

# Code-blending by deaf children with a cochlear implant

*Master's thesis*

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## Table of contents

1. Introduction	p. 4
2. Cochlear implants and language development	p. 6
2.1 <i>What is a cochlear implant?</i>	p. 6
2.2 <i>Language development with a cochlear implant</i>	p. 7
3. Code-switching and code-blending	p. 10
3.1 <i>Spoken languages</i>	p. 11
3.2 <i>Sign languages</i>	p. 12
3.3 <i>Research questions and hypotheses</i>	p. 18
4. Methodology	p. 20
4.1 <i>Subjects</i>	p. 20
4.2 <i>Procedure</i>	p. 21
4.3 <i>Analysis</i>	p. 22
5. Results and discussion	p. 27
5.1 <i>Classification of utterances and code-blends</i>	p. 27
5.2 <i>Word types involved in the code-blends</i>	p. 31
5.3 <i>Code-blends and language abilities per child</i>	p. 32
6. Conclusion	p. 37

## 1. Introduction

Bilingualism is not uncommon. On the contrary, it is the norm in many parts of the world (Petitto et al. 2001). Children may either grow up learning two languages or learn a second language when they are older. In most bilingual situations two (or more) spoken languages are involved. Deaf people, however, often are bilingual in languages from two different modalities: a signed (visual) and a spoken (auditory) language.

A phenomenon that is very common in spoken language bilinguals is code-switching, “the alternative use by bilinguals of two or more languages in the same conversation” (Milroy & Muysken 1995, p. 7). This switching can occur between turns of different speakers, between sentences of one speaker, and even within sentences. The switching between spoken languages is almost exclusively<sup>1</sup> sequential, because it is logically impossible to utter words of two languages at the same time.

Sequential code-switching can also occur between a signed and a spoken language. One can imagine a situation in which a person starts a conversation or a sentence in sign and then switches to a spoken language or the other way around. However, with two modalities, there is yet another possibility: uttering signs and words at the same time. This opportunity of simultaneously using two languages is unique and only possible because two different articulators are involved. Given that the two languages are not used alternatively, the simultaneous use of two languages does not fit the above definition of code-switching, and is therefore termed code-blending (Emmorey, Borinstein & Thompson 2005).

Code-blending has been studied for both hearing (e.g. Emmorey et al. 2005) and deaf bilinguals (e.g. Baker & van den Bogaerde 2008). In this study code-blending of another group of language users will be explored: deaf children with a cochlear implant. This is an interesting group, since these children might be considered as being neither deaf nor hearing, with respect to access to linguistic information from a spoken language. The cochlear implant provides them with auditory information that they could not access before implantation, but it does not make them hearing. This is one of the reasons why deaf children with cochlear

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<sup>1</sup> There are code-switches in which some words are identical in the two languages. These words can initiate a switch and it is unclear if these words belong to one of the languages or to both. Like in the Dutch/English sentence: “Ik wil een goede planning, because that’s important”. In this sentence *planning* is both correct in English and in Dutch, so one might argue that two languages are being used at the same time.

implants in the Netherlands (unlike some other countries) are often provided with both spoken and sign language input in school. Therefore these children can be considered as bilingual in signed and spoken language. Within this group of children the degree of bilingualism may vary since input is not exclusively provided in school, but also in other environments.

The bimodal-bilingualism of the children with cochlear implants investigated in this study also results in the use of code-blended utterances. Baker & van de Bogaerde (2008) have compared the code-blends from deaf children and hearing children of deaf parents. They found that there was a qualitative difference in the code-blends the children produce. One of the main factors that may be held responsible for this difference is the access to spoken language.<sup>2</sup> Since the access to spoken language in children with a cochlear implant is different from both deaf and hearing children, their code-blends might show other characteristics. Based on this hypothesis, I formulated the following research questions:

*Do code-blends of deaf children with a cochlear implant show certain structural patterns?  
Are the characteristics of their code-blends comparable to the code-blends of deaf or hearing children?*

This thesis is organized as follows. In chapter two I will explain what a cochlear implant is and how it affects the language development, in order to provide some background information on the children in my study. I will then describe some of the characteristics of code-switching in spoken languages (chapter 3.1). This will serve as a framework in the analysis of the data. In section 3.2, I will present the results of some previous studies on code-blending in different groups of sign and spoken language users (deaf children without a cochlear implant, hearing children and hearing adults). After presenting all these aspects of the theoretical background, I will present the current study in chapter four. Chapter five will be dedicated to discussing the current study in relation to earlier studies.

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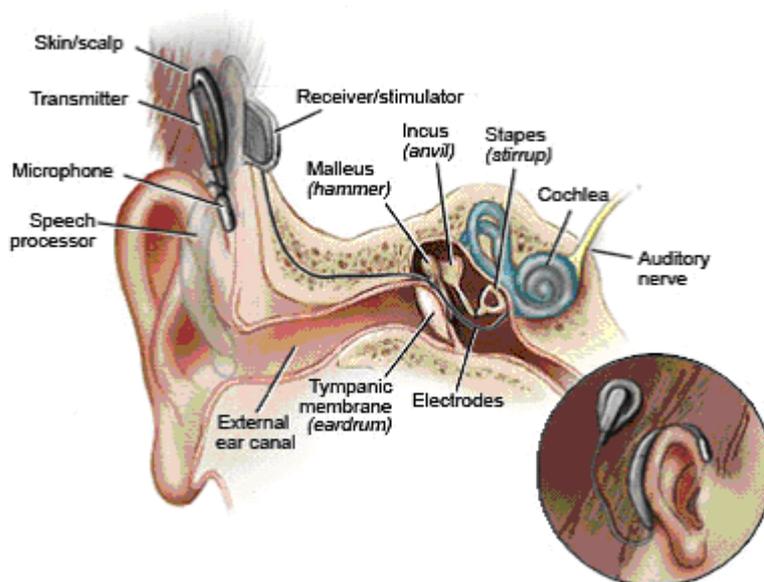
<sup>2</sup> Of course there could also be social factors involved (see Plaza Pust 2005)

## 2. Cochlear implants and language development

In order to provide some background information on the children in this study, section 2.1 is devoted to explaining what a cochlear implant (CI) is. In section 2.2 I will go in to the language development of children with a CI.

### 2.1 What is a cochlear implant?

A cochlear implant is a device that takes over the functions of the middle and inner ear and stimulates the (intact) auditory nerve directly. The implant consists of two parts: a part that is implanted and an external part. (see figure 1) A microphone behind the ear picks up sound waves and sends them to the (external) speech processor. The speech processor modulates the signal which is then conducted to a transmitter behind the ear. The signal is picked up via induction by a receiver under the skin which sends the signal to the electrodes in the cochlea (Coerts, Baker, van den Broek & Brokx 1996).



**Figure 1 Cochlear implant (<http://www.kidshealth.org/parent/general/eyes/cochlear.html>, 2-5-2008)**

The number of electrodes can differ depending on the type of implant, but generally there are around 20 electrodes. These 20 electrodes have to replace the 30.000 sensory cells that a normal hearing person has. This means that only part of the auditory signal is available to a deaf person with a CI. Spencer (2002, p 223) provides an illustrative metaphor to imagine what it is like for a child with a CI to make sense of the “impoverished” auditory signal. She compares it to trying to draw a complete picture of an unfamiliar exotic animal that is

standing behind a picket fence. Only parts of the animal are actually visible and the other parts of the animal have to be completed in one's mind.

## *2.2 Language development with a cochlear implant*

It is known that deaf children experience serious problems in acquiring a spoken language. Therefore, the main reason for parents to decide in favour of a CI for their deaf child is that they want to provide their child with access to a spoken language so it can acquire a spoken language. Parents hope that their child will both understand and produce spoken language, so he/she can easily interact with hearing people. However, as explained above, a deaf person with a CI does not receive input of the same quality as a person with normal hearing.

Cochlear implants provide many deaf children with enough information to understand and produce spoken language, but not all children receive enough information (Spencer 2002, p. 226). In other words: the results vary. However, many researchers have concluded that cochlear implants have a greater effect on developing speech perception than conventional hearing aids (Spencer 2002, p, 227).

There are several factors that influence the effectiveness of a CI. One of the main factors is the age of implantation. According to Tomblin, Barker & Hubbs (2007) the age of implantation has decreased in recent years and the main reason for this decrease is the fact that earlier implantation results in better spoken language development.

Another factor that obviously influences the language development of children with cochlear implants is their language input. There have been several studies on this topic, but the researchers come to different conclusions. Connor, Hieber, Arts & Zwolan (2000) compared the language development of implanted children in total communication settings with that of implanted children in oral programs. In the majority of the total communication settings, a signed system based on spoken English was used. In the oral programs spoken languages was used, sometimes in combination with some training in lipreading. Children in both groups showed the same growth in receptive spoken language vocabulary, but for the children implanted before the age of 5 the receptive vocabulary scores were higher for the total communication children than for the children in oral programs. On expressive vocabulary

measures the total communication group also showed higher scores and growth rates, but only for those children who received their implant during preschool or early elementary school.

Geers, Nicholas & Sedey (2003) tested comprehension and production of English in prelingually deaf children, that had been using their implant for four to seven years. They found that children that used a visual language system did not perform better than the children in oral programs. The children that received oral education even had a broader vocabulary, longer and more complex utterances, better use of bound morphemes and better use of narrative form. Even if the sign productions of the total communication children were added, there was still an advantage for the oral group in both spoken and total language skills. Another study on CI children from different language environments was conducted by Wiefferink et al. (2007). Children growing up in a dominantly monolingual environment (Flemish children) were compared to children growing up in a bilingual environment (Dutch children). The children were followed in their language development (amongst other aspects of development) for a period of three years. Their language development was assessed both on the basis of standard tests and spontaneous language data. According to Wiefferink et al. (2007) children from both the monolingual and the bilingual group showed progress in auditory perception. Development in spoken language and speech intelligibility, however, showed more progress in the children from the monolingual environment than the children in the bilingual environment. The children in the bilingual environment, logically knew more signs than the monolingual children, but their development in NGT did not show progress over the three years. All children seemed to develop a preference for spoken language. The difference in spoken language development between the monolingual and bilingual environment is not necessarily due to the difference in language environment, because the two groups of children also differed in other respects. One difference probably that has influenced the results is the fact that the children from the bilingual group were implanted at a later age than the children from the monolingual group.

Another important issue in the language development of children with cochlear implants is the issue of language choice during the development. Watson, Archbold & Nikolopoulos (2006) investigated the communication mode of children with cochlear implants over a period of five years after implantation. The children were divided into three groups according to age of implantation: implantation before three, between three and five, and after five years of age.

Some of the children were enrolled in oral programs, others in settings with a total communication approach, and yet another group in settings with a bilingual approach. The communication mode of the children was noted at four points in time: pre-implantation, one, three and five years post-implantation. Communication mode was classified as either sign or oral, with sign including BSL and spoken English with sign support and oral being exclusively spoken language. The classification was made by the child's cochlear implant teacher in consultation with the local teacher of the deaf.

The results show that taken together 61% of the children are using oral communication at five years after implantation. Moreover, there was a difference between groups: the younger the children were at implantation, the more they were using oral communication. Many children changed their communication mode over the course of the five years after implantation from signed communication to oral communication. This trend was particularly strong for the group of children that was implanted before the age of three. A similar trend was noticed in the second group, those implanted between three and five. The third group however, did not show this trend towards oral communication. The children implanted after the age of five mostly used the mode of communication that was also used pre-implantation, this was oral communication for 46 % of the children and sign communication for 54 % of the children.

In Watson et al. (2006) teachers were asked what kind of communication mode the child used. Watson, Hardie, Archbold & Wheeler (2008), however, asked the same question to parents, by means of a questionnaire. It is unclear whether these were the parents of the children in the earlier study. The responses of the parents showed the same pattern as Watson et al. (2006). Most of the children shifted towards using spoken language instead of sign language.

In the context of the present study, it is important to note that code-blending was not explicitly discussed in these studies (Watson et al. 2006, 2008). It is most likely that this type of utterances were considered as signed, since sign supported English was classified as a signed mode of communication.

In sum, there are several factors that influence language development in children with a CI. Earlier implantation provides better results in spoken language development than late implantation. The effects of sign or spoken language input on the language development of CI children remain unclear. It is clear, however, that many CI children that start off using sign language eventually shift towards using spoken language.

### 3. Code-switching and code-blending

In order to provide a complete picture of how languages can be mixed, this chapter will first focus on the processes underlying code-switching and the structure of utterances that contain code-switches in spoken languages (section 3.1). Subsequently, in section 3.2, I will discuss earlier studies on code-blends, in which spoken languages and sign languages are involved.

#### 3.1 Spoken languages

According to Muysken (2000) bilinguals produce sentences with words from more than one language in ordinary conversations. One might expect that this mixing of languages is due to insufficient proficiency in one of the languages: if the speaker misses a word from one language, he would simply use the equivalent from the other available language. This, however, is not the case. Mixed sentences are produced fluently and easily and are often uttered by quite proficient bilinguals (Nortier 1990). The sentences that contain such code-mixes<sup>3</sup> have been analysed from a grammatical perspective. It turned out that the code-mixes are not distributed randomly, but occur at specific points in the sentences (Muysken 2000).

Muysken (2000) distinguishes three different processes in code-mixing: insertion, alternation and congruent lexicalization. In the process of *insertion* material from one language is inserted in a structure from the other language. The inserted material can be a single lexical item, as in example (1a) (Canfield 1980:219, In: Muysken 2000, p. 5).

1a. na'iish-crash lá

1sg:pass out-crash EMPH

'I am about to pass out.'

(Navaho/English)

1b. Yo anduve *in a state of shock* por dos días.

'I walked in a state of shock for two days.'

(Spanish/English)

The inserted material can also be more than one item. In example (1b), for instance, an entire English prepositional phrase is inserted into a Spanish structure (Pfaff 1979:226, in Muysken 2000, p.5).

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<sup>3</sup> Muysken (2000) uses this term instead of code-switch, because he thinks this term is more neutral. The term code-switching only seems appropriate for the alternational type of mixing.

As far as the insertion of elements is concerned Muysken (2004) points out that some types of elements are more easily inserted than others. The likelihood of insertion of an element depends on three characteristics: category, complexity and morphology. For each of these characteristics Muysken suggests a hierarchy of insertability. For example, for category, nouns are most easily inserted followed by adjectives etc. The three hierarchies proposed by Muysken (2004, p. 153) are the following:

- a. **category:** *nouns < adjectives < adverbs < verbs < adpositions < conjunctions < ...*
- b. **complexity:** *stems < compounds < fixed phrases < modifier + head combinations < discontinuous idioms < ...*
- c. **morphology:** *nominal plural < participle ending < derivational morphology < ...*

In the second code-switching process, *alternation*, there is a switch from one language into the other, this switch is in both lexicon and grammar. The difference between insertion and alternation is that in the process of insertion elements from one language are embedded in a structure from the other language, while in alternation one language is replaced by the other, as in example (2) (Nortier 1990:126, In Muysken 2000, p. 5)

2. maar 't hoeft niet      li- 'anna ida šefy ana ...  
 but it need not          for when I-see I  
 'but it need not be, for when I see, I...'  
(Moroccan Arabic/Dutch)

In the process of *congruent lexicalization* the involved languages (completely or partially) share the structure of the sentence. The lexicon from two languages is used. Consider the example in (3). (adapted from Pfaff 1976:250, In: Muysken 2000, p. 6)

3. Bueno, *in other words*, el *flight* que sale de Chicago *around three o'clock*.  
 'Good, in other words, the flight that leaves from Chicago around three o'clock.'  
(Spanish/English)

When considering these types of code-mixes (insertion, alternation and congruent lexicalization), the sequential nature of these mixes is apparent. The importance of the notion

of sequentiality will become clear in section 3.2, where the mixing of signed and spoken languages will be discussed.

### *3.2 Sign languages and spoken languages*

In this section I present two earlier studies on code-blending in a signed and a spoken language. The first study was conducted by Emmorey et al. (2005) and focused on hearing adult bilinguals in ASL and Spoken English. The second study, by Baker and Van den Bogaerde (2008), investigated code-blending in both hearing and deaf children bilingual in Dutch and NGT.

Code-blends are interesting, because a signed and a spoken language, unlike two spoken languages, can be combined simultaneously. Emmorey et al. (2005) investigated code-blending between American Sign Language (ASL) and spoken English. Eleven fluent<sup>4</sup> bilinguals participated in their study, ranging from 22 to 41 years of age. All participants were hearing, and had at least one Deaf parent (CODA's, Children Of Deaf Adults).

The study by Emmorey et al. (2005) consisted of three tasks. In the first task the participants conversed with either another ASL-English bilingual who was familiar to them or with an English monolingual who was not familiar to them and did not know any ASL. The order of conversation partners was alternated. The topic of the bilingual conversations was CODA experiences (e.g. interpreting for parents). For the monolingual conversation the topics were more general (e.g. differences between men and women). The second task in this study was to watch a seven-minute cartoon and retell the cartoon to their conversational partner. The subjects had to tell the cartoon to both a bilingual and a monolingual (again the order of conversation partners was alternated). In the last task participants were asked to retell the cartoon to a bilingual conversation partner again, this time, however, using SimCom. In SimCom signs and words are produced at the same time.

Emmorey et al. (2005) only discuss the results of the last two tasks, because for these two tasks the bilingual and monolingual situation were more easily comparable, due to the fact that the linguistic content was the same. In the bilingual situation for retelling the cartoon all participants used spoken English accompanied by infrequent or frequent use of ASL signs, except for one participant who chose to tell the story entirely in ASL. It turned out that code-

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<sup>4</sup> They rated themselves 6 or higher on 7-point fluency scale.

switching (stop talking and start signing) was very rare. Only 5 % of all ASL signs in their data were not accompanied by speech. Code-blending was more common. In a code-blended utterance signs are produced simultaneously with words, as in example (4) and (5) adapted from Emmorey et al. (2005, p 666)

4. Signed: JUMP  
Spoken: So Sylvester who's on the ledge jumps into the apartment

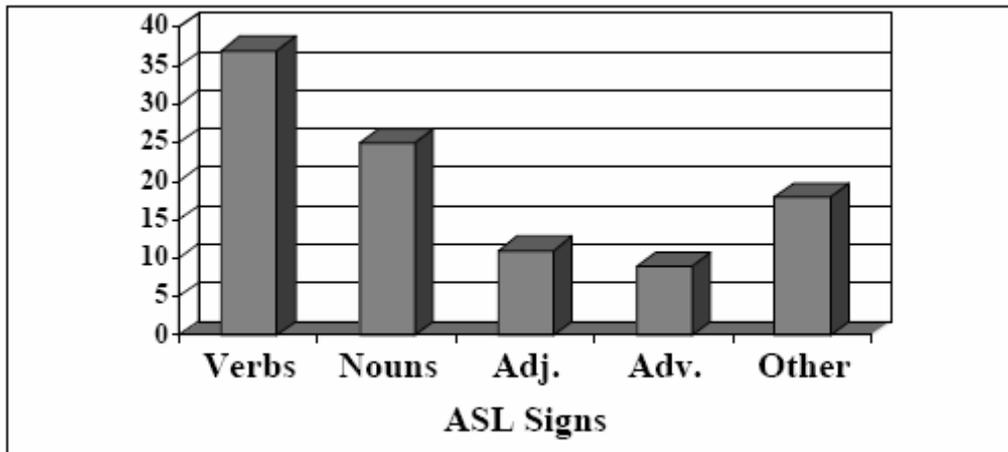
5. Signed: NOT THINK REALLY LIVE  
Spoken: I don't think he would really live

In these examples the signs that are being used are semantically congruent with the English words and this is the case for 94% of all code-blends. This means that in 6% of the code-blended utterances the signs and words do not share the same semantic content. This is illustrated by the example in (6), in which the ASL sign and the English word provide different information (adapted from Emmorey et al. 2005, p. 666).

6. Signed: LOOK-AT-ME  
Spoken: He's like hmm all of a sudden Ack

In this example the sign LOOK-AT-ME is produced simultaneously with the English words "all of a sudden." The signs and words together convey the complete message of the utterance.

Emmorey et al. (2005) also looked at the syntactic properties of the code-blended utterances. They specified the syntactic functions of the signs that occurred in the code-blends and found that verbs were most frequently code-blended followed by nouns (see figure 2). This is in contrast to the findings of Muysken (2000, 2004) who found that in spoken languages, nouns were most easily code-switched, whereas verbs were switched much less often.



**Figure 2 Grammatical categories of ASL code-blends (Emmorey et al. 2005, pp. 667)**

Bimodal utterances have also been studied by Baker and Van den Bogaerde (2008). In contrast to Emmorey et al. (2005), they have investigated bimodal utterances of deaf and hearing children from deaf families. The six children in their study were early bilinguals, learning Dutch and Sign Language of the Netherlands (NGT). The deaf children did not have full access to spoken Dutch and acquired the spoken language through speech reading.

The data was obtained earlier by filming the children in interaction with their deaf mothers (see Van den Bogaerde (2000) for a detailed description). All children were filmed at three years of age and two of the children were also filmed at six years of age. Both the input to and output from the children was analysed. Baker and Van den Bogaerde (2008) created three categories of utterances: Dutch, NGT and code-blended. An utterance is considered code-blended if it consists of both signs and words. Crucially, Baker and Van den Bogaerde also include words that are produced without vocalization.

The code-blended utterances were divided into four categories: code-blended with Dutch as base language, code-blended with NGT as base language, code-blended mixed and code-blended Full. This division is made on the basis of semantics. In a code-blend with Dutch as base language the proposition is uttered in Dutch and signs are added simultaneously, but the signs do not add extra meaning. One sign is semantically congruent with one word, as in example (7) from Baker and Van den Bogaerde (2008).

7. Signed: VALLEN  
 Spoken: die gaat vallen  
 English: that goes fall  
*Translation: That [doll] is going to fall*

In this example, the utterance is in spoken Dutch but while uttering the word *vallen* ('fall'), the sign VALLEN ('fall') is articulated. The lexical meaning of the verb is the same in signed and spoken language and therefore they are semantically congruent. However, the sign VALLEN in this case contains a classifier handshape and therefore provides more information than the Dutch word. The utterance in (7) happens to be structured according to Dutch morpho-syntactic rules, but due to the fact that the children are still in a developmental stage, Baker and Van den Bogaerde do not consider this a criterion for analysing an utterance as a code-blend with Dutch as base language. The fact that the utterance is mostly in Dutch and some signs are added is enough to categorise this utterance as having Dutch as the base language.

The next category is code-blended with NGT as base language. Utterances of this category are fully signed, with some spoken words added that do not contribute meaning to the utterance. As in the code-blends with Dutch as base language, the simultaneously uttered signs and words are semantically congruent. The following example is given by Baker and Van de Bogaerde (2008):

8. Signed: INDEX<sub>hij</sub> JAS BLAUW  
 Spoken: blauw  
 English: INDEX<sub>he</sub> COAT BLUE  
 blue  
*Translation: He has a blue coat*

In this utterance the sign BLAUW ('blue') and the word *blauw* ('blue') share the same meaning and word class. The sentence is structured according to the rules of NGT, but as for the utterances with Dutch as base language this was not a criterion. The utterance is considered NGT based, because the proposition is in NGT.

The third category of code-blending is code-blended mixed. In this type of utterance both words and signs are necessary to compose the meaning of the full utterance. Consider the example in (9) from Baker and Van den Bogaerde (2008).

9. Signed:       POLITIE  ANDER  MENSEN  SCHIETEN  
 Spoken:        politie  andere  mensen  doodmaken  
 English:       POLICE  OTHER  PEOPLE  SHOOT  
                   police  other  people  kill  
*Translation:  The police shot the other people*

In this example the final simultaneously uttered elements belong to the same word class (verb), but are semantically different. The sign SCHIETEN ('shoot') is more specific than the Dutch word *doodmaken* ('kill'). The two verbs are uttered simultaneously at the end of the sentence. This is a common position for a verb in NGT, but in Dutch main clauses verbs are in V<sub>2</sub> position.

There are also examples of code-blended mixed utterances where the simultaneously uttered elements belong to different word classes; see example (10) (Baker and Van den Bogaerde, 2008).

10. Signed:       DAN  HARD  GENOEG  
 Spoken:        dan  als  genoeg  
 English:       THAN  HARD  ENOUGH  
                   then  when  enough  
*Translation:  Then, when [the fish] is hard, it is enough*

In this utterance the sign HARD ('hard') is combined with *als* ('when'). These elements belong to different word classes: HARD is a content word and *als* is a function word. Both the signs and the words are necessary to fully understand the utterance.

The last category of code-blended utterances according to Baker and Van den Bogaerde (2008) is the full code-blend. In this type of utterance the proposition is uttered fully in both words and signs. The utterances do not have to be structurally complete in either NGT or Dutch (see example (11)).

11. Signed:       BOEK PAKKEN  
Spoken:       boek pakken  
English:       book fetch  
*Translation: [I will] fetch the book*

Baker and Van den Bogaerde found that there was a difference between the deaf and hearing children in the amount of code-blends. The utterances of the deaf children were predominantly in NGT and the utterances of the hearing children were predominantly code-blends. Also the code-blended utterances of the deaf children were shorter than the utterances of hearing children. The authors relate this finding to characteristics of the input, since the average number of words in code-blended utterances to the hearing children is also higher than in code-blended utterances to the deaf children. Another factor that might be involved is the fact that deaf children have less access to spoken language.

As far as the type of code-blending is concerned the difference between the deaf and hearing children is clear. The deaf children mainly produce code-blends with NGT as base language. The code-blends of the hearing children are mainly of the types Dutch as base language and mixed. The hearing children also produce some full code-blends, but almost no code-blends with NGT as base language. One of the main reasons for this difference is probably the limited access to spoken Dutch for the deaf children. The children with cochlear implants to be considered in the present study might shed additional light on this topic, because one might expect them to behave differently from the deaf children, given that they generally have more access to spoken Dutch.

Just like Emmorey et al. (2005), Baker and Van den Bogaerde analysed the code-blended utterances according to the grammatical categories involved (see table 1). For both groups of children, they found that nouns are most often code-blended, followed by verbs, which is in line with the findings of Muysken (2000) for spoken languages. Remember that in the study by Emmorey et al (2005) it was the other way around: verbs were more frequently code-mixed than nouns. The most important difference between the deaf and the hearing children is the use of pronouns in the code-blends. In the code-blends of the deaf children no pronouns are involved, whereas the hearing children do produce code-blends with pronouns involved.

**Table 1 Grammatical categories of code-blends expressed as a percentage of all forms in that category in children and mothers (collapsed data) (Baker & van den Bogaerde 2008)**

	Verbs	Nouns	Pronouns	Adj/Adv	Question words
Deaf children	50	56	0	47	(0)
Hearing children	38	52	36	24	(50)
Mothers with deaf children	63	75	4	56	59
Mothers with hearing children	43	61	13	37	65

Figures provided in brackets are percentages calculated on fewer than 10 instances in total

### 3.3 Research questions and hypotheses

Muysken (2000), Emmorey et al.(2005) and Baker & van den Bogaerde (2008) studied code-switching or code-blending. They all paid attention to the different types of switches and blends and the word types that are most likely to be part of a switch or blend. Muysken also shows hierarchies of complexity and morphology. I will not go into these since the categories within these hierarchies are difficult to establish for sign languages.

With regard to the types of switches and wordtypes involved in blends, different patterns were found. These differences can be caused by a number of factors, for instance, the difference in populations and languages studied. In the current study I describe the code-blending patterns as found in children with a cochlear implant. In doing so, I address the following questions:

1. Do code-blends of deaf children with a cochlear implant show a structural pattern with regard to
  - a. the types of code-blends used, and
  - b. word types that are involved in their blends?

As Baker & Van den Bogaerde (2008) suggest, the types of code-blends that are being produced probably depend on the access to spoken language. For deaf children, the limited

access to spoken language causes a delay in spoken language development. The authors were able to show that the deaf children in their study have a preference for using NGT, given that their utterances were predominantly NGT. This preference for NGT is also reflected in their code-blends: most of their code-blends have NGT as base language. The hearing children show an entirely different pattern. They use little NGT and they produce many code-blends. This is in fact their main mode of communication. Their code-blends are in most cases mixed or have Dutch as base language

Since the group of children in the current study use a cochlear implant, their language choice could be different from both the hearing and the deaf children. As was shown in Watson et al. (2006), the preferred language mode of implanted children can even change over time, mostly from signed to spoken language. Since language preference and ability was also reflected in the code-blends of the deaf and hearing children, I also want to answer the following questions:

2. Are the characteristics of the code-blends of implanted children comparable to the code-blends of deaf or hearing children?
3. Do the types of code-blends produced reflect the abilities of the individual children in sign and/or spoken language?

## 4. Methodology

The data that has been used for this study was part of the data collected for a research project of the Dutch Foundation for the Deaf and Hard of Hearing Child (NSDSK, Nederlandse Stichting voor het Dove en Slechthorende Kind, Amsterdam), the Royal Institute for Deaf and Speech Impaired (KIDS, Koninklijk Instituut voor Doven en Spraakgestoorden, Hasselt) and the Independent Information Centre on Cochlear Implantation (ONICI, ONafhankelijk Informatiecentrum over Cochleaire Implantatie, Zonhoven) with funds from ‘Stichting Kinderpostzegels Nederland’ and ‘Nationaal Revalidatiefonds’. A detailed description of the research project and a discussion of the results can be found in Wiefferink et al. (2007)

As was already mentioned in section 2.2, two groups of children with cochlear implants were compared within this research project: children growing up in a dominantly monolingual environment (Flemish children) and children growing up in a bilingual environment (Dutch children). The children were followed in their development for a period of three years. During these three years there were five assessments: a pre-test before implantation and four post-tests at 6, 12, 24 and 36 months after implantation. Several aspects of development were assessed: preverbal communication, auditory perception, spoken Dutch, NGT, speech intelligibility and quality of life. Development in spoken Dutch and NGT was measured by means of standard tests and spontaneous data.

Since the focus of this study is on code-blending with signed and spoken language, the spontaneous data of only the bilingual children has been used. In the following sections I will further present the bilingual subjects, explain the procedure and the analysis of the spontaneous language data of the bilingual children.

### 4.1 Subjects

A total of seven bilingual children were part of the original study: four boys and three girls. One of the girls, Lisa, was not included in my analysis, for two reasons: part of the spontaneous data were missing for this child and secondly she uttered only two Dutch words in the collected data. This was drastically different from the other children.

The remaining six children (presented in table 2) had a bilingual school environment and bilingual early professional support, both spoken Dutch and NGT were used. All parents were

hearing and were advised by professionals to use bilingual communication with their child. Therefore, the parents had all taken sign language courses, but they were not skilled enough to use NGT at home. Most parents spoke Dutch and used the NGT signs to support the spoken language. According to the parents the amount of signs that was used declined over time.

**Table 2 Overview of participants' characteristics (adapted from Wiefferink et al. 2007)**

	<b>Gender</b>	<b>Age of implantation</b>	<b>Start hearing aid</b>	<b>Start professional support</b>	<b>Developmental scores<sup>5</sup></b>	<b>Threshold of audibility (db)</b>
<b>Max</b>	M	2;1	1;0	0;11	92	74
<b>Tim</b>	M	2;1	2;0	1;1	108	91
<b>Thomas</b>	M	1;11	1;4	1;2	104	115
<b>Sanne</b>	F	1;8	1;3	1;2	101	95
<b>Lars</b>	M	2;3	1;7	2;4	98	96
<b>Fleur</b>	F	2;0	1;3	1;3	86	100

The children were implanted at a relatively young age, ranging between 1 year and 8 months and 2 years and 3 months of age. Max, Tim, Sanne and Fleur experienced no technical problems with their CI and wore their CI almost every day during the period of data collection. According to Wiefferink et al. (2007) Thomas had a period of several months during which he sometimes took off the external part of the CI. After some technical adjustments, he wore it without problems. Lars did not wear his CI at home for a while (the length of this period is unknown), but later on started wearing it more often.

The children had developmental scores within the norm-scores. They all scored above 85 on intelligence or developmental tests, i.e. at least within one standard deviation of the norm (100).

#### *4.2 Procedure*

The spontaneous language data of the children was collected at three points in time: 12, 24 and 36 months after implantation. The children were filmed in interaction with an experimenter in a familiar environment, either in their own home or at their school. At each of the assessments the children interacted with a hearing experimenter using spoken Dutch (sometimes supported with signs) and a deaf experimenter using NGT. Several toys and

<sup>5</sup> On the basis of SON-R, BOS, WPPSI or BSIP

books were used to provide a starting point for conversation. Both the spoken and sign language data were transcribed in CLAN.

There were several measures of language development used in order to answer the questions about the influence of language development on the types of code-blends.

One of the measures of language abilities was the CDI (communicative development inventory) list, both for Dutch (Zink and Lejaegere 2002) and NGT<sup>6</sup>. The list for Dutch consisted of 103 words and the list for NGT consisted of 144 signs. These lists were filled out by parents to follow the lexical development of the children in the two languages. The parents had to indicate for every word or sign on the list whether their child used it.

Another measure of language ability was the Schlichting test of language development. With this test only the abilities in spoken Dutch were measured. The children did two parts of the test: sentence development and word development. The sentence development test consisted of 40 items and was designed to measure active syntactic development. The items elicited syntactic structures by means of toys and test materials. The word development test consisted of 62 items, to measure active vocabulary, in which the child had to name concrete objects and pictures (Wiefferink et al. 2007, p. 38 ).

A last indicator of language development in NGT and Dutch was based on the spontaneous language data, in the form of Mean Length of Utterance (MLU).

#### *4.3 Analysis*

The first step in the analysis was identifying the code-blended utterances in the data. I considered all utterances in which both signs and words were uttered as either a code-blend or code-switch. If (part of) the signs and words were uttered simultaneously the utterance was classified as a code-blend. If signs and words occurred within one utterance, but not simultaneously, the utterance was classified as code-switch. Only the code-blends were further analysed.

It is important to note that I have only considered utterances in which words were produced with vocalisation, like Emmorey et al. (2005), but in contrast to Baker and Van den Bogaerde

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<sup>6</sup> The “CDI” list for NGT was a preliminary list and there are no norm scores or validity and reliability measures for this list.

(2008). The children in this study have a cochlear implant and therefore more spoken language input than deaf children. This results in the production of more vocalisations by the CI children than by the deaf children. Another reason for only analysing the code-blends with vocalisations is the fact that mouth pictures are a part of NGT (Schermer 1991, p.59). This means that producing a sign and pronouncing a word without vocalisation is not necessarily using two languages, which means it is not code-blending. Therefore the utterances without vocalisations were not analysed as code-blends.

A problem that arose in classifying the code-blends, lay in the developing phonology, because the children were still in a developmental stage, some words did not sound exactly like the target word. However, it was often possible to unravel the meaning on the basis of context or the co-occurring signs. I decided to consider a vocalisation as a word when the meaning of the word could be derived and the word had at least one phoneme in common with the target word. For example Tom at 24 months after implantation signed “ZIEK” (ill) and while he signed this he vocalised “ie”. In this case it is highly probable that Tom wanted to say “ziek”, because he produces the sign and one phoneme of the spoken word. This means that “ie” was counted as a word.

A related problem was what to consider a sign and what a gesture. For many signs it was clear that they were lexical signs that were part of NGT. Some signs, like waving for saying hello could also be considered as gestures, because people with no knowledge of sign language use this all the time. The argument could be bended in two ways, but I decided for waving (and some other conventionalised gestures) to be a gesture and I consistently excluded those from analysis. For the lexical signs I used more or less the same rules as for the spoken words. The sign had to be recognisable from context, but not all parameters had to be correct. If for example the sign was produced with a different handshape, it was still counted as a sign.

After the identification and transcription (in glosses) of the code-blends, I could analyse the utterances further. The utterances were categorised according to the four categories proposed by Baker and Van den Bogaerde (2008): Dutch-based, NGT-based, Full and Mixed.

In assigning the utterances to the different categories, the following criteria, based on Baker and Van den Bogaerde (2008) were used.

1. Dutch-based: The proposition is uttered entirely in Dutch and signs are added. The added signs do not contribute additional meaning. In other words, the

signs need to be semantically congruent with the words that they simultaneously occur with.

2. NGT-based: The proposition is uttered entirely in NGT and words are added. These Dutch words do not contribute additional meaning. The words that are added are semantically congruent with the signs that they simultaneously occur with.
3. Full: The utterance is both fully signed and fully spoken. The signs and words are semantically congruent.
4. Mixed: Utterances in which signs and words are being used and both the signs and words are necessary to make up the full preposition.

In most cases the categorisation was clear and easy to apply. Some utterances, however, were difficult to classify, as in example (12).

12. Signed:	INDEX	plaatje	SINTERKLAAS
Spoken:	dat is	_____	sinterklaas
English:	INDEX	picture	SANTA CLAUS
	that is	_____	Santa claus <sup>7</sup>
			(Max:36 months after implantation)

Strictly speaking there is a verb uttered in Dutch that is not expressed in NGT. This would imply that this utterance should be classified as having Dutch as base-language. However, in NGT, no copula is necessary to complete the utterance. Therefore this type of utterance was classified as full.

The code-blends were also classified for word type. I distinguished between nouns, verbs, adverbs, adjectives, pronouns, onomatopoeic expressions and a rest category. These word types correspond to the word types that were distinguished by Baker and Van den Bogaerde (2008), except for the newly created category of onomatopoeic expressions. I created this new category, because I felt that the use of these expressions could be a difference between deaf children and deaf children with a cochlear implant. Most words in the data were easily classifiable, but in a case of doubt the decision was made on the basis of the word

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<sup>7</sup> Strictly speaking “Sinterklaas” cannot be translated as “Santa Claus”, but they are very much alike. Sinterklaas is a Dutch tradition with an old bearded man bringing presents on December the 5th.

classification in the ANS (Algemene Nederlandse Spraakkunst, General Dutch Grammar).<sup>8</sup>  
The ANS provides information on the grammatical aspects of contemporary Dutch.

In addition to the classifications, I also wanted to measure utterance length. Utterance length of the code-blends was counted in semantically different words. Consider examples (13) and (14).

13. Signed: CHAIR  
Spoken: brown

14. Signed: CHAIR  
Spoken: chair

The utterance in (13) was counted as 2 units, because the sign and the word are semantically different, but the utterance in (14) was counted as 1, because the sign and the word share the same meaning.

In order to be as specific as possible about my analysis I have listed the additional rules that I used below:

- Both headshake only negation, manual-only negation and headshake and manual negation were counted as 1 segment. If the negation was present and NGT, but not in Dutch, the utterance was classified as mixed.
- Palm up was not counted as a sign.
- An onomatopoeic expression (for example an animal sound), in combination with the noun or verb the sound belongs to, was analysed as full. In the word type classification the onomatopoeic segment was classified.
- Indexes that occurred with Dutch pronouns were classified as full.
- Not all words from an utterance, but exclusively words and signs that were part of the blend were classified for word type.
- In mixed utterances word type was both classified for NGT and Dutch.

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<sup>8</sup> On-line available on: <http://www.let.ru.nl/ans/e-ans/>

In comparing the characteristics of the code-blends of implanted children with those of deaf or hearing children, I will use the results of Baker and Van den Bogaerde (2008).

In order to find out whether the language abilities and language preferences of the children were reflected in their code-blends, the abilities of the individual children in sign and spoken language were measured. The abilities in NGT were reflected in the results on the preliminary CDI list and in the MLU of the NGT utterances. The abilities in spoken Dutch were measured in MLU of the spoken language utterances, the results of the CDI and the Schlichting test.

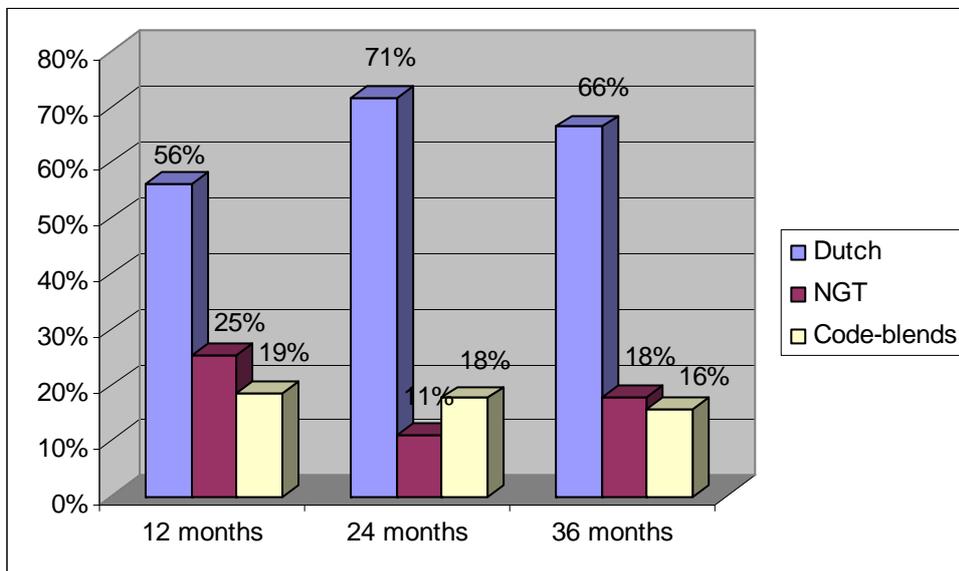
MLU was measured in words instead of morphemes, because determining morphemes in a sign language is not straightforward. Interjections and indices that stood on their own were not counted.

## 5. Results and discussion

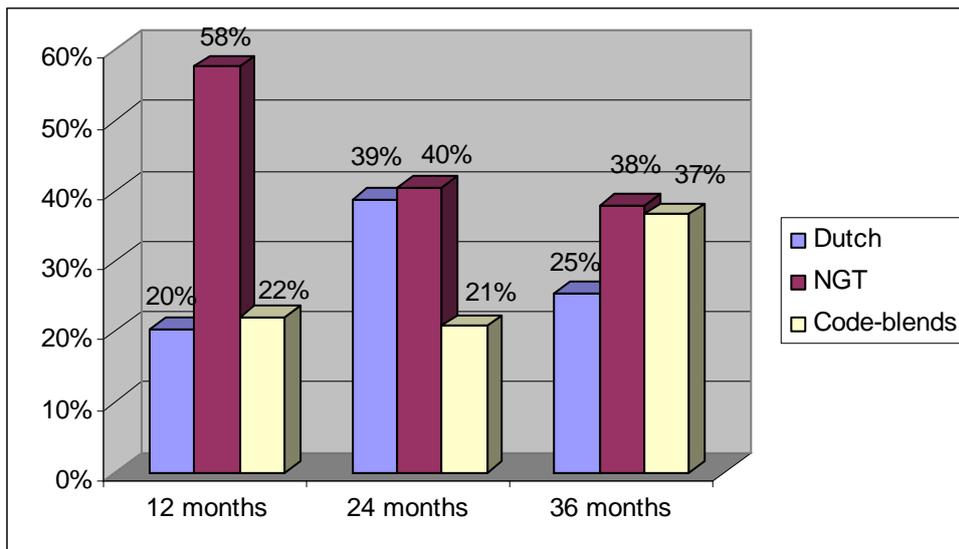
In this section the results are presented and discussed. In the first paragraph of this chapter (5.1) the results for the classification of the utterances will be presented. These results will be compared to earlier finding for deaf and hearing children. In paragraph 5.2 the results for word types in the blends will be discussed and compared to the results for deaf and hearing children from earlier studies. The possible relation between types of code-blends and language abilities will be discussed in paragraph 5.3.

### 5.1 Classification of utterances and code-blends

All utterances of the spontaneous language data were classified as being either NGT, Dutch or code-blend. Taken together the majority of the utterances was uttered in Dutch (45%), followed by NGT (31%) and the code-blended utterances (23%). However, it is more informative to look at the classification of utterances at the different assessments (12, 24 and 36 months).



**Figure 3 Percentages per language mode at 12, 24 and 36 months after implantation during the interviews with a hearing interviewer**



**Figure 4 Percentages per language mode at 12, 24 and 36 months after implantation during the interviews with a deaf interviewer**

Figure (3) shows the percentage of utterances per language mode at 12, 24 and 36 months after implantation in interaction with a hearing interviewer. The percentage of Dutch that is used increases between 12 and 24 months after implantation, but decreases again between 24 and 36 months after implantation. This might be considered unexpected, since both the results from earlier research and the fact that parents indicate a decline in the use of signs would predict an increase in spoken language use during the period of investigation. A possible explanation for these unexpected results could be the fact that the children's abilities in spoken language are varied. If for some children the spoken language development stagnated between 24 and 36 months, this could result in using more NGT. The group is heterogenous in this respect and therefore we should consider these results with caution.

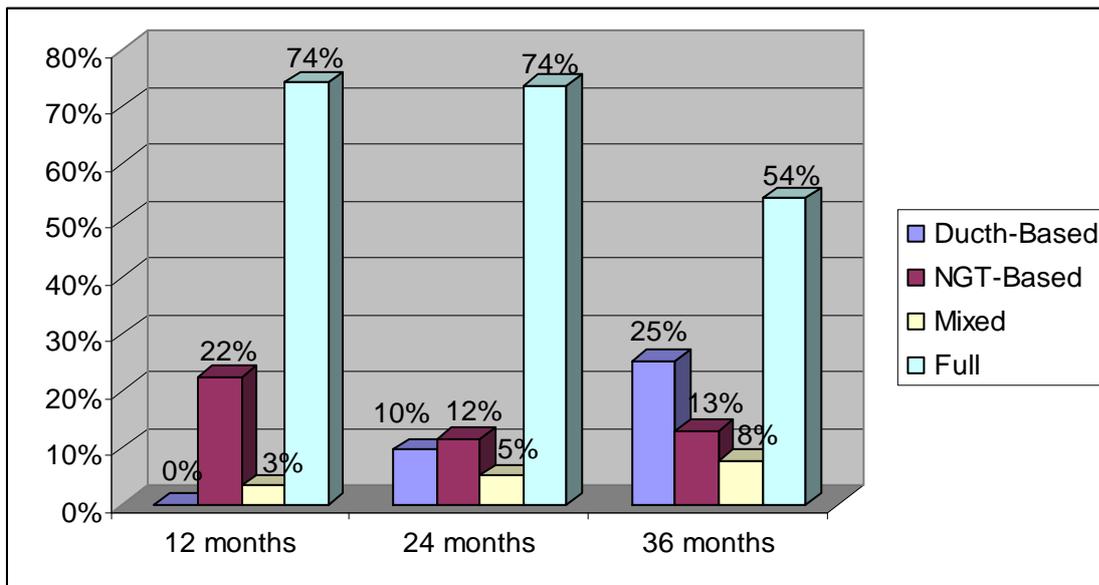
Figure (4) shows the percentage of utterances per language mode at 12, 24 and 36 months after implantation in interaction with a deaf interviewer. The percentage of utterances in NGT decreases overtime, but the decrease between 24 and 36 months is much smaller than between 12 and 24 months, which is again unexpected. These results seem to be connected with the results for the interaction with a hearing interviewer, where the amount of Dutch decreases between 24 and 36 months, while we expected it to increase.

Both for the Dutch and code-blended utterances the pattern is unclear. The percentage of Dutch utterances increases between 12 and 24 months and decreases again between 24 and 36 months. This matches the results for the interviews with a hearing researcher in figure (3). The percentage of code-blends is more or less the same at 12 and 24 months, but increases considerably between 24 and 36 months.

Even though the results in both figure (3) and (4) are not clear cut, the difference in language mode between a deaf or hearing conversation partner is eminent. The children consciously or unconsciously adapt their language mode to their conversation partner. In interaction with the hearing interviewer the percentage of Dutch utterances is much higher than in interaction with the deaf interviewer. The percentage of NGT is higher in conversation with the deaf interviewer. As for the code-blends, the percentage is higher in interaction with the deaf interviewer than in interaction with the hearing interviewer.

Taken together, the children produced a total of 553 code-blends. In this data set, like in those of Emmorey et al (2005) and Baker and Van den Bogaerde (2008), code-switches were rare. In all data I found 15 switches and most of these seemed to be clarifications. For example Max (36 months after implantation) utters the word “paard” (horse) to the deaf experimenter, but when he seems to remember she is deaf, he produces the sign immediately after producing the word. I will not analyse the switches any further, because they are too few to draw any general conclusions about their structure.

The category of code-blends was further classified into Dutch-based, NGT-based, mixed or full. The results for the classification of code-blends that the children produced at 12, 24 and 36 months after implantation are shown in figure (5). The code-blends that the children produced were mostly of the type Full at all assessments. The Full category is large for an obvious reason. The utterances the children produce are very short and many of the utterances consist only of one word. If a code-blend of one semantically congruent word and sign is produced it automatically falls into the category Full. The children in the study of Baker and Van den Bogaerde (2008) produce fewer code-blends of the type Full than the children in this study. This difference might be due to the fact that the children in Baker and Van den Bogaerde produce longer utterances than the children in this study (see p. 34 for specific MLU results).



**Figure 5** Types of code-blends at 12, 24 and 36 months of implantation (all children)

The category of mixed code-blends is small on all assessments, just like for the deaf children in Baker and Van den Bogaerde (2008). Emmorey et al. (2005) do not use the term mixed code-blend, but it is mentioned that only in 6% of the code-blends the word and the sign are not semantically congruent. This means that along the lines of classification by Baker and Van den Bogaerde (2008) the 6% found by Emmorey et al. would be classified as mixed. This also matches the results for the group of CI children in this study.

The percentage of Dutch-based code-blends grows steadily, whereas the percentage of NGT-based code-blends decreases. At 12 and 24 months the percentage of Dutch-based code-blends is smaller than the percentage of NGT-based code-blends, but at 36 months the percentage of Dutch-based code-blends is almost twice as high as the percentage of NGT-based code-blends. One would expect this to be due to the fact that the children in this study show the same shift towards spoken language as the children in the studies by Watson et al. (2006, 2008). The parents of the children indicate that they increasingly use spoken Dutch with their child. This might be an indication of the children's language preference, but this was not directly reflected in their language choice during the interviews, as we have seen before in figure (3) and (4) The percentage of Dutch utterances increased between 12 and 24 months, but between 24 and 36 months it decreased again.

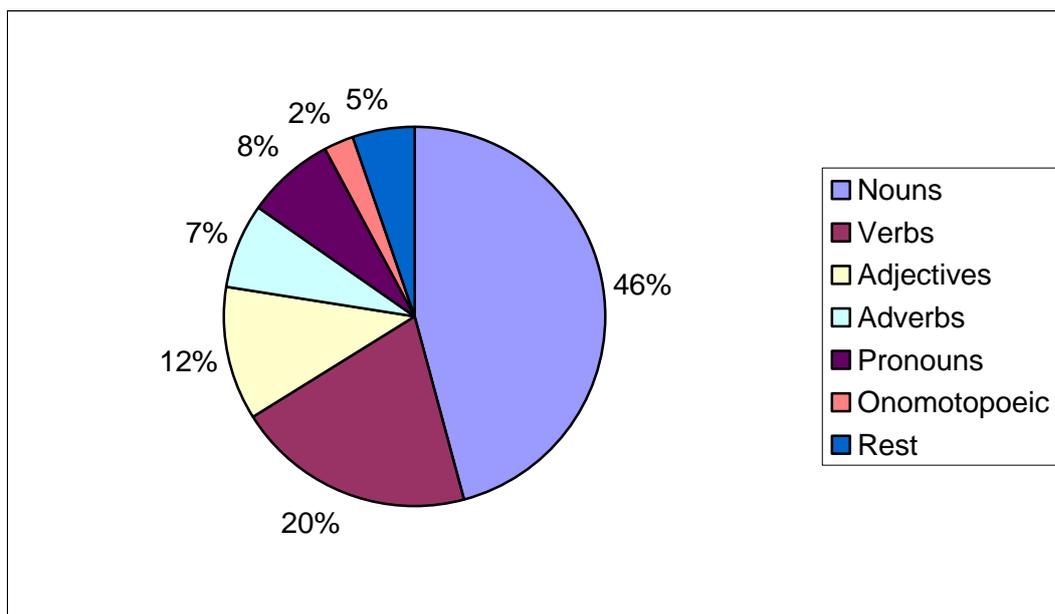
These results can be compared to the results of Baker and Van den Bogaerde (2008). As far as the balance between Dutch-based and NGT-based code-blends is concerned, at 12 months after implantation the children in this study show a pattern like that of the deaf children in the study of Baker and Van den Bogaerde (2008). They produce no Dutch-based code-blends and a considerable

amount of NGT-based code-blends. This is also the case for the deaf children in Baker and Van den Bogaerde (2008). At 24 and 36 months after implantation the code-blends of the CI children increasingly look like the code-blends of the hearing children in the other study. The percentage of Dutch-based code-blends increases. The percentage of NGT-based code-blends remains at the same level. The hearing children in the Baker and Van den Bogaerde study produce less NGT-based blends than the CI children, but it is possible that in a later stage the percentage of Dutch-based code-blends will increase further and the NGT-based blends will decrease. If this is really the case the CI children are behaving more and more like the hearing children, as far as code-blends are concerned.

### 5.2 Word types involved in the code-blends

The results for word types that were involved in the blends are presented in figure 6. It is clear that some word types are blended more easily than others. The following hierarchy can be derived from the results:

Nouns > verbs > adjectives > pronouns > adverbs > rest > onomatopoeic expressions



**Figure 6 Word types involved in the code-blends (n=794)**

Nouns are code-blended most often, followed by verbs and the other word types. This hierarchy looks considerably like the hierarchies in Baker and Van den Bogaerde (2008). They also found that both the deaf and the hearing children blended nouns most often followed by verbs. The deaf children in their study did not blend any pronouns, whereas the hearing children did. The CI children in this study also used pronouns in their code-blends.

However, in the code-blends of the CI children the category of adjectives is bigger than the category of pronouns, whereas this is the other way around for the hearing children in Baker and Van den Bogaerde (2008). One could argue that the CI children are in between the deaf and the hearing children, in this respect. The category of onomatopoeic expressions which I added is the smallest.

### 5.3 Code-blends and language abilities per child

It is also important to look at the results per child, especially because, as was mentioned before, the outcomes of language development in CI children show a reasonable amount of variation.

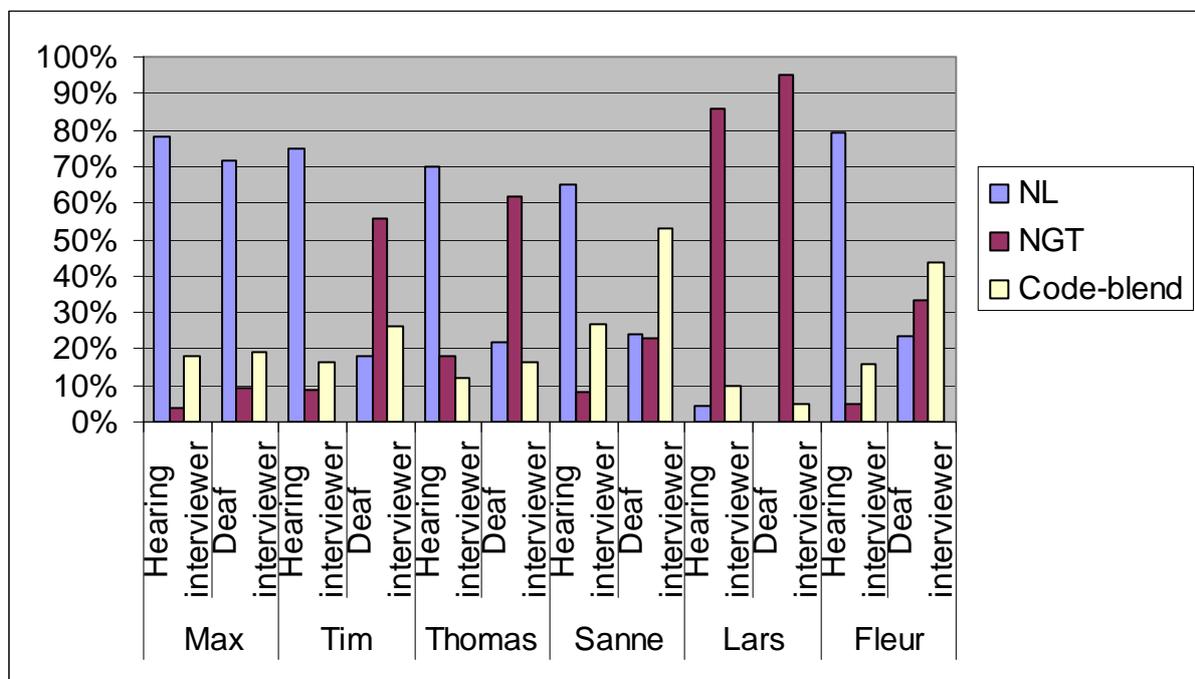


Figure 7 Language mode per child in interaction with a hearing and deaf interviewer

This variation can also be detected in the language mode of the children. As one can see in figure (7) it is clear that for instance Lars feels most comfortable using NGT. He predominantly uses NGT both in interaction with the deaf and the hearing interviewer. One of the other children Max, shows exactly the opposite pattern. He prefers using Dutch, even in interaction with a deaf interviewer. The other children (Tim, Thomas, Sanne and Fleur) seem to adapt their language choice to the interviewer, but in a different manner. Tim and Thomas predominantly use Dutch with the hearing interviewer and NGT with the deaf interviewer.

Sanne and Fleur also predominantly use Dutch in interaction with the hearing interviewer, but in interaction with the deaf interviewer they mostly produce code-blends.

It is highly probable that the type of code-blends a child produces is related to his or her preferred language mode. The graphs in figure (8) show the results for types of code-blends per child in interaction with a deaf and a hearing interviewer. It is important to bear in mind that the amount of produced code-blends differs immensely per child, ranging from 23 to 170 in all six sessions (one with a deaf and one with a hearing interviewer at 12, 24 and 36 months after implantation).

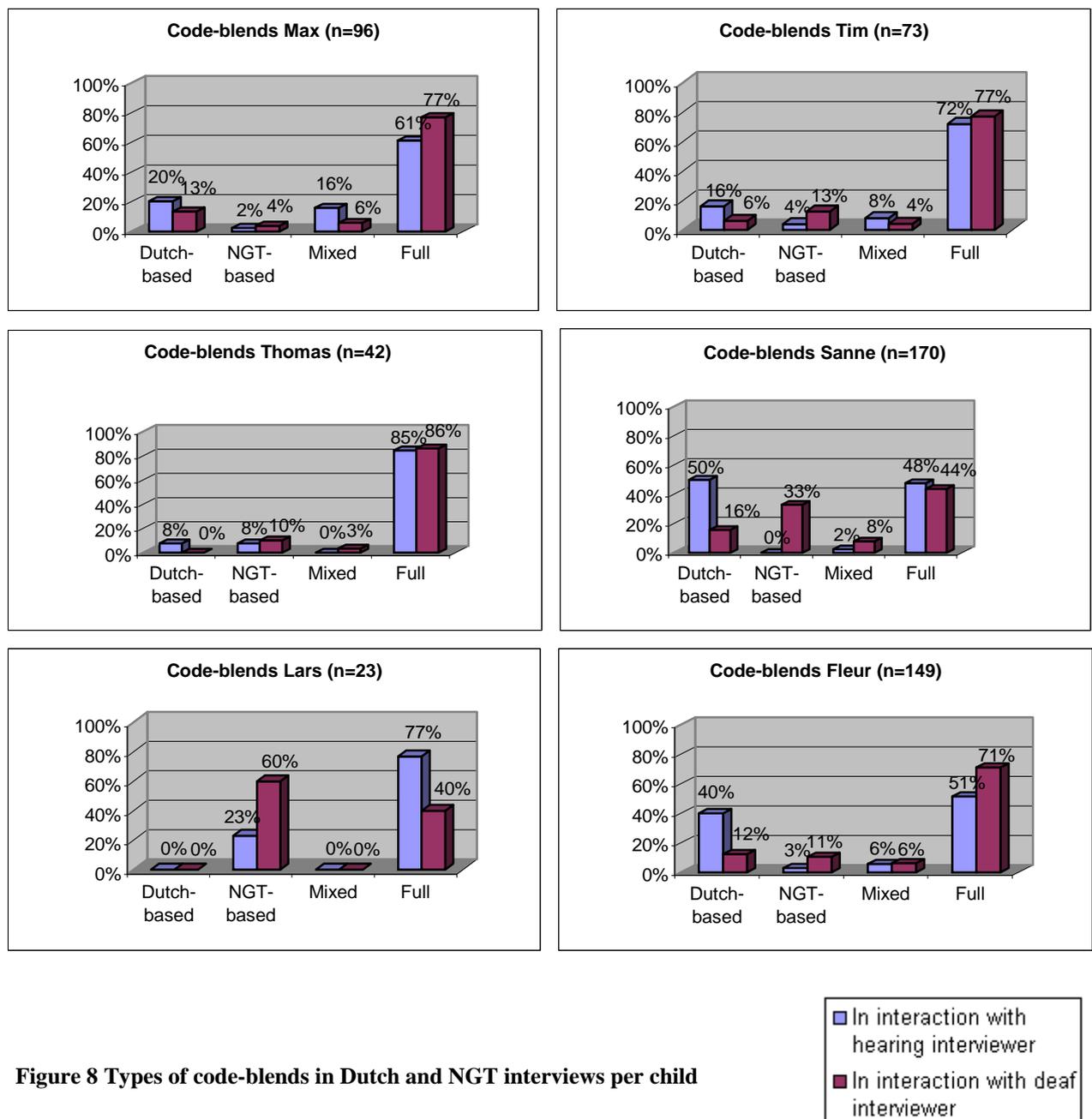


Figure 8 Types of code-blends in Dutch and NGT interviews per child

The Full category is largest in all children, but the percentages of code-blends in other categories differ per child. For example, if you compare the results for Lars and Fleur, it is clear that Lars has a preference for NGT-based code-blends, whereas Fleur produces more Dutch-based code-blends. It is also clear that all children produce more NGT-based utterances in interaction with a deaf interviewer than in interaction with a hearing interviewer. In the Dutch interview situation more Dutch-based code-blends are produced. This shows that the children either consciously or unconsciously adapt their language choice, in the form of types of code-blends, to the language mode of their conversation partner.

In order to relate the types of code-blends from the children to their language abilities, the results for language measures are summarised below. The results for both the Dutch CDI and the preliminary NGT CDI list are presented in table (4). These lists provide information on the lexical development of the children. The Dutch list consisted of 103 words and the NGT list consisted of 144 signs. In table (4) both the amount and percentage of known words and signs are shown at 12, 24 and 36 months after implantation. If we consider, for instance, Thomas at 24 months after implantation, we can see that he knows 19 out of the 103 words on the Dutch CDI list, this is 18 %.

Looking at table (4) one can see that the lexical development in Dutch for both Lars and Thomas is delayed compared to the other children. This could be due to the fact that these children experienced some problems in wearing their CI. If we look back at their graphs in figure (8) we can see that they produce the least amount of code-blends in general and the smallest percentage of Dutch-based code-blends. The children with a better lexical development in Dutch (Tim, Fleur, Max and Sanne) produce more Dutch-based code-blends. These trends seem to indicate a correlation between spoken language development and the amount of Dutch-based code-blends. As far as the lexical development for NGT is concerned, Lars and Thomas do not seem to be slower than the other children. The results for Max and Sanne are not representative for their knowledge of signs. The spontaneous data shows that they know many more signs than the parents indicate. This is understandable, because the parents were instructed to indicate whether their child used a sign or not. If the parents indeed increasingly used spoken language with their child they would not see their child using NGT signs.

Another measure that can shed some extra light on the children's language abilities is MLU. Table (5) shows the mean MLU scores per child per language mode. (See appendix table 1 for more specific MLU scores) Considering the Dutch MLU scores it is clear that again Thomas and Lars score lower than the other children. All other children have a higher MLU in Dutch than in NGT. The MLU for the code-blends is relatively high in all children.

**Table 4 Results from CDI lists for Dutch and NGT (adapted from Van der Zee 2008<sup>9</sup>)**

	Months after implantation	Number Dutch (103)	% Dutch	Number NGT (144)	% NGT	Total (247)	% Total
Thomas	12	7	7	64	44	71	29
	24	19	18	91	63	110	45
	36	47	46	116	81	163	66
Fleur	12	43	41	79	55	122	49
	24	80	78	107	74	187	76
	36	99	96	139	97	238	96
Sanne	12	41	39	90	63	131	53
	24	90	87	<b>31</b> <sup>10</sup>	<b>22</b>	121	45
	36	211 <sup>11</sup>	98	<b>2</b>	<b>1</b>	213	59
Lars	12	4	4	106	74	110	45
	24	11	11	101	70	112	45
	36	64	62	144	100	208	84
Max	12	39	38	60	42	99	40
	24	89	86	107	74	196	79
	36	208 <sup>10</sup>	97	<b>84</b>	<b>58</b>	292	81
Tim	12	61	59	88	61	149	60
	24	76	73	110	76	186	75
	36	94	91	135	94	229	93

**Table 5 Mean MLU of all interviews per language mode per child**

	Dutch	NGT	Code-blends
Max	1,8	1,3	1,9
Tim	1,5	1,1	1,5
Thomas	1,1	1,1	1,2
Sanne	1,5	1,3	2,3
Lars	1,0	1,5	1,6
Fleur	1,5	1,2	2,0

<sup>9</sup> Van der Zee (2008) focuses on the lexical development of this group of CI children.

<sup>10</sup> The numbers in bold indicate scores that are lower than earlier measurements. It is not likely that the children have forgotten many signs, but because Dutch is the dominant language at home, the parents are not able to indicate which signs the child knows.

<sup>11</sup> A more advanced list was used here consisting of 112 words, these were added to the 103 of the other list.

The last measure of language development is the Schlichting test. This was used to test the abilities in spoken Dutch only. Table (6) shows the scores on the part about sentence development and word development at 24 and 36 months after implantation. The scores on the word development tests are missing for Lars.

**Table 6 Scores on the Schlichting test of language development.**

Child	Sentence development (24)	Sentence development (36)	Word development (24)	Word development (36)
Max	74	77	69	59
Tim	71	75	66	68
Thomas	59	67	55	55
Sanne	69	71	74	72
Lars	55	55	-	-
Fleur	70	72	66	67

Generally the scores are not far apart, but again the scores of Lars and Thomas are on the low side. They also had the lowest MLU's in Dutch and scored lowest on the Dutch CDI list. This again shows their language development in Dutch is delayed compared to the other children. It seems likely that this is the explanation for the fact that they produce more NGT-based code-blends than Dutch-based code-blends.

## 6. General conclusion

CI children that receive both spoken and sign language input have the potential of becoming bilinguals. It has been shown for both sign and spoken language bilinguals and bilinguals in two spoken languages that they tend to mix their languages. An important feature of a group of CI children is that it is heterogeneous as far as their language development is concerned, because many factors are involved in determining the development. The mixing of two languages, the structure of this mixing and the relation to the language development were the main focus of this study.

One of the questions I wanted to answer was whether code-blends of CI children showed a structural pattern with regard to the types of code-blends used and whether this was comparable to the code-blends of deaf or hearing children.

This group of children did show a general pattern in that they mostly produced blends of the type Full. It might be expected, however, that this pattern changes overtime in line with an increase in utterance length. Longer utterances will probably result in fewer Full code-blends. The amount of produced mixed code-blends in this study was small, as was the case in the study of Emmorey et al. (2005) and for the deaf children in Baker and Van den Bogaerde (2008). The children in this study (as a group) first showed a preference for NGT-based above Dutch-based code-blends, but later the percentage of Dutch-based blends is higher than the percentage NGT-based blends. Comparing this to the deaf and hearing children in Baker and Van den Bogaerde, it seems that the CI children first behave more like the deaf children and later on they produce more Dutch-based code-blends, like the hearing children.

Not only the types of code-blends, but also the involved word types were focus of this study. I found that nouns were most easily blended followed by verbs, adjectives, pronouns, adverbs, the rest category and onomatopoeic expressions. This hierarchy looked like the hierarchies found by Baker and Van den Bogaerde (2008). The CI children seem to behave in between the deaf and the hearing children from their study.

My last question was whether the types of code-blends produced reflected the abilities of the individual children in sign and/or spoken language. The type of code-blends the children produced seemed to be related to their language abilities, which were indeed varied (as predicted). Some children showed a slower language development in Dutch which was

reflected in the scores on the CDI list, MLU and the Schlichting test of language development. These children also produced less Dutch-based code-blends than the other children. Instead they produced extra Full and/or NGT-based code-blends.

Although it was not part of my research questions, it was interesting to see that the children behaved differently in interaction with a hearing interviewer or with a deaf interviewer. Almost all children seemed to adapt their language mode and even code-blends to their conversational partner. This, along with the production of code-blends, shows that the children were very flexible in their language use.

Some of the findings in this study were unexpected and difficult to explain. One of these findings was that the amount of Dutch that the children used decreased between 24 and 36 months after implantation. It would be interesting to see whether the results would be reduplicated in a next study. If possible, the participation of more subjects would provide a more solid base for an argument. However, altogether the six participants in this study have already provided some important pieces of information.

## References

Baker, A.E., & Van den Bogaerde, B. (2008). Codemixing in signs and words in input to and output from children. In C. Plaza Pust, & E. Morales Lopez (Eds.), *Sign Bilingualism: Language Development, Interaction, and Maintenance in Sign Language Contact Situations*. Amsterdam: John Benjamins. (in press)

Bogaerde, B. van den (2000). *Input and Interaction in deaf families*. PhD Dissertation, University of Amsterdam. Utrecht: LOT.

Canfield, K. (1980). Navaho-English code-mixing. *Anthropological linguistics* Vol. 22 (pp. 218-220)

Coerts, J. A., Baker, A.E., Broek, P. van den & Brokx, J.(1996). Language Development by Deaf Children With Cochlear Implants. In C.E. Johnson & J.H.V. Gilbert (Eds.), *Children's Language* Vol. 9 (pp. 219-234). Hillsdale: Lawrence Erlbaum Associates.

Connor, C., Hieber, S., Arts, H. & Zwolan, T. (2000). Speech, Vocabulary, and the Education of Children Using Cochlear Implants: Oral or Total Communication? *Journal of Speech, Language, and Hearing Research* Vol. 43 (pp. 1185-1204)

Emmorey, K., Borinstein, H.B., & Thompson, R. (2005). Bimodal Bilingualism: Code-blending between spoken English and American Sign Language. In J. Cohen, K.I. McAlister, K. Rolstad, & J. MacSwan (Eds.), *Proceedings of the 4<sup>th</sup> International Symposium on Bilingualism* (pp. 663-673). Somerville. MA: Cascadilla Press.

Geers, A.E., Nicholas, J.G. & Sedey, A.L. (2003). Language Skills of Children with Early Cochlear Implantation. *Ear & Hearing* Vol. 24 (pp. 46s-58s)

Milroy, L. & Muysken, P. C. (1995). *One speaker, two languages: cross-disciplinary perspectives on code-switching*, Cambridge: Cambridge University Press .

Muysken, P. (2000). *Bilingual speech: a typology of codemixing*. Cambridge: Cambridge University Press.

Muysken, P. (2004). Two Linguistic Systems in Contact : Grammar, Phonology and Lexicon. In T.K. Bhatia & W.C. Ritchie (Eds.) *The Handbook of Bilingualism* (pp. 147-168) Oxford: Blackwell

Nortier, J.(1990). *Dutch-Moroccan Arabic code-switching among young Moroccans in the Netherlands*. Dordrecht: Foris

Pfaff, C. (1976). Functional and syntactic constraints on syntactic variation in code-mixing'. In: B. Steever et al. (Eds.) *Papers from the parasession on diachronic syntax*. (pp.248-59). Chicago Linguistic Society.

Pfaff, C. (1979). Constraints on language-mixing: Intrasentential code-switching and borrowing in Spanish/English. *Language* Vol. 55 (pp. 291-318)

Plaza Pust, C. (2005). Language Contact in Deaf Bilingualism. In H. Leuniger, & D. Happ (Eds.), *Gebärdensprachen: Struktur, Erwerb, Verwendung* (pp. 271-307). Hamburg: Helmut Buske Verlag.

Petitto, L.A., Katerelos, M., Levy, B.G., Gauna, K., Tétreault, K. & Ferraro, V. (2001) Bilingual signed and spoken language acquisition from birth: implications for the mechanisms underlying early bilingual language acquisition. *Journal of Child Language* Vol. 28 (pp. 453-496).

Schermer, T, Fortgens, C., Harder, R. & Nobel, E. de (1991). *De Nederlandse Gebarentaal* Twello: Van Tricht uitgeverij.

Spencer, P.E. (2002). Language Development of Children With Cochlear Implants. In J.B. Christiansen, & I.W. Leigh (Eds.), *Cochlear implants in children: Ethics and Choices* (pp. 222-249). Washington, DC: Gallaudet University Press.

Tomblin, J.B., Barker, B.A. & Hubbs, S. (2007). Developmental constraints on language development in children with cochlear implants. *International Journal of Audiology* Vol. 46 (pp. 512-523)

Watson, L. M., Achbold, S.M. & Nikolopoulos, T.P. (2006). Children's communication mode five years after cochlear implantation: changes over time according to age at implant.

*Cochlear Implants International* Vol. 7 (pp. 77-91)

Watson, L.M., Hardie, T., Archbold, S.M. & Wheeler, A. (2008). Parents' Views on Changing Communication After Cochlear Implantation. *Journal of Deaf Studies and Deaf Education* Vol. 13 (pp. 104-116)

Wiefferink, C.H., De Raeve, L., Spaai, G.W.G., Wenners-Lo-A-Njoe, V.T., Vermeij, B.A.M. & Uilenburg, N. (2007). *Onderzoek naar de ontwikkeling van jonge dove kinderen met een cochleair implantaat in een tweetalige omgeving* [Research on the development of young deaf children with a cochlear implant in a bilingual environment].

Van der Zee, R.B. (2008). *Lexical acquisition in deaf children with a cochlear implant*. [MA thesis University of Amsterdam]

Zink, I. & Lejaegere, M. (2002). *N-CDIs: lijsten voor communicatieve ontwikkeling. Aanpassing en hernormering van MacArthur CDIs van Fenson et al.* [N-CDIs: lists for communicative development. Adjustment and standardization of MacArthur CDIs by Fenson et al.]. Leuven/Leusden: Acco.

### **Web references**

[www.kidshealth.org/parent/general/eyes/cochlear.html](http://www.kidshealth.org/parent/general/eyes/cochlear.html)

## Appendix

**Table 1 MLU scores per language mode per child at 12, 24 and 36 months after implantation in interaction with a deaf and hearing interviewer**

	Dutch	NGT	Code-blend
Max H 12	1,1	1,0	1,1
Max H 24	1,9	-	2,2
Max H 36	2,6	-	3,4
Max D 12	1,5	1,8	1,4
Max D 24	2,3	<b>1,0</b>	<b>1,3</b>
Max D 36	1,6	<b>1,3</b>	1,8
Tim H 12	1,1	<b>1,0</b>	<b>1,4</b>
Tim H 24	1,0	<b>1,1</b>	1,3
Tim H 36	2,2	-	1,8
Tim D 12	1,2	1,0	-
Tim D 24	<b>1,7</b>	1,2	1,2
Tim D 36	1,5	1,2	1,8
Thomas H 12	<b>1,0</b>	<b>1,0</b>	<b>1,0</b>
Thomas H 24	1,1	1,1	1,3
Thomas H 36	1,3	<b>1,0</b>	<b>1,5</b>
Thomas D 12	<b>1,0</b>	1,4	-
Thomas D 24	<b>1,2</b>	1,1	<b>1,2</b>
Thomas D 36	1,3	1,1	1,1
Sanne H 12	1,1	<b>1,0</b>	<b>2,5</b>
Sanne H 24	1,2	<b>1,0</b>	1,2
Sanne H 36	2,2	-	4,2
Sanne D 12	<b>2,0</b>	1,9	1,9
Sanne D 24	1,3	1,3	1,5
Sanne D 36	1,5	1,2	2,6
Lars H 12	<b>1,0</b>	1,2	<b>1,3</b>
Lars H 24	<b>1,0</b>	<b>1,0</b>	<b>2,0</b>
Lars H 36	-	1,6	<b>1,5</b>
Lars D 12	-	1,9	<b>1,8</b>
Lars D 24	-	1,5	<b>1,0</b>
Lars D 36	-	2,0	<b>2,2</b>
Fleur H 12	1,1	<b>1,0</b>	<b>1,4</b>
Fleur H 24	1,3	1,0	2,2
Fleur H 36	2,4	-	2,8
Fleur D 12	1,0	1,4	1,2
Fleur D 24	1,7	1,2	2,0
Fleur D 36	1,5	1,3	2,4

Table (1) provides a full picture of the MLU scores of all children on all assessments in interaction with a hearing and a deaf interviewer (indicated in the table as H and D). The MLU's in bold are based on less than ten utterances.