 'not seen' (-). Signs and words are coded as 'seen' when the signer and the addressee are looking at each other. Signs made by the signer within the visual field of the addressee are also coded (+); words produced with voice (+v) are not coded for visibility when addressed to a hearing child. All words addressed to a hearing child without voice (-v) are coded as + or - seen. When there was doubt as to the visibility of a sign or a word, it was coded as not seen (-). This conservative coding may have inflated the percentage of signs and words that were not seen. The intrarater reliability between the two transcribers was satisfactory for these aspects at all ages, except at 1;0 and 2;6 for signs, and for words at 2;0 (see section 4.3.3). At 1;0 the liberal Kappa for signs seen was .56. Disagreement was mainly due to the lack of feedback from the children (e.g. not responding in any way to indicate that a sign was seen). All signs produced by the mothers at 1;0 were checked a third time and, in case of doubt, coded as not seen.
At the age of 2;6 the low Kappa (.62) was caused by a low reliability in scoring signs as 'seen' by Carla (D), who was much preoccupied with attracting the attention of the person behind the camera. She gave little attention and feedback to her mother, which influenced the interpretation of the visibility of signs made in her peripheral vision. Her mother's signs were checked a third time, and in case of doubt coded as not seen. The low Kappa for words seen at 2;0 (.73) was caused by 3 words produced by Carla's mother, which were coded differently by the two transcribers.

To answer the questions on attentional strategies (research questions 6, 7 and 8) we chose the following procedures. Based on studies by Harris et al. (1987; 1989; 1992), Kyle and his colleagues (1987, 1988) and van der Stelt and Jansonius-Schultheiss (1990) (see also section 2.2.1) we categorized the different strategies for attention in two main categories. We distinguish non-explicit strategies, where the mother does not actively manipulate the child's attention, and explicit strategies where the mother actively seeks the attention or the eye-gaze of the child before producing an utterance (see Procedures for details).

Per session all linguistic utterances produced by the deaf mothers are coded for a strategy for attention.

Procedures

<table>
<thead>
<tr>
<th>S</th>
<th>Signer or Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad</td>
<td>Addressee</td>
</tr>
</tbody>
</table>

Non-explicit strategies for attention

A  S is looking at Ad and produces a sign, or a string of signs, in the normal location and/or starts speaking while Ad is looking at her. S waits, as it were, for Ad to look at her spontaneously before producing an utterance (NL, SLN or SC).

There is one subcategory within category A:

A' All second (or subsequent) utterances that are uttered after S already has the attention of Ad (via whatever strategy employed for the first utterance) are coded with A'. S takes advantage of the fact that Ad is already looking at her to produce a second (or subsequent) utterance. It is of no importance whether or not Ad produces an utterance in-between two A' utterances, because what matters is continuous eye contact or visual attention to S.

B  S starts signing in the usual place for that particular sign, or speaking or signing and speaking simultaneously, while Ad is not looking at her.

The basic assumption here is that when S is the mother, it is her intention to induce the child to look up at her when she is signing. This is either caused by a perception of motion within the periphery of the child's vision or, in case of the hearing children when she is speaking, because they hear her voice.
When S is a child we assume that there is no intention on his/her part to induce the mother to look up, since children have no native knowledge of attention-giving and turn-taking behavior (Siple et al. 1990; Swisher 1992). There is no evidence in the use of this strategy that they have acquired this behavior.

**AB** Ad is looking at S, S is not looking at Ad, and S starts signing and/or speaking.

If S is the mother we assume that she is aware that the child is looking at her and that she takes advantage of this fact to produce an utterance. However, if S is a child, we assume that the child has no such awareness (i.e. that the mother is looking at him/her), and thus does not take into account the need for visual attention of the mother.

**Explicit strategies for attention**

C S displaces her sign(s) in such a way that Ad need not look at or towards her in order to perceive the sign(s). So S takes responsibility for the visibility of the sign(s). This strategy can of course only be used with SLN and the signed part of SC utterances. The following subcategories are distinguished:

C1 A lexical sign of an utterance, which usually would be made on or near the body or the head of S is instead made on the body or head of Ad. Ad can thus perceive the sign(s) in a tactile way.

C2 A lexical sign of an utterance can be displaced into the signing space of Ad.

For instance, when the child is sitting on the mother's lap while reading a book. The mother can reach her arms around the child, and produce the signs thus in his/her signing space.

C3 A lexical sign of an utterance can be displaced within the visual field of Ad.

For instance, if a child is looking at an object, the deaf mother may choose to make the sign near the object, while the child is looking at it. Any first (and subsequent) lexical sign that is displaced, i.e. not made in its regular place, causes the utterance to be coded with C3.

**D1** S is looking at Ad, and manipulates an object to gain the attention of Ad for an utterance.

This can be done in the following ways:

D1.1 S moves an object within the visual field of Ad

D1.2 S makes a sound with an object (e.g., squeaky noise in a toy-bear or sounding a bell)

D1.3 S moves a toy and simultaneously makes a sound with it, e.g. banging a toy on the floor.

**D2** S manipulates (the body of) Ad, to indicate that attention should be paid to S.

This is scored in two ways:

D2.1 S adjusts the position of Ad
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D2.2 S taps or touches Ad somewhere on the body
D3 S manipulates attention of Ad:
D3.1 S attracts attention of Ad by the use of voice (e.g. name-calling or shouting)
D3.2 S waves an arm/hand within the visual field or periphery of Ad
D3.3 S makes noise or vibrations by means of, for instance, banging a fist on a table, or stamping on the floor

Exceptional cases
A special category is formed by those linguistic utterances that consist of a pointing gesture with one spoken word or with one lexical sign, in particular those cases where the mother points on or near an object or a picture in a book whilst the child is already looking at it. These utterances (naming or labeling utterances) are coded separately in the following way for later analysis (see Chapter 7)
If a single Point is produced together with one spoken word, or a dislocated sign, the utterance is coded C3. Note, however, that if Ad is looking at an object, and S points on or to this object while producing more than one word, or one or more word(s) simultaneously with a sign in the normal location, the utterance is coded B. Some examples follow below, where the child is looking at the book and the mother is signing/speaking:

(1) sign spoken code
    POINTonbook rabbit C3

(2) sign spoken code
    POINTonbook that's a little rabbit B

(3) sign spoken code
    POINTonbook RABBIT (dislocated near book) that rabbit C3

(4) sign spoken code
    POINTonbook RABBIT (on right side head of S) that rabbit B

Per session we looked at how the mothers tried to attract the attention of their child for all SLN, NL and SC linguistic utterances. Per strategy (A, B, C and D) we totaled the number of linguistic utterances in each language. Some utterances could not be coded for a strategy. For example, it should be clear that those utterances consisting only of a vocative (e.g. Mother calls son: Alex!) are considered to be a strategy for attention and these utterances should be deducted from the total number of utterances. Some utterances could not be coded with a strategy for attention because the child was out of
range of the camera; these utterances were coded as 'rest'. An example should make the coding and analysis clear:

At age 1;6 of Jonas (H) his mother produced 152 linguistic utterances in total (see also Table 5.3). Strategy A was used with 18 utterances, B with 77, C with 54 and D with 2.\footnote{see also Table A6.5d in Appendix to Chapter 6, page 262} Table 6.1 shows how these strategies were distributed over the three language systems:

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
Mother of Jonas & NL & SLN & SC & Total \\
\hline
Strategy A & 1 & 4 & 13 & 18 \\
Strategy B & 39 & 0 & 38 & 77 \\
Strategy C & 0 & 11 & 43 & 54 \\
Strategy D & 1 & 0 & 1 & 2 \\
rest & 1 & 0 & 0 & 1 \\
\hline
Total no. of utterances & 42 & 15 & 95 & 152 \\
\hline
\end{tabular}
\caption{INPUT HC: Strategies for attention used by Jonas' mother at 1;6}
\end{table}

In this example 72% of strategy A is used with SC utterances (13 out of 18), 51% of strategy B with NL (39 out of 77), 80% of strategy C with SC (43 out of 54) and strategy D equally with one NL and one SC utterance. If more than 50% of the use of a particular strategy is linked to a particular language, then that language is noted for that session and strategy.

6.1.1. Accessibility of the input to the children

Here we are interested whether the signs are seen by the deaf and hearing children and whether the deaf children can see the mouthed words (research question 5). In Figure 6.1 we present the percentages of signs that are seen by the deaf and hearing children.\footnote{see Appendix to Chapter 6, Table A6.1 for the raw figures, page 261}
Harris (1992) found 80% of the input as an average percentage for signed and spoken utterances to serve as intake (see also section 2.2.2). We see that for sign input the percentages vary to a certain extent with the individual children in our study. Carla (D) and Alex (H) seem to differ slightly from the other children in that they have somewhat less access to the signed input. However, on average the deaf children can see 83% of the signs and the hearing children 79%, which is comparable to what Harris found for deaf children in England.

If initially during interaction the mothers focus on training the attention-giving behavior of the children, we would expect that as the children grow older and acquire the necessary attention-giving skills, they would see increasingly more signs. There is a slight increase over time, but this is not significant for all children (chi-square test). The deaf and hearing children see the signs offered to them equally well from age 1;0 on, with a peak at 2;6 for all children except Carla (D). We will discuss in sections 6.1.2 and 6.1.4 how the high percentage of visibility of the signs can be explained.

In Figure 6.11 we present the percentages of words seen by the deaf children.3

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3 see Table A6.2 in Appendix to Chapter 6, page 261
On average the deaf children see only 55% of the words spoken or mouthed by their mother, although individually there are great differences (range is 17-91%). Carla's mother does not succeed in getting visual attention for more than 38% of her mouthed or spoken words until Carla is 3;0, when we see an increase to 58%. Laura and Mark seem to be able to access the mouthed or spoken input increasingly better, but only at 3;0 do they see more than 80% of the words in the input.

Most of the spoken input to the deaf children forms part of SC utterances (see Figures 5.1a-c). Therefore the effect of missing the spoken or mouthed is not necessarily equivalent to missing all or part of the semantic content of the utterance. We will discuss how the SC proposition as a whole is distributed over the two channels in section 6.3.

For the hearing children only the mouthed words produced by the mothers (i.e. words produced without voice) require visual attention. When we take into consideration the total number of vocalizations and words produced by the deaf mothers with their hearing children⁴, which is 4677 in total, only 4% (163) are uttered without voice; half of these are not seen by the hearing children. In comparison, the mother of Laura and Mark (D) offers her children 703 and 534 words respectively, 85% of which are produced without voice. Carla's mother produces 733 words, and 94% is produced with voice. We will come back to this fact in Chapter 9, where we will discuss structural aspects of the input. Information on the use of voice by the children is presented in section 6.2.3.

⁴ see Appendix to Chapter 6, Table A6.3, page 261
The hearing children will have no access to NL utterances in which these (unseen) mouthed words are used. If the mouthed words are used in a SC utterance of which the children see the signed part, it will depend on the propositional structure of the SC utterances whether or not the child has access to the full linguistic message or not (see section 6.3). Since the percentage of unseen mouthed words is so small, we decided not to make this analysis at this point. We conclude that the majority of the words offered to the hearing children can serve as uptake since they are heard (see section 1.3.1). Here we assume that the speech of the mothers is intelligible to the children, even though it often (but not always) has characteristics that distinguish it from standard Dutch (see also section 2.2.3).

As discussed in Chapter 5, for all children at most points in time SC is the language mode preferred by the mothers. Although the hearing children have access to the spoken part of SC through their hearing, Laura and Mark (D) seem to miss a substantial part of the spoken or mouthed linguistic information up to 2;6, and Carla (D) even more at all times. Carla has only access to less than 58% of her mother's spoken language production. Her output in fact does resemble what her mother offers, since she has access to most of her mother's signing but fails to see the majority of the spoken or mouthed words (see section 5.3.2). Her output thus seems to reflect what her uptake may have been. However, even though Laura and Mark have better access to their mother's spoken input, they do not reflect her choice of SC in their output, so hearing status seems to be more important.

In section 6.3 we will discuss the effect of the accessibility for the different modalities in more detail.

In the next section we will describe how the deaf mothers achieve accessibility of their input.

6.1.2 Strategies for attention used by the deaf mothers

We saw in the previous section that the input is accessible to the children more or less to the same extent over the years. As we mentioned before (section 2.2.2), it has been shown that deaf mothers seem to train their deaf and/or hearing children to look at or towards her, at least during their first year of life (Gregory and Barlow 1986; Kyle et al. 1987; Harris 1992). If there is no change in accessibility of the input to the children, as they grow older, we may well wonder if there is a change in the way the mothers make the input accessible and if there is a change in the attention-giving behavior of the children. We would expect that the children increasingly pay attention spontaneously so that the mothers need to employ explicit strategies to get their attention less and less often. Here we examine which strategies are employed by the Dutch deaf mothers. Firstly we will look at the relation between non-explicit - explicit strategy use for all mothers over time, and secondly at the distribution of the four main subcategories over the different language modes.
Non-explicit versus explicit strategies
Figures 6.IIIa and 6.IIIb show the use of explicit strategies (C and D), expressed as a percentage of the total use of all strategies by the deaf mothers with the deaf and hearing children respectively.⁵

Figures 6.IIIa and 6.IIIb show the use of explicit strategies (C and D), expressed as a percentage of the total use of all strategies by the deaf mothers with the deaf and hearing children respectively.⁵

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⁵ see Appendix to Chapter 6, Table A6.4 for the raw data, page 261
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As was expected, strategies C and D are used decreasingly over time with most children (see also Waxman and Spencer 1997). Exceptions are the mothers of Jonas and Alex (H) at age 3:0. A very plausible explanation for the increase in the use of explicit strategies seems to be that in these sessions both boys were very busy with their toys and not inclined to pay attention to their mother. Comparing the use of explicit strategies with the deaf children and with the hearing children there is a clear difference at age 1:0. The deaf mothers use explicit strategies proportionally more with the deaf children than with the hearing children, especially with Carla and Laura (D). We will come back to this point in the next section.

In general we can say that our prediction that explicit strategies will be used less as the children grow older is correct. We will next look at which strategies are used specifically with the deaf and the hearing children.

Preferred strategy for attention by the mothers

Looking at the strategies for attention in more detail (see Table 6.2) we see different patterns for the strategy preferred by the deaf mothers at different points in time. A strategy is called 'preferred' when it has the highest percentage of use in one session. Preference for more than one strategy (as for Mother of Carla at 1:6: C/B/D) means that these strategies have the same percentage, plus or minus a difference of 3%.

Table 6.2 INPUT DC+HC: Preferred strategy for attention by the deaf mothers

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Mothers</th>
<th>1:0</th>
<th>1:6</th>
<th>2:0</th>
<th>2:6</th>
<th>3:0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf Children</td>
<td>MCarla</td>
<td>C/B/D</td>
<td>B</td>
<td>D</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MLaura</td>
<td>C</td>
<td>A/C</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>MMark</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Hearing Children</td>
<td>MJonas</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A/B</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>MAlex</td>
<td>B</td>
<td>B</td>
<td>A/B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>MSander</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A/B</td>
<td>A</td>
</tr>
</tbody>
</table>

With the deaf children we can see variation. The mother of Laura and Mark shifts from C (explicit) to A (non-explicit) whereas Carla's mother shows great variation. With the hearing children there is a different pattern. The mothers at first use strategy B, but they all shift at some point to A/B or A. From age 2:0 - 2:6 on the mothers mainly sign and/or speak after the child has looked up, or while the child is not looking (but expected to look up).

Strategy B is a strategy which accommodates most to the fact that the children are hearing. Because the mothers predominantly use SC and NL with voice with the hearing children (see also Rea, Bonvillian and Richards 1988), there is really no need for the hearing children to pay visual attention to their mother (see also section...
6.3. We point out here that we coded the first sign or word in each utterance for use of a certain strategy. We did not analyze here how successful each strategy was in terms of obtaining visual attention at the level of signs and/or words. As will be seen in later analyses (section 6.1.4) the frequent use of a strategy does not imply that it is successful in getting visual attention. The response to different strategies will be discussed in section 6.1.4.

We predicted that if the mothers do need to actively attract their child's attention, they would use different strategies with the deaf and with the hearing children. This is indeed what we found. The mothers attract the deaf children's attention through dislocating signs or by tapping them or waving (substrategies C, D2.2 and D3.2). With the hearing children these strategies also occur but to a much lesser extent, and often accompanied by a vocative (substrategy D3.1). These results confirm findings by Waxman and Spencer (1997) for ASL. Overall we find that until the children are around 2;6 the mothers take responsibility for the visibility of their linguistic input. They adapt to the hearing status of their child in the use of their strategies.

As we already know (see section 5.3), the language choice of the mothers is different with the deaf and hearing children (i.e. SC and SLN with the deaf children, and SC and NL with the hearing children). It is possible that a certain strategy is linked to a particular language. We will discuss this aspect in the next section.

6.1.3 Relationship between strategies for attention and consecutive language input

In the previous section we have shown that the deaf mothers prefer different strategies for attention with the deaf and with the hearing children. Are the strategies that are used by the deaf mothers linked to one particular language? For instance, is it the case that strategy C is only used with SLN and not with SC utterances? (see research question 7 in section 3.2).

We find that strategies A and D are mainly linked to SC at all times for all mothers. Strategy B is also used most with SC utterances although not as consistently. Strategy C seems to be used often with SLN with the deaf children, but with SC with the hearing children. Of course we must take into consideration here that the hearing children were not offered much SLN anyway.

We can draw the conclusion that all of the strategies are used most frequently with SC utterances with the hearing children and with Carla (D). Since with all children SC is used predominantly in the input, we cannot say that we found a preference for a strategy with one particular language as we expected. However, strategy C is used predominantly with SLN with Laura and Mark (D), while with the other children

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7 see for full details Appendix to Chapter 6, Tables A6.6a-f, pages 263-264 and Table A6.6g, page 265
mainly with SC. The choice for a particular strategy seems to be driven more by the focus of the child's attention or by the activity mother and child are engaged in, than by the language choice of the deaf mother.

In the next section we will consider what effect the use of the different strategies has on the attention-giving behavior of the children.

6.1.4 Relationship strategies for attention and attention-giving behavior of the children

Firstly, we would like to know how the children react to the strategies for attention used by their mother. Are these strategies successful? Do the mothers actually manage to attract the visual attention of their child? Secondly, is there a connection between strategy A and the spontaneous visual attention-giving of the children? If all mothers show an increase in the use of strategy A, we can deduce that the children must be looking up at them more often as they grow older. We formulated question 8 in section 3.2 so that these two aspects are covered: "Is there a relationship between the strategies for attention used by the deaf mothers and the attention-giving behavior of their deaf or hearing child?"

Response of the children to strategies B and D

We will first discuss the need for a reaction of the deaf and hearing children to their mother's different strategies. For strategy A no response is expected, since the mother already has the visual attention of her child. If the mother employs strategy B, the child may either respond by looking up (+) or not (-). For strategy C no response is required of the child, since the mother takes care that the child can see the sign(s). Strategy D, however, requires a response of the child, measured in change of eye-gaze direction. So it is the response of the children to strategy B and D that we will discuss next.

In Figures 6.IVa and 6.IVb we present the percentages of positive responses to their mothers' use of strategy B of the deaf and hearing children respectively.8

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8 see Appendix to Chapter 6, Table A6.7 for the raw data, page 265
In general the deaf children respond positively, that is by shifting eye-gaze, to their mother's use of strategy B more often than the hearing children. This is not surprising considering the fact that the mothers mostly use SC or NL with voice with the hearing children. If the mother starts speaking, or signing and speaking simultaneously the hearing child does not need to give visual attention (see also section 6.1.1 and 6.3). Nevertheless, as we showed above (section 6.1.1) the hearing
children see 79% of the signs, by peripheral sight or by dislocation of the signs by the mothers (strategy C).

For strategy D the deaf and hearing children are expected to respond positively to the same extent since the mothers actively try to manipulate their child's attention. Although there is individual variation\(^9\), we can say that Laura, Mark (D) and Sander (H) respond increasingly better as they grow older, but Carla (D), Jonas and Alex (H) are less responsive and not as consistent as the other children.

**Spontaneous visual attention of the children**

In section 6.1.2 we discussed how all mothers show an increase in the use of strategy A over time. This implies that the children look up spontaneously at their mother more often as they grow older. Figures 6.Va and 6.Vb present the actual number of spontaneous looks (raw figures) of the deaf and hearing children in 10 minutes of interaction.\(^{10}\)

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\(^9\) see Appendix to Chapter 6, Table A6.8, page 265

\(^{10}\) see Appendix to Chapter 6, Table A6.9, page 265
We notice first that at 1;0 the hearing children look up at their mother more often than the deaf children. Because of their intact hearing, Jonas, Alex and Sander at this age have had more experience in turn-taking than the deaf children. In previous studies of the deaf mothers of Jonas (at 0;11), Sander (from age 0;3 on) and Alex (from 0;7 on) (Mills and Coerts 1989; Blankenstijn and van den Bogaerde 1989), we found that the deaf mothers always use voice during the first year in the life of the hearing children and hardly sign to them. The hearing children thus receive a considerable amount of auditory input.\footnote{We came across only one instance (Sander at 0;4 in Blankenstijn and van den Bogaerde 1989) as specifically meant by van der Stelt, where the mother seemed to imitate the sound-productions of her son (see also section 1.3.2).} Van der Stelt (1993:215) found for two hearing girls of hearing mothers the following ranges of 'child looking at mother's face' (corrected for 10 minutes of interaction) between the ages 1;0 and 2;0:

\begin{center}
\begin{tabular}{ccc}
1;0 & child 1: 28 & child 2: 4 \\
1;6: & child 1: 10 & child 2: 40 \\
2;0: & child 1: 4 & child 2: 56 \\
\end{tabular}
\end{center}

These numbers of spontaneous looks differ from the range found for the children in our study at the same ages. Child 1 looks a little more often at age 1;0, the same at age 1;6 and less often at age 2;0; child 2 looks less often at age 1;0, and more often at ages 1;6 and 2;0 compared to our hearing children. There is a considerable difference between the two hearing children of van der Stelt, more so than between the hearing children in our study.

We have no information on the interaction of the deaf mothers with their deaf children during the first year. But we know that the deaf children lacked the
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auditory input in such an interaction. They had fewer chances to be in a situation in which turn-taking was practiced and this is reflected in the number of spontaneous looks at their mother at the age of 1;0 (see also Harris and Mohay 1997). The deaf children show a clear increase over time in the number of spontaneous looks, although Carla seems to develop a little later than Laura and Mark. Jonas and Alex, both hearing, show no increase over time, although at age 2;6 we see an increase with a sharp decrease again at age 3;0. Sander does show an increase over time.

Since both deaf and hearing children are seeing 80% of the signs, this would indicate that an 'adequate' level of visual behavior has been reached (see also sections 2.2.2 and 6.1.1). The six children in our study on average look up at their mother once every 14 seconds. More research at later ages of the children, and on visual attention-giving behavior between deaf adults for reasons of comparison, is needed to draw definite conclusions and to establish what an 'adequate level' of visual behavior within sign language communication further entails.

Periods of continued visual contact

Only a few spontaneous looks of the children were unanswered by the mothers in terms of taking the opportunity to convey information. This pattern of communicating, with mutual visual attention is confirmed by the analysis done of strategy A. Strategy A includes a subcategory A' (see section 6.1). This stands for 'All second (or subsequent) utterances that are uttered after S already has the attention of Ad (via whatever strategy employed for the first utterance)'. It is expected that as the children grow older, they will not only look more often at their mother, but also for longer periods while communication is taking place.

In Table 6.3 we present the percentages of utterances coded A' of the total number of utterances. We emphasize that subcategory A' was included in the percentages given for strategy A in sections 6.1.2 and 6.1.3.

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Mothers</th>
<th>1;0</th>
<th>1;6</th>
<th>2;0</th>
<th>2;6</th>
<th>3;0</th>
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<tbody>
<tr>
<td>Deaf</td>
<td>MCara</td>
<td>-</td>
<td>4 (3)</td>
<td>1 (1)</td>
<td>10 (7)</td>
<td>32 (18)</td>
</tr>
<tr>
<td>Children</td>
<td>MLaura</td>
<td>8 (11)</td>
<td>9 (11)</td>
<td>26 (23)</td>
<td>36 (30)</td>
<td>67 (37)</td>
</tr>
<tr>
<td></td>
<td>MMark</td>
<td>1 (2)</td>
<td>19 (19)</td>
<td>45 (29)</td>
<td>21 (15)</td>
<td>34 (44)</td>
</tr>
<tr>
<td>Hearing</td>
<td>MJonas</td>
<td>3 (4)</td>
<td>7 (5)</td>
<td>13 (9)</td>
<td>36 (21)</td>
<td>15 (13)</td>
</tr>
<tr>
<td>Children</td>
<td>MAlex</td>
<td>21 (13)</td>
<td>47 (24)</td>
<td>20 (12)</td>
<td>47 (24)</td>
<td>4 (2)</td>
</tr>
<tr>
<td></td>
<td>MSander</td>
<td>6 (5)</td>
<td>7 (5)</td>
<td>11 (8)</td>
<td>22 (15)</td>
<td>44 (34)</td>
</tr>
</tbody>
</table>

*Percentages are from total number of utterances

Overall we can see an increase in the use of this sub-strategy by all mothers. We find that there is a relationship between strategy A' used by the deaf mothers and the
attention-giving behavior of the children. As the children grow more competent in giving visual attention, the mothers adapt their strategies (see also Waxman and Spencer 1997:113). They take advantage of the fact that the child is looking at them to offer more utterances, and they do this increasingly as the children grow older.

We found that the deaf and hearing children can perceive the majority of the signs offered to them through the various strategies. The perception of the spoken (or mouthed) words varies, however, across the children.

In the next section we will look at how accessible the language output of the children is for their mothers.

### 6.2 Output and accessibility

#### 6.2.1 Accessibility of the output to the mothers

The children are clearly learning by the age of 2;6 to give visual attention to communication, but is their linguistic production accessible to their deaf mother? (research question 9 in section 3.2) In order to answer this question, we coded all vocalizations and words and all movements and signs produced by the children as seen (+) or not seen (-), as has been described in section 6.1.

**Results**

In Figures 6.VIa and 6.VIb we present the percentages of signs and movements (MOV's) seen by the deaf mothers of the deaf and hearing children respectively.12

![Graph showing percentages of signs and MOV's seen by deaf mothers](image)

**Figure 6.VIa OUTPUT DC: Percentages of signs and MOV's seen by the deaf mothers of the deaf children.**

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12 see Appendix to Chapter 6, Table A6.10 for the raw data, page 266
Figure 6.Vlb OUTPUT HC: Percentages of signs and MOV's seen by the deaf mothers of the hearing children. NB No signs are produced by Jonas at age 1;0 and by Alex at age 2;0

The mothers see more than 90% of all signs and MOV's at all times with a few minor exceptions (Alex' mother at 1;0 (83%) and 2;6 (82%), and the mothers of Carla and Laura at 2;0 (88 and 79% respectively)). The deaf mothers are almost constantly visually monitoring their children, also called 'framing' by Fogel (1977, in van der Stelt 1993:65): this means that they are looking at the children continuously, except when they themselves are occupied with a toy or a book. In this situation the mothers alternately look at the toy or book and at the child. The mothers check where the children are looking to be able to follow which particular object or picture the children are paying attention to. This behavior is typical also of hearing mothers (see van der Stelt 1993; Tomasello and Farrar 1986) and partly explains why the mothers see most of the signs produced by the children. The role of the children in the visibility of their linguistic output to their mother will be discussed in section 6.2.2.

In Figures 6.VIIa and 6.VIIb we present the percentages\(^{13}\) of words and vocalizations (voc's) seen by the deaf mothers of the deaf and hearing children respectively.

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\(^{13}\) see Appendix to Chapter 6, Table A6.11 for the raw data, page 266
Figure 6.VIa OUTPUT DC: Percentages of words and vocalizations seen by the deaf mothers of the deaf children

Although we can see an general increase over time for all mothers, the mothers of Carla and Mark show an irregular pattern of words and vocalizations seen at the different points in time. At 2;0 they see more than 80%, but at 2;6 less than 52%. We have no explanation for these fluctuations; there is no difference in the type of activities during the 2;6 sessions from the 2;0 sessions, and the mothers were not less attentive to their children. The children were looking downwards at their toys more often or away from their mothers, which made it more difficult for the mothers to see their lip movements.

Figure 6.VIIb OUTPUT HC: Percentages of words and vocalizations seen by the deaf mothers of the hearing children
For the accessibility of the spoken language production of the hearing children, we find that Jonas' mother never sees more than 58% of the spoken output and Alex' mother only 49% except at 2;6, and there is no development over time. Sander's mother sees her son's spoken output increasingly over time.

In sum we find that the deaf mothers see the majority of the signs and MOV's produced by the children. The mothers' access to their spoken output, vocalizations and words, however, is generally below 52% up to age 3;0. At 3;0 there seems to be a slight improvement for the mothers of all three deaf children. Considering that the deaf children mainly use SLN (see Figures 5.IIa, b and c), and only little SC and NL, we can conclude that the mothers on the whole do not miss much of the linguistic messages of the deaf children. However, access to the full proposition of the SC utterances of the deaf children is dependent on the nature of these utterances; we will discuss these aspects in section 6.3.

The deaf mothers have satisfactory access to the signing of their hearing children, but miss many of their spoken or mouthed words and/or vocalizations. When we look again at the language choice of the hearing children (Figures 5.IId, e and f), we can see that this may have serious consequences for the mothers' access to their language production in general. This is especially the case with Alex' mother, whose son prefers Dutch and SC until age 2;6 and even at 3;0 produces many NL utterances. Jonas' mother has access to approximately half his spoken language production, with Jonas clearly preferring Dutch and SC over SLN. Sander's mother has better visual access to her son's spoken language production than the other two mothers, where Sander prefers SLN and SC over Dutch. We will discuss the nature of the SC utterances and the need for access to the spoken component in section 6.3. But first we will sidestep in the next section to look at the (development of the) awareness of the children for the need of visual accessibility of their language production to their mother.

**6.2.2 Checking for accessibility**

We formulated research question 10 in section 3.2. as follows: "Do the children take care that their mother can see their signs and/or words, and if so, how do they ensure visibility?"

**Method**

In the first instance the same codes for attentional strategies are used as for the utterances of the deaf mothers (see section 6.1). Besides coding the signed and spoken linguistic utterances of the children, we also coded the movements and vocalizations. As the discussion will focus on the awareness of the children that their linguistic utterances should be visually accessible to their deaf mother, we analyzed the data on the attentional strategies in an additional way for the children. We decided to code an utterance of the children with a 'minus' (-) when the mother's attention was not being clearly checked before the utterance was produced. The strategies for attention were coded in the following way (see also section 6.1):
Strategies

- Strategy A and A': neutral (0)
- Strategy AB: child does not check: minus (-)
- Strategy B: child does not check: minus (-)
- Strategy C: child does not check: minus (-)
- Strategy D: child checks: plus (+)

Instead of dividing the attentional strategies in non-explicit and explicit strategies, which was done for the attentional behavior of the mothers, we split up the strategies according to whether or not we could see that the child was checking if the mother was paying visual attention. Below we will discuss the rationale behind this coding system, the attribution of 'plus' or 'minus' to a category.

Strategies A and A', where the Signer/Speaker (S) (in this case the child) and Addressee (Ad) (in this case the mother) are looking at each other is coded neutral (0). We cannot be sure that the child is deliberately seeking the mother's eye-gaze before producing an utterance, or that the child is not checking for visibility. Strategy D, when the child actively tries to engage the attention of the mother is attributed a 'plus', since it is clear that the child (has) checked or is seeking the mother's attention.

A 'minus' is attributed to strategy AB (mother looks at child, but child not at mother), to strategy B (mother is not looking at child) and to strategy C. In the case of strategy C the children never dislocate a lexical sign, but they do produce Points in the visual field of the mother. If an utterance begins with such a Point, the utterance is coded C. However, the children never monitored whether or not the mother was indeed looking at them or at the Point and thus we decided to label strategy C with a 'minus' as well.

Results

We will first describe whether or not the children check if their vocalizations and movements are visible to their mother and next their linguistic utterances.

Checking for visibility of vocalizations and movements in the output

All children except Laura (D) and Alex (H) produce the majority of their vocalizations and movements without checking that their mother is looking at them. Laura produces a few voc's and MOV's while she and her mother are looking at each other at ages 1;6, 2;6 and 3;0. Alex also is looking at his mother for the majority of his vocalizations (n=14) at age 2;6. As we discussed in section 6.2, the mothers miss many of the vocalizations and words produced by the children, although movements and signs are perceived to a much higher degree. We can thus conclude that the vocalizations of the children play hardly any role in the interaction between the deaf mothers and the children, contrary to the interaction of hearing mother-child pairs (van der Stelt 1993). Movements (i.e. sign-babbles) were

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14 see Tables A6.12a-f in Appendix to Chapter 6, pages 266-267
sometimes interpreted by the mothers as signs, but were also ignored on other occasions, even though most of these were visible.

Checking for visibility of linguistic utterances in the output
We will discuss the visibility of the linguistic utterances in the output of the deaf and hearing children from the age of 1;6. Figure 6.Vllla shows the percentages of utterances, which were coded with attentional strategies 'minus' check at the four points in time for the deaf children. We only present the data from 2;0 onward, because before this age the children produced less than 10 utterances.

![Graph showing the percentages of linguistic utterances made without a check for visual attention by the deaf children](image)

In her use of attentional strategies Carla shows only a slightly increasing awareness that she must check whether or not her mother is looking at her. Mark shows a decrease in unchecked utterances from age 2;0 onwards. With Laura at age 2;6 we see a decrease in unchecked utterances. However, at age 3;0 there is an increase again, so there is no clear steady progress. The variation between the children is quite large: from 30% (Mark) to 70% (Carla) at age 3;0 of utterances without a visual check.

Figure 6.VIIIb shows the percentages of utterances without a visual check by the hearing children.

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15 see also Appendix to Chapter 6, Tables A6.13a-c, pages 268 and Table A6.14, page 269
16 see Appendix to Chapter 6, Tables A6.13d-f, pages 268-269 and Table A6.14, page 269
Alex and Jonas do not show consistent behavior and we do not see a decrease in the use of utterances without a visual check, except that at age 2;6 we see an improvement. Sander produces a clearly decreasing number of utterances without a visual check. The difference between Sander and Jonas/Alex is large at age 3;0: 40% versus 80% respectively of unchecked utterances.

In ASL, children from age 2;6 on can be expected to begin to use explicit attentional strategies in sign language interaction situations (Siple, Akamatsu and Loew 1990). These findings are confirmed for SLN. We find that strategy D (actively trying to attract mother's attention by waving an arm, or tapping her) is beginning to be used by Laura (D), Mark (D) and Sander (H) from 2;0 on, by Carla (D) from age 2;6 and Jonas (H) from 3;0 on. It was also found that at that age children become aware of visual attentional requirements in the interaction with a deaf person, in particular the establishing of mutual eye-contact or signing within the other person's visual field. For instance, Richmond-Welty and Siple (1999) discovered that hearing bilingual twins distinguished between hearing and deaf addressees and between English and ASL by different eye-gaze behavior for the two languages. This differentiation was established between the age of 2;0 and 3;0, which coincides with the age found in this study for 'adequate visual behavior (see section 6.1.4).

Summarizing, we have found that Mark (D) and Sander (H) show a clear increase in their awareness that their linguistic utterances should be visually accessible to their mother. This ability seems to materialize after the age of 2;0. Laura (D) and Carla

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17 see Appendix to Chapter 6, Tables A6.13a-f, pages 268-269
(D) show a slight increase in awareness. Jonas (H) and Alex (H) do not show this awareness consistently in their use of strategies. The fact that their mothers see as much as they do of the linguistic utterances can be attributed mainly to the fact that they are looking at the children most of the time during the sessions.

6.2.3 Use of voice by the deaf and hearing children

Another interesting aspect in the interaction with a deaf person is the use of voice. Use of voice is irrelevant and unnecessary with profoundly deaf people, because spoken and mouthe d words are only visually processed. A clue as to the awareness of the hearing children that they are dealing with a deaf person would be the use of words without voice. It is important to remember that the deaf mothers themselves use voice with the hearing children most of the time (section 6.1.1). This is of course a confusing factor for the hearing children.

For the deaf children we would assume that initially they use no voice when signing or mouthing. However, the increasing use of voice by deaf children as they grow older could point to a growing awareness that the spoken language is separate from the sign language.

In this section we will inventorize the use of voice by the deaf and hearing children over time (see research question 11 in section 3.2).

Method

We looked at the number and percentages of words that were produced with voice by the deaf and hearing children. For this analysis we included all vocalizations and all words in the analyzable utterances and in minors ('yes' or 'no' etc.) in NL and SC utterances. The data of the mothers can be found in section 6.1.1.

Suppression of voice by the hearing children

In Table 6.4 we present the data on the words produced by the hearing children with voice.

We see that Jonas (H) almost always uses voice, which is in agreement with his other behavior related to the awareness of the hearing status of his mother. He does not respond visually when asked for attention or look up spontaneously at his mother. Alex (H) at age 3;0 shows a remarkable increase in the number of mouthed words, which does not coincide with his awareness for visual access, e.g. no increase in spontaneous looks (see Figure 6.VIIIb). However, the suppression of voice at age 3;0 indicates that he is aware that his mother cannot hear.

| Table 6.4 OUTPUT HC: Number and (%) of words produced with voice by the hearing children in NL and SC utterances |
|---|---|---|---|---|---|
| OUTPUT | Children | 1;0 | 1;6 | 2;0 | 2;6 | 3;0 |
| Hearing Children | Jonas | 25 (100) | 121 (100) | 129 (99) | 153 (99) | 283 (98) |
| | Alex | 29 (100) | 36 (100) | 150 (99) | 133 (99) | 54 (41) |
| | Sander | 24 (100) | 10 (48) | 5 (5) | 9 (7) | 56 (37) |
Output and accessibility

Sander (H) seems the only child to be aware, at quite an early age (1;6), that the use of his voice is not required in the interaction with his deaf mother. This interpretation is supported by the fact that with the hearing researchers he always used voice. His suppression of voice as an indication of awareness of the hearing status of his conversational partner is supported by his awareness for visual accessibility.

Use of voice by the deaf children.
The deaf children are expected to decrease the use of voice. We do know that deaf children are reported to vocalize a great deal but for sign language production no use of voice is needed. In section 5.1.2 (Table 5.2) we saw that the deaf children produced vocalizations decreasingly as they grow older. We do not know whether or not the deaf children at these ages are aware that words are spoken with voice (compare the use of voice in NL and SC utterances by the mother of Laura and Mark: 15% and by Carla's mother: 95%). A look at their output with voice might shed light on this aspect. We present the data of the deaf children on number and percentages of words with voice, as well as signs co-occurring with vocalizations in Table 6.5.

Table 6.5 OUTPUT DC: Number and (%) of words produced with voice by the deaf children in NL and SC utterances and signs produced with a vocalization in SLN and SC

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>Children</th>
<th>1;0</th>
<th>1;6</th>
<th>2;0</th>
<th>2;6</th>
<th>3;0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Words</td>
<td>Carla</td>
<td>-</td>
<td>79</td>
<td>106</td>
<td>101</td>
<td>42</td>
</tr>
<tr>
<td>+ voice</td>
<td>Laura</td>
<td>10</td>
<td>(100)</td>
<td>8</td>
<td>(72)</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>2</td>
<td>(100)</td>
<td>36</td>
<td>(95)</td>
<td>9</td>
</tr>
<tr>
<td>Signs</td>
<td>Carla</td>
<td>-</td>
<td>15</td>
<td>49</td>
<td>31</td>
<td>18</td>
</tr>
<tr>
<td>+ vocs</td>
<td>Laura</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>25</td>
<td>8</td>
</tr>
</tbody>
</table>

* corrected for 10 minutes

Carla (D) and Mark (D) use voice often but decreasingly at age 3;0, while Laura (D) shows a varied pattern. Carla vocalizes more often in her SLN utterances than Laura and Mark, although at 3;0 less so than at the previous ages. At this age her production of SC utterances also increases, which may indicate that the intelligibility of her spoken language production increases. Her mother also uses her voice most of the time, although Carla has only visual access to roughly a third of her mother's spoken or mouthed input. Use of voice may have a relation with the type of language one is using (Ebbinghaus and Hessmann 1996:28; Lucas and Valli 1992) (see also Chapter 9). It has been suggested that the use of voice triggers the production of the grammatical structures of the spoken language. Suppression of voice would trigger the use of grammatical structures of the sign language.
Laura vocalizes more while signing after the age of 2;6 (kindergarten age) as does Mark. They apparently become aware at this age that mouthed (or spoken) words might have some function or carry meaning and start imitating the lip-movement(s), often with voice. A thorough phonological analysis of the sound productions of deaf children is needed to establish the relationship between vocalizations and the beginning of the production of spoken words (see Beers and Baker 1997; Beers in press). Whether or not there is a relation between the use of voice and the structure of the language output (in particular in SLN and SC) will be discussed in Chapter 9.

6.3 Propositions in two channels

6.3.1 Propositions in the input

We have seen in section 5.3.1 that SC utterances form a substantial part of the linguistic input of the mothers, both to the deaf and to the hearing children. In section 6.1.1 we have shown that on average 83% of the signs are seen by the deaf children and 79% by the hearing children, but that the visibility of the spoken components varies across children and ages. In a SC utterance there can be redundant information because signs and words overlap; on the other hand it is possible that both channels carry separate information. To measure the effect of not seeing part of a particular SC utterance, we need to gain more insight in how the linguistic message is distributed over the two channels in the SC mode. More specifically we want to know whether or not missing the signed or spoken part of an utterance means missing (part of) the semantic content of an utterance for the child. This analysis will also shed some light on the question of the status of SC. As is discussed in section 2.2 a distinction can be made between mouthed information which is redundant and that which is functional. Not all authors are agreed that this is important, however.

**Method**

Since it is possible in SC to produce a word and a sign at the same time in a different channel with either the same or different semantic content, we need to know which part of a proposition is expressed in which channel. We counted as underlying propositions all main verbs or predicates, which had overt (or covert) subjects. This definition is taken from Bellugi and Fischer (1972:184). The analysis is based mainly on work done by Goldin-Meadow and Morford (1990) and on adaptations of their categories by Iverson, Capirci and Caselli (1994) and Heim and Baker-Mills (1996).\(^{18}\) We coded all the linguistic SC utterances except minors and unintelligible utterances (see section 4.4.2) in the following way:

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\(^{18}\) Please note that Heim and Baker-Mills used different terminology: **supportive** for our **complementary**, and **complementary** for our **supplementary** (o.c. p. 248). The terminology used here is taken from Iverson et al. (1994).
**Propositions in two channels**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>f - full</td>
<td>the whole proposition is fully expressed in both channels</td>
</tr>
<tr>
<td>s - supplementary</td>
<td>a part of the proposition is expressed in one channel. It adds essential content and does not overlap with that part of the propositional content expressed in the other channel</td>
</tr>
<tr>
<td>c - complementary</td>
<td>a part of the proposition is expressed in one channel. Its content overlaps totally with the full propositional content expressed in the other channel</td>
</tr>
</tbody>
</table>

**Procedures**

Below we will give some examples for the above categories as well as possible combinations, and discuss these with a view to the necessity of having visual access to one or both channels for the deaf and hearing persons.

- For SC utterance coded 'f' the deaf persons need to see either the signed or the spoken part\(^{19}\) of the utterance to have access to the proposition. The hearing persons need not pay visual attention to the signing, since they have access to the message through their hearing, if the mother uses voice.

  - \(f\) fully signed: POINThorse HORSE
  - \(f\) fully spoken: that is a horse

  (that is a horse)

- For SC utterances coded 'ss' the deaf and the hearing persons need to see both the signed part of the utterance as well as see (for the deaf persons) or hear (hearing persons) the spoken part.

  - \(s\) supplementary signed: HORSE
  - \(s\) supplementary spoken: big

  (the horse is big)

- For SC utterances coded 'fc' the deaf and hearing persons need to see the signed part of the utterance. Since the spoken part has the same semantic content as the sign, it is irrelevant whether or not the persons see or hear the spoken part. The need for visual attention is the same as for SLN utterances.

  - \(f\) fully signed: BICYCLE RED OUTSIDE
  - \(c\) complementary spoken: out

  (the red bicycle is outside)

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\(^{19}\) We will not discuss here which sounds of the spoken language are visually accessible to deaf children during the first years of their language development (see e.g. Dodd and Campbell 1987).
Language accessibility

| c | complementary signed | HORSE? |
| f | fully spoken          | (where is the horse?) |

For SC utterances coded 'cf' the deaf persons need to see the spoken part of the utterance, while the hearing persons need not give visual attention, since they will have access to the proposition through their hearing. The need for visual attention is the same as for NL utterances.

Results
The results of the analysis of propositional content for research question 12 are presented in Figures 6.IXa-f. We will discuss the findings per category.

Full in both channels (ff)
This way of combining signs and words, namely expressing the proposition fully in both channels, is used decreasingly with most of the children. This decreasing use may be linked to an increase in complexity (see section 9.1). The median percentage of use is 33%. The chances for access are optimal, since there is much redundancy.

Supplementary in two channels (ss)
The supplementary category, where the full proposition is distributed over the two channels, is used less with the deaf than with the hearing children. With the deaf children 0-20% (median is 10%) of the utterances are supplementary, while with the hearing children we see a range of 0-41% (median is 29%).
The combination of the two channels in this way requires good attention skills from both the deaf and hearing children. The deaf children however have to pay visual attention to both the mouth and the hands. Also a considerable percentage of words are not visible for the deaf children. If the mothers are aware of this, it is surprising that the mothers use this category at all with the deaf children.

Fully signed and complementary spoken (fc)
From Figures 6.IXa-f it is clear that the deaf mothers use this form of SC often with the deaf children (mean 54%) and much less so with the hearing children (mean 15%). The deaf mothers seem to assume that the deaf children are more focussed on signing.

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20 see for raw data Appendix to Chapter 6, Tables A6.15a-f, pages 269-270
Figures 6.IXa-f INPUT: Percentages of different categories of propositional content in the SC input of the deaf mothers

ff = fully signed and spoken
ss = supplementary signed and spoken
fc = fully signed, complementary spoken
cf = fully spoken, complementary signed
Complementary signed and fully spoken (cf)

Here we see the opposite from what we found for the 'fc' category: the mothers use fully spoken utterances complemented by signs fairly often with the hearing children (median is 27.5%) but much less so with the deaf children (median is 4.5%).

By definition the deaf children need to have visual access to the spoken or mouthed words only in the 'ss' and 'cf' utterances since only here are the words essential. In the 'ff' and 'fc' categories the words are redundant. On average Laura and Mark's mother offers them 13% of the SC input in the form of 'ss' and 'cf' utterances. Laura and Mark see 58% and 69% respectively of the words in these utterances and about 89% of the signs, which means that altogether they miss about 16% of the SC input. In the SC input of Carla's mother, however, 21% is of the 'ss' and 'cf' category. Carla sees only 36% of the spoken parts of these utterances and 74% of the signs. Across time she potentially misses about 40% of the total message in the SC input, which is quite substantial.

For the hearing children quite different conditions prevail; they have access to most of the spoken words through their hearing and they see on average 79% of the signs. They need to pay visual attention to the 'ss' and the 'fc' utterances. The SC input consists on average of 42% of such utterances - and the hearing children miss about 8% of the total SC input. A more detailed study on which part of an utterance is missed (beginning, middle or end) and whether or not the missed items are crucial for understanding the message would reveal more precisely the extent to which hearing and deaf children have access to the SC input offered to them. In the analysis of the children's productions we shall see in global terms to what extent this missed input has an effect on their acquisition.

As described earlier (see section 2.2.1) in her description of SLN Schermer calls a spoken component redundant when it does not add anything to the meaning of the sign (1990:87). Ebbinghaus and Hessmann (GSL, 1996:42) say, on the other hand, that the use of a spoken word which confirms the meaning of a sign also serves a function, as yet to be determined. The question arises, whether 'fc' utterances are truly SC utterances or whether they could be considered SLN utterances (as they would be according to Ebbinghaus and Hessmann 1996). Although Schermer did not describe the form 'cf' (fully spoken, complementary signed) as such, we assume that the signed part in 'cf' utterances is redundant. Perhaps these 'cf' category of SC utterances should be considered Dutch.

The 'ss' category in SC utterances can be compared to what Schermer called specifying, disambiguating or complementing functions of spoken words in SLN utterances. Ebbinghaus and Hessmann (1996) consider the signs and words as semantically related, and to interact in the creation of meaning (1996:44). For them it is still far from clear how exactly they should be integrated into a standard view of sign language.
This propositional analysis does not give us enough evidence to decide on the status of the SC utterances. The fact that 'ss' utterances are produced might suggest a third system as discussed earlier (section 2.2.1). The analysis of the structural properties of the SC utterances (Chapter 9) will shed more light on this matter.

6.3.2 Propositions in the output

We will not present the SC utterances of Laura and Mark in percentages, since the number of SC utterances produced by them is so small. We will discuss their data only in comparison to the use of SC utterances by Carla (D) and the hearing children (Figures 6.Xa-d).

Carla mainly uses 'ff' and 'fc' SC utterances. This means that her mother need not see the words since she has access to the message through the signs, of which she sees a high percentage at all times (see section 6.2.1). Carla does produce some 'ss' utterances (10 in total), and proportionally more so than her mother (compare to Figure 6.IXa). At 1;6 and 2;6 Carla's mother misses approximately 55% of the words produced by Carla, which means that she may have missed the full proposition in these 'ss' utterances.

As said before, Laura and Mark produce only a few SC utterances; Laura only of the 'fc' category and Mark one 'ff' and three 'fc', which means that their mother had no need to access their words because she could access the utterances through the signing.

Jonas (H) produces an ever increasing percentage of 'ss' and 'cf' SC utterances (Figure 6.Xb). For these utterances it is essential that his mother can perceive the words - which she did with varying success at the different points in time. But at 3;0, when Jonas mainly produced 'ss' and 'cf' utterances, she saw less than 60% of the spoken words; this means that she did not have full access to many of Jonas' SC utterances.

Alex (Figure 6.Xc) does not sign very much until 2;6 (see also Figure 5.II) and his mother accessed only around 40% of his words. At 3;0 he signs more than before, both in SLN and in 'ss' (63%) SC utterances. But it is at this very age that his mother sees only 35% of his words. With Alex clearly focussing on spoken language we can conclude that his mother has limited access to her son's linguistic output.

Sander produces many 'ff', and 'fc' SC utterances up to 2;0 (Figure 6.Xd), after which age his production of 'ss' and 'cf' utterances increases. So until 2;0 there was a focus on signs, and later equally on signs and words. In Figure 5.Ilf we saw that Sander at all ages preferred either SLN or SC and never NL as his first language. Only at 3;0 we see an increase of 'cf' utterances, co-occurring with a slight increase in NL utterances. His mother had access to more than 60% of his words, so the conclusion is that Sander's mother has reasonable access to his output, somewhat better than Jonas' and Alex' mother.

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21 see Appendix to Chapter 6, Tables A6.16b and A6.16c, page 271
Figures 6.Xa-OUTPUT: Percentages of different categories of propositional content in the SC output of one deaf child and the hearing children

ff = fully signed and spoken
ss = supplementary signed and spoken
fc = fully signed, complementary spoken
cf = fully spoken, complementary signed
6.4 Relation between quantity of input and attention-giving development of the children

As we discussed in Chapter 2, Harris (1992) and Kyle et al. (1987) found a smaller quantity of input in their deaf mothers. These findings were not confirmed by our data (see Chapter 5). These authors suggest that the smaller quantity of input is probably due to the fact that visual attention is necessary in order to sustain a conversation in a signed language. Since children need to acquire the visual attention skills (Swisher 1992), we would thus suggest that the number of utterances produced by the deaf mothers might be related to (the development of) the visual attention-giving behavior of the children (research question 13 in section 3.2).

Method
We know that the number of spontaneous looks and the number of linguistic utterances increase over this period. We calculated the relation between number of linguistic utterances of the deaf mothers and the number of spontaneous looks of the children as follows. From the five points in time the highest number of linguistic utterances of the mothers was considered to be 100%. The number of utterances produced at the other four points in time, were then divided by the highest number of utterances. The same procedure was followed for the number of spontaneous looks of the children; the highest number of looks is 100%, and the number of spontaneous looks produced at the other points in time are divided by the highest number. This technique should indicate if and how the changes are related to one another.

Results
In Figure 6.Xla-f we present the percentages for the six mother-child dyads. There are no clear patterns here. The mother of Laura (D) and Mark (D) appears to react to the increase in spontaneous looks of the children, since the increase in number of linguistic utterances comes later. Carla's (D) mother increases steadily. The mothers of the hearing children increase the number of utterances ahead of the increase in spontaneous looks. The children's visual behavior seems to have no influence here.
We have no evidence to support Kyle et al.'s views. Furthermore we did not find that the mothers produced clearly less input.
Figures 6.Xia-f Relation (%) between the number of spontaneous looks of the children and the number of linguistic utterances of the deaf mothers.
6.5 Summary

Accessibility of language is an important issue in the context of deaf families. Signing, which has to be visually accessible, is seen by the children, both the deaf and the hearing, around 80% of the time from the first year on. There is little change over time, this is parallel to findings in England. The spoken input is available to the hearing children aurally since the mothers usually use voice, as opposed to mouthing. The deaf children need visual access to the spoken input, whether as Dutch or part of SC. Their access clearly increases to around 80% at 3 years for Laura and Mark. Carla also improves but still misses a considerable amount (40%) of the input.

The high rate of visibility for signing is partly a result of the mothers' continual visual monitoring of the children. They ensure that the children see signing by waiting for the child to look up and do so increasingly over time. They also produce the signs in the child's field of vision. They do sometimes explicitly attract the child's attention but this gets less as the children get older.

In general the children look up at their mother spontaneously more often in time and the mothers produce more utterances while the child is still looking. The mothers see the children's signing more than 80% of the time at all ages and there is no change. The spoken part is seen increasingly more by the mothers of Laura (D), Mark (D) and Sander (H), but this is more variable with Carla (D). No development can be seen with Jonas' and Alex' (H) mothers.

Some of the children learn to check visually before signing but their development is variable. The awareness of the link between looking and signing has led to spontaneous looking for communication of others but not for own production. In SC the semantic content of an utterance can be missed if accessibility is not optimal and the content is in one mode and not the other. The mothers initially express the full content in both signs and words, but this changes with all children, probably as a result of a decline in the number of one constituent utterances. With the deaf children an increase can be seen in utterances which are fully signed, with some overlapping words. With the hearing children utterances which are partly signed, partly spoken (ss) increase. Only Carla of the deaf children produces enough SC to analyze. All children show a decrease in fully spoken and signed utterances. Carla uses fully signed and partly spoken increasingly, the hearing children increase in partly signed and spoken (ss), and two of them in fully spoken, with some overlapping signs (cf).

The mothers' constant visual monitoring and waiting for visual attention behavior results in their language being seen but also promotes the growth of visual monitoring in the children. They are still learning to monitor visual attention for their own communication. However, in the input the model does not have a great affect by 3 years. The mothers mainly use voice in spoken utterances but the hearing children increasingly suppress voice. This reflects the influence of their awareness of the mother's deafness, not the input.
In the SC input the mothers increasingly produce a large amount of utterances that are fully signed and spoken; the children in these SC output also do so, but this decreases with time. This is more a reflection of the growing complexity of the input and output, than a direct influence from the input.

Carla's mother starts to produce more fully signed, partly spoken utterances and so does Carla. The mother of the hearing children start to produce more partly signed, partly spoken utterances and so do the children. The input seems to be influencing the output.

There are some striking differences between the deaf and hearing children that emerge from these analyses. Compared to the hearing children the deaf children increase more clearly in their amount of spontaneously looking; they react more adequately when the mothers begin to sign by looking at her. Two of the deaf children see more of the spoken input; Carla with the hearing children are more variable. The deaf children appear to be learning more quickly to make language accessible, which in view of their dependence on it is not surprising. Sander is in some respects an exception amongst the hearing children, since his behavior is often more comparable to the deaf children. The Simultaneous Communication in the input and output clearly begins to change in character with the deaf and hearing children. The emphasis with the deaf children is on signing, so the category of utterances fully signed, partly spoken becomes more important. With the hearing children the category partly spoken, partly signed (ss) increases for all children, and fully spoken, partly signed for two.

In these categories the spoken part is essential for the full proposition to come across – the mothers shift therefore in the direction of Dutch. The children reflect this input and the children's output becomes differentiated in the same way.