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Universal Grammar in Signed Languages

Contents

Introduction

There are about eighty signed languages in existence in deaf communities all over the world (Wittmann, 281-286). Many of them are still underresearched, but some are investigated intensively, and it is becoming increasingly clear that the investigation of sign languages can make important contributions to linguistics. Looking at similarities between spoken and signed languages enables linguists to gain a better view of the basis for language. 'As grammatical systems, in part, reflect the modality in which they are expressed, the comparison of spoken and signed languages permits us to separate those aspects of grammar which are modality-dependent from those which are shared by all human beings'(Corina 165).

Besides this, the finding of similarities or universals between signed and spoken languages will illustrate two things at once; firstly that signed languages are 'real' languages with all the usual properties and phenomena that have been found to exist in spoken languages; and secondly that a shared basis for language, a Universal Grammar, also exists in signed languages. If the theory of Universal Grammar is applicable to all human languages, any natural signed language should be included.

This thesis will mainly focus on the last argument; similarities in acquisition, grammar and the neural processing of language between signed and spoken languages can prove that Universal Grammar exists in signed language. In the following chapters these three fields (acquisition, grammar and neural basis) will be explained and discussed.

This discussion will rely mainly on work by three investigators in this area, Laura Ann Petitto, Diana Lillo-Martin, and Wendy Sandler. In the field of comparative linguistics involving spoken and signed languages, Laura Ann Petitto has performed a considerable amount of research. She is a Cognitive Neuroscientist and a

Developmental Cognitive Neuroscientist at the University of Toronto, who is known for her discoveries about bilingualism, animal languages and the biological foundations of language as well as her work on signed languages (Petitto Website). In this thesis, her articles on the discoveries of similarities in acquisition between signed and spoken languages will be discussed. Besides that, her articles on the neurological aspects that occur when processing language will be discussed. The last chapter will make use of the articles written by Diane Lillo Martin and Wendy Sandler. Both linguists at the University of Connecticut and Haifa University, respectively, they have investigated the similarities in grammar between signed and spoken languages.

All three authors have studied the similarities between signed and spoken languages and all three authors have published many articles about their findings. In this thesis, however, a small selection of their work is used in order to support the three main arguments for claiming that Universal Grammar exists in signed languages. Two of the arguments (acquisition and neural basis) are supported by articles written by Petitto. In the field of the acquisition programme of signed languages and the process of signed languages in the brain, Petitto has been a pioneer and she is well respected for her research. The third argument focuses on the grammatical similarities between signed and spoken languages. Both Sandler and Lillo Martin have studied this subject and are well known for their findings. All articles used are based on many years of research and should therefore be sufficient evidence to support the claims made in this thesis.

Before any comparisons between signed and spoken language can be made in order to search for similarities that prove the existence of Universal Grammar in sign languages, the term itself needs to be explained. The first chapter will therefore provide an explanation of the theory of Universal Grammar.

The second chapter will provide a brief exposition on signed languages. Questions about the origin of signed languages, the development and cultural issues will be briefly discussed. The third, fourth and fifth chapters will then provide arguments to support the claim that there is evidence for the existence of a Universal Grammar in signed languages covering the acquisition process, grammatical issues and the neural basis of language.

Chapter 1 An introduction to Universal Grammar and Comparative Linguistics

In this chapter the strategy of 'comparative linguistics' will be used to illustrate the notion of Universal Grammar. This chapter is divided into two sections. In the first section, the "Poverty of the Stimulus" argument put forward by Noam Chomsky will be discussed. In the second section, the theory of Principles and Parameters will be explained in order to show how Universal Grammar works.

Poverty of the Stimulus

The most important name within the study of Universal Grammar (or UG, as it will be called from now on) is that of the American linguist Noam Chomsky, a pioneer in the field of UG, in the course of the1960s. Chomsky's theory has formed the world of linguistics with his introduction of UG. The theory that he put forward has been shaped, reshaped and adjusted, but it was never abandoned and it is still used in modern linguistics.

Although many people believe that the acquisition of language is solely based on the language input that a child receives from parents and perhaps other caregivers, input is obviously an indispensible but not the only factor that contributes to learning a language. By doing comparative studies in the linguistic field (comparative linguistics), scholars have found that in the acquisition process there are similarities between all languages that cannot be solely based upon input. There has to be more to the mind that can help a child acquire a language, for example, a shared instinct for learning language: something called Universal Grammar.

UG is the underlying basis for all languages. Using UG enables children to learn a language in a short period of time. Chomsky also proposes that it is reasonable to assume that Universal Grammar is inborn. He claims that all children are born with

an ‘inbuilt’ language system. This system is identical in all human beings, and all children use this inborn grammar to help them acquire the language they learn.

The Poverty of the Stimulus Argument supports the view that there has to be an underlying part of the brain already set to language. The argument means that there are simply not enough stimuli, in the form of language input of any kind, for a child to acquire a language in the way it does.

To claim that a child learns only from input would raise many issues. Consider the following example from Laurence and Margolis in their article “The Poverty of the Stimulus Argument”:

(1) Ecuador is in South America.

(2) Is Ecuador in South America?

(3) That woman who is walking her dog is Tom’s neighbour.

(4) Is that woman who is walking her dog Tom’s neighbour?

(5) * Is that woman who walking her dog is Tom’s neighbour?

English grammar rules state that when a question is formed, the auxiliary verb (‘is’) should be moved to the initial position of the main clause. The first two sentences in the example above are fairly straightforward: the verb ‘is’ is moved to the front of the sentence to form a question. In sentence (4) we see that it is not that easy. Sentence (3) also includes an imbedded clause: ‘who is walking her dog’. Here, we see the grammatical rule; the auxiliary verb needs to be moved to the beginning of the main clause and only then it is a grammatically correct sentence. Let us assume that a child acquiring a language has only heard the first two sentences. In order to form a question as in (2) the child would simply have to move the word ‘is’ to the beginning

of the sentence. However, if sentences (1) and (2) would lead the child to the conclusion that the first *is* of a sentence must be moved, the outcome would be ungrammatical (Laurence 222-223).

It is striking that children do not make these kinds of mistakes. However, if we look at the rule underlying sentence (4), we see that in order to make a correct English question out of sentence (3), a child would have to know how to distinguish between the main clause and the embedded clause, and above all, he or she would have to know how to recognize an auxiliary verb, because it is the auxiliary of the main clause that is moved.

Obviously, a child acquiring a language does not consciously use grammatical rules like this, but they are able to produce correct sentences. What Chomsky tries to show using the Poverty of the Stimulus is that there is no possibility a child could have picked up this precise grammatical rule from the first two sentences and there is also no possibility a child consciously uses grammatical terms like 'main clause' or 'auxiliary verb' and thus there must be an underlying device in the human mind –or 'brain'- that knows how to use the input of language in order to make sentences like (4), without actual knowledge of grammatical rules.

The Poverty of the Stimulus Argument shows that there has to be more that helps a child acquire a language than just input from caregivers. It shows that there is an underlying system in the brain that provides grammatical rules for us, independently of the input, and helps us apply those aspects to new sentences.

The Poverty of the Stimulus Argument shows that there has to be an underlying basis for language already set in the mind. With this basis, language is acquired. This also means that this basis, Universal Grammar, is the same for every child born (in any part of the world), since at birth it is not yet clear for children which

language they are 'allocated' to. In order to explain how this universal basis works and how it is 'triggered', the Principles and Parameters Model will be discussed in the next section.

Principles and Parameters

The Principles and Parameters Model shows that with the input a child receives (a specific language), his or her 'language system' is triggered into learning that language (Lightfoot 1).This 'language system' contains certain Principles. Principles are universal; they are the same in every language. Parameters are different: they refer to forms of systematic variation between languages. Parameters can be seen as switches: for every language a restricted set of switches is activated. Every language then has its own collection of parameters activated. With the input that a child receives (language spoken by caregivers), in the language learning process a child will have to determine the correct (yes/no) value for the parameter in question. So parameters are choices and they are used to define a specific language, while Principles are the underlying basis, that what all languages have in common (Lightfoot 2).

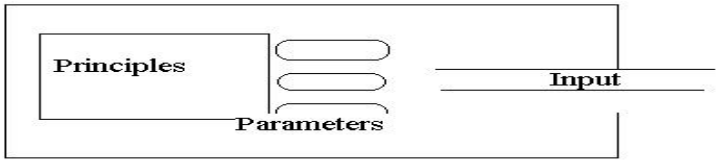

Figure 1

As shown in Figure 1, the principles are universals and they are the same for every language. The parameters are options; they can be activated depending on the input a child receives. This process is called the 'setting' of the parameters. The setting of the parameters is thus determined by the input that a child receives.

Figure 1 is still a rather abstract example. In order to make it easier to grasp the concept of Principles and Parameters, an example of a Parameter will be provided. An example of a parameter is WH-movement. WH-movement is the movement of the 'wh-words', for example, 'who', 'when' and 'which' in English. Although it is called WH-movement because of the English wh-words, we find this phenomenon in more languages. For this example, we will look at English and Dutch (Cook 20).
When a person speaking English utters the question equivalent of a sentence such as

(1) I see John

he will have to put in a 'wh-word'; in this case 'who'.

(2) Who do I see?

Chomsky makes a difference between the deep structure of a sentence (where syntactic structure is defined in general terms) and the surface structure (the output, where language-specific word order appears given the syntactic nature of the given sentence).
The deep structure of sentence (2) would be

(3) I see who?

This may sound strange to a speaker of English, but in the English syntax this would make more sense since the object usually comes after the verb. However, to correctly utter the sentence the wh-word needs to be *moved* to the front.

Another language in which we find movement is Dutch. The same sentence as (1) in Dutch would be:

(4) Ik zie John

(5) Ik zie wie? (deep structure)

(6) Wie zie ik? (surface structure)

We now have two different languages in which we see movement when questions are being formed. A language which has no movement in question sentences is Japanese (Cook 21). In Japanese, as you can see in (7) and (8), there is no direct movement in the sentence (as you can see in (3) and (2) and for Dutch in (5) and (6)), but instead a 'question-word' is added to the end (the element 'ka') and the word 'soko' changes to 'doko'.

Niwa-wa soko desu. (The garden is there) (7)

Niwa-wa doko desu ka? (Where is the garden?) (8)

There are changes made in sentence (7) to form a question like (8), but there is no movement such as we see in Dutch and English (Cook 21). This example shows that for a child learning English or Dutch, the parameter for using WH-movement should be set (or 'switched on') while in Japanese it should stay 'off' since they do not use this form of movement.

Investigators of the Principles and Parameters Model search for universals (Principles) by looking at similar grammatical issues in all languages (Parameters). Up until recently, the investigation of UG focused exclusively on spoken languages.

However, since the investigation of signed languages became executed more and more seriously, the question naturally arose whether signed languages also use Universal Grammar and whether they can be used for comparative linguistics. The next chapters will claim that signed languages also use UG and provide arguments for the use of signed languages in comparative linguistics.

Chapter 2 Signed Languages

In this chapter the origin and development of signed languages will be discussed. We will look at what exactly defines a signed language and why it is important that they are used in (comparative) linguistics.

What are signed languages?

Signed languages are visual-gestural languages used by deaf people (Petitto 1). With the use of the hands, various shapes are formed which all have their own meaning. These hand shapes or 'signs' are not to be confused with gestures. Gestures, such as pointing at someone or something, are used in any language, by all human beings and are often even used before an actual language is acquired. Signs however, are part of a specific language: they can be seen as the 'words' of a signed language. A sign is built up from three elements; the shape of the hand, the location of the hand and the movement of the hand (Stokoe 20).

Signed languages can be divided into two categories; naturally evolved languages and artificial languages. Artificial languages, such as 'Francaise Signee' are mainly used for educational purposes and are not used in everyday life by the deaf community. These languages are made up for a specific purpose and have not evolved naturally, so for that reason we cannot compare them to (naturally evolved) spoken languages.

All naturally evolved signed languages have 'identical linguistic properties common to the world's spoken languages' (Petitto 4). They have all the structures - syntactic, semantic, morphologic- that spoken languages possess and are 'entirely equal in complexity and richness to that what is found in spoken languages.'(Petitto 4) Signed languages also follow the same acquisition programme: deaf babies acquiring

a signed language reach the same stages of acquisition on an identical timescale as hearing babies that learn a spoken language.

Besides the grammatical aspects of signed languages, the socio-linguistic aspects of signed languages are also comparable to spoken languages. Signed languages have gone through the same developments as spoken languages when it comes to the expansion of the lexicon. Signed languages also have different variants (‘accents’) relating to age, sex and social group, have language rules for politeness and turn-taking, know humour and poetry and form a distinct cultural group within one particular language (Petitto 2).

There are many naturally evolved signed languages used all over the world, however, most of the research discussed in this thesis focuses on American Sign Language (ASL) since this is the signed language that has been, by far, most extensively investigated.

In the next chapters three different arguments will be discussed that support the claim that not only are signed languages real languages, but that they share such similarities with spoken languages as to make plausible the idea that theory properties are covered by Universal Grammar. Firstly, the acquisition of language and the nature and importance of babbling for hearing as well as deaf babies will be addressed. Following that, a rather technical approach of proving the existence of UG will be discussed: this is the use of brain scans in investigating the linguistic behaviour of deaf and hearing people. The last argument will focus on yet another aspect, which is more grammatical. Here, an explanation will be provided of the use of a similar parameter setting in English and ASL: WH-movement.

As this chapter explained, signed languages are natural human languages and should thus be comparable to spoken languages in grammar as well as acquisition.

Chapter 3 Similarities between spoken and signed languages

This chapter will explain the similarities in acquisition between signed and spoken languages, in particular the similarities occurring while babbling. First of all, the concept of babbling will be discussed. Second, a comparison will be made between signed and spoken babbles. The last section of this chapter will focus on signed babbles and how they can be researched.

Babbling

One of the first stages that children reach when acquiring a language is babbling. The babbling stage for speaking babies is defined by the uttering of sounds that have no apparent meaning, but are phonologically possible units within a language. For instance, a baby learning a spoken language will start with babbles like 'bababa'. Babbling has always been assumed to be connected to speech. It has been supposed to flex the oral-motor capacity in order to learn how to speak (utter sounds). However, research has found that babbling also occurs in deaf babies who are acquiring a signed language. So if babbling occurs in signed languages as well as in spoken languages, it seems plausible to assume that it is not exclusively the development of the oral-motor capacity (Petitto 1515). As Petitto shows in many of her articles about babbling[1] the same stages occur in silent babbling (with the hands) and spoken babbling. In the next three sections three articles about babbling written by Petitto and co-authors will be discussed.

First of all in their article "Left hemisphere cerebral Specialization for Babies while Babbling", Petitto and Holowka investigate that babbling babies use the left part

[1] For all articles about babbling used for this thesis see bibliography.

of the brain while babbling. The left part of the brain has been assumed to be connected to language for quite some time. Many studies by different and independent scholars have shown that the left part of the brain is the part where language is processed (Holowka, 1515).

The use of this "language-part" of the brain while babbling rules out the idea that babbling is merely a means of developing the oral-motor capacity, since this part of the body is not ruled by the left part of the brain. Thus, as the research concludes, babbling is the beginning stage in the development of language learning and does not restrict itself solely to the development of the oral-motor capacity. This should also mean that babbling should not be restricted to spoken language, since it is not specifically connected to the oral-motor capacity.

For this study of the left hemisphere the authors makes use of mouth asymmetry studies. These studies look at the opening of the mouth while speaking or uttering non-speech sounds and in doing so try to discover which part of the brain is used when. 'In adults, the presence of right asymmetry in mouth aperture during linguistic tasks has been widely used as a key measure of left hemisphere cerebral specialization for language' (Holowka 1515). Mouth asymmetry studies are based on older asymmetry studies that argue that every nerve path in the body is cross-wired. In simplistic terms, asymmetry studies mean to say that when a person lifts his or her left leg, the right part of the brain has given the order to do so. Therefore if children (learning a signed or spoken language) use right mouth asymmetry during babbling, this should mean that they actually use their left part of the brain (e.g. 'the language part').

For the investigation, 10 babies, acquiring either English or French, were studied. They were all between the ages of 5 and 12 months. All babies were in the

first stage of syllabic babbling. Syllabic or reduplicated babbling is the stage in which babies aged 7 to 10 months utter sounds (syllables) which do not have meaning, such as “dadada” or “bababa” (Petitto 1493). Within this syllabic babbling, three different types of oral activity were distinguished: babbles, non-babbles and smiles. In this research babbles were ‘defined as vocalizations that contained [...] phonetic units, found in spoken language, had [..] syllabic organization and were produced without apparent meaning or reference; all vocals lacking any of these criteria were coded as non-babbles’ (Holowka 1515). In coding the three different types of mouth opening, Petitto and Holowka discovered that the ‘babies’ mouth opening differed depending on whether a babble, non-babble or smile was produced’ (Holowka 1515). It appeared that babies used right mouth asymmetry while babbling, left mouth asymmetry while smiling, and equal mouth opening while non-babbles were produced.

There are a number of conclusions that Holowka and Petitto draw from this research. First of all, they claim that their findings demonstrate that babies use the left hemisphere for babbling, pointing out that babbling is the beginning of the development of the ‘inbuilt’ language functions. Besides that, they claim that the left mouth asymmetry in smiles should point to that fact that babies use the right hemisphere to utter emotions, like adults do, from as early on as 5 months. For this thesis, however, it is important to note that this research led to the discovery of how babbling is formed in the brain, because this shows that babbling is language based. Babbling is not only the activation for the oral-motor system, but is actually the start of acquiring any language, since it appears to activate the inbuilt language system in the left hemisphere.

Deaf baby babbling

If babbling is not merely used for the activation of the oral-motor system but is actually language based, one would also expect to see this development in deaf babies acquiring a signed language. And, interestingly enough, we do.

In their article "Babbling in the Manual Mode; the Ontogeny of Language" Petitto and Marentette report on an investigation into manual babbling. In this research, they compared the behaviour of five infants. Two of them were deaf infants of deaf parents, acquiring ASL, three of them were hearing infants acquiring a spoken language. First of all the researchers noted every manual gesture the both deaf and hearing infants made, to distinguish between normal infant signing (such as raising the arms to be picked up) and between actual sign babbles (syllabic manual babbling). Both groups used gestures as well as syllabic manual babbling, however they differed in quantity of production. The deaf infants used syllabic manual babbling for 32 up to 71% of the time that they were babbling, the hearing babies 4 up to 15% (Petitto 1494). There are a number of similarities the authors find in their study of the acquisition of the language; the stages of manual babbling were similar to the stages of vocal babbling and on the same time course (Petitto 1494):

1) Both hearing and deaf babies used vocal jargon babbling (which occurs from 12 to 14 months). They are meaningless babbling sequences that sound like sentences.

2) Deaf babies produced phonologically possible, but non-existing forms of the ASL lexicon, just as hearing babies produce phonologically possible but non-existing forms of the spoken language they learn.

3) There was continuity between phonetic and syllabic forms used in deaf infants manual babbling and their first signs. Like hearing infants, deaf infants

produce their first signs from the pool of phonetic and syllabic types rehearsed in their babbling.

4) First signs and first words occur at similar ages (10-12 months) and the quantity is also similar; there is little variation (same hand shapes, same reduced set of consonants and vowels).

As we can see, there are quite a few aspects that are similar for hearing and deaf babies. The stages the babies go through while babbling: the vocal jargon babbling, the non-existing forms they use, and the timescale on which all of the stages are reached are equal to both hearing and deaf babies. From this research Petitto concludes that: "Similarities in the time course, structure, and use of manual and vocal babbling suggest that there is a unitary language capacity that underlies human signed and spoken language acquisition" (Petitto 1495).

The difference between gestures and signs

In her paper "Language Rhythms in Baby Hand Movements" Petitto reports on the discovery that hearing babies acquiring a signed language know how to distinguish gestures from signs. As pointed out in the previous chapter, there are differences between signs and gestures. When using signs (babbling manually) babies use a restricted set of units that have no apparent meaning, and these units are formed syllabically. Gestures are non-syllabic: they occur in every language and are therefore not language-specific.

Petitto compared two groups of babies: hearing babies acquiring a signed language and hearing babies acquiring a spoken language. The babies' developmental stages should be equal except for the language input both groups get. In this article Petitto reports the finding that the hearing babies acquiring a signed language use both

signs and gestures, just like hearing babies acquiring a spoken language use sounds (words) and gestures. In spoken language, it is easy enough for babies to distinguish between gestures and sounds, since they differ from each other in modality. Hearing babies acquiring a signed language however, also distinguish between signs and gestures, even though the modality is the same. Even at this early stage of language acquisition babies know which shapes of the hands are part of the language they learn and which shapes are gestures and are therefore not part of that language.

In addition to this Petitto found that babies' manual babbling is restricted to the space in front of the body, which is also the space used for signing in a sign language such as ASL. Gestures however were not restricted at all, but used in exactly the same way as hearing babies acquiring a spoken language used them. This finding again shows that babies acquiring a signed language can distinguish between signs and gestures in a very early stage.

Besides that, Petitto discovered that the rhythms of the movements made by the babies using their hands were lower in frequency when occurring in front of the body than when used outside of that restricted place. "The low frequency hand activity corresponds to the rhythmic patterning of adult sign language and only these low-frequency movements had the qualitative properties of silent linguistic hand babbling" (Petitto 35). She assumes that babies are sensitive to rhythmic language patterns of natural language. What she means is that any naturally evolved language implies the use of patterns. These are not only the purely grammatical patterns, but also include phonological patterns. Thus, babies can distinguish between these 'rhythmic' patterns in the language input they receive and use them to activate their language system.

Differently from signs, gestures of any kind are not patterned, they do not belong to a specific language and they have no syllabic organization. The fact that babies in their use can discriminate between the two is remarkable. Such a distinction could only occur if a baby can understand the underlying language patterns, for which he or she would need a thorough understanding of how language works; the language system or UG.

So far we have seen that the stages of babbling (manually as well as spoken) are almost equal in occurrence and development. Besides that, hearing babies learning a signed language can distinguish between gestures and signs, showing that there is an underlying grammatical basis behind signed babbles. It can therefore be concluded that babbling, whether signed or not, is the beginning of the activation of the language system. Besides that, many similarities in this activation process show that signed and spoken languages are similar to one another and share the same basis, the language system which we call UG.

Chapter 4 The neural basis for language using brain scans in hearing and deaf people

In this chapter the use of brain scans, PET, MRI and Near Infrared Spectroscopy will show that there is a neural basis for language. Three articles written by Petitto and co writers will explain how these scans work and how such a conclusion can be drawn.

In the preceding chapter about babbling, the use of the left hemisphere in infant babbling was discussed. One of the methods of investigating the use of this is to look at asymmetric mouth movements; it was shown that deaf and hearing babies are similar in exhibiting asymmetric movement. In this chapter we will look more closely at the use of the left hemisphere when language is processed.

In her work, Petitto also investigated the neural basis of language, using brain scans. These techniques involved MRI and PET scans and Near-Infrared Spectroscopy. These are all neurological means for investigating how the brain works and more specifically in Petitto's work: how the brain processes language. The previous chapter briefly discussed the part in the brain that is used for language; the left hemisphere. The use of this part of the brain while acquiring language in the babbling stage was discussed and findings on similarities between spoken and signed languages were summarized. In this chapter the focus will be on the similarities of the activation of certain parts of the brain while processing language.

In the investigation by Petitto and her co-workers the focus lies on investigating the activation of the brain while processing language in all human beings. The participants that the investigators used for this research are not only children but they have also looked at hearing and deaf adults and how their brain processes language input.

In their article "Speech-like Cerebral Activity in Profoundly Deaf People Processing Signed Languages: Implication for the Neural Basis of Human Language" Petitto and the other authors looked at activity in the left hemisphere of profoundly deaf people (people who have been deaf since birth) processing signed languages. For this investigation, a number of profoundly deaf people were studied, using different signed languages, so that the results would be the same for all signed languages. They were compared to a group of hearing people, who lacked command of any sign language. Both groups were given the same tests, so as to find similarities or differences between them. With the help of PET scans, the researchers could find patterns of brain activities. The expectation that the left hemisphere of the brain is not merely used in speech and/or hearing was confirmed in the results. "Common cerebral activation patterns were observed in deaf and hearing people involving a brain site previously shown to be associated with the search and retrieval of information about spoken words" (Petitto 13965). It is striking that the tasks that were the most different from each other in terms of modality of input (vision vs. hearing) showed the most similarity in brain activity. From this it can be concluded that it is not the form of input that has a specific effect, but the way in which that input is processed. The left part of the brain has so far been considered to be used for auditory input only. However, even with stimuli different in vision vs. hearing, the brain reacts the same way. This can be taken to show that the left hemisphere is not solely used for auditory input. As Petitto states: "The discovery of STG (superior temporal gyrus –left part of the brain) activation during sign language processing in deaf people is also remarkable because this area is considered to be a unimodal auditory processing area" (Petitto 13966).

This specific part of the brain was previously thought to be specifically linked

to speech and hearing. Although, as Petitto says, some studies have shown that STG activation when hearing people were confronted with "lip reading, the phonological working memory and musical imagery" (Petitto 13966). These tests have all been done on hearing people. This study, however, shows activation of STG in profoundly deaf people; deaf people who have never processed spoken or heard sounds. Therefore it can be concluded that "(…) the human brain can entertain multiple pathways for language expression and reception, and that the cerebral specialization for language functions is not exclusive to the mechanisms for producing and perceiving speech and sound" (Petitto 13966).

In her article "Cortical Images of Early Language and Phonetic Development Using Near Infrared Spectroscopy", Petitto makes another discovery. As the previous chapter about babbling showed, activation of the left hemisphere while babbling leads to the conclusion that the linguistic part of the brain is used and that babbling is language-learning based. In this specific article, Petitto uses near infrared spectroscopy on very young children. These children have not yet entered the babbling stage and any activity in the left hemisphere can therefore be taken to support the claim that children activate their language system at a very early stage; even before they start babbling.

Near- infrared spectroscopy is a method for determining activation in the brain. Highly sensitive probes are placed on the participants' head which emit infrared light at different wavelengths. With the use of the infrared light, oxygen absorption can be determined in the part of the brain that is being tested. The results are sent to a computer that digitalizes them and gives a highly reliable outcome as to what part of the brain is used (or is more active) during certain (linguistic) tasks (Petitto 219). The children tested did not yet speak and were not yet old enough to have entered the

babbling stage, but in all of the children's brains activation was found within the 'classic language areas' (Petitto 217). They were given tasks that were both linguistic as well as non-linguistic (e.g. exposure to language – speaking to the child in simple, but grammatical sentences- vs. exposure to non linguistic stimuli – flashing black and white checkerboards) (Petitto 221). The activation found in the left hemisphere was only seen when linguistic tasks were performed, thus implying that even with infants who do not yet speak or babble, the 'language part' of the brain is used. We can therefore conclude that even before children enter the babbling stage, they already use their inbuilt language system.

In another article on similar issues, "The morphometry of auditory cortex in the congenitally deaf measured using MRI" Petitto and co-researchers report on an investigation using MRI scans to test the brains of profoundly deaf adults. The question the authors asked themselves before starting the research was whether or not the auditory cortical regions (Heschl's gyrus –HG- and planum temporale –PT-) were used in deaf people's brains and if so, how they were used. The hypothesis would logically be that it is not used in the same way, since there is no auditory input. But will it be used in another way or will it not be used at all? As the authors put it: "If an environmental influence such as musical training, occurring relatively late in auditory cortical development, can produce this degree of change, it seems reasonable to predict that a complete elimination of auditory input should produce changes of at least a similar magnitude" (Penhune 1221).

For the investigation, two groups were compared: a group of hearing people and a group of profoundly deaf people. Using MRI to scan the auditory cortical regions in the brains of both groups, the researchers found striking results. It would be expected that the auditory cortical regions of the deaf people should deviate from the

hearing group, since they are not used in the same way, but in reality there was little difference between the use of the cortical regions in the deaf and hearing participants. The results showed “neither significant global differences in cortical volume between deaf and hearing groups nor specific differences in auditory regions” (Penhune 1222). The conclusion that can be drawn from this finding is “that auditory language experience is not required for the development or maintenance of auditory cortical asymmetries, suggesting that the possible substrates of auditory language function may be largely innate and not dependent on auditory experience” (Penhune 1222).

The remarkable conclusion of this article is that there is no apparent need for auditory input in order to activate those parts of the brain, PT and HG that were always considered to be dependent on auditory input in order for them to develop. This research shows that even without this input, these parts of the brain still function as language-processing cortical regions. Thus we can conclude that the language-specific part of the brain will be used for that specific purpose anyway, with or without auditory influence.

In these three articles Petitto and the other authors show that first of all, the left hemisphere is not only used to process auditory input. Secondly, they found out that children activate this part of the brain even before they start babbling. Thirdly, using MRI scans they tested the specific regions in the left hemisphere of the brain, formerly thought of as auditory cortical regions, finding that the use of these regions was the same for both hearing and deaf people. These articles each show that the language-specific part of the brain is used for any form of input, signed or spoken.

Chapter 5 WH-movement

In this last chapter, WH-movement will be discussed. WH-movement was briefly mentioned in the first chapter, but here we will take a closer look at it. A comparison between spoken and signed language (in this case ASL) will be made in order to support the existence of a mutual basis: the language system.

As the previous chapters showed, Petitto has performed extensive research in the field of the neurological basis of language. The studies of babbling as well as those on the use of the left hemisphere of deaf people processing a signed language are very interesting and contribute to the argument that "there is more to the mind" and a Universal Grammar exists also in signed languages. These are the neurological and biological foundations to support the argument. It is, on the other hand, also interesting to discuss similarities that show the existence of UG by looking at the more purely grammatical aspects of both spoken and signed languages.

If in syntax universals are found between spoken and signed languages, the outcome can be twofold. First, finding WH-movement in ASL again makes the point that sign languages are "natural" languages. Second, it would be interesting to find in this sign language a phenomenon that for spoken languages falls within the range of phenomena dealt with via UG, by a parameter choice.

In Sandler and Lillo-Martin's work "Sign Language and Linguistic Universals" a whole range of grammatical universals is discussed. Similarities between signed and spoken languages were found in morphology, phonology, syntax and modality. One of the aspects that the authors researched is WH-movement. WH-movement has always been thought to be a parameter setting that belongs to spoken languages, but Lillo-Martin and Sandler discovered that WH–movement also occurs

in signed languages. “That syntactic movement exists [in signed languages] and is subject to the same constraints found in spoken languages provides strong evidence for the universality of such linguistic properties” (Sandler 477).

Diane Lillo-Martin is a professor at the University of Connecticut and specializes in Linguistics. She has written many articles on the similarities between spoken and signed languages, and has had the help of Wendy Sandler in investigating WH-movement in ASL. Wendy Sandler is a professor of Linguistics at the University of Haifa. Their joined research on comparisons between spoken and signed languages has been as wide as to include phonology, morphology, and syntax (Sandler). In the syntax of ASL they have found many syntactic phenomena that can also be found in spoken languages, including embedded clauses, word order issues, pronouns and null arguments.

However, the focus in this chapter will be specifically on one issue that they have both addressed in many articles: WH-movement. This concept has been briefly explained in the chapter about universal language, but will need a more thorough description.

The main reason for choosing the WH-movement parameter setting is that it occurs in many languages and many people will therefore be familiar with the phenomenon. Showing that ASL has WH-movement, and therefore shares this parameter setting with, for instance, English and Dutch shows that ASL falls within the range of UG. Issues have been raised on whether WH-movement exists in ASL, but since the first articles on the subject were published in the course of the 1990s, the subject was thoroughly researched and most scholars now agree that WH-movement in ASL exists. Using Lillo-Martin and Sandler’s articles on WH-movement, the term itself will first be explained.

In ASL there are more ways available to form a question than just the WH-word (like in English or Dutch). As explained in the first chapter, WH-movement says that when forming a question, the wh-word is moved to the front of the (main) sentence. Consider the following examples:

1. Tim has destroyed what (DS)
2. What has Tim destroyed? (SS)

In English, the WH word moves to the left, as in most languages that have WH-movement; to the initial position. Let us now take a look at the same sentence in Dutch:

3. Tim heeft kapotgemaakt wat (DS)
4. Wat heeft Tim kapotgemaakt? (SS)

In the Dutch sentence, we see the same movement: 'wat' is moved to the initial position in order to form a question.

Not all languages have movement for questions, among the languages that do not are Japanese and Chinese (recall chapter 1). In those languages the question-word remains in the deep structural position.

There have been a number of studies that looked at WH-movement in signed languages, specifically in ASL. In most ASL question sentences there is a wh-word at both the beginning and the end of the sentence (Figure 1).

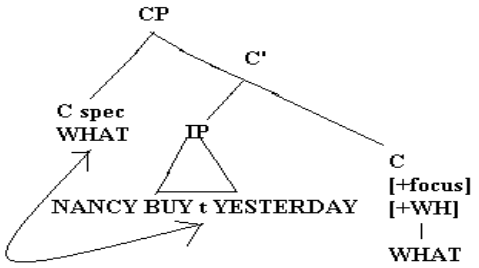

Figure 1

Figure 1 shows that the wh-word 'what' moves from the middle of the sentence to the initial position (Petronio 21). Before the wh-word is moved, the sentence does not yet have its accurate form for the language, at that point it is in its Deep Structure (DS) that I discussed in the first chapter.

When the wh-word is moved from the middle of the sentence to the initial position, the outcome is the question as it would be asked in ASL, the Surface Structure [or SS]. The sentence in deep structure would look like this:

(7) Nancy buy what yesterday what (DS)

The outcome in the surface structure would be:

(8) What Nancy buy yesterday what (SS)

ASL, like English, is an SVO (Subject, Verb, Object) language (Sandler 431). The second sentence is a correct sentence used in ASL. The latter wh-word does not move: it is the so-called 'base generated double'. "This type of sentence-final double also occurs with other focused/emphasized constituents, such as modals, verbs, and quantifiers" (Sandler 437). In other words, the repetition of words at the end of a

sentence occurs in more constructions than just in questions. For instance, doubles are also used in negations such as:

(9) *Ann cannot read cannot (Ann cannot read)*

This latter sentence shows that in ASL the repetition of words at the end of a sentence is not uncommon. The earlier examples show that in ASL there is movement of the wh-words to the initial position, just as in English and Dutch.

Similarities on this grammatical level show us that first of all a sign language such as ASL is a 'real' language in terms of grammar and can therefore play a role in any research for universals in languages. Secondly, this similarity in grammar between three different languages (ASL, English and Dutch) proves that there is a basis underlying this particular grammatical issue that is shared by all three languages.

Conclusion

The aim of this thesis was to find evidence for the existence of Universal Grammar in signed languages. In this thesis many similarities have been discussed between spoken and signed languages. First of all, there are a number of important similarities in the process of language learning and in the acquisition of the languages in question. Petitto and co-researchers have shown that babbling, which has always been thought to be exclusively linked to spoken languages, also occurs in the acquisition of signed languages. They have shown that the stages the deaf and hearing babies go through are highly similar. This in its turn suggests that the development of the language within the brain does not depend on the specific form of language a child learns. Besides that, Petitto discovered that while babies babble they use their left part of the brain (the left hemisphere, which is the 'language-part') which shows us that babbling is definitely a part of the acquisition process of language.

The same conclusion can be drawn from her articles addressing the neural basis of language. All brain research involving PET, MRI and near-infrared spectroscopy have shown that there is activation in the left part of the brain even before children enter the babbling phase, proving that they already use the 'language-part' of the brain before they utter their first meaningful sound or use their first sign. Furthermore, she found interesting results using MRI scans to look at the activity in the specific cortical regions of the left hemisphere. Certain regions of this part of the brain that had always been considered to be exclusively used for auditory input were also used in the same way by deaf adults who had never heard a sound. This result, combined with the results of the other investigations, shows that there is a basis for language present in the human mind from the moment of birth (or even before) and

that the part of the brain used for this basis is not solely used for auditory input but is sensitive to language in general.

The last argument used to support the claim was a little different from the rest of the presented research. Here, the focus was on grammatical similarities. It was shown that a particular grammatical phenomenon, WH-movement, occurring in a number of spoken languages (including Dutch and English) also occurs in sign language. This shows that even though the languages are produced in different modalities (sound vs. vision), and over time have developed separately, this does not exclude grammatical similarities. Combined with the preceding arguments about acquisition and the neural processing of language, it can be concluded that there is an underlying basis for all human languages: a Universal Grammar that is present in both spoken and signed languages.

Works Cited

Baker, Stephanie A, William J Idsardi, Roberta Michnick Golinkoff and Laura Ann Petitto.

"The Perception of Handshapes in American Sign Language." Memory & Cognition 33 (2005) 887-904.

Cook, Vivian J. and Mark Newson. Chomsky's Universal Grammar: An Introduction. Oxford: Blackwell Publishing, 2007.

Corina, David and Wendy Sandler. " On the Nature of Phonological Structure in Sign Language." Phonology 10 (1993) 165-207.

Holowka, Siobhan and Laura Ann Petitto. "Left Hemisphere Cerebral Specialization for

Babies While Babbling." Science 297 (2002) 1515.

Kovelman, Ioulia, Mark H. Shalinsky, Katherine S White, Shawn N. Schmitt, Melody S.

Berens, Nora Paymer and Laura Ann Petitto. "Dual Language Use in Sign-Speech Bimodal Bilinguals: fNIRS Brain-Imaging Evidence." Brain & Language 109 (2009) 112-123.

Laura Ann Petitto: University of Toronto Scarborough. Mea Productions Inc. 25 June 2011

<http://www.utsc.utoronto.ca/~petitto/index.php>.

Laurence, Stephen and Eric Margolis. " The Poverty of the Stimulus Argument." British

Society for the Philosophy of Science 52 (2001): 217-276.

Lightfoot, David. How to Set Parameters: Arguments from Language Change.

Massachusetts: MIT Press, 1992.

Lillo-Martin, Diane. Universal Grammar and American Sign Language: Setting the Null

Argument Parameters. Dordrecht: Kluwer, 1991.

Meier, Richard P., Kearsy Cormier, and David Quinto-Pozos, eds. Modality and Structure in

Signed and Spoken Languages. New York: Cambridge University Press, 2002.

Penhune, Virginia B., Roxana Cismaru, Raquel Dorsaint-Pierre, Laura Ann Petitto and

Robert J. Zatorre. "The Morphometry of Auditory Cortex in the Congenitally Deaf Measured Using MRI." NeuroImage 20 (2003) 1215-1225.

Petitto, Laura Ann. "Are Signed Languages 'Real' Languages?" International Quarterly of

the Sign Linguistics Association 7 (1994) 1-10.

Petitto, Laura Ann. "Cortical Images of Early Language and Phonetic Development Using

Near Infrared Spectroscopy." The Educated Brain: Essays in Neuroeducation. Ed. Antonio M. Battro, Kurt W. Fisher and Pierre J. Lena. England: Cambridge University Press, 2007.

Petitto, Laura Ann and Ioulia Kovelman. “The Bilingual Paradox: How Signing-Speaking

Bilingual Children Help Us to Resolve Bilingual Issues and Teach Us About the Brain’s Mechanisms Underlying All Language Acquisition.” Learning Languages 8 (2003) 5-18.

Petitto, Laura Ann, Marina Katerelos, Bronna G. Levy, Kristine Gauna, Karine Tetreault and

Vittoria Ferraro. “Bilingual Signed and Spoken Language Acquisition from Birth: Implications for the Mechanisms Underlying Early Bilingual Language Acquisition.” Child Language 28 (2001) 453-496.

Petitto, Laura Ann, and Paula F. Marentette. “Babbling in the Manual Mode: Evidence for the

Ontogeny of Language.” Science 251 (1991) 1493-1495.

Petitto, Laura Ann, Robert J. Zatorre, Kristine Gauna, E.J. Nikelski, Deanna dostie and Alan

C. Evans. “Speech-like Cerebral Activity in Profoundly Deaf People Processing Signed Languages: Implications for the Neural Basis of Human Language.” PNAS 97 (2000) 13961-13966.

Petitto, Laura Ann, Siobhan Holowka, Lauren E. Sergio, Bronna Levy and David J. Ostry.

“Baby Hands that Move to the Rhythm of Language: Hearing Babies Acquiring Sign Language Babble Silently on the Hands.” Cognition 93 (2004) 43-73.

Petitto, Laura Ann, Siobhan Holowka, Lauren E. Sergio and David Ostry. "Language Rhythms in Baby Hand Movements." Nature 413 (2001) 35-36.

Petronio, Karen and Diane Lillo-Martin. "WH-movement and the Position of SPEC-CP: Evidence from American Sign Language." Linguistic society of America 73 (1997) 18-57.

Sandler, Wendy and Diane Lillo-Martin. Sign Language and Linguistic Universals. New York: Cambridge University Press, 2006.

Vugt, van Ton. "Stoogelen is Googelen voor Doven." Handicap Nationaal. 31 July 2011 < http://www.handicapnieuws.net/maandag24-7/015/015.php>

Wittmann, Henri. "Classification Linguistique des Langues Signees Non Vocalement." Revue Quebecoise de Linguistique T&A 10 (1991) 215-288.