BOSTON UNIVERSITY

GRADUATE SCHOOL OF ARTS AND SCIENCES

Dissertation

THE ACQUISITION OF CLASSIFIERS IN VERBS OF MOTION AND VERBS OF LOCATION IN BRAZILIAN SIGN LANGUAGE

by

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Submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

2006

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Acknowledgments

This study would never be possible without the support and encouragement of many people. I would like to express my gratitude to these people:

First of all, I'm grateful to my Lord and Savior Jesus Christ, who is my strength, my helper, my refuge. He is my best friend, always present in the difficult times, taking care of my family and me.

Very special thanks to my loving husband, Antonio Almeida, for his support, encouragement, love and patience, and to all my family, here or in Brazil, who were always present in every moment. I'm grateful to my mother, who passed away without seeing the completion of this dream, and my sister, Marcia, my best friend – these two, who I depended on constantly, have a special place in my heart.

Professor Robert Hoffmeister, my advisor, who I will always esteem for his knowledge, helpfulness, patience, and passion for Deaf people and everything related to this work. I learned a lot from him, and I'll never forget the values communicated through his care, his compassion to people, and his advocacy for those in need. Professor Shanley Allen, who is not only a professor with great knowledge and expertise, but is also so sensitive to the needs of others. I'm very grateful for all of her help. Professor Cathy Harris, for her promptness in attending to me every time I needed her support, and Professor Cathy O'Connor from whom I have learned a great amount about being more than a competent professional.

I would like to acknowledge the Deaf adults and Deaf children who participated in this work with great enthusiasm. I'm thankful also to the staffs of the schools, Deaf associations, Ministerio Ephata, Projeto Ouca – Jocum, and so many active workers in the Deaf community in Belo Horizonte and Uberlandia, MG, Brazil, who helped me both when I was in Brazil and here in the United States. Special thanks to Pr. Ronilson Lopes, Nubia Aguila, Moacyr Leao, Lucio and Adriana Amorim. I'm afraid of being unjust for naming some and forgetting others, for so many contributed in many forms.

My colleagues and friends at BU, for their encouragement, support and suggestions to improve my work. Special thanks to Sarah Fish, Melissa Thrasher, Alejna Brugos and the participants of the Research Sharing Forum.

I'm also thankful for Aurora Wilber, for her tireless work reading this study and correcting my English. Her suggestions and comments were always of great value. I also thank to Rebecca Williams, who helped with the last-minute corrections.

Last but not least, I'm thankful to the Brazilian Agency CAPES, for the grant I received to support most of my study in the Boston University. My gratitude also to the Applied Linguistics Program, especially to Cathy O'Connor, and also to the GRS, who provided me with financial support for the fifth year. Without all this support it would be impossible to fulfill what in the beginning was only a dream. I hope that this final work will make it all worthwhile.

THE ACQUISITION OF CLASSIFIERS IN VERBS OF MOTION AND VERBS OF LOCATION IN BRAZILIAN SIGN LANGUAGE

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ABSTRACT

This dissertation explores the relationship between the language model to which children are exposed and their resulting language acquisition. Bickerton (1981) and others claim that children can become proficient in a language even when they are exposed only to non-proficient speakers. It is not clear whether a particular threshold of proficiency in the input is required for complete acquisition in the child. The acquisition of Brazilian Sign Language (LSB) is an ideal testing ground to assess the limits of Bickerton's claim. Most Deaf children in Brazil are born to hearing parents and learn LSB at schools from teachers who are not proficient signers. This dissertation explores the effect of the variation of proficiency of LSB input on the acquisition of one linguistic structure, in 61 children aged 4:6 to 11:10. Two other variables are examined as controls: length of exposure to LSB, and chronological age.

The structure under study is the classifier. In signed languages, classifiers are used with verbs to indicate properties of the Theme including visual-geometric characteristics, abstract semantic category, and instrumental function. This study assesses the effect of the earlier-mentioned variables on the age of onset of production of classifier handshapes, the relative difficulty of production of different handshapes, and errors produced indicating the sequence of classifier acquisition.

Results show that even children with highly impoverished input attain some proficiency and provide partial evidence for Bickerton's hypothesis. Children selected similar handshapes to represent objects, regardless of a plethora of choices based on object form, and regardless of degree of fluency in the input. Deaf children also consistently categorized the objects differently; using handshape, while hearing children organized these objects using other properties. The quality of input also creates differences; for example, children exposed to more proficient input were more consistent in demonstrating handshape orientation in space.

Although exposure to non-fluent speakers is not a sufficient condition for internalizing the parameters of language resulting in fluency, and increasing exposure to skilled language models *helps* improve language skills, children with impoverished input show consistent patterns in their acquisition providing evidence for some innate cognitive process underlying language learning.

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List of Abbreviations

ASL	American Sign Language
BCL	Body Classifier (the signer uses his/her whole body to represent the referent's body
BPCL	Body Parts Classifier (the signer represents the referent's body part, such as legs, an animal's paws, using his/her hands)
CLASS	Denomination of entity classifier = SCL (semantic classifier)
DCDP	Deaf children of Deaf parents
DCHP	Deaf children of hearing parents
HANDLE	Handle classifier = ICL (instrument classifier in Supalla, 1982)
ICL	Instrument Classifier
LBH	Language Bioprogram Hypothesis
LIBRAS	Lingua Brasileira de Sinais = LSB
LSB	Lingua de Sinais Brasileiros (Brazilian Sign Language)
RO task	Real Objects Task
SASS	Size and Shape Specifier
SCL	Semantic Classifier
UFMG	Universidade Federal de Minas Gerais (Brazil)
VoL	Verb of Location
VoM	Verb of Motion

Chapter 1 – Introduction

1.1. Introduction

This study evolved from my previous interest in Deaf youths' language problems. I have been a Brazilian Sign Language (LSB) interpreter for more than 20 years. As an interpreter in a developing country such as Brazil, I had the opportunity to have contact with Deaf people of all ages and many different backgrounds. I was always concerned about some youths and even adults who seemed not to have any language. When someone tried to communicate with them using a signed language, the Deaf person usually imitated the signs, but clearly did not understand anything[1]. In addition, there were some other youths that had many difficulties in understanding others and making themselves understood, despite the ability to use signed language.

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[1] In1984 I met a 24-year-old Deaf man who lived with his mother in a very poor neighborhood. He did not have any contact with other Deaf people or LSB users, and he had never attended school. His mother brought him to our church (a Brazilian Baptist church) to get some help, as he was unable to get a job and to have an independent life. As an interpreter for the Deaf in the church, I tried to communicate with him using LSB. He first started to laugh at my signs, clearly understanding nothing. Later, he started to copy my signs, such as when I signed YOUR NAME WHAT? (What is your name?), he responded by imitating the sign NAME. I asked him: YOUR AGE WHAT? (How old are you?), he attempted to produce AGE (using a different handshape). He seemed to like the attention from all the people in our group, which consisted of many Deaf and hearing people. As a result he frequented the meetings. It was difficult to communicate with him, but everyone used gestures and gradually he started learning to communicate with us. Someone got him a job as a gardener in a company. Some of the Deaf adults introduced him to the Deaf association. He then became involved in the activities of the community and left the church, but we kept in contact. The last time we met, in 2001, was at the bus stop near the Deaf association and I asked him where he was going. He told me he was going to take the bus downtown, to a specific street which has the name of a Brazilian State. I asked him: "You can't read, how do you know the address?" He answered: "the Deaf taught me the names of the streets, so I don't need to read." He traced a small schema of a place in downtown that the Deaf community uses to meet. He was so precise in the identification that I barely remembered how limited his communication was when we first met. It was still difficult to understand him, as his signing seemed to be "truncated" (he produced his sentences using a different structure, and he was still using some of his homesigns) but the contact with the Deaf community was definitely of vital importance to his achieving independence in his life.

In a prior research study[2] (Bernardino, 1999), I examined the signed language production of a group of Deaf children of hearing parents from an oral school for the Deaf, in Brazil. Although signed language was prohibited in class, the Deaf children were acquiring it from their peers and using it as their main form of communication. The signing characteristics of the Deaf children appeared to display differences according to the time of their language acquisition. It was clear that early learners signed differently from late learners. Their signing skills also reflected whether their parents accepted sign language. The variation in the Deaf children ranged from a Portuguese-like sign structure; to an LSB-like signing structure, and some did not show any consistency in their signing. The signing of the late learners was more gesture-like. The Deaf children in this group did not use the space in front of them to mark grammatical relations between the referents (Bernardino, 1999). It was clear that to fully understand their development using a signed language I had to look at younger Deaf children's language acquisition. In addition, further examining the signing structure of Deaf subjects would be necessary to determine what strategies they relied upon to acquire language.

Almost every Deaf child of Deaf parents (DCDP) acquires a signed language from their Deaf parents in the same way as hearing children acquire a spoken language from their hearing parents (Newport & Meier, 1985; Emmorey, 2002). In contrast, most Deaf children of hearing parents (DCHP) do not have access to a consistent language from birth, because of their hearing impairment. Over 90% of Deaf children are born to hearing parents who do not know signed language. As a result, DCHP may have no

[2] Master's thesis, UFMG, Belo Horizonte

effective language exposure in infancy and early childhood (Emmorey, 2002; Lane, Hoffmeister & Bahan, 1996; Emmorey et al, 1995; Mayberry and Eichen, 1991; Newport & Meier, 1985; Goldin-Meadow & Mylander, 1984). Because hearing parents are not encouraged to use a viable signed language, their children usually are exposed to a language input that is impoverished or inadequate. Consequently, DCHP have to rely on their innate mechanisms to construct their language system (Hoffmeister, 1996; Gee & Goodhart, 1995; Meier, 1984; Goldin-Meadow & Mylander, 1984).

Bickerton (1981) claims that children can become proficient speakers of a language even when they are exposed only to non-proficient speakers. This is based on the “language bioprogram hypothesis” (LBH), which claims that all children are endowed with a biological capacity for acquiring language. Every child has the capacity to transform inconsistent input into more complex structures of language. Deaf children should be no exception to this theoretical premise. The bioprogram must consider the issues of age and type of exposure as older children who have not been exposed to any language will have difficulty learning that language. Andersen (1983) widens the LBH with the “nativization hypothesis.” According to the nativization hypothesis, children who are unable to access language in their environment rely on their biological capacity for language. This biological capacity supports the creation of a language that relies on internal rules specified by this capacity (Andersen, 1983). This hypothesis accounts for young children’s early language being different from that of adults. These differences have been researched (Mounty, 1986) and appear to be due to limited cognitive capacity (among other reasons). This hypothesis also accounts for second language learners’ limited processing capacity in the early stages, pidginization and creolization, as well as for the acquisition of signed languages (Mounty, 1986; Gee & Goodhart, 1995). The Deaf children in the former study (Bernardino, 1999) seemed to be acquiring language in the same way as the children who acquired pidgins, which give rise to creole languages (Bickerton, 1981, 1984, 1990).

The capacity to acquire a language declines with age. Adults exposed to a first language later in life are not able to sufficiently master a second language, whether it be spoken or signed. The timing of the initial language experience during early brain development delimits language-learning ability (Mayberry, Lock & Kazmi, 2002; Mayberry & Lock, 2004).

1.1.1. Definition of LSB and its relation to the Brazilian Deaf community

Brazilian Sign Language (LSB) is the signed language used by the Deaf community in Brazil. The history of LSB is similar to the history of ASL, since both were influenced by French Sign Language as part of the establishment of Deaf education. The Deaf teacher Laurent Clerc went to Connecticut with Thomas Gallaudet in 1817 and began to use a signed language adapted to English to teach American Deaf people (Lane, Hoffmeister & Bahan, 1996). In 1855, Ernest Huet, another French Deaf teacher, moved to Brazil. In 1857 he founded the first Brazilian school for the Deaf (Imperial Instituto de Surdos-Mudos, now Instituto Nacional de Educacao de Surdos – INES), in Rio de Janeiro. Its founding received the approval and assistance of the Brazilian emperor, D. Pedro II (Rocha, 1997:5). Huet remained in Brazil until 1861, and after training two teachers to replace him, he moved to Mexico (Rocha, 1997:6).

There are no records that show how much influence the language used by Huet had on the Deaf children in the Institute, or describe the methods he used to communicate with the Deaf children. What is known is that the signed language used by the Deaf people in the institution was considered “gestures” and “mimicry” (pantomime), and it was used officially in the education of the Deaf only in the 1980s, in a Total Communication program. However, sign language was always the preferred communication form for the students and also, unofficially, for some teachers (Rocha, 1997: 30).

Brazil is a country of huge territorial extension. There are very big cities that have almost all the commodities of developed countries. On the other side, there are small villages of difficult access, far away from the big cities, with no electricity or plumbing. There are also mass groups of very poor houses on the periphery of big cities, called “favelas,” with subhuman conditions of life, but many people live there because these places are near to where they can find jobs and they cannot afford to pay rent in better places. Many Deaf children are from these poor environments, or from those small country villages. Some parents have no information on how to educate their Deaf children, and they become isolated at home, deprived from formal education. Sometimes the Deaf children are enrolled in mainstream classes with hearing children, and have no contact with other Deaf children.

Usually, when a child is diagnosed as deaf, the parents have very few options to educate her. Differently from the US, in Brazil there are few schools for the Deaf. The Institute for the Deaf in Rio de Janeiro (INES) is one of the few institutions where Deaf children from many parts of the country have contact with LSB. Some of the existing schools for the Deaf adopt the “oralist” approach, that privileges teaching spoken language and does not accept the use of a signed language. Nonetheless, LSB exists and is transmitted from one generation to the next, usually through their contact at school. The transmission of a signed language from child to child is unfortunately the typical process of language acquisition in Deaf children (Lane, Hoffmeister, & Bahan, 1996). The DCHP models for language acquisition in Brazil are older peers and non-proficient signing teachers.

The different background of the Brazilian Deaf people in relation to the American Deaf people may be responsible for many possible differences between LSB and ASL. In contrast to ASL users, LSB users did not have residential schools where Deaf children would have contact with native users of a signed language. In Brazil there are Deaf associations where Deaf people meet to promote games and to integrate, as happens in the US, but usually the Deaf adults have minimal contact with Deaf children. There are many cases of Deaf people who had their first contact with LSB at an adult age, and despite that they adopted LSB as their preferred form of communication. As a minority, Deaf people have little influence in the governmental decisions related to the education of Deaf children. There is also the fact that many Deaf adults who were educated in the oralist approach are against the use of signed language in education, which reinforces the movement of inclusion of Deaf children in mainstream schools.

The signed language that Brazilian Deaf children have contact with at school is not usually full-fledged LSB. The few educators who use a signed language usually learn the vocabulary of LSB and use it with the grammar of the spoken language (Portuguese), without knowledge of the LSB grammar. A large number of educators have no formal instruction in LSB, but they learn to communicate with the Deaf students in their class (Bernardino, 1999). In Brazil the recent approval of a law recognizing LSB as the language used by the Deaf community (April 2002[3]) has resulted in some efforts to prepare Deaf adults to teach LSB to Deaf children, their relatives, and professionals involved in Deaf education, such as teachers and interpreters.

1.1.2. Introduction to classifiers in signed languages

In the present study, the language acquisition of Deaf children from ages 4 to 11 is examined specifically focused on the acquisition of classifier handshapes. A detailed definition of classifiers in spoken and signed languages is presented in Chapter 2. According to Quadros & Karnopp (2004), classifiers are part of the native lexical inventory in LSB. Classifiers underlie the formation of many of the lexical items that exist in the language today. Classifier forms appear to be a required structural component in the creation of new signs.

The use of classifiers in verbs of motion and location in ASL is a matter that has been examined for many years (Supalla, 1990, 1986, 1982; Schick, 1990, 1987; Hoffmeister et al., 1997; Liddell, 2003; Slobin et al., 2003), but there are very few studies

[3] In April 2002 the Brazilian Government recognized the Lingua Brasileira de Sinais (LIBRAS) as the language of the Deaf community, appropriate to be used in the education of Deaf children. Despite the fact that what was recognized was the name "Lingua Brasileira de Sinais", not the acronym, LIBRAS, it is being used in some instances concomitant to LSB (Lingua de Sinais Brasileira), which was recognized by a huge part of the community as the best denomination of the language. Here, I'll be using LSB, which is in accordance with a decision of the Deaf community in a national conference in Porto Alegre, Brazil, in 1999. When this national conference took place, the recognition project that would be approved later was already in the National Congress, with the acronym LIBRAS.

about these constructions in LSB (Ferreira-Brito, 1995; Quadros & Karnopp, 2004), and no other known study about Deaf children's use of classifiers in LSB. Supalla (1982, 1986) claims that in ASL the verb morphology is distinct from the morphology of spoken languages. The verb root consists of morphemes such as handshape, movement, and location of the hand that are combined simultaneously. In verbs of motion and location, "*the handshape is typically the classifier morpheme of the verb of motion or location (i.e., it marks the classification of the noun as, for example, legged vs. non-legged)*" (Supalla, 1986: 183). Verbs of motion and verbs of location are special types of verbs distinguished from what Supalla calls "frozen verbs," or lexicalized verbs. Verbs of motion and location are verbs that are used in the formation of new words (or new signs). Some lexicalized verbs were originally created as verbs of motion or verbs of location. Supalla gives the example of the lexicalized verb FALL-DOWN in ASL, which has an inverted "V" handshape. This handshape is commonly used as a classifier to indicate two legs. Originally it was used to indicate a two-legged entity falling down. As a lexicalized sign, it is now used to indicate any object that falls down. The handshape in a lexicalized sign is no longer an independent and productive morpheme as it is in verbs of motion and location.

As Newport & Meier (1985) point out, classifier constructions appear iconic because the visual form of the signed production appears to resemble the referent. However, the accurate and appropriate use of handshapes in these verbs requires awareness of many rules involved in the correct representation of the referent (Hoffmeister et al., 1997; Supalla, 1982). For Deaf children to acquire the appropriate and accurate use of classifier handshapes in verbs of motion and location they have to be exposed to a language input that "makes sense" (Hoffmeister, 1996). The acquisition of a classifier handshape used inside verbs of motion and location is a challenge that children must overcome because they may not have adequate language models.

1.2. Objectives pursued and statement of hypotheses

The Brazilian Deaf children that are part of this study may not be exposed to appropriate or accurate use of classifier handshapes, since most of them do not have contact with proficient signers until a relatively late age. Since the correct use of classifiers involves knowledge of the handshapes that are used by the Deaf adult community, how are the Brazilian Deaf children able to learn and use classifiers without contact with Deaf adults?

The peculiar circumstance that involves Brazilian Deaf children language acquisition, mainly the children of hearing parents, is a matter that needs more investigation. Can a child learn a first language with limited exposure? To what extent do quality and quantity of exposure to a first language determine a child's production abilities in that language? Can high quantity of exposure compensate for low quality of exposure? Brazilian Deaf children are a population that can help shed light on these questions, because of their circumstantial characteristics: they have very limited or no access to the spoken language because of their hearing impairment, and the signed language that should be completely accessible is not sufficiently available because the language models are not skilled. In spite of this, some Deaf children have been exposed to signed language for many years, and have this language as their main form of communication.

The study about acquisition of classifier handshapes can answer these questions, since classifiers are present in the foundation of a signed language, and are responsible for new lexicon formation. As the Brazilian Deaf children may not be exposed to the fluent use of classifiers, they would have to rely on some strategies to respond to stimuli that elicit the production of classifiers. One type of strategy is production of a classifier that they have never been exposed to by reanalyzing lexical items, and modifying them to create a new form. When children modify any aspect of the language to produce an output, the process is described as "strategies within the linguistic system." Another type of strategy is using limited language knowledge to try to respond to a language task. In this strategy, children would have to rely on other resources (i.e. gestures) to represent an object that they do not know how to represent using classifiers. This use of gestures to produce an output is described as "strategies outside the linguistic system."

This study tests four hypotheses:

1. Quality of exposure is a significant factor in determining output.

   Deaf children who are exposed to proficient signers from birth (i.e., Deaf children of Deaf parents, DCDP) are expected to perform better on language tasks than Deaf children who are exposed mostly to non-proficient signers (i.e., Deaf children of hearing parents, DCHP).

2. Quantity of exposure has a significant effect in determining output, but it cannot fully compensate for quality of exposure.

Deaf children who have more time of exposure to signed language (e.g., DCHP with more than 5 years of exposure) will be able to respond to a language task more proficiently than the Deaf children who have less time of exposure; however, since they are not exposed to good language models, they may not produce output that is considered fully grammatical by the language community.

3. Chronological age has a significant effect in the production of output.

Chronological age appears to be determinant in the acquisition of classifier handshapes, since classifiers are complex constructions that are not mastered until age 8 or 9 (Schick, 1990; Kantor, 1980). It is expected that the Deaf children younger than 8 years of age will have more difficulty in producing correct classifier handshapes not because of the complexity (markedness) of the handshapes, but because they have to associate the handshape to an object to represent it. The acquisition of classifier handshapes seems to be a developmental issue that the children need maturation to achieve. It is expected that the DCDP younger than 8 years old would be able to produce correctly at least some types of classifier handshapes, which would confirm studies about ASL acquisition (Supalla, 1982; Schick, 1990).

4. Children with high quality and/or quantity of exposure will produce output within the linguistic system; children with low quality and/or quantity of exposure will produce output based on processes outside the linguistic system (i.e. gesture).

The Deaf children who are exposed to better language models and those who have more time of exposure to signed language (DCDP and DCHP with more than 5 years of exposure) will be able to reevaluate aspects of the language to produce classifiers that they may not be aware of how to produce. This hypothesis reflects the fact that a language model will drive the child's choice to what is already known. The child that has language input will make choices according to the target language, and even his/her incorrect choices will involve handshape reanalysis of lexical items already known. This can be exemplified with the handshape errors that Supalla (1982) found in his subjects, when the children of Deaf parents chose a handshape from a citation form instead of choosing from the morphological system to produce a classifier. The children in Supalla's work relied on their language knowledge to make their classifier handshape choices even though the handshape chosen was incorrect according to the adult patterns. In contrast, Deaf children who have been exposed to signed language for less time will not have sufficient language knowledge to rely on the linguistic system to produce the output. It is hypothesized that these children will rely on a basic gestural process to represent items that they are not able to represent using signed language. This hypothesis echoes studies of a signed language created without a language model (Goldin-Meadow, 2003; Goldin-Meadow & Mylander, 1984; Senghas and Coppola, 2001).

In order to evaluate these four hypotheses, 61 Brazilian Deaf children ages ranging from 4-11 years were tested in a language task that elicited the production of classifiers. The research questions were:

1. How accurate are Brazilian Deaf children in producing classifier handshapes?
    - Influence of parental hearing status (i.e., evaluation of quality of exposure)
    - Influence of length of exposure to signed language (i.e., evaluation of quantity of exposure)
    - Influence of age
2. What type of handshape errors do Brazilian Deaf children produce in classifier formation?
    - Hardest and easiest handshapes to produce
    - Substitution patterns
    - Influence of iconicity
3. What strategies do Brazilian Deaf children use when they are not able to produce a classifier?
    - Evidence for a "linguistic system"
    - Evidence for a "basic gestural process"

1.3. Study design and contributions of this study

This study comprises 6 chapters. Chapter 1 is the introduction. Chapter 2 includes a review of research on the structure and acquisition of classifiers in signed languages, focusing first on the morphosyntax of classifiers, second on the acquisition of classifiers in signed languages, and third on the consequences of inadequacy of input to language acquisition. Continuing, there is an explanation of the differences between classifiers and gestures, and the Brazilian Deaf children's situation is presented. Chapter 3 provides an explanation of the methodology used in this study. Chapter 4 contains the statistical results. Chapter 5 describes the qualitative results of the study, which consists of the presentation of the children's responses to the task. Chapter 6 provides the discussion of the findings, as well as the conclusions of this study. It also provides direction for further research, in addition to the relevance of the current study to the research on the acquisition of classifiers.

This study is a significant contribution to linguistic studies of language acquisition, especially the critical period for language acquisition and the resources that children rely upon to communicate. The majority of Deaf children studied do not have contact with proficient users of LSB, but many of them use signed language in their daily interactions. Two issues are remarkable:

1. Exposure to impoverished input allows the research to chart the unfolding of language acquisition; and
2. Examining what happens when a child must create a sign or a gesture to communicate helps to understand what internal process they rely upon.

This study also contributes to the field of sign language studies, since LSB is a signed language that shares many similarities to ASL, but has some differences that make LSB very distinctive (e.g., according to Quadros, 1999, in LSB the focus construction can be embedded between CP and IP, which differs from ASL). The fact that both ASL and LSB share the contribution of French Sign Language in their background can be helpful to delineate the similarities and differences in comparisons between the two languages at the level of classifier creation and use.

The cross-linguistic contribution is that the methodology used in this study can be helpful for further comparative studies about users of both languages (LSB and ASL), because this study makes use of existing tasks which are currently used in ASL acquisition studies of Deaf children (Hoffmeister et al., 1997; Fish et al., 2003). The intent of this study is not a comparison of ASL and LSB, though occasionally some comparisons are made.

Chapter 2 – The Structure and Acquisition of Classifiers in Signed Languages - Literature Review

2.1. Introduction

In this chapter, a review of literature about classifiers in spoken and signed languages is presented, as well as a discussion of the similarities between them. The initial point of this chapter is a discussion of the morphosyntax of classifiers. First, there is an explanation about classifiers in spoken languages. Next, there is a discussion about the controversy over the use of the term “classifier” to denote constructions in signed languages that have been compared to classifiers in spoken languages. An explanation of the policy that is adopted in this study in relation to this ongoing discussion is presented. Then, a review of research concerning classifiers in signed languages is presented. This is followed by the identification of the different types of classifiers in LSB and their characteristics among adult users. Finally there is a review of literature about acquisition of classifiers in signed languages. This is followed by a discussion about the consequences of inadequacy or the impoverishment of input.

2.2. The morphosyntax of classifiers

2.2.1. What is a classifier?

Classifiers are morphemes that classify nouns according to semantic criteria (Senft, 2000). Grinevald (2000) defines classifiers as “*overt systems of nominal categorization of clear lexical origin used in specific morphosyntactic constructions*”

(Grinevald, 2000:61). For example, in some classifier languages you cannot enumerate pencils, oranges and blankets without specifying that the pencils are long and rigid, the oranges are round, and the blankets are flat and flexible. The morphosyntactic position in the sentence and the semantic function of classifiers are distinct from other terms that are used for reference and for the purpose of classification of a noun.

2.2.1.1. Morphosyntactic position

Classifiers belong to one of the several different systems of classification of nouns that exist in many spoken languages. English does not have a system of classifiers. According to Grinevald (2000, 2003), the classifier system appears in the intermediate level between the lexical and grammatical systems. Figure 2.1 below illustrates Grinevald's characterization of classifiers (Grinevald, 2003: 93):

Figure 2.1 – Intermediate position of classifiers according to Grinevald (2000, 2003)

Lexical ……………... ←	……. Lexicogrammatical ……..	...……… grammatical →
measure terms	CLASSIFIERS	noun classes
class terms		gender

According to Grinevald, the lexical system may include terms for the classification of measurement (e.g., a *glass* of milk or *stacks* of paper), and classifying morphemes used in the derivational process of word formation (e.g., cardiolog*ist*, psychiatr*ist*, chem*ist*) or terms used in compounding (e.g., police*man*, bar*man*, sales*man*).

Class and measure terms[4] are also found in many other languages and are part of the lexicon of a language. Grammatical systems are part of the morphosyntax of a language and they form the other end of the system of nominal classification. Grammatical systems are composed of gender and noun class components. Some languages such as French and Portuguese have different gender assignments to the same common objects (e.g., *la fourchette* and *une chaussure* are feminine terms for “the fork” and “a shoe” in French, while in Portuguese these same items are masculine - *o garfo* and *um sapato*). Noun class systems are found in the languages of Nigeria and Congo, for example, Bantu languages. The examples below are from Shona (Dembetembe, 1995) a Bantu language:

mu-komana	(class 1)	“a boy”
chi-komana	(class 7)	“boyishness, in the way boys behave”
u-komana	(class 14)	“boyhood”

Grinevald (2003) identifies four major types of classifier systems that are discussed in the literature of spoken languages: (1) Genitive classifiers – used in possessive constructions; (2) numeral classifiers – present in quantitative constructions; (3) noun classifiers – associated with the noun directly; and (4) verbal classifiers – which are used inside the verb form, where they “*classify the nominal arguments of the verb on a semantic basis similar to that of classifier types found within the noun phrase*” (Grinevald, 2003: 93).

Classifiers can be used in many places in the clause, but there are two main instances where classifiers can be incorporated: in agreement within the noun phrase (in

[4] A class term is a noun or morpheme that is used to identify nouns according to specific categories. In English, for example, the morpheme ‘*ist*’ in the word ‘psychiatrist’ is an agentive that indicates ‘the person who works with psychiatry’; in the compounding ‘salesman’, man is an agentive morpheme that indicates ‘male person who sells beings’.

genitive, numeral and noun classifiers), or in referencing an external nominal argument in the verb, as in verbal classifiers (Grinevald, 2003).

Grinevald (2003) claims that the most common use of classifiers in the discourse is as reference tracking devices. It seems that the classificatory function of classifiers "*is no more than a secondary classifying effect* (Grinevald, 2003: 99)." Classifiers are mostly used in anaphoric constructions (Grinevald, 2000; Zavala, 2000), even though there are registers of classifiers that are used "quasi-anaphorically" (Wilkins, 2000: 158), such as, when there are other elements in the phrasal structure that provide the definite third-person reference form. Classifiers are also used in a determiner-like function referring to specific nouns in the discourse (Grinevald, 2000).

2.2.1.2. Semantic function

Lucy (2000) makes a distinction between 'classifying nouns' as linguistic forms and 'classifying referents', which are relative to the classification of experiences. This means that despite the fact that nouns make reference to specific referents, the language user has in mind the characteristics of the referent, not the characteristics of the noun. In this sense, it is not the linguistic form that is classified, but the language user's experience. For example, note the classifiers that occur with the noun *ha'as* (banana) in Yucatec Maya (Lucy, 2000: 329):

'*un-tz'iit*	*ha'as*	"one 1-dimensional banana (i.e., the fruit)"
'*un-waal*	*ha'as*	"one 2-dimensional banana (i.e., the leaf)"
'*un-kuul*	*ha'as*	"one planted banana (i.e., the plant/tree)"

In these examples, it is not the noun *ha'as* (banana) that is classified, but the referent that the speaker has in mind (the fruit, the leaf or the tree). The experience of the speaker is what leads him/her in the choice of the classifier that is used with the noun.

Lucy explains how classifiers classify referents using the Yucatec Maya construction '*un-tz'iit kib'*, which is translated as "one long-thin candle." The use of the classifier "long-thin" seems redundant, since candles usually are long and thin; however, the lexical item '*kib'* that is translated as 'candle' has the meaning of "wax." Thus, the expression "one long-thin wax" comprises the meaning according to the speaker's experience, which means that the classifier is chosen to specify that the "wax" that is referred to is "long and thin." In this type of classifier construction, the information of the shape of the referent counts in the choice of the classifier to be used.

Grinevald (2000) qualifies the semantic profile of three of the four major types of classifiers:

> "numeral classifiers = physical categories
> *two-ROUND oranges*
> *three-LONG RIGID pencils*
> *four-FLAT FLEXIBLE blankets*
>
> genitive classifiers = functional categories
> *my-EDIBLE food*
> *his-DRINKABLE potion*
> *their-TRANSPORT canoe*
>
> noun classifiers = material / essence categories
> *an ANIMAL deer*
> *the ROCK cave*
> *MAN John*" (Grinevald, 2000: 72)

Grinevald does not include verbal classifiers in this analysis. The verbal classifiers are incorporated in the verb differently than the three types that are used inside the noun phrase as displayed above. She points out that there are two types of verbal classifiers. One type of verbal classifier is a generic noun that may be used as a classifier. The other consists of an affix that is used with the verb. The semantics of the first type is similar to noun classifiers, and the second has the semantic characteristics of numeral classifiers.

2.2.2. Controversy over Classifiers

There are many discussions about the use of the term "classifier" to denote the signed language constructions that have been compared to classifier systems in spoken languages. Schembri (2003: 17) claims that this comparison is problematic, since the spoken languages that are compared to signed languages in the literature (such as Navajo and other Athabaskan languages) are not appropriately viewed as classifier languages[5] according to Grinevald's definition:

> "*Grinevald's (1996) definition suggested the following four criteria for distinguishing true classifiers from related classificatory phenomena:*
> *(a) Classifiers are overt morphemes.*
> *(b) They constitute a morphosyntactic subsystem.*
> *(c) They are semantically motivated systems of classification that do not classify all nouns.*
> (d) *They are subject to discourse-pragmatic conditions of use. (Schembri, 2003:15)*"

Schembri (2003) states that despite the fact that the choice of classifiers in spoken languages is motivated by discourse-pragmatic factors, the use of these classifiers always reproduces different perspectives on the characteristics of the nouns they are related to

[5] Schembri (2003) presents many criticisms of Allan's (1977) typology of classifier languages, which served as the basis for Supalla and other signed language linguists who claim that signed languages have constructions that are similar to classifiers in spoken language.

(e.g., in Burmese, a classifier that refers to a river will show if it is related to “a river on a map,” “a river as a path to the sea,” or “a river in general”). He claims that in signed languages there are other elements that influence the choice of handshape in a classifier construction beyond the visual characteristics of the referent. For example, in a semantic classifier, the handshape represents the agent, patient or theme of the verb, but the handshape has to be selected according to whether the referent is animated or not, which is natural in other classifier languages. In contrast, the handshapes chosen for classifiers in handling verbs (instrument classifiers – ICL) or in verbs of visual-geometric description (size and shape specifiers – SASSes) do not seem to have many similarities to classifiers in spoken languages. Schembri does not accept the extension of the term “classifier” to account for these instrument classifiers and size and shape specifiers in the same way as it accounts for other types of classifiers. For this reason, he believes that classifiers in signed languages do not have a primary function of classification.

In his conclusion, Schembri states that the handshape units used in signed language constructions seem to constitute a type of morphosyntactic subsystem that has properties similar to certain types of words that are found in some spoken languages, like noun classes or measure terms; however, because the selection of a particular handshape is partly *motivated by perceived characteristics of the referent*, and because the use of *these handshapes does not have a primarily classificatory function*, they cannot be considered true “classifiers” as they are defined within spoken languages. This conclusion does not make sense, since Lucy’s examples illustrated earlier (section 2.2.1.2) are motivated by characteristics of the referent.

Despite Schembri's and others' suggestions for new nomenclature, many authors continue to use the terms "classifier constructions" (Sandler & Lillo-Martin, (in press); Aronoff et al., 2003; Emmorey and Herzig, 2003; Emmorey, 2002) or "classifier predicates" (Liddell, 2003; Supalla, 2003) to indicate predicates which contain classifiers. Aronoff et al. (2003) claim that some classifiers in spoken languages are not identical to classifiers in signed languages, but the use of the same label "*has the advantage of encouraging comparison among the various classifier systems, which is likely to result in a better understanding of sign language classifiers and their behavior*" (Aronoff et al., 2003: 64).

Aronoff et al. (2003) suggest that from the innumerable types of noun classification that exist in spoken languages, verbal classifiers are the best forms for comparison to signed language classifiers. In contrast to other types of classifiers that occur inside the NP structure, verbal classifiers are located inside the verb form. They do not classify the verb, but rather any noun that is associated with this verb. According to Grinevald (2000), verbal classifiers seem to be divided into two subtypes: one that is similar to numeral classifiers, in which the physical characteristic of the object is obligatory (e.g., two "round" oranges, three "long and rigid" pencils), and other that has similarity to noun classifiers, in which the material or essence of the object is obligatory (e.g., an "animal" deer, the "rock" cave).

Following Grinevald's (2000) typology of classifiers[6], Aronoff et al. (2003) claim that the physical and essence categories of the two types of verbal classifiers are clearly

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[6] See item 2.2.1.2 Semantic function of classifiers in spoken languages

similar to the formal categorization of classifiers in signed languages (see also Sandler & Lillo-Martin, in press, for an extensive discussion about the similarity of classifiers in signed languages to verbal classifiers). As an example, Aronoff et al. compare the Cayuga classifier *treht-* (VEHICLE), which falls into the "essence" category, to signed language "entity" classifiers (SCL, in this study). They claim that these two classifiers are similar in semantic and also on morphological grounds, given that both are bound morphemes. They make another comparison to some prefixes in Digueno, which are classifiers that refer to physical characteristics of nouns (e.g., long, small round, or a bunch of objects)[7]. These classifiers in both signed and spoken languages represent physical characteristics of objects and are bound forms that classify nominals.

Another point which may be causing confusion is that Aronoff et al. suggest that signed language classifiers are not similar to classificatory verbs in Navajo, which they have been compared to, nor are they similar to the forms that they have been compared to in Allan's (1977) work. Classifiers in signed languages do share many similarities to verbal classifiers, and to other forms of classifiers that exist in spoken languages, such as numeral and noun classifiers.

Aronoff et al. contend that much like verbal classifiers, which are used in discourse as referent tracking, backgrounding and modifying devices, and whose classificatory function seems to be secondary, classifiers in signed languages share the same expressive functions, not only the semantic and morphological characteristics that were discussed above.

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[7] Examples of signed language classifiers (SASSes) that bear the same characteristics are in Figure 2.4

Given that the debate regarding classifiers and signed languages has not been settled, I will define the terms I will be using in this study to deal with these signed language constructions. The term “classifier constructions” refers to the system of “signs” that are not lexicalized (not in citation form), but are subject to discourse-pragmatic conditions of use. For example, there is a lexicalized form for CAR in LSB (and ASL) that is represented by two hands in “S” handshape (as if the signer were holding the car’s wheels). During the discourse, the signer introduces the car using the lexicalized form (see Figure 2.2), but when referring back to it (as in “the car is parked next to the tree”), he does not use the lexicalized form, but a classifier (using a “B – palm down” handshape) instead.

Figure 2.2 – Representation of “car” in LSB (lexicalized and classifier forms)

(a) lexicalized form	(b) classifier form
“S” handshape on both hands	“B – palm down” handshape
“*I bought a car*”	“*my car is parked (next to the tree)*”

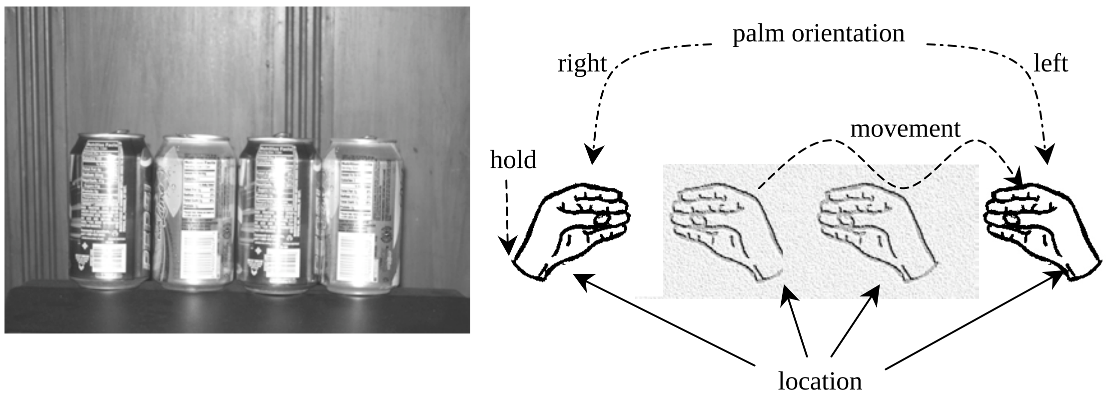
Classifiers are used in verbs of motion and location, and in handling verbs (according to Supalla, 2003). For the purposes of this study the simple term “classifier” will be used to denote the articulators (hands and body) used in the five types of classifiers described by Supalla (1986). These five types continue to be used and are commonly referred to as classifiers in the literature about signed languages.

2.2.3. Classifiers in signed languages

2.2.3.1. Morphosyntactic position of signed language classifiers

Supalla (1986) claims that classifiers are morphemes that are used in verbs of motion and location in ASL to refer to the noun that is performing the action of the verb or the noun being located. Lexical items in ASL (and in other signed languages) are composed of the movement of the hand(s) or other body parts in the space in front of the signer. Every lexical item has 4 basic phonological parameters (handshape, palm orientation, movement and location) that together constitute a morpheme. Verbs of motion and location differentiate from lexical items because they are larger units. In VoM and VoL one of the phonological parameters (i.e., handshape) represents a morpheme (the classifier). According to Supalla (1982), verbs of motion and location in ASL are mostly produced as single phonetic features (or as being one syllable long), yet they are composed of two basic groups: movement (which includes change in one of the three articulation parameters: orientation, location, or shape) and articulators. The motion/location morphemes combine with the articulator morphemes (the hands or body) to form the stem of the verb. The classifier is formed in a particular shape and orientation, and located in a particular place in a VoM or VoL. It is obligatorily affixed to the movement root, which is attached to the movement path. The function of the articulator (handshape) is to classify and locate the nouns, according to their visual-geometric characteristics, their abstract semantic category or by marking an instrument that manipulates the object that is being referred to. The handshape can represent the central object in the discourse (as the active articulator), or the secondary or the ground object (as the stative articulator). Figure 2.3 shows a representation of parameters of a verb of location in signed languages.

Figure 2.3. Representation of parameters of a verb of location in ASL and LSB



Cans in a row – representation using "C" classifier handshapes

In Figure 2.3 the "C" handshape on the left (palm orientation to the right) is a classifier that represents the leftmost can in the picture, with a hold movement root that Supalla (1982) calls "stative." This left hand is the secondary hand that represents the ground object. The right hand represented in the picture with the palm orientation to the left is the primary hand (a second classifier because each hand can have independent reference). The primary hand is the only hand that moves (in this example) in stamping movements to the right in different locations along a path. These stamping movements, combined with the other parameters are used to represent the multiple cans in the scene, resulting in a verb of location.

Supalla groups classifiers into 5 categories: (1) size-and-shape specifier (SASS), in which the handshape represents the size and the shape of an object; (2) semantic classifier (SCL), where the handshape represents the semantic category of the object; (3)

instrument classifier (ICL), in which the handshape represents either the visual representation of the instrument, or the function of the hand operating the instrument; (4) body classifier (BCL), in which the whole body is used to represent animate nouns that have bodies and limbs; and (5) body part classifier (BPCL), where the hand is used to represent a body part of the referent.

Schick (1987) reduces ASL classifiers into 3 general categories: (1) CLASS, which corresponds to Supalla's semantic classifiers, (2) HANDLE, which is similar to Supalla's instrument classifiers, indicating the category of classifiers that represent the handling of an object, and (3) SASS, which is similar to Supalla's SASS category and includes classifiers used as adjectives. Schick does not say anything about the classifiers referring to the signer's body or body parts (body and bodypart classifiers).

Hoffmeister et al. (1997) emphasize that classifiers in ASL are incorporated into verb frames. They are used with a pronominal function to refer to an object mentioned earlier. The handshapes that are used in verbs of motion and location may appear to be iconic representations, but actually they are not, since the accurate and appropriate use of handshapes requires awareness of the rules that control the shape, orientation, location, movement, pronominal reference and other features involved in the correct representation (Hoffmeister et al., 1997: 6).

Sandler & Lillo-Martin (in press) claim that classifiers in signed languages have a function of backgrounding, clearly in a way that has more than a pronominal function. The relation of figure to ground that is established using the two articulators (both hands) occurs due to the simultaneity that is made possible by the manual-visual system. They cite an example of the construction “my friend has a fancy car, a Porsche”. The signer represents someone driving a car, stopping it, parking it, and the secondary hand keeps or holds the hand in time as the “car parked”, while the primary hand represents the friend who “goes shopping, does errands, and when finish, goes back to car and zooms off.” The holding of the “car parked handshape” is a reference to the “friend’s car” throughout the discourse, not to the friend. The backgrounding function of the secondary hand in a figure-ground construction makes classifiers in signed languages very distinctive.

Sandler & Lillo-Martin claim that verbs containing classifier constructions do not observe the same rules as common verbs. Classifier constructions are also different from lexical items in their morphological structure. In lexical items, all four phonological units combine to establish one meaning. In a verb containing a classifier, each structural element in the classifier has relevant meaning, which turns it into a morphological unit rather than in a phonological unit. The phonological form of lexical items also differs from the phonological form of classifiers. This last claim reinforces the comparison of classifiers in signed languages to classifiers in spoken languages due to the intermediate position of classifiers according to Grinevald (2000, 2003).

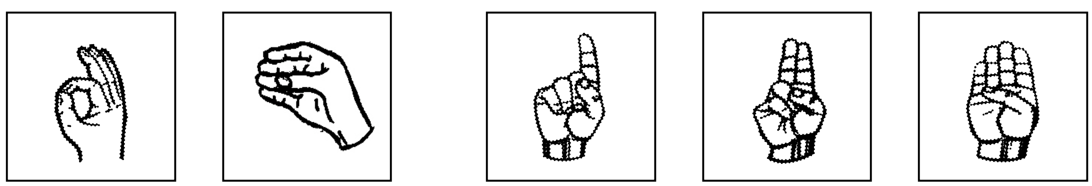
2.2.3.1.1. Types of classifiers

In this study we are considering the five main types of classifiers in signed languages, according to Supalla (1982): size and shape specifiers, semantic classifiers, instrument classifiers, body classifiers, and body part classifiers. Each is described in turn.

(a) Size and Shape Specifiers - SASS

Size and shape specifiers (SASS) illustrate the size and/or shape of the object to which they refer. They are considered hand-part morphemes in Supalla’s terminology (as opposed to single handshape morphemes) because typically only one part of the hand is used to show the size and/or shape. For example, the extended index finger can represent a “thin and straight object,” but by adding a second finger, it now represents a “narrow and straight object.” The shape of the referenced object dictates which hand-parts are to be selected. Objects may be represented as straight or round, as well as variations of width or depth that are associated with the referents. Examples of SASSes are in Figure 2.4.

Figure 2.4 – Examples of handshapes used in SASSes (size and shape specifiers) in ASL



ROUND & SMALL (e.g., a coin)	ROUND, LARGE & DEEP (e.g., a cylinder)	THIN & STRAIGHT (e.g., a pole)	NARROW & STRAIGHT (e.g., a knife)	WIDE & STRAIGHT (e.g., a board)

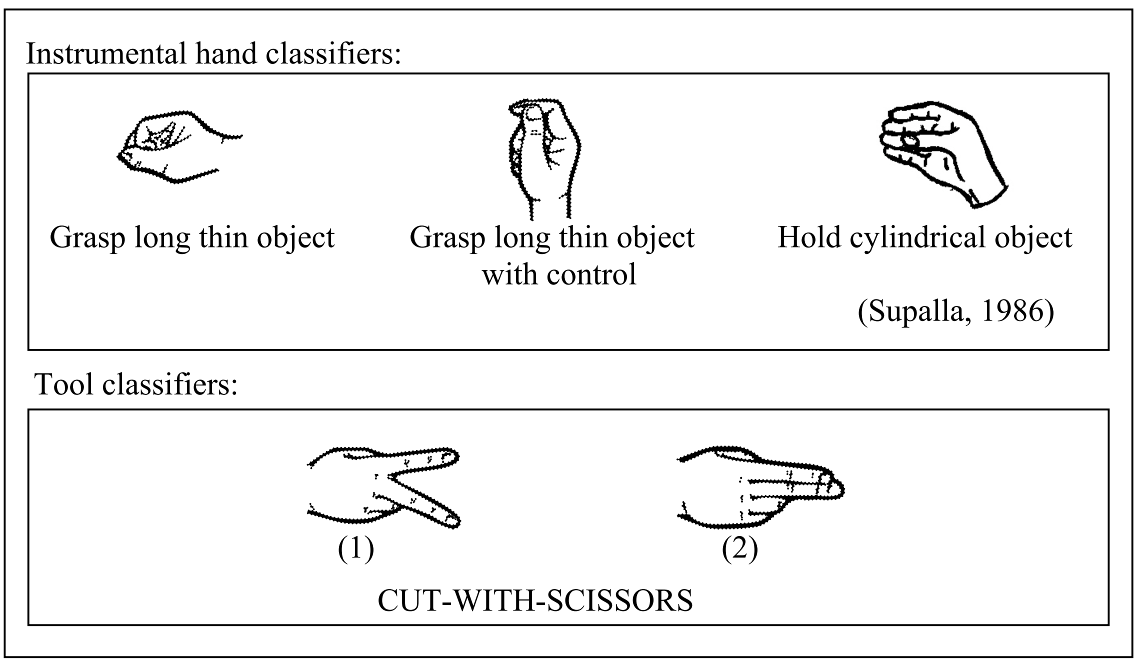
(b) Semantic Classifiers - SCL

When compared to SASSes, the semantic classifiers (SCL) are more abstract in their representation of objects. Supalla (1982) claims that although they might have originated as SASSes, they no longer make reference to the visual-geometric characteristics of the object, but they refer to the semantic categories to which the object belongs. As an example, the classifier for TREE is realized as a spread hand combined with the extended forearm. This classifier resembles the shape of a conventional tree, but it is used to represent any kind of tree, even pine trees or palm trees, which have a different shape.

(c) Instrument Classifiers - ICL

The handshape used in the instrument classifier (ICL) category is chosen according to the role the noun represents in the discourse. If the focus of the discourse is on a human manipulating an object, then an *instrumental handshape* classifier is used. If the agent is manipulating a tool, the visual-geometric characteristics of the tool will be represented using a *tool* classifier (Supalla, 1986). Examples of ICL are found in Figure 2.5.

Figure 2.5 – Examples of handshapes used in ICL (instrument classifiers) in ASL



(d) Body Classifiers - BCL

Supalla (1986) claims that the internal components of a body classifier (BCL) are governed by a separate morphophonological system. Instead of involving the hand articulators to represent referents, the whole body of the signer is used to refer to the animate referent. As an example, Supalla cites the verb HIT-IN-THE-EYE, in which a handshape in the shape of a fist moves in direction of the signer's eye, using the body of the signer as a BCL. There are many restrictions to the use of this classifier type, such as: the referent must be an animate noun, it can mark only one referent at a time, the reference scale[8] of the handshape used in combination with a BCL must be consistent, and other restrictions involving the movement path across space.

(e) Body Part Classifiers - BPCL

The bodypart classifier (BPCL) category consists of two articulatory components, both involved in semantic representation: the handshape that marks the shape of the body part, and the body location that marks the spatial orientation of the body part (Supalla, 1986). Supalla claims that the BPCL shares the same characteristics as bodypart classifiers in spoken languages, which are "*based on the perceptual saliences of shape, size, and spatial orientation* (Supalla, 1986: 194)." He points out that in ASL the representation of the attributes of body parts are made using a combination of SASS handshapes and body locations. To represent a body part, the signer can point to a

[8] The reference scale in the use of handshapes is according to Supalla's (1982) definition. The noun represented must agree with the reference system: "Real reference system" or "Abstract reference system." The real reference system is analogue to the real world scale; the abstract reference system represents the referent in small proportions (see Fig. 2.6.a, the representation of legs using index fingers). When classifiers are combined with others the reference scale must be consistent. For example, if the VEHICLE classifier is used over a human body it must represent a toy, unless the signer's body refers to a giant.

location on his/her body or trace the outline of his/her body (e.g., make a circle around his/her face) and then use a handshape that better represents the attributes of the body part. Examples of handshapes used in bodypart classifiers in ASL are on Figure 2.6.

Figure 2.6 – Examples of handshapes used in BPCL (bodypart classifiers) in ASL

(a) Representation of legs (b) Representation of eyes

2.2.3.2. Semantic function

Supalla (1982) claims that the choice of a classifier to represent a noun is constrained by several factors, including the semantic role of the noun in the event. If the noun is an agent, an instrument, or patient in the event, it will influence the choice of the classifier to be used. For example, the instrument classifier (ICL) used for "driving the car" (when there is an agent involved) can never be used if the car is moving without a driver. Even if there is a driver, but the focus is on the whole car and not on the driver, the ICL cannot be used. Classifiers can be used to focus in at the micro or macro level of reference to objects. Figure 2.7 shows some examples of classifiers for cars used in ASL.

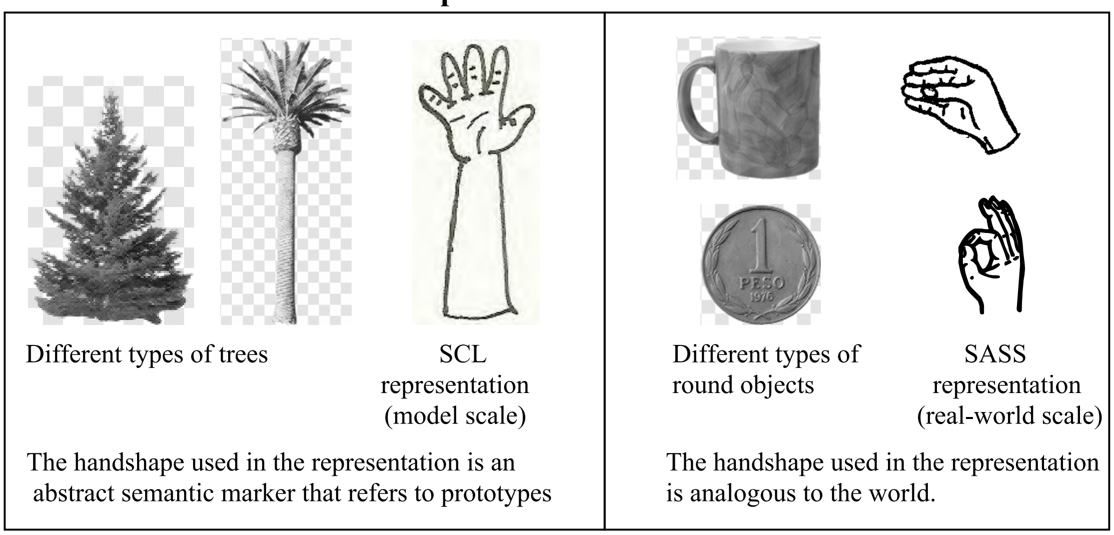
Figure 2.7 – Types of classifiers for cars used in ASL

"*driving the car*"
(ICL – instrument classifier)

"*the car is moving*"
(SCL) – focus on the whole car

Schick (1987) states that a classifier predicate can be expressed in one of two dimensions: it can be in a *model scale*, where all objects are composed as miniatures of real-world or in a *real-world scale*, where every reference point is analogous to the world. For example, in constructions involving semantic classifiers (SCL), the handshape used is an abstract semantic marker that refers to prototypical categories of objects (see Figures 2.7 and 2.8). She points out that in the model scale, the distances and sizes are used to represent, rather than imitate, the real world. In the representation in a real-world scale, however, the constructions have "*a close-up perspective point with a local scope of attention*" (Schick, 1987: 31). Schick claims that SASSes are always used in real-world scale.

Figure 2.8 – Comparison of model scale (SCL) and real-world scale (SASS) representations in ASL

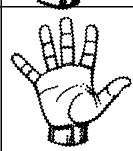


2.2.4. Classifiers in LSB

There are very few studies about classifiers in LSB. Ferreira-Brito (1995) and Quadros & Karnopp (2004) are among the few published reports that make any reference to classifiers in LSB. There are a few other published materials created with the objective of teaching LSB that mention how to produce some classifiers, but they refer mostly to the production of SASSes (Pimenta, 2001).

Ferreira-Brito (1995) observes that in LSB, classifiers are used in verbs of motion and location, similar to ASL. She identifies some of the more productive classifiers in LSB, which are described in Table 2.1.

Table 2.1 – Description of classifier handshapes most frequently used in LSB (according to Ferreira-Brito, 1995: 107-112)

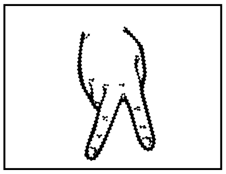
Handshape		Use and examples
Y		Used to represent a fat person walking; large objects with irregular form (such as telephone, coffee pot, shoe heel, iron, airplane, submarine, cow horn); clothes, food, and other objects in a home
B		Handshape with some variations such as extended thumb, used to represent flat, plain, or lumpy surfaces (such as vehicles, the roof of a house, a foot in a shoe, a book, a house, wheels of a train)
G (1)		Used to describe linear forms, to indicate places using the tip of the finger, and to represent objects long and thin (person, pole, nail)
F		Used to represent small cylindrical objects (such as coins, buttons, a drop of water), to show manner of holding small and thin objects, and using both hands to describe cylindrical long objects (such as a thin tube)
A (S)		Used to hold objects (such as a knife, an umbrella, or a bunch of flowers)
V		Used to represent people (one person walking – V pointing down, or two standing people – V pointing up)
5		Used as noun substitute, can refer to many entities (plural) or only one entity (no examples provided)

Ferreira-Brito suggests that other handshapes are used as classifiers in LSB, but she limits her explanation to the use of the classifiers presented in Table 2.1. She claims that besides the handshape, the palm orientation can be an important element in certain classifier formations (as it is in ASL). The "V" classifier in LSB (and in ASL), for example, can represent one person walking when the palm orientation is toward the signer and the fingers point to the ground. When using the same handshape with the palm facing the receiver and the fingers pointing up, the meaning of two persons walking or standing side by side is intended. Palm orientation is a very important element in this case because the two articulations of the "V" handshape constitute two different classifiers as follows:

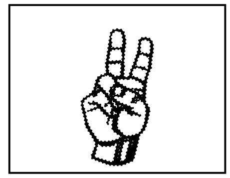
1. A singular classifier that represents the legs (palm orientation facing in, or "V" pointing down), (see Figure 2.9.a) and
2. A dual classifier (palm orientation facing out) representing two people (see Figure 2.9.b).

Another example of how the palm orientation is important in classifier articulation would be the "3" classifier in ASL, where having the hand palm to the left means VEHICLE (see Figure 2.9.c), but having the hand up with the palm facing out can mean THREE-PEOPLE or the numeral 3 (see Figure 2.9.d).

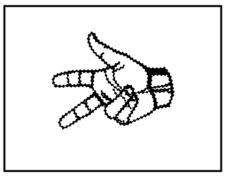
Figure 2.9 – Differences in meaning due to differences in palm orientation in LSB and ASL



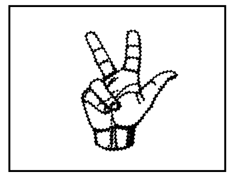
a. LSB "V" point down – 1 person walking



b. LSB "V" point up – 2 people side by side



c. ASL "3" cl, palm to the left - VEHICLE



d. ASL "3" cl palm out – THREE-PEOPLE

Other LSB classifier handshapes are used in the adult community that have not yet been described in the literature about classifiers in LSB. Some of these classifiers are being described in this work; many of them are very similar to the handshapes used in ASL. The following section describes the LSB classifier handshapes relevant for the present study. It is based on some preliminary work about the use of classifiers by LSB adult users.

Two independent studies about the production of classifiers in LSB were conducted in order to determine the handshapes typically used by LSB Deaf adults to represent the stimuli used in the present study. In the first study (Bernardino, Hoffmeister & Allen, 2004), five Deaf adults fluent in LSB responded to each item on the RO task, the same task applied to the children in this study. In the second study (Bernardino & Hoffmeister, 2004), four Deaf adults (all DCDP), also fluent in LSB, evaluated the production of the signers in the first study, and classified their responses as "correct," "wrong," or "acceptable." This confirmed the findings in the first study, and was used to establish the target handshapes for the present study.

Brazilian Deaf adults often consider more than one handshape correct to represent the same stimulus in LSB (Bernardino & Hoffmeister, 2004). For example, for the bodypart classifier (BPCL) for legs, a signer can use either the "1" handshape pointing down (which is similar to ASL), or the "B palm down-extended-arm" handshape with extended arms and tips of fingers pointed to the floor. The "B" handshape, however, was never used by Deaf adults to represent standing person's legs. It seems that the "B" handshape can replace the "1" handshape only when the feet are in focus, which does not happen in the stimulus where the person is standing. For this reason, the "1" pointing down handshape is preferred to represent legs over the "B palm down" handshape.

The representation of BPCL for eyes also presents some restrictions. The LSB adult signers prefer to use the "V" handshape (from the verb LOOK) to represent eyes in a stimulus in which the eyes "look up-down" or "look sideways." The "F" handshape, which focuses on the shape of the eyes, is also used in the representation, just as in ASL, as well as the "1" handshape on both hands (which marks the split of the "V" handshape).

The size and shape specifiers (SASS) used in LSB are also very similar to those found in ASL. In the representation of cans, for example, the "C" handshape for cylindrical objects is used, which can also be used as instrument classifier (ICL) for holding cylindrical shaped objects. The ASL handshapes for representation of SASSes on Figure 2.4 and ICL on Figure 2.5 are the same used by Deaf adult signers in LSB to represent these categories.

The semantic classifier (SCL) for VEHICLE in LSB is represented using the “B palm down” classifier, which is similar to other Signed Languages, such as Israeli Sign Language (Aronoff et al., 2003), and Indo-Pakistani Sign Language (Zeshan, 2003). There is another classifier for VEHICLE, however, that was observed in LSB: “curved-V palm down.” This classifier is used in LSB by some native signers, who use it in plural constructions, such as in “a line of cars,” for example (Bernardino, Hoffmeister & Allen, 2004).

Despite some small differences, LSB classifiers show many similarities to ASL classifiers in form and use, as reported by other linguists, such as Ferreira-Brito (1995), and Quadros and Karnopp (2004). The influence of the French Sign Language in the history of both ASL and LSB may be one of the reasons for the similarities between them. LSB shares many similarities to ASL, but it has some significant differences. ASL focuses on the shape of the eyes, which is represented by using the “F” handshape. Although the ‘F” handshape is also used for ‘eyes’ in LSB the preferred handshape is the “V” handshape which indicates the lines of sight. Novice learners acquire these conventions and the details of language use through contact with the adult community; conversely, native signers acquire signed languages from their Deaf parents. The acquisition of classifiers in signed languages is the next topic that is addressed in this study.

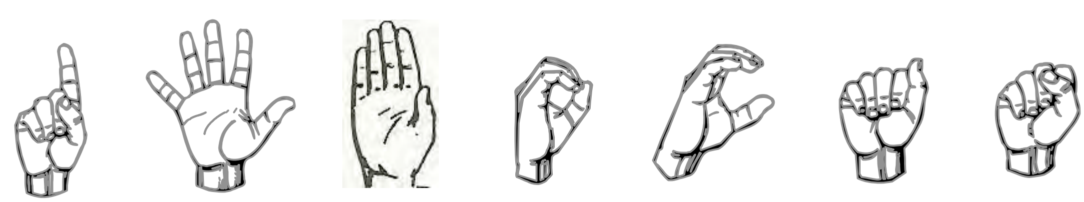
2.3. Acquisition of classifiers in Signed Languages

Several factors are relevant in the acquisition of classifiers. In this section we discuss four factors in turn: handshape markedness, cognitive complexity, structural complexity, and iconicity.

2.3.1. Handshape Markedness

The markedness of the handshape is important in the choice of the handshape that can be used in a classifier to represent a noun, because not only is the shape of the hand involved in this choice, but also the ease in the production of the chosen handshape. According to (Boyes-Braem, 1981), the unmarked handshapes can be used for the greatest number of morpho-phonemic purposes. The more marked handshapes, however, are less easy to produce and less natural, which demands more control of the movements of the hand. There are seven handshapes that are considered the 'least marked handshapes' in ASL research: the "1," "5," "B," "O," "C," "A," "S" handshapes (see Figure 2.10). According to Boyes-Braem, these handshapes are among the most frequently used in ASL, and they are found in all signed languages already studied. These handshapes are among the first acquired by children, and they are least confused in experiments of visual perception (Boyes-Braem, 1981: 238).

Figure 2.10. The least marked handshapes (according to Boyes-Braem, 1981)



(1) (5) (B) (O) (C) (A) (S)

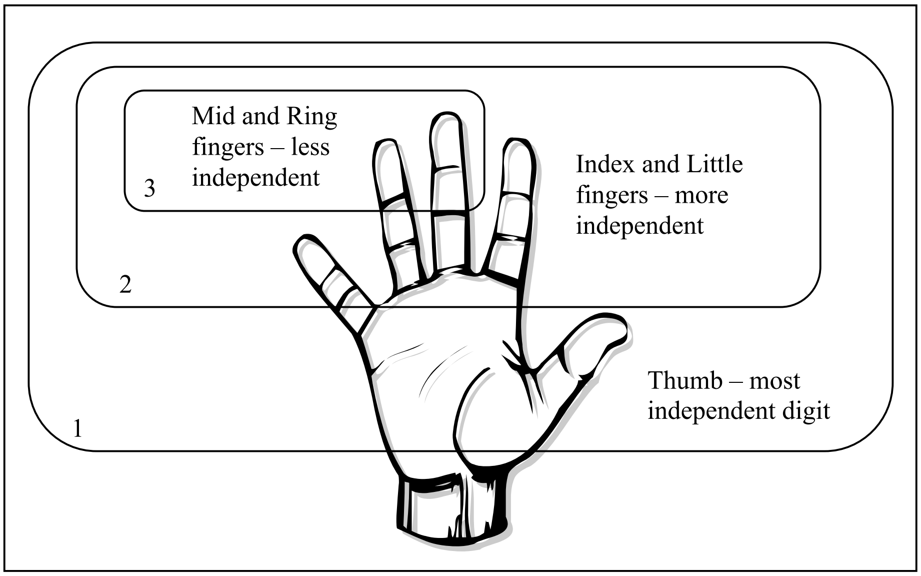
Boyes-Braem (1981) claims that these handshapes are more “natural” than other more marked handshapes for two reasons:

1. These handshapes are the most used for many tasks in daily life. They are the handshapes used for pointing, grasping and holding;
2. These handshapes are easier to produce than marked handshapes, due to the anatomy of the hand.

The first reason points to the daily tasks in which the hands are commonly used. Independently of culture or hearing status people use these handshapes even unconsciously. The use of these handshapes in signed languages is an extension of the actual use of the hand to the representation of the action performed by the hand.

The second reason is extensively explained in Boyes-Braem’s (1981) study. She points out that the thumb is the most independent of the fingers due to its independent muscles and joints. The index finger is the second in the rank of independence, due to a separate extensor muscle that distinguishes it from the other fingers. The little finger has also the advantage of another separate extensor muscle that distinguishes it from the last two fingers, although it shares a branch from the tendon that unites the three fingers. The mid and ring fingers are the least independent of all fingers in the hand, which have more limits to their movements.

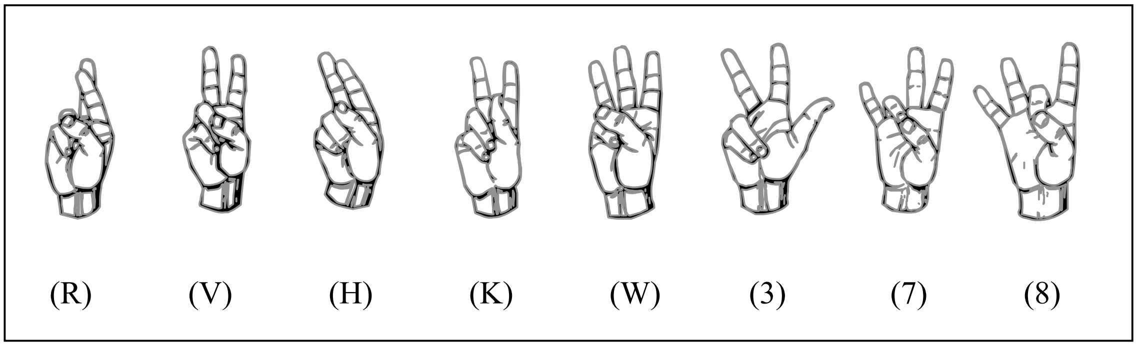
Figure 2.11 – Rank of independence of the digits of the hand (Boyes-Braem, 1981)



Looking at Figure 2.11 and comparing it to the group of unmarked handshapes it is possible to see the anatomical reasons of the easiness of these handshapes. The "5" handshape is the open hand; this handshape and the "B," "O," "C," and "A" use the hand as a whole. The "1" handshape involves the extension of the index finger, and the "S" handshape is performed with the whole hand closed with the thumb over the other fingers.

The production of marked handshapes involves the independent use of the fingers that are more difficult to manipulate. Boyes-Braem claims that the handshapes that are considered physically more difficult to produce and that are consequently the more marked are "R," "V," "H," "K," "W," "3," "7," and "8." Examples of the most marked handshapes are in Figure 2.12.

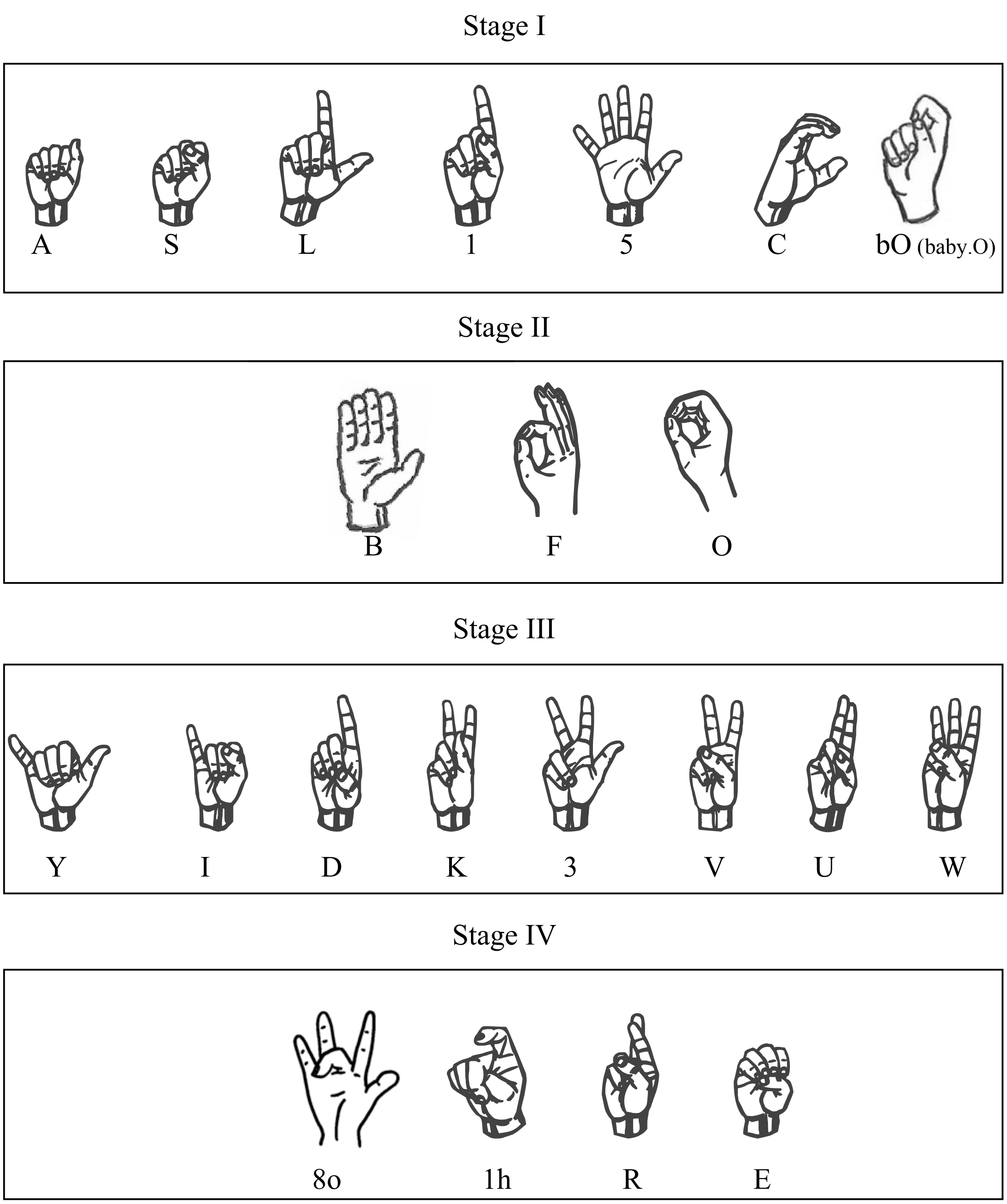
Figure 2.12. The most marked handshapes (according to Boyes-Braem, 1981)



One or both hands can be used in the production of signs. One-handed signs usually are produced with the individual's dominant hand. The production of two-handed signs is constrained by symmetry and dominance conditions (Battison, 1978). The symmetry condition imposes that if both hands move in the production of a sign, these handshapes have to be the same. If the handshapes are different, the dominance condition states that only one hand can move and the stationary hand must be unmarked, or any handshape chosen among the "1," "5," "B," "O," "C," "A," "S" handshapes.

Boyes-Braem (1990) specified 4 stages for acquisition of handshapes based on the handshape markedness just described, which are shown in Figure 2.12. According to her hypothesis, children's acquisition of handshapes is influenced by two factors: anatomical development and "serial finger order" (see Figure 2.11), which is related to the relation between the fingers that are chosen in a handshape configuration. Anatomical constraints would influence the early stages of acquisition, and serial finger order would be more influential in later stages of acquisition (Boyes-Braem, 1990). The handshapes in the first two stages (I and II) are the ones that are acquired first, and the handshapes in the other two stages (III and IV) are more difficult and are acquired later.

Figure 2.13 – Stages of acquisition of handshapes according to Boyes-Braem (1990)



Note: This Figure is based on Marentette & Mayberry's (2000: 73) Figure 5.1

Marentette and Mayberry (2000) described the phonological system of a hearing child of Deaf parents who was acquiring ASL. They evaluated the handshapes she acquired from 1 to 2 years of age. In their study, Marentette and Mayberry cited many studies that supported Boyes-Braem's hypothesis of the stages in which the handshapes are acquired. The results of their own study also showed that the child they observed acquired first the handshapes "5," "1," "A," and "B," three from the first stage and one from the second stage.

Marentette and Mayberry observed that the first handshapes acquired are those that are "*easy to produce, perceptually salient, and frequent in the target language*" (Marentette and Mayberry, 2000: 87). The child they observed made substitutions of the ASL target handshapes according to three principles. The first principle implies *the preference for spread handshapes*. The girl substituted "5" for "B" in her production because "5" is more natural and easy to produce than "B," which have the fingers held tight together. The second principle is that *unmarked handshapes are preferred over marked ones*. The child substituted the unmarked "1" for "Y," which is marked. The third principle states that *there is a preference for open finger position.* According to this principle, the child substituted all "bent" handshapes (such as "C," "bent-B") with the "5" handshape. Marentette and Mayberry explain that this can be due to anatomical preference for fully extended handshapes or even because fully extended handshapes are more perceptually salient.

In their conclusion, Marentette and Mayberry (2000) state that the acquisition of handshape is not facilitated by any preexisting mental representation. It is constrained by the easy of production, perceptual salience and frequency in the input.

2.3.2. Complexity in the acquisition of classifiers

The peculiar characteristics of classifiers in signed languages is a challenge to the language learner, because the child has to acquire the appropriate handshape to use in a reference, and also learn the rules that control the features involved in the correct representation of the event (Supalla, 1982; Schick, 1987; Hoffmeister et al., 1997). The linguistic complexity of the classifier system is one reason that children do not master the use of classifier constructions until 8 or 9 years of age (Kantor, 1980; Schick, 1990; Emmorey, 2002). In order to master the classifier system in a signed language, the children must be able to coordinate the two hands to represent figure and ground, to express the path and manner of the action, to indicate the appropriate viewpoint and to chose the correct scale of reference (model or real-world scale) that best represent the event (Emmorey, 2002).

Despite the visual characteristic of signed languages, children do not see nor acquire language as “holistic pantomime” (Supalla, 1982), but they acquire the subcomponents of the language one by one, sequentially (Supalla, 1982; Schick, 1987). Children learning signed languages acquire the morphemes that are more salient first, in the same way as hearing children first acquire the salient spoken morphemes that tend to be syllabic, stressed and easily segmentable. In contrast, morphemes that are less perceptible are more difficult to learn (Schick, 1987).

In the acquisition of classifiers, children first have to be able to select the correct handshape that best represents the noun. In ASL, semantic classifiers (SCL) are initially acquired as whole units, instead of being acquired morpheme by morpheme (Supalla, 1982; Schick, 1987). In the first stages of acquisition of SCL, children replace adult classifier forms with a more primitive or unmarked handshape (such as “B” or “1”) (Supalla, 1982). Errors occur in children because they do not know the rules that constrain the classifier handshape use, or in which situations the use of a more general form is acceptable (Schick, 1987). Hence children may substitute an incorrect unmarked handshape form for a more marked classifier form. Other errors by children in producing SCL’s may include selecting an incorrect classifier form, such as creating an incorrect classifier by using the handshape from a citation form (frozen sign) rather from the morphological categories of classifiers (Supalla, 1982). Supalla maintains that as the children get older, they reduce their incorrect replacement handshapes and start to select the correct classifier form.

Supalla (1982) claims that in the acquisition of SASS handshapes, the *shape* morpheme is acquired first. Children acquire the straight shape first; the round shape is acquired later. For straight shapes, the *thin* morpheme (“1” handshape) is acquired first; the *wide* morpheme (“B” handshape) is next, and finally the *narrow* morpheme (“H” handshape)[9]. For round SASSes, children equally acquire *size* and *depth*, without preference. The acquisition of handshapes that indicate *shape* appear to be affected by the markedness of the handshape. In the acquisition of straight shapes, for example, the first

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[9] For visualization of the handshapes, please refer to Figure 2.4 above

acquired morphemes are among the least marked handshapes (“1” and “B”), while the last morpheme acquired (“H”) is thought to be among the more marked handshapes (Boyes-Braem, 1981; see Figures 2.10 and 2.12).

Markedness of handshapes is also related to the acquisition of instrument classifiers (ICL), since the most unmarked handshapes are those primarily used for grasping, holding and pointing. Schick (1987) comments that some HANDLE classifiers (which corresponds to Supalla’s (1982, 1986) “instrumental hand classifiers”, a subgroup of the instrument classifier category “ICL”) are reported to be used in predicates at very early ages. These forms refer to specific actions such as BRUSH-HAIR, DRINK-BOTTLE, and BRUSH-TEETH, which compare with the first general verbs that hearing children acquire in spoken languages.

Supalla (1982) observes that children usually violate the linguistic restriction on using an ICL in place of an SCL. SCLs refer to objects that move by themselves. Children may use an ICL form to show the object’s movement. It is not clear whether the child means to represent a path (SCL) or is pushing the object through space (ICL). For example, in ASL a child may use the “C” handshape to represent a moving car instead of using a “3” handshape.

Schick (1987) compared the acquisition of three types of classifiers (SASS, HANDLE/ICL and CLASS/SCL) in Deaf children of Deaf parents (ages 4:5-9:0). She found that semantic classifiers (CLASS/SCL) were acquired first, followed by size and shape specifiers (SASS) and handle/instrument classifiers (HANDLE/ICL) last. She proposed the following reasons for this sequence:

- The production of SCL does not require multiple dimensions (e.g., shape, size, depth), which is easier for children to process; however, SASS and ICL require the consideration of these dimensions;
- SCL handshapes do not have internal morphemes – they are analyzed as a whole unit;
- Contrary to what she expected, that HANDLE/ICL would be easier than SASS to produce because they are always in real-world scale, SASS was acquired earlier. SASSes are categorized according to physical characteristics of the referent. They are adjectival. HANDLE/ICL involve action associated with an object. Their use requires an agent, and the movement/path involved in the transference of the object through space. (Schick, 1987).

The results of Schick's studies indicate that linguistic complexity is an influential factor in the acquisition of classifiers, not just markedness of handshape. The fact that the most unmarked handshapes are the ones that are typically used in daily tasks seems to be very important in the acquisition of classifier handshapes, but it is not the only driving force in the acquisition process. The choice of the best classifier category to represent an object seems to challenge the young learner. Even so, there are claims that other features such as iconicity are facilitating tools in the acquisition of classifiers, which is the topic of the following section.

2.3.3. Iconicity in the acquisition of classifiers

Slobin et al. (2003) question the claim that iconicity does not play an important role in the acquisition of signed languages. First of all, he cites Mandel's (1977) definition of iconicity as the "*use of signs and other gestures perceived as bearing <u>some</u> visual relationship to their referents*" (Slobin et al. 2003: 276 – their emphasis). They claim that the iconic relation of handshapes to referents exists, even though the sign or handshape can be conventionalized in the language. It means that there is some visual relationship between the handshape used to represent a cup and the cup in the real world, but this representation is not a mimetic depiction, because the handshape used can be part of the conventions of the language. Slobin et al. suggests that the iconicity many researchers claim does not take place in the acquisition of signed languages is the "iconicity of movement patterns," (Supalla, 1982; Newport & Meier, 1985; Schick, 1987) not the iconicity of handshapes, which is "*central to the acquisition and creative use of 'classifiers'*" (Slobin et al. 2003: 277). Using the results of studies with young Deaf children (< 3 yrs old) of Deaf and hearing parents and mothers that are learning ASL and SLN (Sign Language of the Netherlands), they suggest that iconic principles underlie the acquisition of classifiers from early ages and in the acquisition of L2.

Slobin et al. (2003) observed the acquisition of the same types of classifiers in Schick's (1987) study: entity/semantic classifiers (SCL), instrument classifiers (ICL), and size and shape specifiers (SASS). They divide ICL into *manipulative handle* (Supalla's *instrumental hand classifier*) and *depictive handle* (Supalla's *tool classifier*). "Manipulative handle" refers to the representation of the manipulation of an object (e.g., manipulation of a screwdriver using an "S" handshape), while "depictive handle" refers to the shape of an object being manipulated (e.g., using an "H" handshape to represent the screwdriver). They show examples of Deaf children as young as 2;5 using manipulative handle handshapes, and other Deaf children as young as 1;10 making use of depictive handle handshapes. They also present examples of children as young as 2;1 using SCL in play activities with their hearing or Deaf mothers and other Deaf research assistants. The only type of classifier that did not occur in Deaf children's production was SASS. They did find an example of a hearing mother, an L2 learner (1 years and 7 months of contact with ASL), who creatively used a SASS during one of the home visits, although it was not considered a correct use of the classifier. According to Slobin et al, her handshape was based on a direct iconic representation of the object.

Slobin et al. suggest that there is a direct relationship between the iconicity that exists between the referents and the handshapes used to represent them. In manipulative handle classifiers, the handshapes used are literal gestures of the activity (the conventionalization of handshapes makes them distinct as signs), and in depictive handle classifiers the handshapes reflect the physical characteristics of the referents. Furthermore, in SCL they claim that both children *and* hearing mothers see the handshapes as having iconic characteristics.

Iconicity is considered responsible for the creation of homesigns among Deaf children of hearing parents who do not have any contact with a signed language (Slobin et al.2003). These children appear to refer to objects based on some salient physical property creating systematic and productive gestures that are used with many other objects in which these properties share saliency (Goldin-Meadow & Mylander, 1984; Goldin-Meadow, 2003, and others). Slobin et al. claim that the handshapes Goldin-Meadow and collaborators found in their studies functioned as HANDLEs, SASSes, and SCLs, even though the children were using a system of gestures, not a conventional language.

Slobin et al. conclude that although in the acquisition of a signed language the learner has to acquire the handshapes that are conventionalized in the language, the classifiers that are being acquired are not composed of arbitrary symbols. The “gesture-to-sign continuum” has parameters that need to be defined. The early signs as well as the errors children make while acquiring a signed language can help in understanding those parameters. They claim that Deaf children follow a developmental course in which a conventional gesture can be incorporated into the language. The children’s task is to adequately incorporate these gestures into signed utterances that are functioning as components of the adult system.

The classifier system of signed languages is very complex. In the acquisition process, children can take advantage of the most salient properties of the object (such as its shape) to acquire the correct handshapes that best represent it. Some handshapes are acquired as whole units, others are acquired in stages: simpler and unmarked forms appear first, more complex forms appear later. In the learning process, children commit errors and violate constraints, but they can take advantage of the adult models and learn from them. The real problem is when they do not have a language model to help in the establishment of parameters (as in the case cited above, in studies of Goldin-Meadow), or when the language model is inadequate. This is the topic of the next section.

2.4. Consequences of inadequacy of input

As mentioned above there are a few studies that claim that children can become proficient speakers of a language even when they are exposed only to non-proficient speakers (Bickerton, 1981; Singleton, 1989; Singleton & Newport, 2004).

Bickerton (1981, 1984) uses the Language Bioprogram Hypothesis (LBH) to explain that a creole is formed when children are exposed to and attempt to acquire a pidgin (an auxiliary language that arises when speakers of mutually incomprehensible languages are in contact) as their native language. According to the LBH, children appear to apply innovative features in the newly acquired creole language that are not found in the antecedent pidgins. When exposed to pidgin languages children expand basic structures in the input resulting in the creation of new syntactic rules, use of articles, verbal auxiliaries, relativization, and many other features that do not exist in the source pidgin. Bickerton claims that if the children simply learned the pidgin and did not modify it, there would be no differences between the language used by pidgin speakers and the first generation of creole speakers. A pidgin, however, does not have structure, while a creole presents the same type of structure as any other natural human language (Bickerton, 1990).

Bickerton claims that the innovative aspects of creole grammar are similar across creoles from different origins. Examining Hawaiian Creole, he perceived that its grammar was not similar to the languages spoken by Hawaiian immigrants, nor to the Hawaiian indigenous language, nor to English, the politically dominant language. This fact supports the notion of a biological capacity to create language in the absence of an appropriate model (Bickerton, 1990).

The bioprogram would consist of the core structure of language, which should not be confounded with Chomsky's language universals (Bickerton, 1981). Universal Grammar (UG) includes a set of parameters or subsystems that are subdivided into a finite and small number of possible settings. These settings and their combinatorial process constitute all possible core grammars of human languages. The bioprogram grammar is composed of a list of preferred settings that the child would assume appropriate in the absence of contrary evidence (Bickerton, 1984).

There are several examples of studies about children isolated from language models, such as Genie (Curtiss, 1977), who was restrained from linguistic input until the age of 13, and who did not develop much language even after being exposed to good language models. Genie apparently was able to develop some properties of language, but not to acquire a "true" language. She suffered the effects of acquiring her first language after the critical period for learning a language. Children who are exposed to a language input that is impoverished or inadequate, such as Genie and most Deaf children of hearing parents (DCHP), have to rely on their innate mechanisms to create their own language systems (Hoffmeister, 1996; Gee & Goodhart, 1995; Meier, 1984; Goldin-Meadow & Mylander, 1984; Goodhart, 1984). According to the nativization hypothesis (Andersen, 1983), children who cannot have access to the environment's language for any reason turn back to their biological capacity for language and create their own language according to internal rules specified by this capacity. In contrast, when children are exposed to a language input that is accessible and coherent, they denativize in the direction of this language.

According to Emmorey (2002: 217), "*the long-term effects of a delay in first language acquisition appear to be much more detrimental than the effects of acquiring a second language late in childhood*". Second language learners have the advantage of general linguistic knowledge about their first language, but Deaf children who are exposed to a first language late in childhood have no other language for reference. They begin the acquisition process with limited understanding about morphological and phonological systems or of syntactic principles (Mayberry & Eichen, 1991; Mayberry & Lock, 2004a).

Senghas and Coppola (2001) present an example of impoverished input that has resulted in the creation of a new Signed Language. They describe how Nicaraguan Sign Language (LSN) is being developed since the establishment of a school for the Deaf in 1977. The Deaf individuals in Nicaragua lived in isolation and each of them appeared to have their own gestures, or homesigns, to designate objects and actions. When they came together at the new school they started to combine their homesigns to form more structured sentences. The new generations of Deaf children who arrived later and were exposed to the early form of the Nicaraguan Sign "language" started creating new forms in their signed language. Senghas and Coppola (2001) examined 24 Deaf Nicaraguan signers divided according to the age of exposure to language (early-exposed – before 6;6

years; middle-exposed – from 6;6 to 10 years; and late-exposed – after 10 years of age). All of them had at least 4:5 years of exposure to the language. Senghas and Coppola found that the early exposed children signed more fluently, more rapidly and hastily than the other two later exposed groups. They also did not reproduce exactly what they learned from the older adults, but instead they changed the language as they internalized it. The youngest members of the community systematized the language they learned in specific ways. For example, the youngest members of the group are using more spatial modulations for indicating shared reference than the older members, which increases the specificity of the language (Senghas and Coppola, 2001). There are many studies about this language that point to the conclusion that its structure and lexical items are being developed with each new generation, from simpler forms to more complex ones (Senghas, 1995; Senghas et al., 1997; Senghas & Coppola, 2001; Coppola, 2002).

In the creation and evolution of LSN it is possible to see how children are active language builders when they have the opportunity to interact in a language form that is accessible to them, such as a signed language. As Senghas and Coppola found, the earlier children acquired the "primitive language," the better they were able to transform it and systematize it in a way that better suited their language communication needs.

Another example of inadequate input to Deaf children is presented in a study about a Deaf boy named "Simon" (Singleton, 1989). Singleton & Newport (2004) claim that Deaf children are able to exceed their language models, when the input they receive is not consistent and structured. In fact, they found that a Deaf child surpassed his Deaf parents who are late learners of ASL in a task that elicited production of verbs of motion.

The boy's production was comparable in accuracy to native ASL children of the same age; however, his production of classifier handshapes was less accurate than the native signers' production, but more consistent than the production of his parents. They concluded that the boy seemed to have reorganized the inconsistent input he received from his parents, but, unlike hearing children acquiring spoken languages, who have a phase of language regularization, he seemed to be permanently regularizing the language. This process occurred because he did not have a stable language pattern to follow.

2.5. Classifiers versus non-classifier (gesture) forms

What is the linguistic difference between the production of classifiers in signed languages and the production of gestures? The line between them seems to be very minor, and sometimes difficult to establish when we consider the gestures used by Deaf children who are exposed to inadequate language input. Studies about the creation of gestures in young Deaf and hearing children can help to shed light on the main differences between gestures and linguistic signs. Petitto's study (1992) evaluated the gestural creation of hearing children of hearing parents and Deaf children of Deaf parents (8-20 months old) who are exposed to good language models from birth (hearing parents users of English and French, and Deaf parents users of ASL and Langue des Signes Quebecoise, LSQ). Susan Goldin-Meadow and her colleagues' (Goldin-Meadow, 2003; Goldin-Meadow & Mylander, 1984; Goldin-Meadow & Morford, 1985; Feldman, Goldin-Meadow & Gleitman, 1978; Singleton, Morford & Goldin-Meadow, 1993) studied Deaf children of hearing parents who created gestural systems to communicate, without a language model (ages range from 1 to 6 years). All studies analyzed the creation of *symbolic gestures*, or gestures that involve some degree of representation and reference. The main difference between these studies is that in the first (Petitto, 1992) the children created gestures to expand their primary linguistic channel (spoken or signed), but in Goldin-Meadow and others' (Goldin-Meadow) studies the children created gestures to fulfill their communication needs.

Evaluating the gestures created by children who have a primary language (signed or spoken), Petitto (1992) agrees that there are similarities between symbolic gestures and children's first signs or words; however, she argues that there are clear differences due to aspects of language that are domain-specific. Comparing the production of symbolic gestures to the children's early lexical items she observed that symbolic gestures were used mostly with the function of reinforcing a request when the children failed to obtain what they wanted by using the primary linguistic channel. In contrast, lexical items were used with various different purposes and also to name objects. Symbolic gestures were extremely context dependent, and the children in her study produced them only after they had comprehended or produced a corresponding word or sign. She also observed that symbolic gestures did not have a one-to-one correspondence with referents, which means that the same gesture was used to refer to different objects, and the same object was referred to by using different gestures.

Conversely, Goldin-Meadow and her colleagues (Goldin-Meadow, 2003; Goldin-Meadow & Mylander, 1984; Goldin-Meadow & Morford, 1985; Feldman, Goldin-Meadow & Gleitman, 1978; Singleton, Morford & Goldin-Meadow, 1993) followed the development of 10 DCHP who invented their own manual communication systems, since they had no access to a first language due to their profound hearing impairment. The hearing parents had decided to educate their children using only speech. Between the ages of 13 months and four years they had not shown any significant progress in English. At an early age, the children started creating isolated gestures such as pointing and other signals that indicated the object or event to which they referred. After some time, they started to combine those gestures to form simple sentences with a typical ordering of patient-action. Goldin-Meadow and Mylander (1984) found that the Deaf children's gestures were not a product of any environmental influence, such as copies of their caretakers' gestures, but they were "resilient." Goldin-Meadow and Mylander (1984) defined "resilience" as the capacity children have to invent some properties of language without any formal language input.

Some of the resilient properties of words (individual gestures) are specified in Goldin-Meadow's (2003: 186) work. They are:

- Stability – the gestures created do not change with changing situations;
- Paradigms – the smaller parts of the gestures can be recombined in the production of new gestures to produce different meanings;
- Categories – parts of the gestures have definite shapes that are associated with particular meanings;
- Arbitrariness – although iconic, the specific meaning of shape x in a gesture can have arbitrary aspects;

- Grammatical function – gestures have different grammatical functions (as noun, verb or adjectives).

The gesture systems produced by these children do not conform to gestures used concomitant to speech. Goldin-Meadow (2003) claims that they carry the full load of communication, and in this sense they are similar to conventional signed languages. Their structure is also more similar to signed languages than to the structure of gestures associated to speech.

In her analysis of Deaf children's created gestures in comparison to their hearing mothers' gestures, Goldin-Meadow found that each mother used her gestures in a more limited way than her child. In contrast to the children's gestures, the mothers' gestures lacked coherence. For example, she observed that one of the mothers represented a wide object using a narrow handshape (such as "O," used in signed languages to represent narrow poles), and a narrower object using a wider handshape (such as "C," that in signed languages represents wider poles). The mothers' gestures lacked coherence mainly because they had no intention of replacing the speech, but were reinforcing it, in the same way as the children in Petitto's study used their gestures. The mother's gestures as well as the gestures in Petitto's study were clearly non-linguistic, since they were used to represent extra-linguistic information. In contrast, the Deaf children's signs created from gestures in Goldin-Meadow's study were used consistent and coherently, correctly representing all of the intended information.

In Goldin-Meadow's (2003) study the Deaf children's gestures had a limited set of handshapes that they used consistently to represent objects. They used their handshapes in two definite ways:

(a) to represent a hand manipulating an object, or

(b) to represent the object

The limited set of handshapes they used each denote a limited class of objects, and they also had a limited set of movement forms, each representing a class of actions. Goldin-Meadow points out that the Deaf children started producing unanalyzed gestures that later would serve as their own input from which to derive new gestures. The regularity found in these gestures indicates that these children's simple morphological systems were coherent and systematic.

There are limitations in the gestures described by Goldin-Meadow (2003) and Goldin-Meadow & Mylander (1984). These authors have claimed that "*linguistic input is less important to the development of certain properties of language than to the development of others*" (Goldin-Meadow & Mylander, 1984:8). Although some properties can be created without a language model, others are more "fragile," as Goldin-Meadow and Mylander pointed out. They define "*as 'fragile' those properties of language that children fail to develop without a supportive linguistic environment*" (Goldin-Meadow & Mylander, 1984: 109).

Therefore, can we say that the children's gestures in Goldin-Meadow's study are linguistic representation of objects, and the gestures of the mothers and the children who have a primary language are not? We claim that they can be considered *linguistic* in the sense that they were consistent, coherent, and contained all the information the children wanted to communicate, but also *proto-linguistic*, since they lacked what Goldin-Meadow calls the “fragile properties” of language.

The concept of *protolanguage* was first introduced by Bickerton (1990) in reference to the language used by “*trained apes, children under two, adults who have been deprived of language in their early years, and speakers of pidgin*” (Bickerton, 1990: 122). As the noun suggests, protolanguage is not a language, but an intermediate stage for children under two, who are acquiring language but do not have all cognitive functions working properly due to brain immaturity. He also defines protolanguage as a “*mode of linguistic expression*” that is not as “complete” as language, that apes can learn, speakers of pidgin use as an interlanguage, and adults who acquire language late can acquire but are not able to develop into language. Bickerton identifies five principles that differentiate protolanguage from language, which we can also observe in relation to the gestures created by Goldin-Meadow’s children. The differences are:

(a) Differences in the superficial order of constituents – In protolanguage, the formal structure is absent, and the order of constituents follows a functional approach. In the same way, Goldin-Meadow points out that the structure of the gestural systems was similar to the early structure of children learning conventional languages. She also says that “*the content of young children’s communications is determined more by what’s on their minds than by the particular linguistic models their language provides for them*” (Goldin-

Meadow, 2003: 113). The structure of gestures is functional in this instance, unlike language.

(b) Differences involving null elements – When there is no overt constituent in a language, it can be predicted, and the circumstances under which it occurs are subject to principles that vary from language to language. In protolanguage, as in gestural systems, any constituent may be absent from any position (even verbs), and it cannot be predicted (see Goldin-Meadow, 2003: chapter 10).

(c) Differences in the subcategorized arguments of verbs – This difference is closely related to the former. Verbs subcategorize for arguments that must be overtly realized unless the language permits, but the argument must be syntactically marked and unambiguous. For example, the verb *give* subcategorizes for three arguments: the agent, the recipient, and the object given. In protolanguage, any of the arguments may be absent and the meaning of the utterance is dependent upon the context, the knowledge of the speaker's intention or any other factor. In Goldin-Meadow children's gestural systems the same was observed, and the meaning of the absent arguments was inferred by the context.

(d) Differences in the mechanisms for expansion of utterances – In languages, an utterance such as "*Mary plays the piano*" can be expanded as "*Mary plays the piano in a happy manner,*" or "*Mary plays Mozart on the piano in a happy manner,*" and so on, which is called recursion. Bickerton claims that in protolanguage this resource rarely appears, but he claims that it should be learned as an idiom, since there is no evidence of any syntactic principles in effect. Goldin-Meadow claims that gestural systems are recursive, and also that children's complex utterances have elements that are shared across propositions. However, she claims that the children in her study "*show none of the biases for the direction of redundancy reduction found in children learning language from conventional models*" (Goldin-Meadow, 2003: 123). This means that the recursion that she claims to occur in the children's gestures is limited, and it is not similar to that found in languages.

(e) Difference involving the presence (or absence) of grammatical items – Protolanguage does not have grammatical items such as inflection, number or person agreement, complementizers, quantifiers, and other elements that have grammatical function in the utterance. Goldin-Meadow found clear evidence of the presence of grammatical items in at least one of the children's gestural systems. By 3;3, David's gestures were marked by inflection (verbs and adjectives were marked and nouns were unmarked), by abbreviation (with different movements distinguishing similar gestures with different grammatical function), and by position of arguments in an utterance.

As already stated, the gestures produced by children and adults who have a primary language such as the children in Petitto's (1992) study, and the mothers in Goldin-Meadow's (2003) study, are not similar to the gestural systems produced by the Deaf children in Goldin-Meadow's study. However, the similarities of the gestural systems described by Goldin-Meadow to the protolanguage characteristics appointed by

Bickerton reveals that they do not have the linguistic features of full signed languages classifiers. It seems that the gestural systems used when the children are not exposed to an adequate language input are in an intermediate stage, which is comparable to Bickerton's protolanguage that is present in children's ontogeny.

Another important point in the comparison of gestural systems with signed languages is that when the children in Goldin-Meadow's study started to have contact with a signed language (such as ASL), their gestures lacked meaning, mainly because they were outside the language conventions. Those children had to learn the conventional signs of the signed language they were acquiring to replace their gestures. Conventionalization is needed for a sign to communicate meaning linguistically. Although the children's gestures were consistent, coherent, and carried a great amount of information, that information could not be transmitted to unfamiliar people. Additionally, it is not possible to assume that even the people who were familiar with the children's gestures understood everything they used in their gestural system. In contrast, signed languages are conventional, the children have to learn the correct handshapes and the appropriate form in order to use signs properly.

Slobin et al. (2003) claims that the gestural systems created by Goldin-Meadow and her collaborators' Deaf children are part of a gesture-to-sign continuum, whose parameters and dimensions are not yet well defined. They suggest that studying the early acquisition of handshapes of a standard signed language and the production of homesigns together can provide evidence about the "gesture" side of the continuum. On the other hand, the study of handshape errors, substitutions (in imitation) and later acquisition can show the other side, or the “sign” end of the continuum.

In sum, most Deaf children of hearing parents do not have good or even any language models from birth, which can result in language problems that prevent them from developing normally in terms of either timing or patterns of acquisition; however, some of these children have shown the ability to construct their own language system without the help of a language model, such as the gesture systems invented by DCHP in Goldin-Meadow and Mylander’s (1984) study. In the same way, Deaf children exposed to impoverished signed language from birth have been shown to develop native-like ability in a signed language such as ASL (Singleton, 1989). Although children exposed to inadequate input were able to create language-like systems, those “primitive forms” have some differences that make them distinct from signed languages.

2.6. The Brazilian situation

Most Deaf children of hearing parents (DCHP) do not have access to a consistent language from birth, because of their hearing loss. Because over 90% of Deaf children are born to hearing parents who do not know signed language (Emmorey, 2002; Emmorey et al, 1995; Mayberry and Eichen, 1991, Goldin-Meadow & Mylander, 1984), those children may have no effective language exposure in infancy and early childhood. In comparison to Deaf children of Deaf parents (DCDP), who are exposed to signed language from birth, DCHP typically are not exposed to an effective language like ASL until 3 to 5 years of age[10]. This means that even in the best situation most Deaf children are not exposed to a signed language until after three years of age, when many of them enter school programs for the Deaf. This delayed language exposure potentially may affect the language learning proficiency (see Mayberry, Lock & Kazmi, 2002 and Mayberry & Lock, 2004b for more information on the critical period and its effect on the acquisition of a signed language).

There are many countries outside of the US where the education of Deaf children still emphasizes speech training to the exclusion of signed language, and others which do not have an educational system for Deaf children, but require that they attend regular public schools with hearing children. This environment does not attend to their unique language needs. In Brazil, for example, DCHP are discouraged from signing because of the false belief that if they learn to sign they will not be able to speak. These children are deprived of a viable process of access to language which results in serious consequences for their cognitive development. Many children are enrolled in schools for the Deaf, but the teachers and professionals are not very fluent in the use of a signed language, and in some cases they have no background in signed language. At the same time, Deaf children are in contact with other Deaf children who use a signed language at school as their principal form of communication.

The Brazilian Deaf children of hearing parents (DCHP) are strong candidates to test the bioprogram hypothesis. The majority of these children, like most of the Deaf children of hearing parents in the world, do not have any contact with a signed language

[10] In the US most Deaf children are required to enter into educational programming at 3 years of age. However only 50% of Deaf children are enrolled in programs using a signed language.

before they enter school. If they are enrolled in a school with many Deaf children, they start acquiring signed language from their peers by age 6 or 7 (in rare cases, by 4 or 5 years old); if not, they are usually transferred to a special school for the Deaf later on, when they fail to learn in mainstream schools. Furthermore, there are many cases of children who cannot learn in schools for hearing children, but they are enrolled in and stay at the same school for many years, for there is no other option for better education in the community, and the family does not have resources for moving to another place. Some of these children, like the children in Goldin-Meadow (2003) and Goldin-Meadow & Mylander's (1984) studies, live in an environment that is full of social stimulation, and they are capable of creating a gestural language to communicate their feelings at least partially; but there are many others whose parents work hard for many hours a day to get enough means to survive. Some of them live in big families with a very small income to share, besides many other problems that are common in a developing country like Brazil. The Deaf children who live in environments like this usually are deprived of or have poor social stimulation, and the family delegates the task of education to school, mainly because they do not know how to deal with the problem. Most of the children in this study are from very poor families, and also most of them are from schools for the Deaf where the teachers use signed language but are not skilled in it.

The age of input and the type of input greatly affects the acquisition of a signed language in the Deaf. The variation in accessible models of language for Deaf children even in an educationally advanced country like the US suggests that, regardless of whether both the input process and the acquisition process in Deaf children have been examined in the detail necessary to provide solid conclusions as to the effects of the accessible input, the results of this examination have not been applied well.

The previous research on acquisition of classifiers has contributed in large extension to signed languages' research. In spite of that, there are some issues that need more attention. First, ASL is the most-often discussed model for acquisition, since there are few other studies that deal with acquisition of classifiers in other signed languages (i.e., Slobin et al., 2003, who deals with acquisition of classifiers in ASL and Sign Language of the Netherlands; and Morgan & Woll, 2003, dealing with acquisition of classifiers in British Sign Language), and no known study about acquisition of classifiers in Brazilian Sign Language. This study will present interesting data about classifier acquisition in Deaf children of Deaf parents and Deaf children of hearing parents, which is a great contribution to signed languages research. Another issue that needs more study is the fact that most of the studies deal with native signers only. This study intends to join the few exceptions (as Slobin et al., 2003) that look at the acquisition of classifiers in native and non-native children, as the Brazilian Deaf children described in this study.

There are other matters, however, that have been overlooked in the research on acquisition of classifiers. One example is the use of other strategies of reference, such as the use of gestures replacing conventional signed languages in signing children. This topic has been explored in studies about Deaf children creating language (i.e., Goldin-Meadow, 2003), but there is no known study that examines how the previous gestural language influences the acquisition of a signed language. This study addresses the issue superficially, leaving space for further research in this area.

Chapter 3 – Methodology

3.1. Introduction

This study evaluates the acquisition of classifier handshapes among Brazilian Deaf children. The main objectives pursued include the verification of the influence of parental hearing status, chronological age, and length of exposure to signed language in the acquisition of classifier handshapes. Other important objectives of this study are to provide an analysis of the handshape errors the children make when trying to produce a classifier, and to verify the strategies the Brazilian Deaf children use when they are not able to produce a classifier.

This chapter describes the methodology used in this study. The subjects that participated in this research, how they were identified and contacted are detailed in this chapter. The tasks employed are presented in detail, followed by a description of the procedure used to obtain the data. Further detail is provided on how the data was coded and which elements were evaluated. Finally, there is an account of the quantitative analysis employed, with a description of how the responses were grouped and further analyzed.

3.2. Subjects

Subjects were identified by contacting schools for the Deaf and local Deaf associations. The data was collected at the schools and in the Deaf associations' headquarters, which helped to locate subjects who were not enrolled in those schools.

The subjects are 61 Brazilian Deaf children between the ages of 4:6 and 11:10 years old (54 to 142 months), with a mean age of 8:2 years old, from local schools for Deaf children in large cities in the southeast of Brazil. There are 4 children of Deaf parents and 57 children of hearing parents. It was difficult to find Deaf children of Deaf parents at the time the data was collected, so the number of these subjects reflects the small percentage of the population who are native signers. Table 3.1 presents the description of subjects' background according to age.

Table 3.1 – Subjects' background according to age (raw numbers)

Children's age	Parenting		Gender		Hearing loss			
	Deaf Parents	Hearing Parents	Male	Fem	Profound	Severe/ profound	Severe	No info
4 – 5 yrs	1	10	5	6	6	0	3	2
6 – 7 yrs	1	10	5	6	5	1	3	2
8 – 9 yrs	2	26	13	15	17	2	1	8
10 – 11 yrs	0	11	6	5	8	1	1	1
Total	4	57	29	32	36	4	8	13

Note: includes all 61 subjects (4 DCDP and 57 DCHP)

The Deaf children of hearing parents' (DCHP) language background is as follows:

- 11% of the children are from schools where there is a working Deaf adult (LSB instructor), and 89% are from schools where there are no Deaf adults working at the school.
- The children who do not have a signing Deaf adult language model are learning language from each other, which is the traditional transmission form for signed languages (Moores, 1996; Lane, Hoffmeister & Bahan, 1996).

- The time of exposure to a signed language varies across ages, as many of the children do not enter school until later and is reflected in the children's time in school, which varies from 1 to 84 months at the time of this research.

The four children of Deaf parents (DCDP) have varying language backgrounds. The youngest has two Deaf parents and his father also has Deaf parents; he is a third generation LSB user. Two other children (the 7-year-old and one of the 9-year-olds) are siblings. They both have two Deaf parents who use mainly LSB to communicate; however, the proficiency of their parents is unknown. The fourth child (the other 9-year-old) also has two Deaf parents who have LSB as their main communication form. Her parents are active in the Deaf community, but their proficiency is also uncertified. All DCDP attend schools for the Deaf, and their hearing teachers communicate using signed language.

3.2.1. Distribution of subjects

The subjects were grouped to verify the influence of three variables in the acquisition of classifiers: parental hearing status, chronological age and length of exposure to a signed language. To verify the influence of parental hearing status, the 4 Deaf children of Deaf parents (DCDP) were analyzed as one group. Despite the fact that it is a small group, their results are compared to the results of the other children, since they are exposed to a signed language from birth. The remaining 57 Deaf children of hearing parents (DCHP) are grouped according to chronological age and length of exposure to a signed language.

Table 3.2 presents a description of the subjects according to parentage. The DCDP mean age is 7:7 and mean length of exposure is 92 months. The DCHP mean age is 8:3 and they have an average of 31 months length of exposure to a signed language. The data in Table 3.2 indicate that although the mean age of the two parentage groups is very similar, the two groups' mean length of exposure to signed language is very different. The DCHP on average start to have a contact with a signed language after 6 years of age, which is the mean age they start school. Even though the oldest DCHP is 11 years old, there is an approximately 4-year discrepancy in average length of exposure. More details of the DCHP according to age are presented in Table 3.3.

Table 3.2. Description of all subjects according to parentage

Subjects	No. of Subjects	Mean Age	Mean Length of Exposure	No. of Response Trials
DCDP	4	7:7	92 mos.	120
DCHP	57	8:3	31 mos.	1710

Table 3.3. Description of DCHP according to age

Subjects	No. of Subjects	Mean Age	Mean Length of Exposure	No. of Response Trials
4-5 years old	10	5:0	9 mos.	300
6-7 years old	10	7:0	14 mos.	300
8-9 years old	26	9:0	39 mos.	780
10-11 years old	11	10:6	49 mos.	330

A description of the DCHP according to length of exposure is presented in Table 3.4

Table 3.4. Description of DCHP according to length of exposure

Subjects	No. of Subjects	Mean Age	Mean Length of Exposure	No. of Response Trials
0-12 months	18	6:7	5 mos.	540
13-24 months	8	6:9	20 mos.	240
25-36 months	8	9:4	35 mos.	240
37-48 months	9	9:3	43 mos.	270
49-60 months	7	10:2	56 mos.	210
61-74 months	7	9:6	67 mos.	210

Comparing the results in Table 3.2 with the results in Table 3.3, the difference in mean length of exposure of the DCHP youngest group (4-5 years old) to the mean exposure of the DCDP is even higher. The DCHP youngest group has less than 10% of the DCDP mean length of exposure. The mean exposure of the DCHP with the most exposure to signed language (10-11 years old) is less than half of the DCDP's mean, even though the DCDP's mean age is lower. These results clearly show the picture of Deaf children in Brazil. Brazilian Deaf children have their first contact with a signed language at a very late age, although they need to master a language before they start school.

The results in Table 3.3 indicate that according to age, the DCHP's mean length of exposure increases gradually, but not regularly. There are older Deaf children who have entered school late (after 6 or 7 years of age), and consequently they have had their first contact with a signed language at a very late age.

Table 3.4 presents the distribution of the number of subjects by age groups. There are 6 group intervals of 12 months each. 32% of the sample consists of subjects who are exposed to a signed language for less than a year. 40% of the subjects have been exposed to a signed language for at least 4 years. The mean length of exposure of the DCHP ranges from 5 to 67 months. Table 3.5 shows the distribution of the 61 subjects according to parentage, age and length of exposure.

Table 3.5 – Distribution of subjects according to parentage, age, and length of exposure to signed language (raw number)

Ages	DCDP	DCHP					
		0-12 mos.	13-24 mos.	25-36 mos.	37-48 mos.	49-60mos.	61+ mos.
4-5 yrs	1	8	1	1	0	0	0
6-7 yrs	1	5	5	0	0	0	0
8-9 yrs	2	5	2	3	7	4	5
10-11 yrs	0	0	0	4	2	3	2
Total	4	18	8	8	9	7	7

Note: includes all 61 subjects (4 DCDP and 57 DCHP)

3.3. Task

The subjects were presented with a task that is designed to elicit knowledge of classifiers, called the Real Object Task (RO). The RO task is a sub-task of the ASL Assessment Instrument (ASLAI)[11], in which instructions were adapted to LSB. The task consists of pictures depicting different events. The stimuli consist of 27 questions designed to elicit verbs of motion and location. One handshape for each of the 27 questions (primary hand) was counted for each question. Three questions required more than one handshape so each handshape was counted separately for these items. The three handshapes that were counted are in the complex constructions: 'dumptruck,' 'window opening,' and 'elevator.' The target handshapes in LSB were determined in two independent studies (Bernardino, Hoffmeister & Allen, 2004, and Bernardino &

[11] The RO task was developed at Boston University's Center for the Study of Communication and the Deaf for assessing Deaf children linguistic developmental level in ASL (Hoffmeister et al., 1990)

Hoffmeister, 2004). In the first study, five Deaf adults fluent in LSB saw the stimuli on a TV (the same task presented to the Deaf children in this study) and responded to each item on the RO task. The five subjects were filmed and their responses were transcribed and organized by the first author . In the second study, four Deaf adults (all DCDP), also fluent in LSB, evaluated the responses of the signers in the first study. They were presented each question one at a time on a TV (the stimuli), and subsequently they saw each signer on another TV answering the same question.. They were requested to rate the responses of the signers as “correct,” “wrong,” or “acceptable.” This confirmed the findings in the first study, and was used to establish the target handshapes for the present study. In the current study, both the “correct” and “acceptable” handshapes were considered targets in the ratings of the children. A list of the stimuli according to the categories tested is in Table 3.6.

Table 3.6 – Summary of categories present in the Real Objects Task (RO)

	Category	Stimulus	Target handshapes	Number of questions
BPCL	Legs	Extended/straight legs, crossed and swing legs	1 point down B palm-down with extended-arm	4
	Feet	Foot tap and duck feet	B palm-down	2
	Eyes	Crossed eyes, look up-down, look sideways	V palm-down F 1 palm-down	3
	Hand	Hand feel floor	5 palm-down	1
People	Persons in line	Persons in line	4	1
	Person	Man upside down	V or U	1
Objects	Cars	Cars in line, in different arrangements	B palm-down B palm-side Curved.V	3
	Cans	Cans in rows or in tower	C	3
	Books/videotapes	Books and tapes (in shelves)	B palm side, fingers point up	2
	Pencils	Pencils	1 palm down	3
	Paper	Stacks of paper	B palm-down	1
Complex constructions	Dumptruck (bed)	Truck's bed	B palm-down	1
	Dumptruck (dirt)	Dirt on back of a truck	Curved.5 palm down	(1)
	Window (open)	Opening	S palm-up	1
	Window (LOOK)	Look through	V palm-down	(1)
	Elevator (open)	Doors opening	B palm-out	1
	Elevator (LOOK)	Look out	V palm-down	(1)
Total number of questions / responses				30

Notes: (1) The numbers in parenthesis indicate a second handshape required in a complex question.
(2) Multiple handshapes in "target handshapes" indicate that there is more than one option

The degree of difficulty for the items varies from simple to complex. Both singular and plural objects are presented in the stimuli; plural items are more difficult to represent as they require more linguistic information. Data was collected using a Panasonic VHSC camcorder. The equipment used to elicit responses was a 23" TV monitor and a Panasonic 1/2 VHS VCR with remote control. Each subject was recorded using JVC 30 minute videotape. Most of the children (54) were filmed at their respective schools. A small number (7) were filmed at the local Deaf association. The tasks were presented to all subjects by the author[12] with the help of another experienced LSB interpreter, who recorded the interaction using the equipment described above.

In all categories, except in the complex constructions, the subject only has to use one handshape to represent the stimuli, but may use the same handshape on both hands. In the complex constructions, however, multiple handshapes are required to represent the different items contained in two segments in the frame. For example, in "window open," the subject must first represent the man opening the window, then hold one hand to indicate that the man continues to hold up the raised window, while using another hand to represent the man looking out of the window (a "same/time-while" or temporal adverbial construction – Allen, Greenwald & Hoffmeister, 2000), which represents the second segment of the stimuli. As can be observed in the description of the RO task, the levels of difficulty increased in complexity to measure the children's ability in the use of classifiers at different ages. The different levels of complexity will help to establish the knowledge of classifier handshapes and their use according to different age levels. The similarities and differences in children's production to the adult targets can help in understanding how children understand and represent the world and at what age they appear to function at the adult level of linguistic knowledge.

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[12] I have been an LSB interpreter for more than 20 years.

3.4. Procedure

All children were tested individually in a room where only the experimenter and the person who was recording the interaction were present. The instructions from the ASL testing video were adapted to LSB and presented by a Deaf signer. The child was shown these instructions in LSB[13], and the experimenter certified the understanding before starting the test. Children who did not completely understand everything were told that he/she should "sign in the way you think it should be signed using 'SIGN-LANGUAGE[14].'" This information was the only instructions added to the original instructions on the video monitor. Since many of the children have never had any contact with a Deaf adult, the complementary instructions were necessary for comprehension. If the child did not understand the instructions in LSB (conveyed by a Deaf signer), or if the child did not understand signed language at all, the instructions were replaced by gestures of pointing to the TV monitor, facial expressions and manual gestures used by the speaking community that have general meaning of "what" (e.g., both hands open on the sides, palms up, shrugged shoulders and protuberant lips). No vocalizations were used, and the experimenter and the interpreter (both hearing) used LSB to communicate to each other when children were present in the room. All the items were presented during the same session. Each session lasted approximately half an hour.

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[13] A Deaf adult presented the instructions in ASL in the original RO task. The instructions were translated into LSB with the help of a Deaf signer, who was also the person who presented them on the video.

[14] SIGN-LANGUAGE is an LSB lexical item; sometimes it was replaced by the lexical item SIGN, as in the expression "SIGN WHAT (?)," meaning 'What is the sign (for)?'

3.5. Data Coding

The videotape responses that consisted of any kind of representation using hands (classifier handshapes) were coded and analyzed using SignStream[15]. The other responses were coded and analyzed using Microsoft Excel. Six response categories were established to evaluate children's performance in the RO task. Each of the children's responses received a score from 0 to 5. The criteria for each of the six response categories are summarized below:

(a) Correct response – The production of a classifier handshape in response to the stimulus presented that matched the target handshape(s) used by the Deaf adult community was considered correct. To be considered correct, not only the shape of the hand had to be similar to the target, but also the palm orientation and position of the hand/fingers, since these parameters are essential to represent a referent. Another consideration is the fact that in LSB sometimes more than one handshape may be considered correct to represent the same item (e.g., "V," "1" and "F" to represent eyes). In this case, the multiple target handshapes have the same value. In contrast, there are times in which more than one handshape is considered correct in one context, but in another context one of them is considered incorrect (e.g., "B" or "1" are considered equally correct to represent *crossed legs*, but to represent *a standing person's legs* the "B" handshape is considered inaccurate). In this

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[15] SignStream is a multimedia database tool that assists in the transcription and analysis of video-based language data. It is being developed by researchers from Boston University, Gallaudet University and Dartmouth College.

case, the correctness is evaluated according to the stimulus responded to. Correct responses were given a score of “5.”

(b) Inaccurate attempt – Responses that used a classifier handshape that was not identical to the target handshape in all parameters (shape, palm orientation, finger position) were categorized as an inaccurate attempt. The use of a handshape to trace the arrangement of the objects in the stimulus was considered an attempt to symbolically represent the stimulus, and was included in this category. These responses were scored “4,” since they consisted of an attempt to respond to the stimuli presented that, while inaccurate according to the adult target, nonetheless shows a linguistic use of signs.

(c) Pointing – The responses that consisted of pointing to the TV, or to any object in the room without an attempt to represent the stimulus seen were categorized as pointing. Pointing is considered a primitive signaling device that enters in the lexicon of a signed language with a pronominal function (Hoffmeister, 1978). This type of response received a score of “3”.

(d) Naming – The responses that consisted of naming the more salient object in the stimulus without an attempt to represent it were categorized as naming. The attribution of a noun to an object sometimes consisted of an LSB sign that is used in the Deaf community, but sometimes it consisted of a homesign. Since both the lexical items and the homesigns constituted an identification of the object seen, this type of response was scored “2.”

(e) Mimicry – When the stimulus presented showed a person (or persons) performing any action and the child's response consisted of an imitation of what s/he saw without trying to represent it using her/his hands, this type of response was categorized as mimicry. Responses that consisted of mimicry were given a score of "1." Mimicry seems to be more representative than naming, in the sense that the child not only identified the referent (as in naming it), but s/he tried to represent the subject's action; however, considering the types of responses in relation to be more "linguistic-like" or "gesture-like," clearly responses that consisted of mimicry are more "gesture-like" than responses that consisted of naming an object.

(f) No response – Finally, instances when a child saw a stimulus on the TV and refused to provide any response, but only shrugged her/his shoulders or looked to the other side of the room, were categorized as no response. This type of response was scored "0."

In no case in which the children tried to represent the stimulus using their hands was considered "gesture." Since this is a tentative response using the hands to represent an object, it was assumed that the handshape was used linguistically. The analyses of handshape errors (in Chapter 5) will help to distinguish which of the handshapes used in the "inaccurate attempts" are more representative (linguistic-like) and which ones are less representative (gesture-like).

3.6. Statistical analysis

The children's productions are evaluated according to three subjects variables: parentage, age, and length of exposure to signed language. The purpose of this analysis is to evaluate the significance of these three variables in Deaf children's acquisition of classifier handshapes.

3.6.1. Analysis of DCDP responses

This analysis presents the descriptive results of the DCDP taken together. The results are evaluated according to the proportion of responses in each response category described above, since the number of subjects is not large enough to do statistical analyses by age. The results of the DCDP are presented individually according to age, since they are exposed to a signed language from birth, the issue of length of exposure is moot..

3.6.2. Analysis of DCHP responses

The first analysis presents the descriptive results of the DCHP. It first presents the statistical proportion for all subjects' responses in each response category. Then, there is a description and analysis of their responses according to age and according to length of exposure.

The second is a linear regression analysis of the total scores the DCHP produced. Linear regression is used to analyze the influence of age and length of exposure to the total scores produced.

3.6.3. Analysis of DCHP results according to response categories

The results are presented according to the six response categories described above. The first analysis is a multiple linear regression analysis of the influence of age and length of exposure using the proportions of correct responses and inaccurate attempts of the DCHP. The second analysis is also a multiple linear regression analysis of the influence of age and length of exposure using the proportions of other responses produced (i.e., pointing, naming, mimicry, and no response).

3.6.4. Comparison of DCDP and DCHP results

The mean responses of the DCDP and the DCHP in the production of correct responses and inaccurate attempts are compared. This comparison shows the pattern of development of the DCHP in relation to DCDP since DCHP are acquiring language mainly from each other, while DCDP have adult LSB language models. This analysis also shows the language knowledge of children who are exposed to signed language for more time in relation to the children who are exposed for less time. It is possible to perceive the length of time in which the exposure to a signed language makes a difference in the language acquisition.

3.7. Qualitative analysis

The children's productions are evaluated qualitatively, to verify the relationship of handshape as an appropriate representation of classifier forms to age and length of exposure. The results are presented according to lexical group categories, for both the DCDP and the DCHP.

3.7.1. Analysis of lexical categories

The proportions of the children’s responses are grouped according to the lexical categories. The results are evaluated according to the Brazilian Deaf adults’ targets, which are presented before each discussion of the handshape category. There are four lexical categories: (1) representation of body parts, which includes legs, feet, eyes, and hand; (2) representing people, includes persons in line and man upside down; (3) representation of objects, includes cars, cans, books and videotapes, pencils, and stacks of paper; and (4) the representation of complex constructions, which includes dumptruck, window, and elevator. The proportions of the children’s correct responses and inaccurate attempts in each lexical category are presented statistically and evaluated qualitatively.

Chapter 4 – Statistical Results

4.1. Introduction

This chapter presents the statistical results of the participants' responses to the Real Objects (RO) task. In this chapter results are considered with respect to three subject variables: hearing status of parents (Deaf children of Deaf parents – DCDP, Deaf children of hearing parents – DCHP), chronological age (4:5 – 11:8 years of age), and length of time of exposure to signed language in DCHP (2-74 months of exposure). As noted in chapter 1, we expect DCDP to outperform DCHP because we assume that the quality of their signed language input is superior. Although the Deaf parents' production was not evaluated, it is assumed that their proficiency in LSB is comparable to the proficiency of other Deaf adults in the community[16]. We also expect children's performance to improve with chronological age as a result of their improved cognitive abilities, and we expect children's performance to improve with length of exposure to a signed language.

As noted in chapter 3, the children's responses on the RO task were categorized as "correct," "inaccurate attempt," "pointing," "naming," "mimicry," and "no response" in terms of the target classifier handshapes determined through the "independent study" described in chapter 3 (Bernardino, Hoffmeister & Allen 2004; Bernardino & Hoffmeister 2004). In that study, 5 fluent speakers of LSB produced responses for each of the stimuli in the RO task, and a further 4 fluent speakers of LSB evaluated their

[16] Only the LSB proficiency of the parents of the youngest DCDP was evaluated, as part of the "independent study" (Bernardino, Hoffmeister & Allen, 2004; Bernardino & Hoffmeister, 2004). This child's father also has Deaf parents and his mother acquired LSB by 3 years of age, from older Deaf sisters.

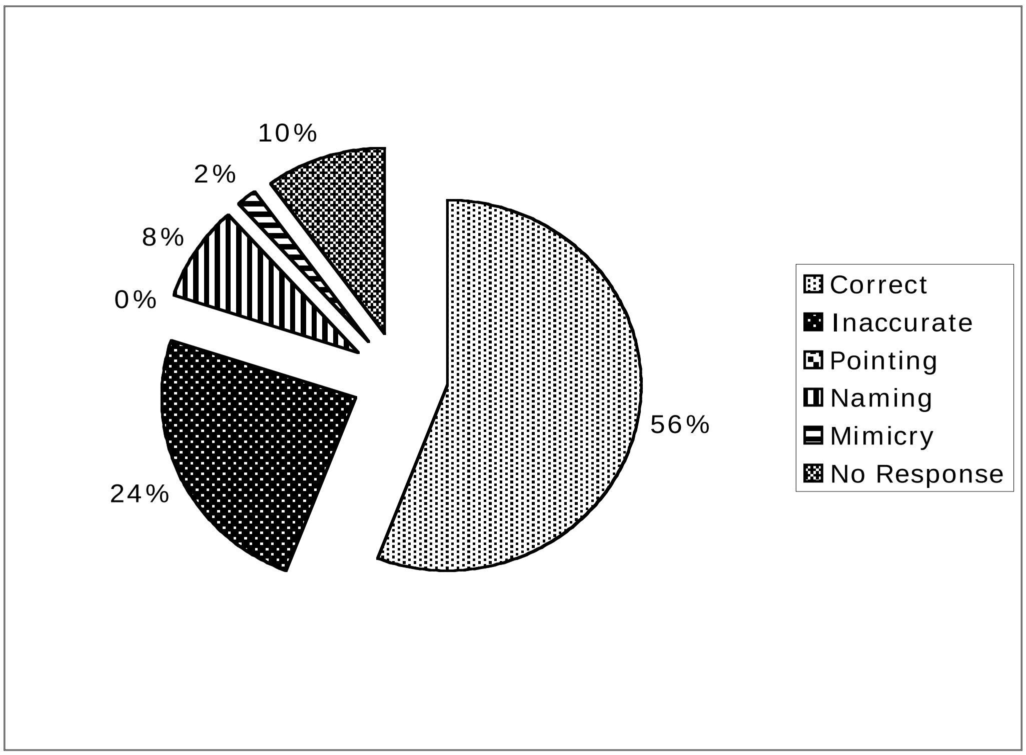
responses. Those classifier handshapes determined by the adults to be either fully grammatical in LSB, or not strictly grammatical but commonly used in LSB, are included here as the set of target classifier handshapes for the children. As discussed in chapter 3, each response category received a score according to the degree of linguistic knowledge it revealed. Responses categorized as "correct" received the highest score (5) because they showed the most evidence of linguistic knowledge on the part of the child. Responses categorized as "no response" received the lowest score (0) because they showed the least linguistic knowledge. The score for each item was added together to produce a total score on the RO task for each child out of a possible 150. In the following sections, results are discussed in terms of both total score on the test, and in terms of responses of each category type. The results for the DCDP are presented in section 4.2. The overall results for the DCHP are presented in section 4.3, and results for the DCHP broken down by types of responses are presented in section 4.4. Section 4.5 presents a comparison between the results for the DCDP and the DCHP.

4.2. Results for Deaf children of Deaf parents

In this section, the results of the DCDP are presented for all the stimulus items taken together. Since there are only 4 DCDP, we present descriptive results only since the numbers of subjects are not large enough to do statistical analyses. We first present results for all the children together, and then present the proportions of responses in each response category for each of the four children separately.

The DCDP scored relatively well on the RO task, with their total scores ranging from 91 to 136. Chart 4.1 shows the responses of the DCDP according to the six response categories.

Chart 4.1. Proportion of DCDP responses to the RO task



As chart 4.1 indicates, 80% of the DCDP responses consisted of classifier handshapes (56% correct responses and 24% inaccurate attempts). The remaining 20% of their responses consisted of naming (8%), mimicry (2%), and they did not respond to 10% of the stimuli. When the DCDP did not know the answer they chose to respond within the LSB classifier system. The relatively high proportion of inaccurate attempts points to the fact that the DCDP are exposed to good language models (such as their parents), but also to non-proficient signers, as their hearing teachers and schoolmates. This fact may influence negatively the results.

Next, we present the results of children individually. Recall that the overall study tests two hypotheses: that children's performance improves with increased age (i.e., increased cognitive ability), and that children's performance improves with increased length of exposure to a signed language. In DCDP, the variables age and length of exposure are identical since they are exposed to a signed language from birth. We expect that the proportion of correct responses and inaccurate attempts will be higher in older (more exposed) children than in younger (less exposed) children, because these response types represent a more linguistic use of language. Within these two types of linguistically based responses, we expect that DCDP will produce more correct responses than inaccurate attempts because they have access to good adult models in their parents' signing. We also expect that all other types of responses (i.e., pointing, naming, mimicry, and no response) will be low across the board for DCDP because of their good language model, and that they will be lower in older children, because these response types represent a more gesture-like use of language.

The proportion of DCDP responses in each category is presented in Table 4.1.

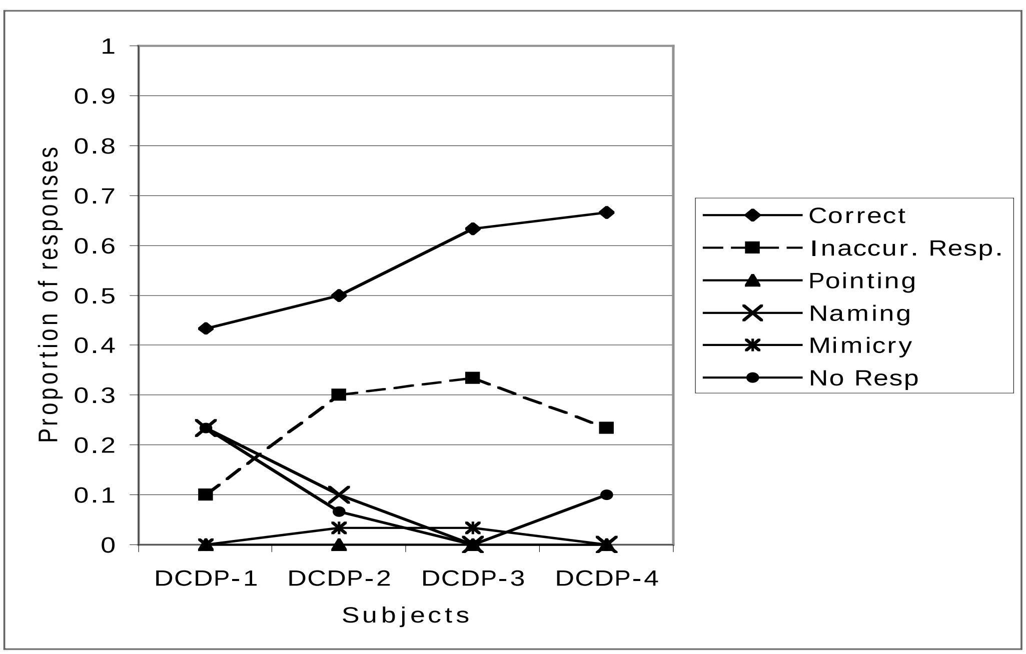
Table 4.1. Proportion of DCDP responses in each response category

Subjects	Age	Correct responses	Inaccurate attempt	Pointing	Naming	Mimicry	No response	Total score
DCDP-1	5:6	0.43	0.10	0.00	0.23	0.00	0.24	91/150
DCDP-2	7:0	0.50	0.30	0.00	0.10	0.03	0.07	118/150
DCDP-3	9:0	0.64	0.33	0.00	0.00	0.03	0.00	136/150
DCDP-4	9:3	0.67	0.23	0.00	0.00	0.00	0.10	128/150

Note: The results of the 4 subjects refer to the production of 30 handshapes in response to 27 questions.

The results presented in Table 4.1 confirm the hypothesis that older (more exposed) children produce more classifier handshapes than younger (less exposed) children. The DCDP overall also produced more correct responses than inaccurate attempts, as we predicted, which probably results from the good models of signed language that they receive as their input. No DCDP produced pointing and a very small proportion of their responses consisted of mimicry. The proportions of naming and no response were higher in the youngest subject's responses and lower in the older subjects' responses. One exception is in the production of no response, which showed a small increase in the responses of the oldest subject. This information is represented graphically in Chart 4.2.

Chart 4.2. Proportion of DCDP responses in each response category



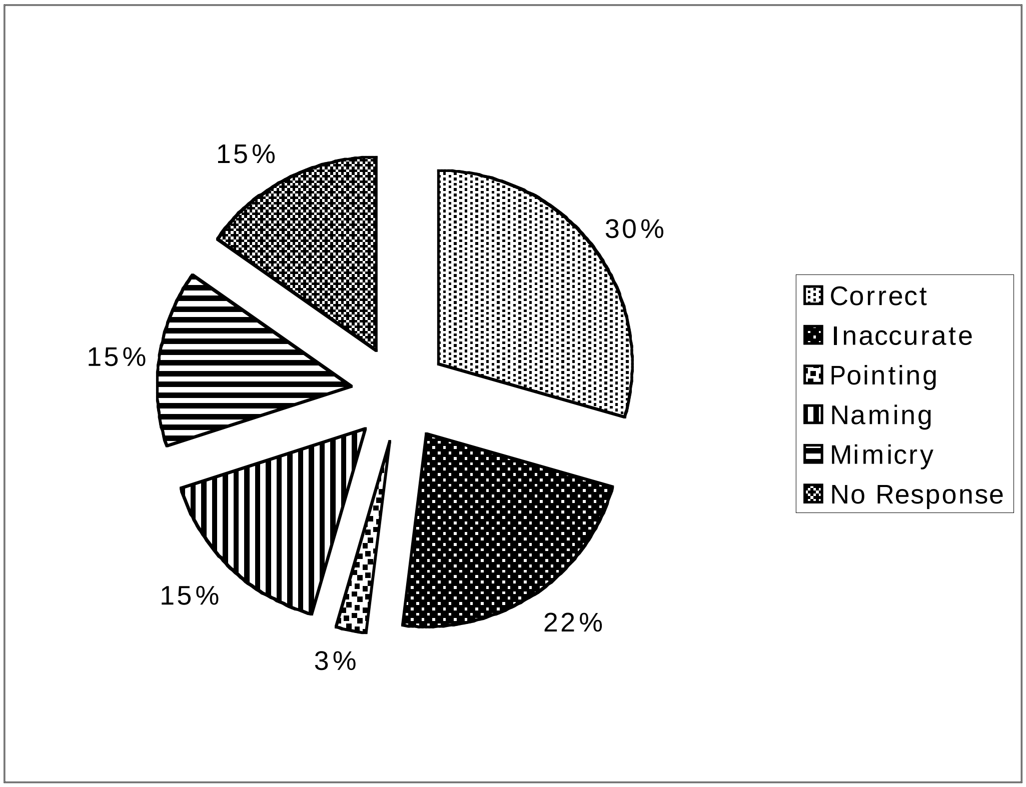
4.3. Results for Deaf children of hearing parents

In this section, results for DCHP are presented. Section 4.3.1 shows descriptive results by both age and length of exposure. Section 4.3.2 shows results of statistical analyses evaluating the effect of the two-predictor variables on the total test score out of a possible 150. Section 4.3.3 shows results of statistical analyses evaluating the effect of the two-predictor variables on each of the six response categories.

4.3.1 Descriptive results for Deaf children of hearing parents

In this section, the descriptive results for the DCHP are presented for all the stimulus items taken together. Not surprisingly due to their relatively impoverished language input, DCHP scored less well than DCDP on the RO task. Their total scores on the task covered a wide range, from 24 to 143, indicating substantial variability within this group, which will be explored later. Chart 4.3 shows the proportion of the DCHP responses to the RO task.

Chart 4.3. Proportion of DCHP responses to the RO task



As shown in chart 4.3, the proportion of the DCHP's production of classifier handshapes is only 52% (30% correct responses and 22% inaccurate attempts), which is a very small proportion compared to the 80% of DCDP who produced classified handshapes. The other types of responses the DCHP produced sum up 48% (3% of pointing, and the proportion of naming, mimicry, or no response is 15% each). Interestingly, the proportion of the DCHP's inaccurate attempts is only 2% smaller than the DCDP's proportion of the same category (24%), which suggests that the DCHP are attempting to use the correct classifier handshape.

As noted earlier, the overall study tests two main hypotheses: that children's performance improves with increased age (i.e., increased cognitive ability), and that children's performance develops with increased length of exposure to a signed language. Therefore, results are next presented grouped by age, and then by length of exposure. Note that, although the correlation between these two variables is quite high (r = .71), it is not perfect. In other words, in contrast to the situation for DCDP, not every DCHP of a given age has been exposed to a signed language for the same length of time. Therefore, at this stage of the study, we present the results separately for each of the two variables.

As for the DCDP, we expect that the proportion of correct responses and inaccurate attempts will be higher in older and more exposed DCHP than in younger and less exposed DCHP, because these response types represent a more linguistic use of language. However, we do not expect any differentiation, at least at the youngest ages, between these two types of linguistically-based responses in DCHP. They do not have access to good adult models either at home or at school, and therefore have relatively little basis upon which to select correct handshapes over inaccurate ones. Further, we expect that the non-linguistic types of responses (i.e., pointing, naming, mimicry, and no response) will be relatively high across the board for DCHP because of their poor language model. However, we expect them to be lower in older children, as they gain more confidence in the linguistic aspects of a signed language. Finally, we expect the total score to increase with age as the children's responses reflect more linguistic knowledge.

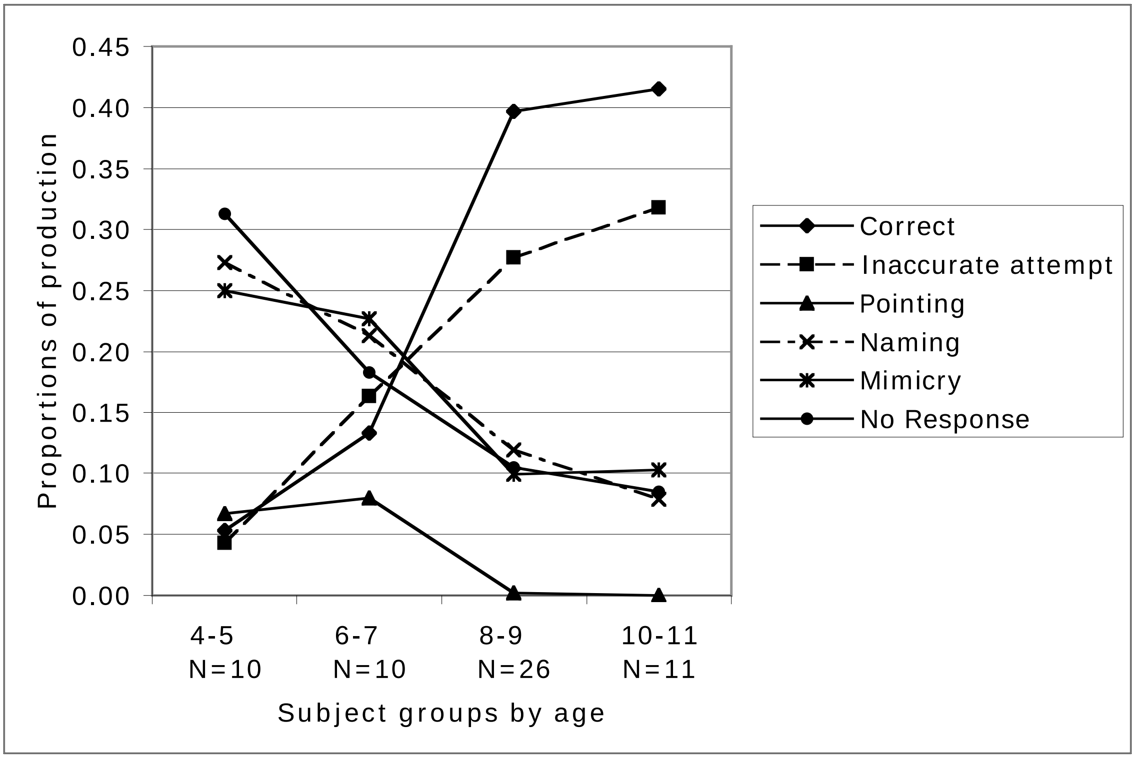
Table 4.2 shows the mean responses of the DCHP in each response category within each of four age groups (4-5, 6-7, 8-9, 10-11 years old).

Table 4.2. Proportion of DCHP responses in each response category according to age

Age groups	N	Types of responses						Total score (mean)
		Correct	Inaccurate attempt	Pointing	Naming	Mimicry	No response	
4 – 5	10	0.05	0.04	0.07	0.27	0.25	0.31	43/150
6 – 7	10	0.13	0.16	0.08	0.21	0.23	0.18	66/150
8 – 9	26	0.40	0.28	0.00	0.12	0.10	0.11	103/150
10 – 11	11	0.42	0.32	0.00	0.08	0.10	0.09	108/150

As predicted, the production of classifier handshapes (correct and inaccurate attempts) is higher in the older age groups, and the production of other responses that do not involve classifier handshapes is lower in the older age groups. Further, at the youngest ages there is little difference between the proportions of correct handshapes and inaccurate attempts at classifier handshapes. In the older age groups, more correct handshapes are produced. Finally, the total score increases with age. This reflects the fact that a large proportion of the responses in the younger age groups are not linguistically based, consistent with the poor language model that these children receive. Chart 4.4 shows the same results in another format.

Chart 4.4. Proportion of DCHP responses in each response category according to age



Observe that the beginning point of the two responses that are considered more linguistic (correct responses and inaccurate attempts), as well as that of pointing[17], which is used in signed languages with the pronominal function, start at about the same point at 5 years of age, when the DCHP in Brazil have their first contact with a signed language. The production of classifier handshapes is higher in older children (correct and inaccurate attempts), while the proportion of pointing starts decreasing by 7 years of age. In contrast, the other gesture-like responses (mimicry, naming, and no response) start in a higher proportion and decrease as children age. The highest proportion of correct responses of DCHP is 42%, which the children achieved by 11 years of age.

[17] We consider pointing to be more gesture-like than linguistic-like, although it can develop into a pronominal form later on.

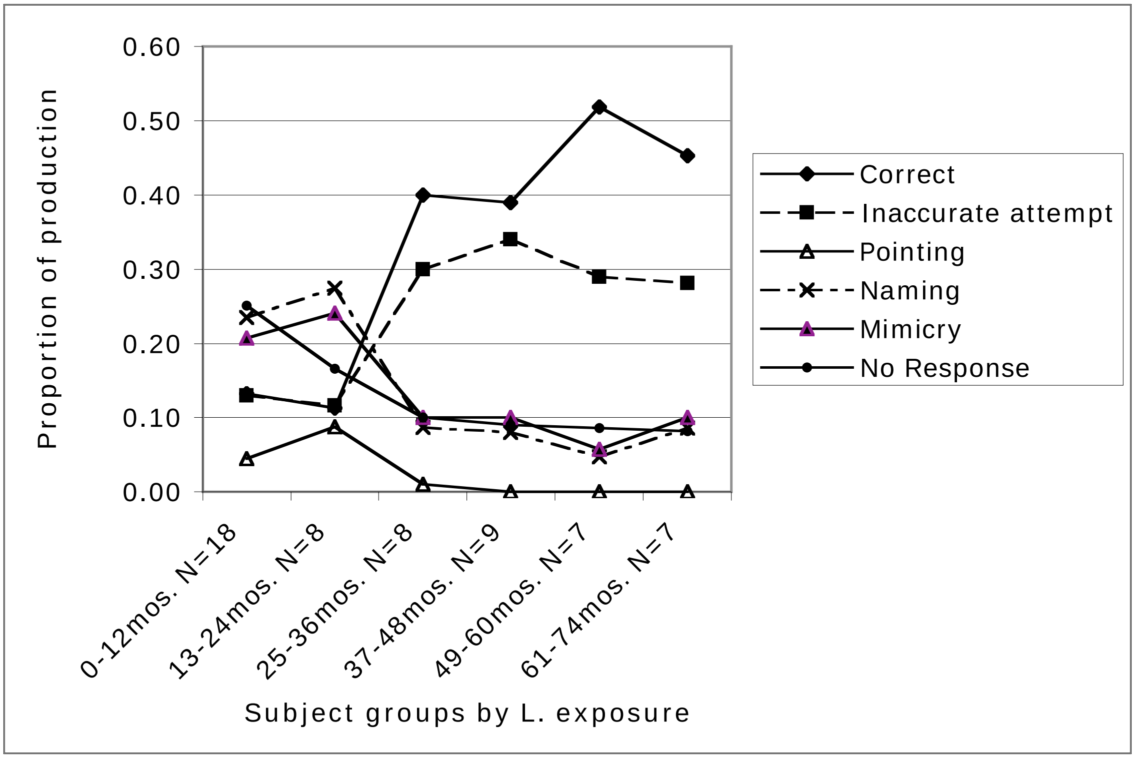
Not surprisingly, the results according to length of exposure show similarities to the results according to age. Table 4.3 shows the means of the DCHP according to six length of exposure groups (0-12, 13-24, 25-36, 37-48, 49-60, 61-74 months of exposure).

Table 4.3. Proportion of DCHP responses in each response category according to language exposure

Exposure groups	N	Types of responses					
		Correct	Inaccurate attempt	Pointing	Naming	Mimicry	No response
0 – 12 mos.	18	0.13	0.13	0.04	0.24	0.21	0.25
13 – 24 mos.	8	0.11	0.12	0.09	0.28	0.24	0.17
25 – 36 mos.	8	0.40	0.30	0.01	0.09	0.10	0.10
37 – 48 mos.	9	0.39	0.34	0.00	0.08	0.10	0.09
49 – 60 mos.	7	0.52	0.29	0.00	0.05	0.06	0.09
61 – 74 mos.	7	0.45	0.28	0.00	0.09	0.10	0.08

These results seem to indicate three qualitatively different stages in response patterns. In the two least exposed groups, children produced only 11% correct responses and 12% inaccurate attempts. In the next two exposure groups, the percentages jump to between 30% and 40% for each response type. In the two most exposed groups, the correct responses again jump noticeably, but the inaccurate attempts stay relatively constant. The use of other strategies is relatively high in the first two exposure groups, and then drops off considerably. Chart 4.5 presents the same data in a more visual format.

Chart 4.5. Proportion of DCHP responses in each response category according to exposure groups



4.3.2. Linear regression analysis for "total score"

In this section, we assess the effect of age and length of exposure on the total test score out of 150 for the DCHP. Recall that each subject responded to 30 items on the Real Objects test, and each item was assigned a score out of 5 (see chapter 3). Therefore, the maximum possible score that a child could receive on the test is 150.

A multiple regression analysis was conducted to assess the combined influence of the independent variables age and length of exposure on the dependent variable total score. Further, bivariate linear regression analyses for each independent variable (age and length of exposure) in relation to the dependent variable total score were conducted separately, to evaluate the main effect of each independent variable. Table 4.4 presents the descriptive statistics with the results for the three variables.

Table 4.4. Descriptive Statistics for DCHP

	Range	Mean	Std. Deviation	N
Total Scores	24 – 143	87.2	34.77	57
Age (years)	4:5 – 11:8	7.9	1.93	57
Length of exposure (mos.)	2 – 74	31.5	22.53	57

A multiple regression analysis was conducted to evaluate the improvement of the total scores in the production of handshapes according to age and length of exposure. The predictors were the actual ages of the children (in years) and the number of months that the children had been exposed to a signed language at the time of the test. The linear combination of the predictors was significantly related to the total score, $F(2,54) = 32.75$, $p < .01$. The sample multiple correlation coefficient was .74, indicating that approximately 55% of the variance in the total score can be accounted for by the linear combination of age and length of exposure.

In Table 4.5 we present indices to indicate the relative strength of the individual predictors. The bivariate correlations between the independent variables (age and length of exposure) were positive, as expected, and both variables were statistically significant ($p < .01$). The partial correlations between total score and each of age and length of exposure were also significant ($p < .01$).

Table 4.5. The Bivariate and Partial correlations of the Predictors with Total Scores

Predictors	Correlation between the predictors and total score	Correlation between each predictor and the total scores controlling for the other predictor
Age	.70*	.42*
Length of exposure	.67*	.35*

* $p < .01$

The correlation coefficient between age and length of exposure was also significant r (55) = .71, $p < .01$. On the basis of these correlational analyses, we conclude that both age and length of exposure to a signed language are responsible for the variance in total score for the DCHP.

In order to evaluate the main effect of each independent variable (age, length of exposure) we conducted separate bivariate linear regression analyses for each independent variable. Relevant information concerning the analyses is given in Table 4.6. As indicated, neither 95% confidence interval for the slope contains the value of zero, so both age and exposure are significantly related to total score. As hypothesized, the score was higher for both older children and children with more exposure. Approximately 48% of the variance of the total score was accounted for by its linear relationship with age, and approximately 45% of the variance by its relationship with exposure. Therefore, an increase in both independent variables is strongly related to the increase in total score.

Table 4.6. Separate bivariate correlations of age and exposure with Total Scores

	Total score and Age	Total score and Length of Exposure
Predicted overall scores	+12.5	+1.04
Overall age	-11.2	N/A
Overall length of exposure	N/A	+54.6
95% CI for slope	9.03 to 16.02	.73 to 1.34
F	$F(1,55) = 51.53^*$	$F(1,55) = 44.89^*$
Correlation	.70	.67
Amount of variance	48%	45%

* $p < .01$

4.4. Results for DCHP according to response categories

The results of the production of the DCHP are evaluated according to the 6 types of response categories (correct, inaccurate attempt, pointing, naming, mimicry, and no response). In order to evaluate the effect of each response category, the proportions of the productions in the 6 response categories were analyzed separately. Multiple regression analyses were conducted to assess the combined influence of the independent variables (age, length of exposure) in the production of each dependent variable (correct, inaccurate attempt, pointing, naming, mimicry, and no response). Further, bivariate linear regression analyses for each independent variable in relation to each dependent variable were conducted separately, to evaluate the main effect of each independent variable on each dependent variable. For easy presentation of results, the analyses of the production of correct responses and inaccurate attempts are presented in section 4.4.1, since both responses involve the production of classifier handshapes. The analyses of the production of pointing, naming, mimicry, and no response are in section 4.4.2, for these other responses are not classifier handshapes. Table 4.7 presents the descriptive statistics with the means and standard deviations for the two independent variables (age and length of exposure), and two of the six dependent variables (correct responses and inaccurate attempts).

Table 4.7. Descriptive Statistics of classifier responses for DCHP (N=57)

	Range	Mean	Std. Deviation
Age (years)	4:5 – 11:8	7.9	1.93
Length of exposure (mos.)	2 – 74	31.5	22.53
Proportion of correct responses	0 – .77	0.29	0.22
Proportion of inaccurate attempts	0 – .60	0.22	0.17

4.4.1. Multiple Linear Regression analysis for combined predictors of correct responses and inaccurate attempts

In the two sets of multiple regression analyses, the linear combination of the independent variables (age, exposure) was significantly related to the proportion of correct responses, $F(2,54) = 29.33$, $p < .01$ and to the proportion of inaccurate attempts, $F(2,54) = 13.30$, $p < .01$. The multiple correlation coefficient of correct responses was .72, and of inaccurate attempts was .58, indicating that approximately 52% of the variance of the proportion of correct responses and approximately 33% of the variance of the proportion of inaccurate attempts in the sample can be accounted for by the linear combination of age and length of exposure.

Table 4.8 presents indices to indicate the relative strength of the individual predictors in the two analyses. The bivariate correlations between the independent variables (age and length of exposure) were significant ($p < .01$) and positive in both measures (for correct and inaccurate responses), as expected, indicating that the increase of both independent variables is strongly related to the increase in correct responses and inaccurate attempts. The partial correlations between age and length of exposure with correct responses were also significant (age $p < .05$, length of exposure $p < .01$), as shown in the table results. The partial correlation between age and inaccurate responses was significant ($p < .01$), but the partial correlation between length of exposure and inaccurate responses was not significant.

Table 4.8. The Bivariate and Partial correlations of the Predictors with Proportion of Correct Responses and Inaccurate Attempts

Predictors	Correlations between the predictors and		Partial Correlations between each predictor and	
	Correct responses	Inaccurate attempts	Correct responses controlling for the other predictor	Inaccurate attempts controlling for the other predictor
Age	.65**	.57**	.34*	.49**
Length of exposure	.68**	.46**	.44**	.11

*$p < .05$, ** $p < .01$

On the basis of these correlational analyses, we conclude that both age and length of exposure to a signed language are responsible for the variance in the proportion of correct responses and inaccurate attempts of all DCHP.

In order to evaluate the main effect of each independent variable (age, length of exposure) with correct responses and inaccurate attempts we conducted separate bivariate linear regression analyses for each independent variable. Table 4.9 shows relevant information concerning the analyses for correct responses and for inaccurate attempts.

Table 4.9. Separate bivariate correlations of age and exposure with Correct Responses and Inaccurate Attempts

	Correlation of age with		Correlation of exposure with	
	Correct responses	Inaccurate attempts	Correct responses	Inaccurate attempts
Predicted overall scores	+.075	+.05	+.007	+.003
Overall age	-.297	-.16	N/A	N/A
Overall length of exposure	N/A	N/A	+.082	+.12
95% CI for slope	.05 to -.49	.03 to .07	.005 to .009	.002 to 005
F	$F(1,55) = 40.3$*	$F(1,55) = 26.3$*	$F(1,55) = 47.38$*	$F(1,55) = 14.64$*
Correlation	.65	.57	.68	.46
Amount of variance	42%	32%	46%	21%

* $p < .01$

As indicated, neither 95% confidence interval for the slope contains the value zero, so both age and exposure are significantly related to correct responses and inaccurate attempts. As hypothesized, the production of correct responses and inaccurate attempts was higher for both older children and children with more exposure. Approximately 42% of the variance of the correct responses and 32% of inaccurate attempts was accounted for by its linear relationship with age, and approximately 46% of the variance of correct responses and 21% of inaccurate attempts was accounted for by its relationship with exposure. Therefore, an increase in both independent variables is strongly related to the increase in correct responses and inaccurate attempts.

In sum, the results indicate that age is strongly related to the increase of correct responses and inaccurate attempts in the production of classifier handshapes. This means that the older DCHP produce more classifier handshapes, which results in more correct responses or inaccurate attempts than those produced by younger DCHP. The results also indicate that the length of exposure to a signed language is strongly related to the increase of correct responses and of inaccurate attempts in the production of classifier handshapes. The children who have had more time of exposure to a signed language tend to produce more correct handshapes than the children who have had less exposure

4.4.2. Multiple Linear Regression analysis for combined predictors of other types of responses

Four sets of multiple linear regression analyses evaluated how the independent variables (or predictors) age and length of exposure predicted the proportions of the dependent variables pointing, naming, mimicry, and no response produced by DCHP. The descriptive statistics showing all means and standard deviations are in Table 4.10.

Table 4.10. Descriptive Statistics of other responses for DCHP (N = 57)

	Range	Mean	Std. Deviation
Age (years)	4:5 – 11:8	7.9	1.93
Length of exposure (mos.)	2 – 74	31.5	22.53
Proportion of pointing	0 – .60	0.03	0.09
Proportion of naming	0 – .53	0.16	0.15
Proportion of mimicry	0 – .40	0.15	0.14
Proportion of no response	0 – .53	0.15	0.13

The relevant information concerning the analyses for each dependent variable is presented in Table 4.11. The linear combination of the independent variables (age, exposure) was significantly related to the proportion of pointing, naming, mimicry and no response.

Table 4.11. Multiple linear regression analysis for age and exposure with other responses

Dependent variables	F	Multiple correlation coefficient	Variance of the dependent variable by linear combination of age and exposure
Pointing	$F(2,54) = 3.74$*	.35	12%
Naming	$F(2,54) = 11.65$**	.55	30%
Mimicry	$F(2,54) = 8.07$**	.48	23%
No response	$F(2,54) = 13.52$**	.58	33%

*$p < .05$, ** $p < .01$

The variance in the proportion of each dependent variable (pointing, naming, mimicry and no response) indicate that an additional proportion (12% for pointing, 30% for naming, 23% for mimicry, and 33% for no response) of the variance is contributed by having the both predictors (age and length of exposure) versus having only one of the predictors in the equation.

In Table 4.12 we present indices to indicate the relative strength of the individual predictors in the four analyses. The bivariate correlations between the independent variables (age and length of exposure) were negative, as expected, for the predictions of all dependent variables. All bivariate correlations were statistically significant ($p < .01$, except the correlation between pointing and length of exposure $p < .05$). The partial correlations among age, length of exposure and the proportions of pointing, naming, mimicry, and no response were not significant, except for the partial correlation between naming and length of exposure (holding age constant, $p < .05$), and in the partial correlation between no response and age (holding length of exposure constant, $p < .05$) that were both significant.

Table 4.12. The Bivariate and Partial correlations of the Predictors with Proportion of Pointing, Naming, Mimicry, and No response

	Predictor: Age		Predictor: Length of Exposure	
	Bivariate Correlations	Partial Correlations	Bivariate Correlations	Partial Correlations
Pointing	-.35**	-.32	-.27*	-.05
Naming	-.47**	-.20	-.53**	-.40*
Mimicry	-.46**	-.32	-.42**	-.19
No response	-.56**	-.40*	-.50**	-.22

*$p < .05$, ** $p < .01$

On the basis of these correlational analyses, we conclude that both age and length of exposure to a signed language are influential in the variance of the proportion of pointing, naming, mimicry and no response in all productions of DCHP. This means that older children who have had more exposure to a signed language produce less pointing, naming, mimicry, and no response in tasks that elicit the production of classifier handshapes.

In order to evaluate the main effect of each independent variable (age, length of exposure) four sets of bivariate linear regression analyses evaluated how the independent variables (or predictors) predicted the proportions of the dependent variables pointing, naming, mimicry, and no response produced by DCHP. The relevant information concerning the analyses for each dependent variable with age is presented in Table 4.13 and for each dependent variable with exposure is presented in Table 4.14.

Table 4.13. Separate bivariate correlations of age with other responses

	Pointing	Naming	Mimicry	No response
Predicted overall scores	+.16	-.04	-.03	-.04
Overall age	-.02	+.43	+.41	+.46
95% CI for slope	-.03 to -.005	-.05 to -.02	-.05 to -.02	-.05 to -.02
F	$F(1,55) = 7.5$*	$F(1,55) = 15.8$*	$F(1,55) = 14.7$*	$F(1,55) = 24.7$*
Correlation	.35	.47	.46	.56
Amount of variance	12%	22%	21%	31%

* $p < .01$

The 95% confidence interval for the slope does not contain the value of zero in any of the bivariate correlations of age with the four types of other responses (pointing, naming, mimicry, no response). Approximately 12% of the variance of pointing, 22% of naming, 21% of mimicry and 31% of no response were accounted for by their linear relationship with age. Therefore, an increase in age is strongly related to the decrease in any of the four types of responses other than classifier handshapes.

Table 4.14. Separate bivariate correlations of exposure with other responses

	Pointing	Naming	Mimicry	No response
Predicted overall scores	-.001	-.003	-.003	-.003
Overall exposure	+.06	+.26	+.23	+.25
95% CI for slope	-.002 to .000	-.005 to -.002	-.004 to -.001	-.004 to -.002
F	$F(1,55) = 4.2$	$F(1,55) = 21.63$*	$F(1,55) = 11.88$*	$F(1,55) = 18.52$*
Correlation	.27	.53	.42	.50
Amount of variance	7%	28%	18%	25%

* $p < .01$

The 95% confidence interval for the slope does not contain the value of zero in the bivariate correlations of exposure with three out of the four types of other responses (naming, mimicry, no response). As the CI for slope contains zero in the bivariate correlation of exposure with pointing, this indicates that length of exposure is not related to the proportion of pointing produced. In contrast, the overall exposure is significantly related to the proportion of naming, mimicry and no response. Approximately 28% of the variance of naming, 18% of mimicry and 25% of no response was accounted for by their linear relationship with exposure. Therefore, an increase in exposure is strongly related to the decrease in the proportion of naming, mimicry and no response. As hypothesized, the production of naming, mimicry and no response was higher for both younger and children with less exposure. In contrast, the production of pointing is not related to the length of exposure to a signed language.

In sum, age and length of exposure are inversely related to the responses that were not in the classifier form, which means that in older children and children with more exposure the responses that consist of pointing, naming, mimicry and no response tend to decrease. Table 4.15 presents the relevant information concerning the analyses of the variances that predict the proportions of the dependent variables when the independent variables ("age" and "length of exposure") are combined, as well as the proportions of the main effects of the individual predictors over the four dependent variables.

Table 4.15. Analyses of variances and of the Predictors with Proportions of Pointing, Naming, Mimicry, and No response

Predicted variables	Proportion of variance as effect of age and length of exposure combined	Main effects of individual predictors – proportion of variances as effect of	
		Age	Length of exposure
Pointing	.12	.12*	.07
Naming	.30	.22**	.28**
Mimicry	.23	.21**	.18**
No response	.33	.31**	.25**

* weakly related, ** moderately related

As the results in Table 4.15 indicate, age has a weak effect in the decrease of pointing, while length of exposure is not related to its decrease. The decrease of the other types of responses are moderately related to the effects of age and length of exposure combined, as well as the effects of both predictors considered individually.

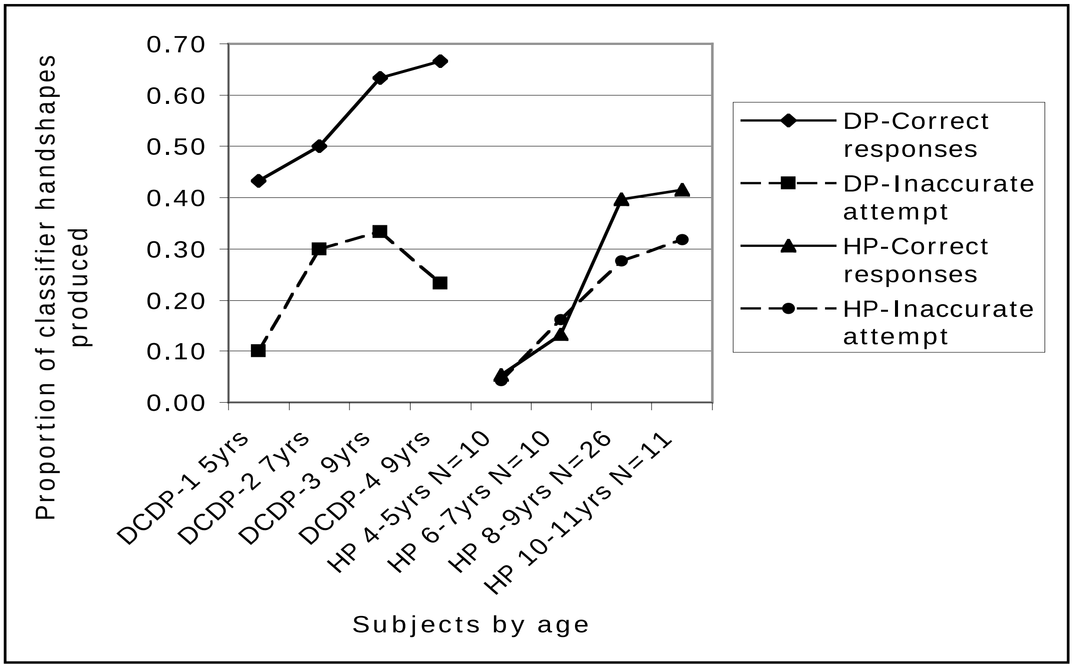
4.5. Results of DCDP compared to results of DCHP

In this section, the mean responses that the DCDP produced are compared to the mean responses of the DCHP. As shown in the former sections, the hypotheses concerning the influence of age and length of exposure were both confirmed in relation to all types of responses.

As a result of the differential in input, we expect that the means of the DCHP's correct responses will not measure up to the DCDP's correct responses. We also expect that the means of the DCHP's inaccurate attempts will be higher than the DCDP's inaccurate attempts for the same reason. The responses other than classifier handshapes produced are expected to be higher for the DCHP than for the DCDP.

In order to compare the DCHP to the DCDP, only the production of correct responses and inaccurate attempts will be discussed at first. The production of other responses is analyzed separately. The results of classifier handshapes produced (correct and inaccurate categories) are first compared according to age, followed by a comparison according to length of exposure. Chart 4.6 presents the results of both the DCDP and DCHP according to age, by combining Charts 4.3 (production of DCDP's correct responses and inaccurate attempts) and 4.4 (production of DCHP of correct responses and inaccurate attempts according to age groups).

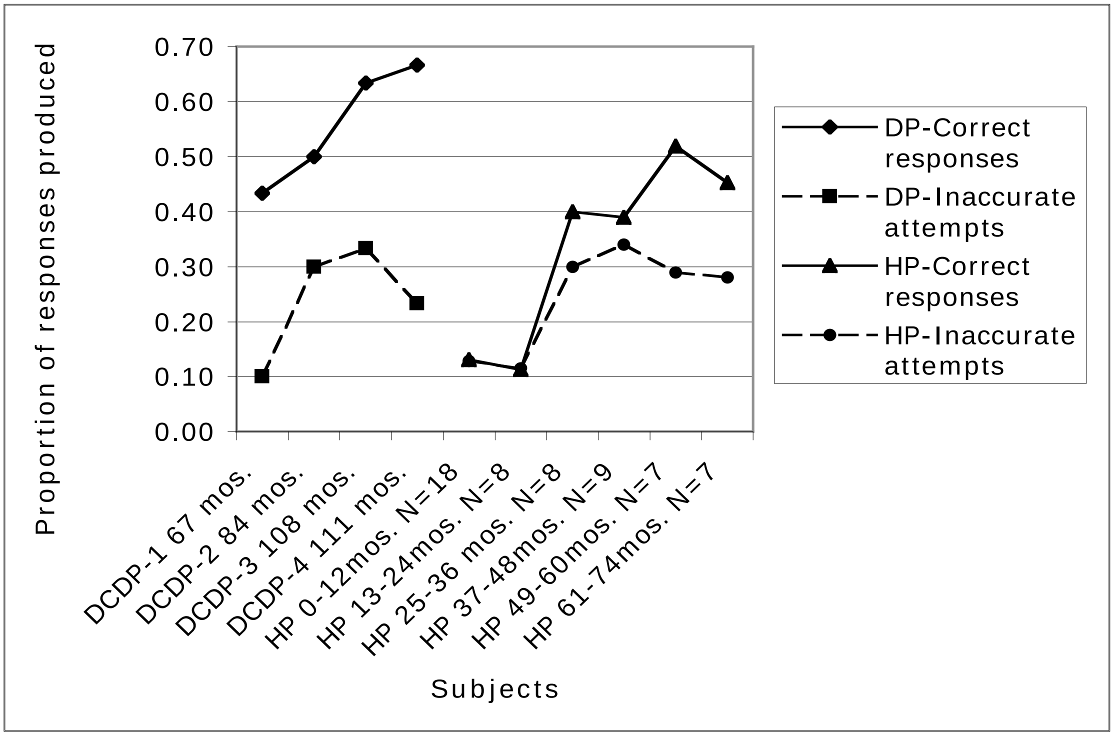
Chart 4.6. Comparison of the mean results of DCDP and DCHP in the production of correct responses and inaccurate attempts (proportions according to age)



The results according to age indicate that by 9 years of age the DCHP's production of correct handshapes (40%) almost reaches the production of the youngest DCDP (43%), who is 5 years old. Even the oldest DCHP (11 years old) was not able to surpass the youngest DCDP in this task. In the production of inaccurate attempts, the 9-year-old DCHP's production (28%) is near to the 7-year-old DCDP's production of the same responses (30%). The oldest DCHP also produces a similar proportion of these responses (32%) to one of the 9-year-old DCDP (33%). These results suggest that the DCHP acquire signed language in the same way as the DCDP, but at a slower pace.

Chart 4.7 presents the results of the DCDP compared to the results of the DCHP according to length of exposure. The Charts 4.3 (production of DCDP) and 4.5 (production of DCHP according to exposure) are combined for easy explanation.

Chart 4.7. Comparison of the mean results of DCDP and DCHP in the production of correct responses and inaccurate attempts (proportions according to L. exposure)



The results according to length of exposure show a similar pattern but a different result. By 48 months of exposure to a signed language, the DCHP almost reached the production of the youngest DCDP who was exposed to signed language for 67 months. When the DCHP are exposed to signed language for about 60 months, they are able to produce a similar amount of correct responses as the 7-year-old DCDP. These results suggest that length of exposure and age are correlated in the production of correct responses, which confirm the results of the previous sections.

Comparing the production of non-classifier forms ("pointing," "naming," "mimicry," and "no response"), the results of the DCHP show that they produced more of these types of responses than the DCDP, either evaluating by age or by length of exposure (compare DCDP results in Table 4.1 with DCHP results by age in Table 4.2 and by length of exposure in Table 4.3). These results confirm the hypothesis that the DCHP would produce more non-classifier responses than the DCDP.

In sum, comparing the production of classifier handshapes by DCDP and DCHP, the results suggest that the DCHP acquire signed language in relatively the same way as the DCDP, but they acquire it more slowly. The facts that the DCHP may be exposed to impoverished input, and that they start to have contact with a signed language late seem to be the main reason for this delay. The three hypotheses about the comparison between the DCDP and the DCHP stated in the beginning of this section were confirmed:

(a) The means of correct responses produced by the DCHP will not measure up to the means of the DCDP – in both comparisons (by age and by length of exposure) the DCDP outperformed the DCHP; however, we observed that the DCHP achieve better performance when they have more time of exposure and when they are older.

(b) The means of inaccurate attempts produced by the DCHP will surpass the means of the DCDP – this hypothesis was only confirmed in relation to the oldest DCDP. Actually, the means of inaccurate attempts of the DCHP were relatively lower than the means of the DCDP.

(c) The production of other responses ("pointing," "naming," "mimicry," and "no response") will be higher in the production of DCHP than in the production of the DCDP. This hypothesis was also confirmed, since the DCHP produced more non-classifier forms than the DCDP in all results by age and by length of exposure.

To conclude, the results revealed that the three subject variables that were considered in this study (hearing status of parents, chronological age, and length of exposure to signed language) affected the production of classifier handshapes. Since there are fewer DCDP to compare with the DCHP, the DCDP are not sufficiently representative of the Brazilian Deaf community; however, the results of this study generally confirm the superiority of the DCDP over the DCHP in the production of classifier handshapes, and replicate other studies about signed language acquisition (Emmorey, 2002; Singleton & Newport, 2004). The other variables (age and length of exposure) are both shown to be strongly related to the increase of the production of classifier handshapes in DCHP, and moderately related to the decrease of other strategies than the production of classifiers, such as naming, mimicry, and no response.

In the following chapter, the handshapes produced are analyzed in detail, to evaluate the children's accuracy in responding to the task using classifier handshapes. We also analyze their handshape errors to determine what we can learn from them. Since the statistical results have shown that the variables age and length of exposure to signed language are highly correlated, and also that the length of exposure reveals better the improvement of the DCHP, in the next chapter only two of the three variables evaluated in this chapter (parentage and length of exposure) will be considered for the analyses.

Chapter 5 – Qualitative Results

5.1. Introduction

Chapter 4 consisted of the statistical relationship of handshape with age and length of exposure to signed language. Chapter 5 presents the qualitative discussion of the relationship of handshape as appropriate representations of classifier forms to age and length of exposure. In this chapter the results of all children and all stimuli are considered with respect to the two subject variables: parentage (DCDP, DCHP) and length of time of exposure to signed language (0-12 months, 13-24 months, 25-36 months, 37-48 months, 49-60 months, over 61 months). Section 5.2 presents the results separated into handshapes representing body parts, section 5.3 presents the results of handshapes representing people, in 5.4 the results are handshapes representing general objects, and section 5.5 shows the results of handshapes representing items in complex constructions.

The results analyzed in this chapter are only for those in which the children responded using a classifier handshape, which represents a proportion of the results of DCDP and DCHP described in chapter 4 (DCDP, 80% of responses; DCHP, 55% of responses). The children's production of handshapes was divided into two categories ("correct" and "incorrect"). The handshape responses were evaluated in terms of the classifier handshapes determined by the adult target studies described in chapter 2 (Bernardino, Hoffmeister & Allen 2004; Bernardino & Hoffmeister 2004). The responses other than classifier handshapes are categorized as "other responses."

The results are presented according to lexical group categories. Although there are 30[17] possible handshapes in the RO task, several items use the same object in different arrangements (e.g., cars arranged in a U shape, cars arranged in an L shape, cars arranged in a zigzag shape), or the same body part in different situations (e.g., eyes crossed, eyes moving up and down). Since these handshapes represent the same target item(s), they constitute one lexical group and are analyzed together.

The classifier for some of these lexical groups can be represented in LSB by one handshape (e.g., cans, represented using "C" handshape). Other items may be represented by selecting two or three possible classifier handshapes (e.g., cars, represented using "B" handshape with palm down, "B" handshape with palm to the left side, or "curved.V" with palm down).

The data is organized into the proportion of correct and incorrect handshapes that the children produced. In order to help the reader follow the various handshape forms each discussion includes pictures showing the target handshapes used by the Brazilian Deaf adults. The object/body parts that allow more than one handshape are indicated, as well as the restrictions in the handshape use.

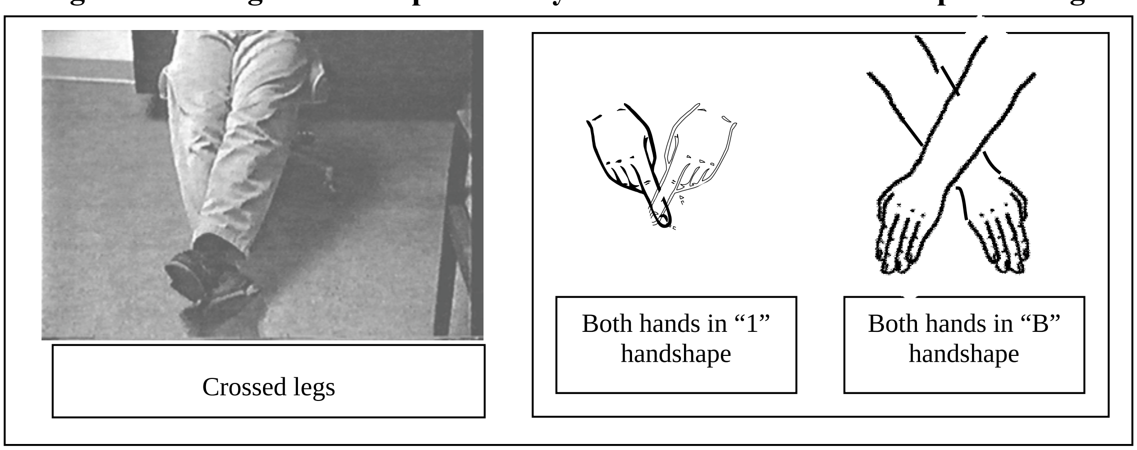
[17] Recall that there are 27 stimuli in the RO task. However, three require 2 different handshapes to be represented correctly. These stimuli are (1) "Dump truck," for which the correct response consists of the representation of the truck's bed and representation of the pile of dirt on the ground that has presumably come from the back of the truck; (2) "Window opening," for which the correct response consists of representing a person opening a window and representing the action of looking through the window; and (3) "Elevator," for which the correct response consists of representing the doors of the elevator opening and also representing a person (operator) moving his head out and looking to the left side of the elevator. For ease of exposition, we simply talk of these as though they were separate stimuli, yielding a total of 30 stimulus items.

5.2. Results according to lexical categories for body parts

In this section, the results of the handshapes that represent body parts are presented. As already stated, in LSB some items can be represented using more than one handshape (e.g., eyes can be represented using "V," "F," or "1"), but not all handshapes are considered acceptable in all contexts (Bernardino & Hoffmeister, 2004). To represent 'LEGS' for example, the Brazilian Deaf adults primarily used the "1" handshape, but the "B" handshape (that focus on the feet) was also accepted in the stimuli that show a person seated and the feet can be observed.

The first lexical subgroup of body part classifiers presented is "legs." The Deaf adults represented 'legs' using two handshapes: "1" pointing down (1+1) and "B" palm down with extended arm as presented in Figure 5.1.

Figure 5.1. Target handshapes used by Brazilian Deaf adults to represent legs



The "1" handshape can be used to represent a wide variety of stimuli with legs: a person's crossed legs, standing with legs shaking, or other stimuli that focus on the legs. The "B" handshape, however, is used only when the feet are in evidence. This means that if a person is standing the signer must use the "1" handshape. Table 5.1 shows the results of the representation of legs according to language exposure groups.

Table 5.1. Proportion of DCDP & DCHP representation of legs ("1+1" pointing down" and "B+B" handshapes) according to language exposure

Subjects		N	Correct handshapes		Incorrect handshapes				Other responses	Total
			1 + 1	B + B	V.pt.down	R '	B + B*	Other hs		
DCHP	0-12 mos.	61	0.03	0.07	0.03	0.03		0.02	0.82	1.00
	13-24 mos.	30		0.03					0.97	1.00
	25-36 mos.	29	0.10	0.17	0.17	0.07	0.03		0.45	1.00
	37-48 mos.	32	0.25	0.25	0.03	0.06	0.09	0.06	0.25	1.00
	49-60 mos.	27	0.11	0.37	0.07	0.11	0.11	0.04	0.19	1.00
	61+ mos.	27	0.07	0.26	0.07	0.04		0.07	0.48	1.00
DCDP (from birth)		16		0.44	0.13	0.13	0.19		0.13	1.00

N = number of effective responses (all responses except "no response")
Note 1: "B" handshape use is considered incorrect in some contexts
Note 2: The category "other hs (handshapes)" indicates isolate cases that were not repeated

There is a discrepancy between what Deaf adults consider correct and what Deaf children use. Most of the children (DCDP and DCHP) use the "B" handshape, which is acceptable to represent legs when the focus is on the feet, but is not the best option. Even the DCDP, who are exposed to Deaf adults prefer to use the "B" handshape, suggesting an over-generalization when representing standing persons' legs. There are four possible reasons for the children's option for the "B" handshape:

(1) The children focus on feet instead of focusing on legs – it is possible that the feet are perceptually more salient than the legs for the children. If this is true, the children may be representing the more salient body part.

(2) There is an input problem – the children rarely see the "1" handshape to represent legs in their environment. Many of the hearing non-proficient adults may resort to gestures (mimicry) to represent legs, because they may not know how to represent them using classifiers. The DCHP may not be exposed

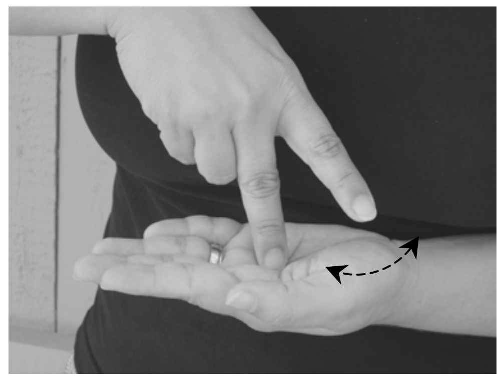
to other options. In the two independent studies described in chapter 2 to determine the handshape target in LSB for this study (Bernardino, Hoffmeister & Allen 2004; Bernardino & Hoffmeister 2004), the "B" handshape to represent legs was preferred by late learners, and was considered "acceptable" by the Deaf adults who rated the responses as correct or acceptable. Parents of the DCDP are themselves DCHP and may be late learners. Hence, for the DCDP, it may be possible that their parents prefer the "B" handshape.

(3) Feet could be easier to represent than legs – if this is correct, more children will be able to represent feet (both within the DCDP and DCHP), which is the next body part analyzed.

Besides the "B" handshape to represent a standing person's legs, both the DCDP and the DCHP represented legs using two incorrect handshapes that are a modification of LSB lexical items. The "V.point.down" handshape is used to represent a standing person in verbs such as STAND, WALK, and RUN (see Figure 5.2). The same fingers used in this handshape (index and middle fingers) are used in the lexical items SEAT and CHAIR. So, both fingers are associated with the legs. The Deaf children may have over-extended the concept of "*index and mid fingers = legs*" and represented legs with an internal movement of the index finger ("V.point.down" handshape) to represent someone's leg moving up and down (from the sign STAND). They did the same internal movement of the mid finger to represent crossed legs using the "R" handshape in the sign SEAT (Figure 5.2). This internal modification of a lexical item was not found in the Deaf adults tested (Bernardino, Hoffmeister & Allen 2004), and is not allowed in ASL (Hoffmeister, personal communication), as lexical items are frozen forms, which means that the lexical items (such as the represented in Figure 5.2) cannot be internally modified to represent anything other than 'WALK'.

Figure 5.2. Deaf children's modifications in lexical items to represent legs

(a) Lexical item STAND



(b) Modified to represent moving leg

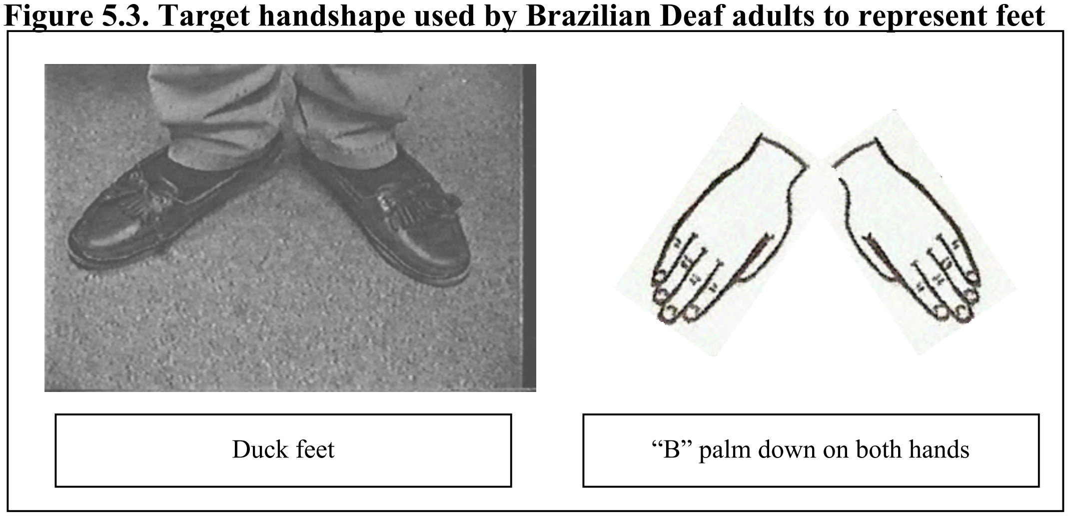
(c) Lexical item SEAT

(d) Modified to represent legs of a sitting person

Another important observation from Table 5.1 is that the number of "other responses" is lower for the children who have more contact with signed language (except for the DCHP group exposed for more than 61 mos., who produced non-classifier responses close to 50% of the time). It seems that as children have more contact with signed language they take more risks and try to represent what they see using more linguistic-like structures, instead of relying on gesture-like responses, as in the use of mimicry. However, since they may not be exposed to good language models, they have limited strategies for representing objects.

The second lexical group representing body parts that is presented is “feet.” The Deaf adults used only the “B” (palm down) handshape to represent feet, which is presented in Figure 5.3.

Figure 5.3. Target handshape used by Brazilian Deaf adults to represent feet



The representation of feet may be a challenge to Deaf children. Each hand is used to represent each foot. This involves conceptualizing each foot as independent units and translating this into two handshape representations. Table 5.2 shows the results of the representation of feet.

Table 5.2. Proportion of DCDP & DCHP representation of feet ("B+B" handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes				Other responses	Total
			B + B	1dn	Bsd	Vptdn	Other		
DCHP	0-12 mos.	32	0.09	0.03	0.09		0.03	0.75	1.00
	13-24 mos.	15		0.07				0.93	1.00
	25-36 mos.	15	0.47	0.07		0.07		0.40	1.00
	37-48 mos.	18	0.44	0.06	0.06		0.06	0.39	1.00
	49-60 mos.	14	0.57	0.21	0.07			0.14	1.00
	61+ mos.	14	0.57			0.07		0.36	1.00
DCDP (from birth)		8	0.88			0.12			1.00

N = number of effective responses (all responses except "no response")

The results in Table 5.2 indicate clearly that the children with longer exposure choose the B handshape as the primary representation for "feet." The DCDP almost reach ceiling on this item putting them in direct agreement with the Deaf adult LSB user. The remaining handshape errors by the DCHP appear to be in order of preference: "1" palm down handshape which focuses on placement of feet and sometimes uses two hands, the "B" palm side handshape which also focuses on placement and the "V" pointing down handshape which focuses on legs but uses only one hand.

Comparing Tables 5.1 and 5.2, the results indicate that the DCDP were more likely to produce the "B" handshape for feet (88%) than the handshape for legs (44%). The DCHP represented feet more correctly than they represented legs, although they did not reach 60% of correct responses. This result suggests that the representation of feet is less complicated than the representation of legs. For the younger children (up to 24 months), it seems that the conceptualization of the hands as representative of the feet is more complex, as most of the younger DCHP were not able to represent feet using their hands.

If the assumptions about the use of the “B” handshape to represent legs were correct, they can also be applied to feet. The first two assumptions (feet are more salient than legs and so will have higher proportions) seem to be confirmed, since the children produced feet correctly more often than legs. Even so, the DCHP production of feet (and legs) indicates that they are not proficient in representing these body parts. There is improvement with the children with more exposure (as well as in the older children). They are acquiring the use of these handshapes at a slower pace than the DCDP, which may be a consequence of their input.

Three incorrect handshapes were produced by the children: “1” palm down, “B” palm side, and “V” pointing down. The most used incorrect handshape appears to be the “1” palm down which indicates only the position and/or movement of the feet in the stimuli.

Figure 5.4 shows the Deaf adults’ representation of hand, and Table 5.3 shows the children’s results of the representation of hand according to language exposure groups. The use of the children’s hand to represent someone else’s hand seems to be the easiest task proposed to the Deaf children

Figure 5.4. Target handshape used by Brazilian Deaf adults to represent hand

Table 5.3. Proportion of DCDP & DCHP representation of hand (“5” handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshape	Other responses	Total
			5	B.down		
DCHP	0-12 mos.	16	0.75	0.13	0.12	1.00
DCHP	13-24 mos.	8	0.88		0.12	1.00
DCHP	25-36 mos.	7	1.00			1.00
DCHP	37-48 mos.	9	1.00			1.00
DCHP	49-60 mos.	6	0.83		0.17	1.00
DCHP	61+ mos.	7	0.86		0.14	1.00
DCDP (from birth)		4	1.00			1.00

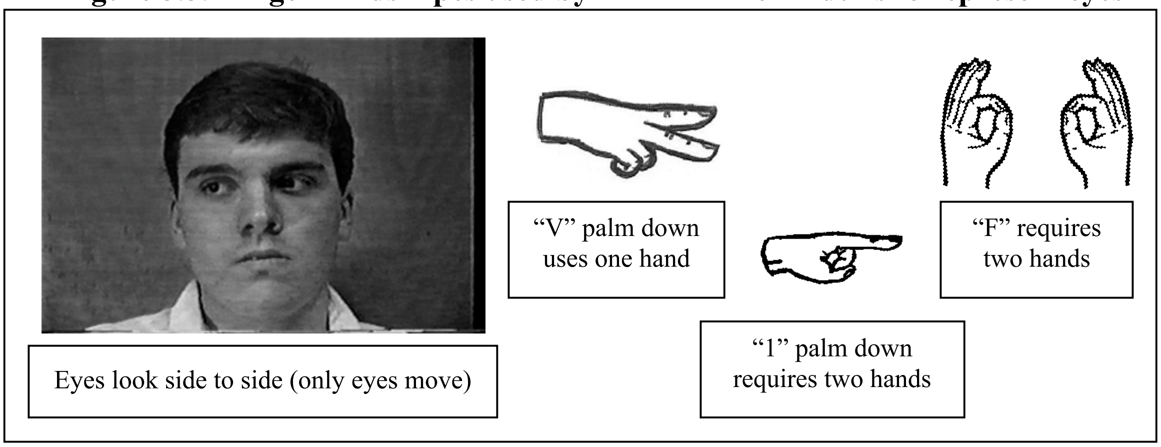
N = number of effective responses (all responses except "no response")

Most of the children had no problem representing the hand using the “5” handshape. It appears that the younger children just imitated the moving hand tapping the floor in the stimulus.

It seems that the younger children may be using the imitation while the older children may have been trying to look for some linguistic frame to represent the stimulus. This may be so because some of the older children only showed their hand (same “5” handshape as in the stimulus), but at a different location and palm orientation (which was considered as “other responses”) and some even vocalized “hand”. The only incorrect handshape used was “B” (palm down), which is very similar to the “5” handshape, but all fingers are joined together.

The final lexical subgroup of body parts tested is ‘eyes.’ The Brazilian Deaf adults represented EYES using three different handshapes shown in Figure 5.5.

Figure 5.5. Target handshapes used by Brazilian Deaf adults to represent eyes



The most common handshape used by the Brazilian Deaf adults to represent eyes is the “V” (palm down) handshape, which is the same handshape used in the verb LOOK. The other two handshapes were used to represent “crossed eyes” (“1” and “F”) and “eyes moving side to side” (“F”). In the Deaf adults’ evaluation, two handshapes were considered correct (“V” and “F”) and one was considered acceptable (“1”) for representing eyes in LSB. The “V” and “1” handshapes represent the line of sight (not BPCL but possibly both come from the tracing strategy), while the “F” handshape represents the shape of the eyes, a BPCL.

Table 5.4. Proportion of DCDP & DCHP representation of eyes ("V" and "1+1" handshapes) according to language exposure

Subjects		N	Correct handshapes		Incorrect handshapes				Other responses	Total
			V	1+1	B	G	O	Other hs		
DCHP	0-12 mos.	44	0.14	0.11	0.02				0.73	1.00
	13-24 mos.	21		0.10					0.90	1.00
	25-36 mos.	22	0.27	0.27			0.09	0.09	0.27	1.00
	37-48 mos.	25	0.08	0.40	0.16	0.20			0.16	1.00
	49-60 mos.	19	0.26	0.58					0.16	1.00
	61+ mos.	21	0.33	0.52					0.14	1.00
DCDP (from birth)		11	0.27	0.55	0.09			0.09		1.00

N = number of effective responses (all responses except "no response")

As the results in Table 5.4 indicate, none of the Deaf children used the "F" handshape to represent eyes. The preferred handshape for both the DCDP and DCHP was the "1" handshape, which the Deaf adults considered acceptable. Considering that the DCDP have been exposed to signed language from birth, it is important to observe that the DCHP surpassed them slightly (2-3%) by 60 months of exposure and up. Even the younger children who have been exposed for less than 24 months were able to respond correctly in just a small proportion, which is their best result for body parts after the representation of hand.

Considering the incorrect handshapes, the most used was the "B" handshape, which is unmarked and easy to produce. This handshape choice looks more like a gesture than a handshape to represent an object. The DCHP and even the youngest DCDP used this handshape to show only the direction of the movement of the eyes, instead of representing it linguistically.

The other two incorrect handshapes ("G" and "O") focus on the size or shape of the eyes (the Deaf adults primarily represented eyes using the "F" handshape). It is interesting to note that one child tried some different handshapes to represent the shape of the eyes. As there were 3 stimulus items showing eyes, in the first item he tried to produce a handshape but after many minutes thinking for a while, looking at his hands he decided not to answer the question. The next time he started by producing a "round" shape using a newly created handshape that looks like a "modified R" (see picture in the appendix). Finally he produced an "F" handshape that was changed into an "O."

In the following section, the results for objects other than body parts are grouped into lexical categories according to the similarities of the objects and the handshapes used to represent them. Following the same distribution of information, the handshape used by the Deaf adults to represent the stimulus is presented first, followed by a table showing the Deaf children's proportions of handshapes produced.

5.3. Results according to lexical categories for general objects

The lexical groups are defined according to the similarities of the objects tested. For example, books and videotapes have a similar shape, and when they are arranged in space their appearance is very similar. These two objects are analyzed as one lexical group, since the Deaf adults represented them using the same handshape. The remaining objects such as "cars," "cans," and "pencils" consist of separate lexical groups, each one produced with a distinct handshape.

The first lexical group presented in this section is "cans," which are represented by the Deaf adults using a "C" handshape. The stimuli present cans in three different spatial arrangements: (1) cans in two rows, (2) cans in a row, with one down on its side; and (3) a tower of cans. Figure 5.6 shows the Deaf adults' handshapes used to represent cans and Table 5.5 shows the children's results.

Figure 5.6. Target handshapes used by Brazilian Deaf adults to represent cans

Cans in a row, one down

"C" handshape (both hands)

Table 5.5. Proportion of DCDP & DCHP representation of cans ("C" handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes			Other responses	Total
			C	C '	B '	O		
DCHP	0-12 mos.	49	0.20	0.02	0.08	0.10	0.59	1.00
DCHP	13-24 mos.	22	0.32		0.09		0.59	1.00
DCHP	25-36 mos.	24	0.67		0.08	0.13	0.13	1.00
DCHP	37-48 mos.	26	0.50	0.27	0.04	0.04	0.15	1.00
DCHP	49-60 mos.	21	0.90			0.05	0.05	1.00
DCHP	61+ mos.	21	0.43	0.29	0.13	0.10	0.05	1.00
DCDP (from birth)		11	0.73			0.09	0.18	1.00

N = number of effective responses (all responses except "no response")

The "C" palm-to-side handshape for cans is a real object classifier handshape that represents a hand holding a can. The representation of these stimulus items requires the use of both hands: a stationary secondary hand holds a can in one location and the primary hand moves, representing the position of each can in relation to the secondary hand.

The average production of 73% by the DCDP for the CANS stimuli is somewhat misleading since the 9-year-old DCDP achieved a score of 100%, which is not shown in the table because of averaging scores. The DCHP by 60 months of exposure the DCHP were producing 90% correct responses using the “C” handshape.

There is a steady rate of improvement with longer exposure, except in the 37-48 month group and the oldest group. Those children who have been exposed to a signed language up to 60 months achieved a 90% correct score suggesting that this handshape representing cans has been acquired. Those with 61+ months of exposure produced the most varied responses. It is possible that since the children may not be exposed to good language models, they have not internalized a specific set of handshapes to represent ‘cans,’ so they attempt to use different handshapes with the different sets of stimuli configuration.

The use of incorrect handshapes indicates that many of the children’s handshape errors are produced because of the lack of handshape inventory to reference round objects. Most of the DCHP used variants of the “C” handshape (such as small.C/3, open.8, open.9, curved.5), and the “O” handshape (see figures of all handshapes in the appendix). All these handshapes except “O” and “curved 5” reference a round shape but do not show depth. The “O” handshape represents a round and deep shape similar to the correct “C” handshape, but of a smaller diameter, which is not appropriate to represent cans, more appropriate for cylinders.

Many other DCHP chose the “B” handshape (and variations in curvature of the hand and palm orientation) to represent cans. We have already observed in the representation of other stimuli that this handshape was used with a general perspective of a handshape that references any object. The children who chose this handshape were not showing the shape of the cans, but their position/location in space, as well as the height of groups of cans (representing a tower of cans or cans displaced side-by-side, in which two of the cans had cans on top of the second row).

The proportion of “other responses” is higher in the first DCHP groups (59%) with less exposure and decreases in the more exposed groups. The responses in this category consisted mostly of naming and gestures showing the act of drinking.

The next lexical group presented is cars. The stimuli show cars in 3 different arrangements: (1) cars arranged in a “U” shaped arrangement, (2) cars in an “L” shaped arrangement, and (3) pairs of cars in a zigzag shape (alternating aft and forward on the left and right side of the midline). Figure 5.7 shows the Deaf adults’ handshapes used to represent cars and Table 5.6 shows the children’s distribution of handshapes produced.

Figure 5.7. Target handshapes used by Brazilian Deaf adults to represent cars

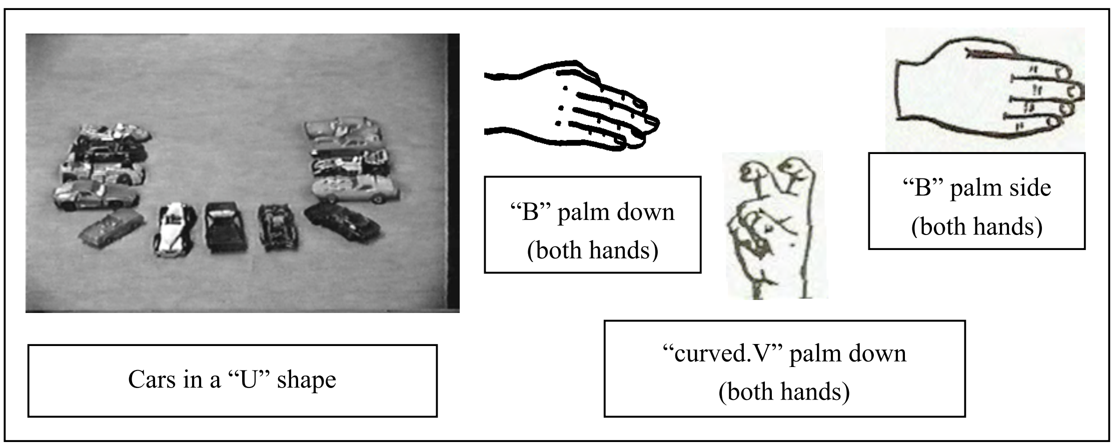


Table 5.6. Proportion of DCDP & DCHP representation of cars ("B" palm-down and palm-side handshapes) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes			Other responses	Total
			B.dn/B.sd	C ' down	1	Other		
DCHP	0-12 mos.	48	0.15	0.04	0.04	0.02	0.75	1.00
	13-24 mos.	22	0.09	0.18	0.05	0.05	0.64	1.00
	25-36 mos.	24	0.29	0.42	0.08		0.21	1.00
	37-48 mos.	27	0.41	0.22	0.15	0.11	0.11	1.00
	49-60 mos.	21	0.33	0.52	0.10	0.05	0.00	1.00
	61+ mos.	20	0.55	0.20	0.10	0.10	0.05	1.00
DCDP (from birth)		12	0.75	0.25				1.00

N = number of effective responses (all responses except "no response")

As the results in Table 5.6 indicate, no Deaf children used the target "curved.V" handshape. The DCDP responded to the stimuli producing a mean of 75% using a "B" handshape (palm down or palm to the side). As happened in the responses for cans, the mean responses of the DCHP did not show regularity in the improvement of the children with more exposure, although in general those with more exposure produced more correct handshapes. The children with more exposure reached the highest proportion (55%) of correct handshapes. A point to consider is that some of the children used the correct handshape but did not represent the plural process as the Deaf adults did, placing each hand in a location to indicate the location of a car. These children responded to the stimuli using the "B" handshape in only one hand to trace the arrangement of the cars. Since the correct handshape ("B") to represent cars is the same handshape the children use generically to represent any item, the proportions shown in Table 5.6 may include the ones the children produced correctly by chance.

The handshape errors presented in Table 5.6 indicate that most of the errors consisted of a handshape indicating the handling the cars as if they were being arranged in position. This was done by using a “C” handshape and its variants (small.C/3, open.8, open.9, tight.C), as well as the “G” handshape (included among “other handshapes” that were used less frequent). Interestingly, the “C.down” handshapes were used tracing the extent or shape of the cars (in arrangements such as cars in zigzag), or tracing the cars’ path (in cars in “U” and in “L” shaped arrangements). Even the DCDP produced 25% of their responses using the “C.down” handshape to represent handling the cars and placing them in the correct arrangement. The other handshape most used was the “1” handshape used exclusively to trace the arrangement of the cars. Observe that the frequency in the use of incorrect handshapes is not evenly distributed according to length of exposure (more in the less exposed and less in the more exposed children). The lack of pattern in the distribution of handshape use indicates that the children are attempting to use different handshapes to represent cars, but they do not to have a coherent pattern to follow.

Another lexical group presented is the representation of the item *stacks of paper*. The stimulus shown in the RO task consisted of three stacks of paper: small, medium and large stacks placed on a flat surface. The Deaf adults represented this stimulus mainly using variations of the “G” handshape (one handed form), but they considered the “B” palm down handshape placed at different height levels acceptable (one or two hands may be used). Figure 5.8 shows the handshapes the Deaf adults used and Table 5.7 shows the distribution of the children’s production.

Figure 5.8. Target handshapes used by Brazilian Deaf adults to represent stacks of paper

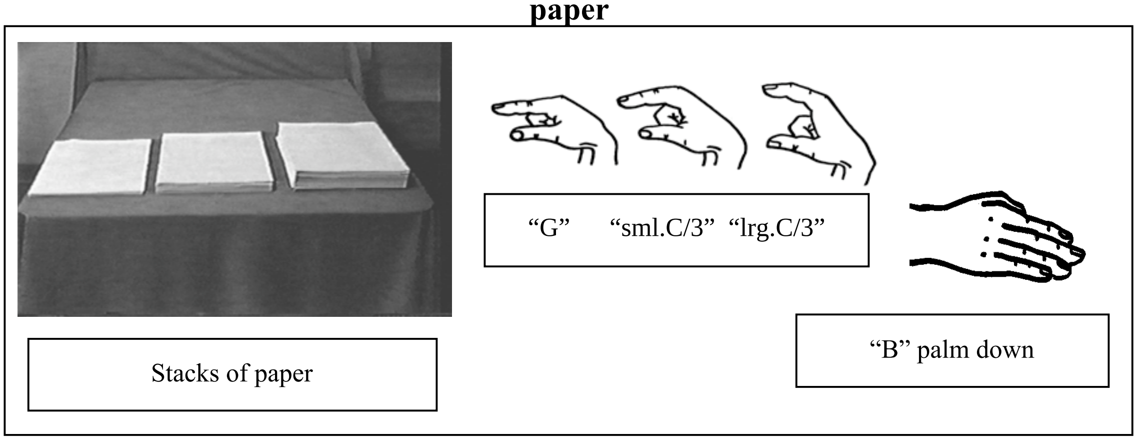


Table 5.7. Proportion of DCDP & DCHP representation of stacks of paper ("G" plus variants and "B" palm-down handshapes) according to language exposure

Subjects		N	Correct handshapes		Incorrect handshape	Other responses	Total
			G (+ variations)	B.down	B.side		
DCHP	0-12 mos.	14		0.21		0.79	1.00
	13-24 mos.	6		0.17		0.83	1.00
	25-36 mos.	8	0.25	0.38	0.13	0.25	1.00
	37-48 mos.	8	0.25	0.38	0.13	0.25	1.00
	49-60 mos.	7	0.43	0.57		0.00	1.00
	61+ mos.	7	0.14	0.57		0.29	1.00
DCDP (from birth)		4	0.25	0.75			1.00

N = number of effective responses (all responses except "no response")

In the same way as happened in the representation of eyes, in which the children chose the acceptable "1" handshape instead of the adults' preferred "V" for representing eyes, to represent the *stacks of paper* most of the children preferred the acceptable "B" handshape over the "G" handshape. The DCDP produced 100% of correct responses using the "G" handshape (25%) and the "B" palm down handshape (75%). The DCHP proportions of correct responses in this lexical category were the highest among non-body parts representation. By 60 months of exposure, the DCHP reached ceiling (100%) on correct handshapes used for this item, followed by the most exposed DCHP (71%).

Interestingly, the DCHPs' responses using the "B" handshape show a developmental pattern, in which the less exposed children (0-24 mos.) produced a small number of correct handshapes and the proportion of correct responses increased as length of exposure increases.

The only handshape that was used in substitution was the "B" palm side handshape, which was used generically to represent objects (stacks of paper) placed at some location. Interestingly, the children who used this handshape produced it at different locations, moving both hands together. This type of representation is more gestural than linguistic, although the children who used this handshape have more than 2 years of exposure. The same children that used the "B" palm side handshape to represent paper represented many different objects (such as "legs") using the same handshape in the same palm orientation.

The proportion of responses other than classifier handshapes was very high in the first two less exposed groups. This would suggest that to represent this item an internalized store of classifier structure is necessary and this can only be acquired through exposure. Since the gestures for this item would likely not include the "G" handshape, the children had no other place to draw upon except from their store of other responses (mimicry, gesture, etc.).

Other stimuli that the children represented using the "B" handshape are books and videotapes. The Deaf adults represented these items using only the "B" palm side, fingers pointing up shown in Figure 5.9. The Deaf children's responses to the items displaying books and videotapes are presented in Table 5.8.

Figure 5.9. Target handshapes used by Brazilian Deaf adults to represent books and videotapes

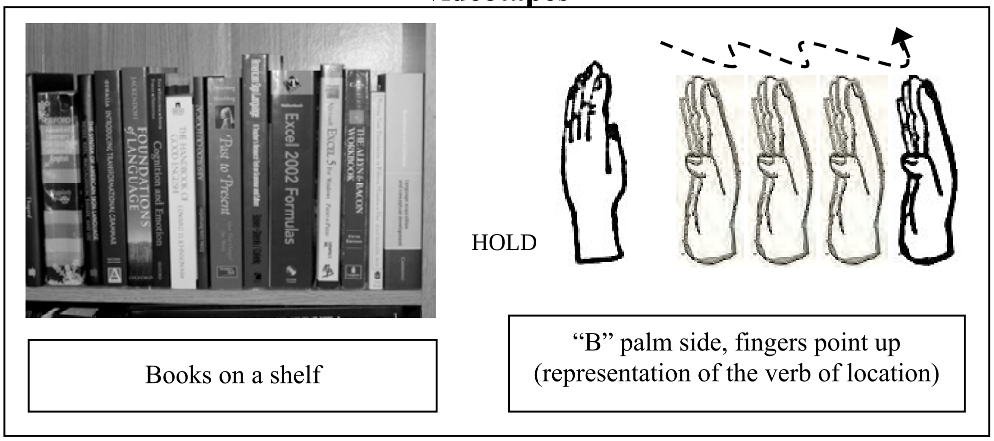


Table 5.8. Proportion of DCDP & DCHP representation of books and videotapes (“B” palm-side, fingers pointing up handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes				Other responses	Total
			B.side-up	Bsd	C '	G	Other		
DCHP	0-12 mos.	22	0.14	0.05	0.09		0.05	0.68	1.00
	13-24 mos.	14		0.07	0.07			0.86	1.00
	25-36 mos.	16	0.19	0.19	0.13	0.06	0.06	0.38	1.00
	37-48 mos.	17	0.29	0.18	0.18		0.12	0.24	1.00
	49-60 mos.	14	0.50	0.14	0.07	0.07	0.14	0.07	1.00
	61+ mos.	14	0.36	0.14	0.07	0.07		0.36	1.00
DCDP (from birth)		8	0.38		0.13	0.13	0.25	0.13	1.00

N = number of effective responses (all responses except "no response")

The results in Table 5.8 suggest that representing this lexical category seems to be complicated, even for the DCDP. Note that the DCDP produced only 38% of correct handshapes, while the DCHP exposed for about 60 months reached 50%. Although the correct handshape is an unmarked “B,” the same handshape used to represent cars and stacks of paper, the required orientation is fingertips up and palm to left (for right hand) and palm to the right (for left hand). The children seem to have difficulty in associating the handshape used to represent flat objects, to objects in an upright position since it requires an orientation very different than what they have been using to represent other objects.

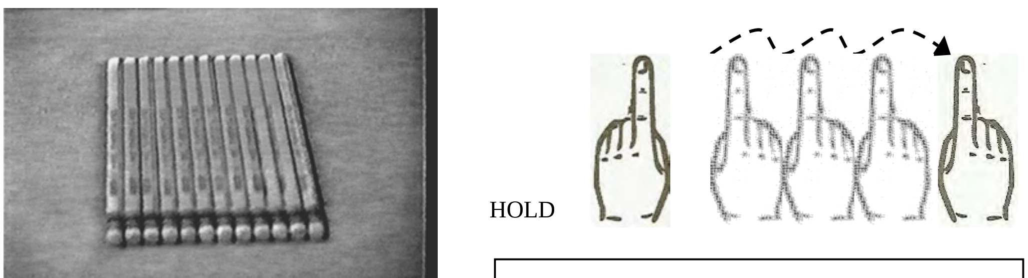
Note that among the incorrect handshapes, the “B” palm side handshape (fingers pointing to the front) was used in every DCHP exposure group. In this case, it seems that the children are using the “B” handshape generally and are able to rotate it for some orientations but not all positions.

Further, the two other more frequent handshape errors were the “C’ ” handshape and its variants (small.C/3, open.8, open.9, tight.C), and the “G” handshape. All of these ‘C’ handshapes were used in handling verbs. These handshapes were combined with movement paths as if the children were placing the object (books, videotapes) on a shelf. The remaining handshapes, “B” and “5” were used to represent the objects as a whole (for example, both hands in the “5” handshape, palm front, moving hands from center to sides, or one hand in the “B” handshape palm down showing the height of each book and tape). These handshapes were used more as a gesture than a linguistic representation of the item.

The “other responses” consisted of pointing and naming, and the higher proportions were in the two less exposed groups. There is no pattern showing that the use of other responses decreases in the more exposed groups. This result suggests that the children not only had problems identifying which handshape to use, when they did not know the handshape they sometimes named or pointed to a similar object in the room (a library) because they did not know how to represent it. It is a common response in Deaf children who want to show you something but do not have the appropriate communicative skill or vocabulary.

The next lexical group examined is typically present the everyday discourse of school. The stimuli consisted of 3 items showing (1) pencils in a row, (2) pencils displaced randomly over a flat surface, and (3) pencils inside a cup that was on its side. The target handshapes used by Deaf adults to represent these stimuli are in Figure 5.10, and the children's responses are in Table 5.9.

Figure 5.10. Target handshapes used by Brazilian Deaf adults to represent pencils



Pencils in row

"1" palm down handshape on both hands or "B" palm down (hold) and "1" (moves)

Table 5.9. Proportion of DCDP & DCHP representation of pencils ("1" palm down handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes						Other responses	Total
			1	Bsd	C'	G	F	O'	Other		
DCHP	0-12 mos.	39		0.08	0.03	0.03	0.05	0.08	0.08	0.67	1.00
DCHP	13-24 mos.	19		0.05			0.11	0.05	0.05	0.74	1.00
DCHP	25-36 mos.	21	0.29	0.05	0.14	0.38				0.14	1.00
DCHP	37-48 mos.	24	0.13	0.17	0.08	0.08	0.08	0.08	0.17	0.21	1.00
DCHP	49-60 mos.	20	0.15	0.25		0.30	0.05	0.10		0.15	1.00
DCHP	61+ mos.	21	0.05	0.38	0.10	0.05		0.14	0.05	0.24	1.00
DCDP (from birth)		11				0.36		0.36		0.27	1.00

N = number of effective responses (all responses except "no response")

Although pencils are very familiar objects in their elementary school, the 3 different arrangements of pencils appear to be the most difficult task for these children. None of the DCDP responded using a correct handshape. In the DCHP, the highest proportion is 29%. The low scores are surprising given that pencils must be present in the hearing teachers discourse.

The 3 different arrangements involve plural representation in complex spatial arrangements. Each item required the children to figure out the handshape and then they had to insert the handshape into a spatial representation of the arrangement. They had to refer to the pencil using the right handshape, "1" classifier and then produce the appropriate verb of location. This combination of factors may also have negatively influenced the results of both the DCDP and the DCHP.

None of the children represented the pencils in a row using the adult form, "B" palm down handshape. Not only was it difficult for the children to "see" the "1" handshape as representative of pencils, it was even more difficult for them to identify each finger of the "B" handshape as representative of a pencil, or the handshape as a plural. Interestingly, the DCHP from all exposure groups used the "B" palm side handshape to represent the pencils; clearly this is a generic handshape that is used to represent "any object." Observe that there is an increase in the use of this handshape to represent pencils among the DCHP, since the more exposed group of children used it more frequently.

Most of the other handshape errors for this item consisted of handshapes that are used in handling verbs ("G," "F," "C" plus its variants, "O" and "baby.O"). The children used these handshapes to trace the location of each of the pencils in the arrangements. Maybe they are representing pencils as "shape," which suggests that they are not identifying the relationship that exists between the index finger and a pencil (long and thin), but instead they are using their hands as "tweezers" to trace the *shape* of the pencils in each location.

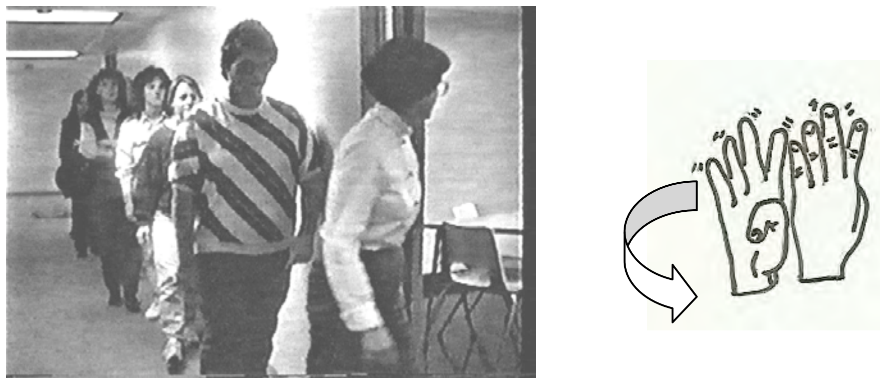
There is no pattern showing that as the children are more exposed to a signed language they produce this type of response less frequently.

5.4. Results according to lexical categories for people

In this section, the results of the handshapes that represent people are presented. There are two stimulus items in this category: people in line entering a room and a man upside down.

The first lexical subgroup of people that is presented is "people in line." This lexical category also involves the use of a plural handshape embedded in the classifier, similar to how the Deaf adults represented pencils in a row. The stimulus requires that the "4" handshape is to be used to represent people in a line and these people in line turning to enter in a room. Figure 5.11 shows the handshape the Deaf adults used to represent the stimulus, and Table 5.10 shows the children's representation to this stimulus.

Figure 5.11. Target handshapes used by Brazilian Deaf adults to represent persons in line



Persons in line

“4” handshape (both hands)

Table 5.10. Proportion of DCDP & DCHP representation of persons in line (“4 + 4” palm side handshapes) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes			Other responses	Total
			4+4	Vptdn	Bsd	1ptdn		
DCHP	0-12 mos.	13		0.08	0.15	0.15	0.62	1.00
	13-24 mos.	5		0.20		0.20	0.60	1.00
	25-36 mos.	6	0.17	0.67	0.17			1.00
	37-48 mos.	8	0.13	0.63	0.25			1.00
	49-60 mos.	7	0.14	0.43			0.43	1.00
	61+ mos.	7	0.43	0.43	0.14			1.00
DCDP (from birth)		4	0.50			0.25	0.25	1.00

N = number of effective responses (all responses except "no response")

The Deaf adults represented this stimulus with a “4” handshape on both hands; they represented the line turning and entering a room by turning their own hands while moving them forward. This is a very complex representation, so only the Deaf children who were able to use the “4” handshape on both hands to represent persons in line were evaluated. Actually, this configuration is the same used in the LSB’s lexical item QUEUE, which supposedly is also used frequently in schools.

The results in Table 5.1 indicate that even the DCDP had problems in responding correctly using the “4” handshape to represent people in line, producing only 50% correct responses. Among the DCHP exposure groups, the highest proportion of correct handshape is among the most exposed children (61+ months of exposure). Their responses using the “4” handshape reach 43% correct response, while the other three less exposed groups produced about 15% each. Among the most exposed group of children’s responses, only one child’s response was identical to the adults (turning the hands to represent the persons turning to enter the room).

The most frequent handshape among the incorrect handshapes was “V.pointing.down,” which is the handshape used in the LSB lexical item WALK (the people in the video were walking along a wall, then turned into a room). The children represented the plural by repeatedly producing WALK (V.pointing.down) + TURN (rotate wrist). Instead of representing persons using a plural/mass noun handshape (e.g. “4”), the children represented walking by legs and entering a room. Some then used the repetition of the handshape and the movement to mark the plurality. Note that in two of the groups’ (25-48 months) a higher proportion of responses consisted of the “V.pointing.down” handshape. These children seem to be reanalyzing the sign they know (which is normally used often) and modifying it represent the stimulus item.

The other handshapes used (“B” palm side, and “1.pointing.down”) were used to indicate only the path (front + turn) of persons entering a room. The use of these latter two handshapes is more gesture-like than linguistic. The use of this type of gesture is very context dependent; however, this type of response was also found among the DCDP.

This result indicates that when the DCDP do not know how to answer to a stimulus, they may resort to gestures.

The proportion of responses other than classifier handshapes was high in the two less exposed groups (60% each), but also relatively high among the DCHP with 49-60 months of exposure's group. Some of the DCDP (25%) also used other strategies to respond to this stimulus. These other than classifier responses consisted mostly of mimicry, where the children actually represented the persons walking by moving their own bodies, mimicking the people's action.

The next lexical group consists of representing a man upside down. The Deaf adults represented this stimulus using two handshapes: "U" and "V," both considered equally correct. The Deaf adults target handshapes are presented in Figure 5.12, and the children's performance is presented in Table 5.11.

Figure 5.12. Target handshapes used by Brazilian Deaf adults to represent a person upside down

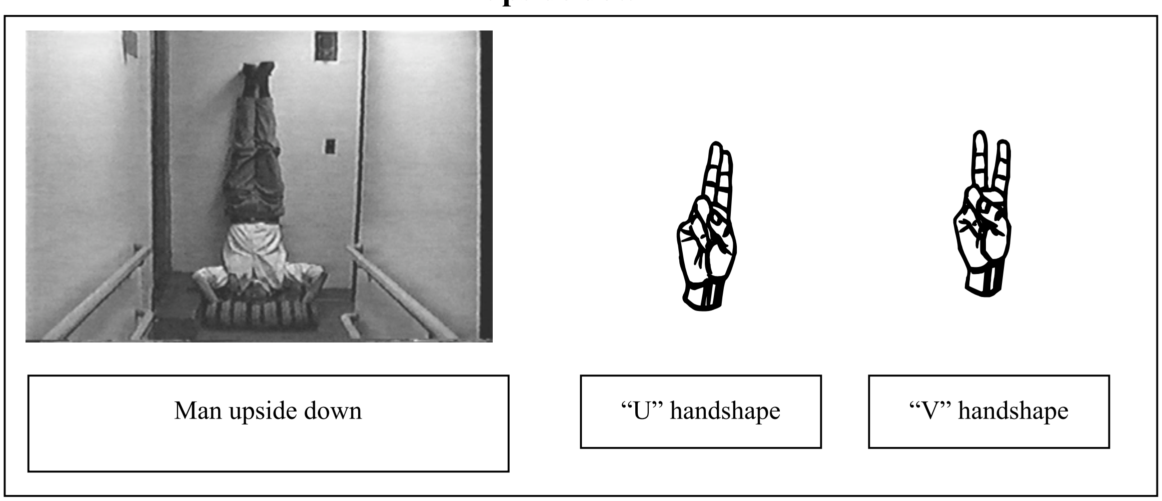


Table 5.11. Proportion of DCDP & DCHP representation of a person upside down ("U" or "V" handshapes) according to language exposure

Subjects		N	Correct handshapes		Incorrect handshapes		Other responses	Total
			U	V	B '	Other hs		
DCHP	0-12 mos.	13	0.08	0.08	0.08		0.77	1.00
	13-24 mos.	7					1.00	1.00
	25-36 mos.	7	0.43	0.29	0.14		0.14	1.00
	37-48 mos.	9	0.33	0.11	0.11	0.11	0.33	1.00
	49-60 mos.	7	0.29	0.43	0.29		0.00	1.00
	61+ mos.	6	0.17	0.50		0.17	0.17	1.00
DCDP (from birth)		4	0.75	0.25				1.00

N = number of effective responses (all responses except "no response")

The Deaf adults considered both the "U" and "V" handshapes equally correct to represent this stimulus. The DCDP preferred the "U" handshape (75% or responses), but some used the "V" handshape (the other 25%). Two of the DCHP exposure groups (25-36 months and 49-60 months) produced a high proportion of correct responses (72% when combining the proportions of "U" and "V"). It seems that this handshape is relatively easier to acquire and use since 72% of the children with 36 months of exposure were able to use the correct form. A large difference is found among the subjects who are exposed for less than 2 years: they were only able to use the correct handshape in less than 20% of responses (0-12 mos.) or produced no classifier handshape at all (13-24 mos.).

The other responses consisted basically of mimicry, with very few productions of pointing and naming. The group with the least exposure to sign language had the highest number of responses using mimicry. This suggests that when the younger/less exposed children do not know how to respond, they take advantage of more basic strategies, in this case a move towards gestures.

5.5. Results according to lexical categories for complex constructions

This section presents the results of the handshapes that represent complex constructions. These constructions are more difficult to represent, since they involve the use of 2 handshapes each, simultaneously or sequentially. The next 5 lexical categories are from 3 stimulus items:

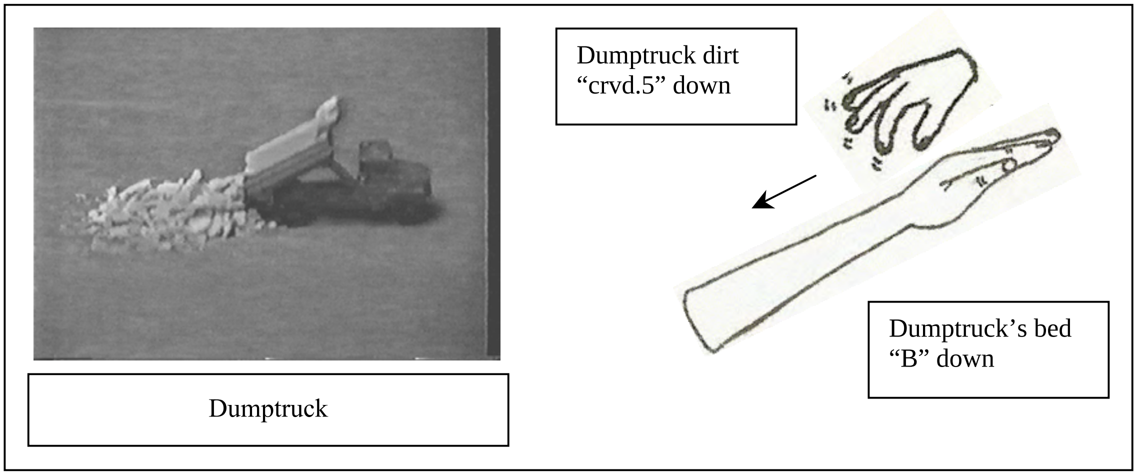
(1) the dumptruck, which shows a truck with raised bed and dirt on the ground at the end of the bed:

(2) window opening, which constitutes a scene in which a man opens a window and looks through it, and

(3) elevator opening, a stimulus that shows elevator doors opening, a man puts his head out and looks to the side.

These 3 stimuli are presented according to the handshapes involved in the construction: there are 2 handshapes for dumptruck, one for the truck's bed and one for the dirt; there are 2 handshapes for window opening, 1 handshape to represent the man opening the window and 1 handshape to represent the action of looking through the window. There are two handshapes for the elevator, 1 handshape representing the elevator doors opening and 1 handshape to represent the action of looking out the elevator's doors. In order to facilitate the comprehension of these items, the figures that precede each stimulus shows the picture of the 3 stimuli and the handshapes used in their representation. Figure 5.13 shows the stimulus and representation of dumptruck.

Figure 5.13. Stimulus “dumptruck” and the target handshapes used by Brazilian Deaf adults to represent truck’s bed and dirt



The Deaf adults represented the dumptruck (bed) using the “B” palm down handshape to represent the bed of the truck and the “curved.5” palm down handshape for the dirt that falls down to the ground. There is no movement in the stimulus, but the Deaf adults represented the implicit action that is represented by the stimulus. Table 5.12 shows the children’s proportions of responses to the truck’s bed.

Table 5.12. Proportion of DCDP & DCHP representation of dumptruck-bed (“B” palm down handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes			Other responses	Total
			B.down	Bup	crvBup	Other		
DCHP	0-12 mos.	11	0.45			0.09	0.45	1.00
	13-24 mos.	7	0.43	0.14	0.29		0.14	1.00
	25-36 mos.	4	0.75	0.25				1.00
	37-48 mos.	8	0.38	0.13		0.38	0.13	1.00
	49-60 mos.	5	0.80		0.20			1.00
	61+ mos.	5	0.40		0.20		0.40	1.00
DCDP (from birth)		4	0.50			0.25	0.25	1.00

N = number of effective responses (all responses except "no response")

The representation of a dumptruck bed and the dirt falling down is very complex, because it involves the simultaneous use of both hands where each hand is a different classifier handshape. The DCDP responded using the correct handshape only 50% of the time. This mean was less than 2 DCHP exposure groups (25-36 mos., 75% and 49-60 mos., 80%). Note that even the children with less exposure time were able to represent the truck's bed correctly using the "B" palm down handshape (about 45% in the two less exposed groups); however, among the DCHP there is an uneven pattern of improvement - as the children have more exposure, the average correct responses vary in the exposure groups.

The handshape used in this stimulus is unmarked (B), and many children represented only the bed part of the stimulus, which coincided with the adults' representation. The incorrect handshapes that were mostly used ("B" palm up and "curved.B" palm up) differ from the target basically by the palm orientation. The "curved.B" handshape is highly iconic, since it represents the shape of the truck bed as a 'box' or container (which has sides and depth).

The alternate responses produced by the children consisted primarily of naming (the truck, using an LSB lexical item TRUCK or a gesture that was similar as someone driving a truck, such as "changing gears") as well as several instances of pointing.

The results in the representation of the pile of dirt were very different. The children's proportions of handshapes produced are in Table 5.13.

Table 5.13. Proportion of DCDP & DCHP representation of dumptruck-dirt (“curved.5” palm down handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes		Other responses	Total
			crvd5.down	A/S	Other		
DCHP	0-12 mos.	3	0.33	0.67			1.00
	13-24 mos.	1				1.00	1.00
	25-36 mos.	3	0.33	0.33	0.33		1.00
	37-48 mos.	3	0.67	0.33			1.00
	49-60 mos.	1			1.00		1.00
	61+ mos.	2	0.50	0.50			1.00
DCDP (from birth)		1	1.00				1.00

N = number of effective responses (all responses except "no response")

In contrast to the responses used to represent the truck’s bed, only one DCDP responded to the task of representing the dirt. This child used the “curved.5” palm down handshape, as the Deaf adults did. The highest proportion of responses (67%) was produced by the DCHP who are exposed to sign language for up to 48 months. The remaining groups of DCHP produced from none (0%) to less than 50% correct responses. This indicates that this handshape is more difficult to produce, not because of a hand articulation problem, but the difficulty in choosing a classifier form that is quite different from that of the truck bed form and is of another type altogether. The dirt classifier form is a mass noun classifier that reflects a SASS property of shape. The complexity of this classifier with the added complexity of combining it with another classifier on the second hand makes this a very difficult item to represent for most of the children.

Some of the children did attempt to classify the dirt pile by associating the dirt with a closed fist (“A” or “S” handshapes) to represent a ‘clump’ of something. 67% of the less exposed DCHP group responded using this handshape, as well as 50% of the children who were exposed for more than 61 months. The children who chose these handshapes to represent this part of the stimulus may see these handshapes as less marked, and consequently easier to produce. They may also stem from a more basic gestural system, as those handshapes are among the handshapes used by the children who created a system of gestures in Goldin-Meadow and colleagues' work (Goldin-Meadow, 2003).

The next stimulus presented is the elevator, in which the elevator's doors open and a man moves his head out to look to the side. Figure 5.14 shows a picture of the stimulus, frozen when the man looks out, and includes the Deaf adults' signed representation. Table 5.14 that follows shows the children's proportions of handshapes produced in response to the elevator's doors opening.

Figure 5.14. Stimulus "elevator" and the target handshapes used by Brazilian Deaf adults to represent the stimulus

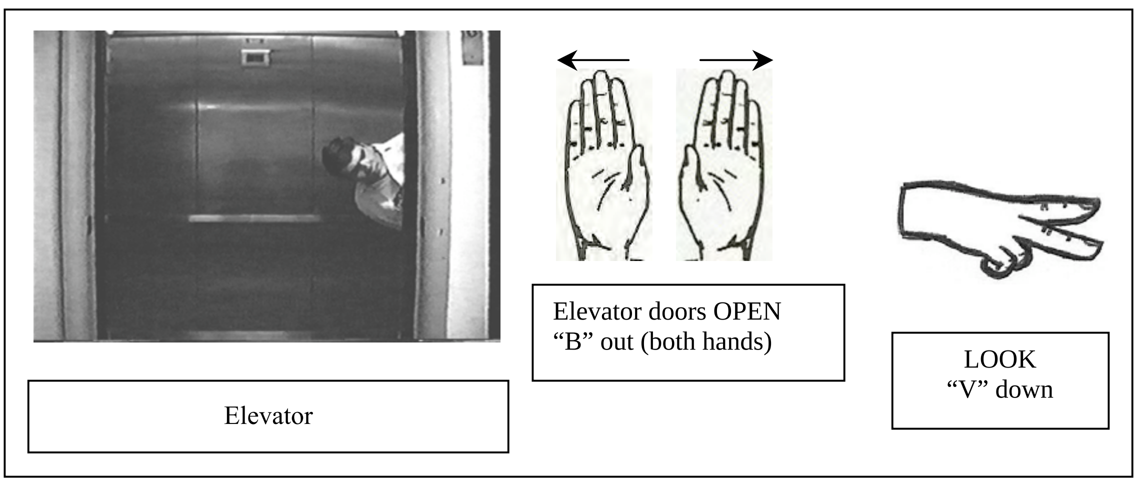


Table 5.14. Proportion of DCDP & DCHP representation of elevator doors' opening ("B" palm out handshape) according to language exposure

Subjects		N	Correct handshapes	Incorrect handshapes					Other responses	Total
			B+B (front-	Bsd	Bbk	crvB	Ssd	Other		
DCHP	0-12 mos.	12	0.25			0.17	0.08		0.50	1.00
	13-24 mos.	6	0.17	0.50					0.33	1.00
	25-36 mos.	8	0.25	0.13	0.25		0.13	0.13	0.13	1.00
	37-48 mos.	7	0.43	0.14		0.29	0.14			1.00
	49-60 mos.	5	0.40	0.20	0.20			0.20		1.00
	61+ mos.	6	0.33		0.50		0.17			1.00
DCDP (from birth)		3	1.00							1.00

N = number of effective responses (all responses except "no response")

All DCDP responded correctly using the "B" palm out handshape on both hands to represent the first part of this stimulus. Conversely, the highest proportion of correct responses among the DCHP is 43%, produced by 48 months of exposure

The handshapes used to represent this part of the stimulus are very iconic; however, the correct handshape is "B" with the palm facing outward. 50% of the DCHP who are more exposed to a signed language used the "B" handshape with the palm facing towards them. Some of the other children produced the "B" handshape with the palms facing each other (palm side, or "Bsd" in Table 5.14). Although iconic, the correct pattern of palm orientation is what distinguishes the correct from the incorrect use of the same handshape. The other handshapes used ("curved.B" and "S" palm side) are very gesture-like, since the "curved.B" was used as if the children were holding one side of the door to mimic the man looking out (which is the other part of the stimulus – LOOK), and the "S" handshape replaced the "B" palm out handshape with the same movement. The other handshapes used were not recurrent.

The children who did not respond using a classifier handshape generally named the elevator or used mimicry (such as “pressing the bottom” to call the elevator). The less exposed children produced 50% of responses using this resource, and the two consecutive groups produced reduced proportions.

The second part of the ‘elevator’ and ‘window opening’ stimuli (LOOK) use the same handshape (“V” palm down), and they are presented together. The next lexical item presented is in response to the stimulus window opening. The Deaf adults used the “S” palm up handshape on both hands, as if they were holding the window tightly and pushing it up. Figure 5.15 shows the stimulus (image frozen when man looks through window) and adults’ representation of window opening, and Table 5.15 has the proportions of the children’s responses to this stimulus.

Figure 5.15. Stimulus “window opening” and the target handshapes used by Brazilian Deaf adults to represent the stimulus

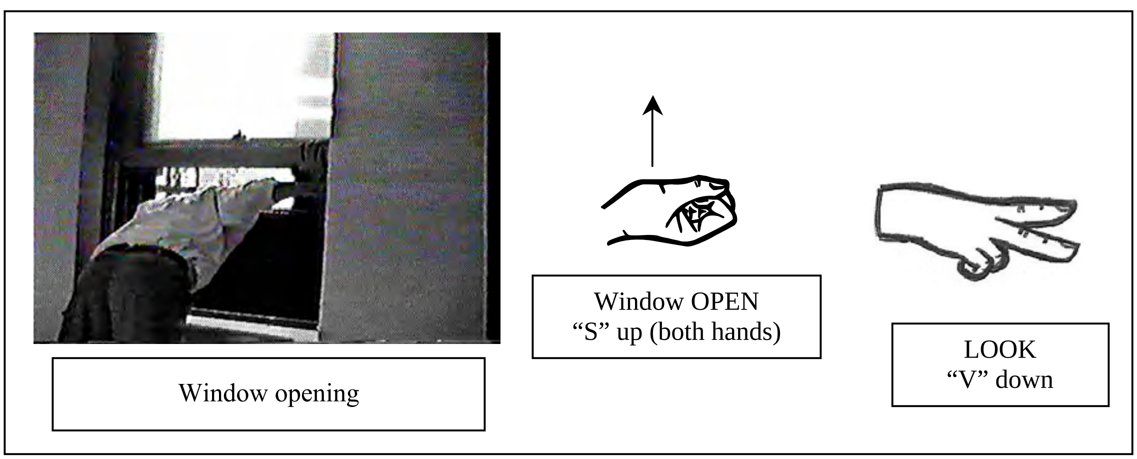


Table 5.15. Proportion of DCDP & DCHP representation of window opening ("S" palm up handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes				Other responses	Total
			S.up	C ' up	B ' up	A/Sdn	Other		
DCHP	0-12 mos.	12		0.50	0.25	0.08	0.08	0.08	1.00
	13-24 mos.	6	0.17	0.17	0.17	0.17		0.33	1.00
	25-36 mos.	8	0.13	0.25		0.38	0.13	0.13	1.00
	37-48 mos.	9	0.11	0.33	0.11	0.11	0.11	0.22	1.00
	49-60 mos.	5	0.40	0.20	0.40				1.00
	61+ mos.	4		0.50			0.25	0.25	1.00
DCDP (from birth)		3		0.33		0.33		0.33	1.00

N = number of effective responses (all responses except "no response")

The results in Table 5.15 indicate that the DCDP who responded to the task did not represented the 'opening' using the same handshape as the Deaf adults. Even among the DCHP, the few responses reached only 40% correct according to the target handshape. The fact that the DCDP who are exposed from birth did not use the correct handshape may be an indicator that some of the DCHP's results could be reached by chance, since the DCHP may not be exposed to a signer that uses the "S" handshape to represent someone opening a window. Some DCHP may be regularizing their language use as they age and have more time of exposure, since the children who are exposed for up to 60 months are among the oldest children in the whole group (mean age 10.2).

Thinking in terms of iconicity, one of the incorrect handshapes used ("C" palm up) seems to be more iconic to represent someone opening a window than the target "S" palm up handshape. Not surprisingly, most of the DCHP chose the variants of the "C" handshape (such as "C," "tight.C", and "curved.5") to represent the stimulus, as well as one out of the 3 DCDP who responded to the task. There is no regularity among the exposure groups that show increasing or decreasing use of these handshapes as the children have greater exposure time.

Among the other incorrect handshapes used, the “B” palm up is more “gesture-like” than the “A” or “S” palm down handshapes. The “B” handshape was used generically, as in other stimuli, to represent the action of opening, while the “A” and “S” handshapes represent someone holding the window tightly and moving it up; however, the handshape is not the same as the target (“A”) or the palm orientation is wrong (“S” palm down). Some of the children produced other handshapes that were not recurrent, but in small proportions.

The responses other than classifier handshapes represent a small fraction in most of the groups, and they consisted basically of naming the stimulus (using the LSB lexical item WINDOW) or pointing to the TV.

Finally, the last lexical group presented is LOOK, which was present in both ‘elevator’ and ‘window opening.’ Table 5.16 presents the proportion of handshapes produced in response to that part of both stimuli.

Table 5.16. Proportion of DCDP & DCHP representation of LOOK (“V” palm down handshape) according to language exposure

Subjects		N	Correct handshape	Incorrect handshapes		Other responses	Total
			V	1	B		
DCHP	0-12 mos.	15	0.47	0.07		0.47	1.00
	13-24 mos.	11	0.18	0.18		0.64	1.00
	25-36 mos.	13	0.92			0.08	1.00
	37-48 mos.	17	0.59	0.06		0.35	1.00
	49-60 mos.	13	0.77			0.23	1.00
	61+ mos.	12	0.92		0.08		1.00
DCDP (from birth)		5	0.80			0.20	1.00

N = number of effective responses (all responses except "no response")

The Deaf adults responded to this part of the stimuli producing a body classifier[18] (BCL) and the verb LOOK at the same time. In this analysis we are considering only the production that involves any handshape use. The DCDP produced 80% of the responses using the "V" handshape (or the verb LOOK). Among the DCHP, large proportions of responses consisted of the production of the verb LOOK; however, there is no pattern of responses indicating that the children who are exposed longer produced better results than the children who are exposed for less time. Even the children who are exposed for less than one year were able to respond 47% correctly, and the groups who are exposed for about 36 months, and for more than 61 months reached the highest results (92%).

Note that there are very small proportions of incorrect handshapes used. These are the "1" handshape (also used by the children to indicate the line of sight in other stimuli that showed eyes) and the generic "B" handshape.

The "other responses" were primarily imitation, in which the children used only their own bodies to represent the persons looking through the window or out of the elevator, without using their hands. The two groups with less exposure time produced the highest proportions of mimicry, but the groups exposed for 37 to 60 months also used this resource. Even among the DCDP, 20% of their responses consisted only of mimicry. This indicates that most of the subjects have acquired and use the lexical item LOOK, but there are some that do not master its use.

These results indicate that among the two parentage groups (DCDP, DCHP) there are subjects that have acquired the use of some handshapes in specific situations, others

[18] This means that the Deaf adults used their own bodies to represent the person in the stimulus moving to the front and looking to the side; however, this movement was always accompanied by the verb LOOK.

seem to be guessing well and producing correct handshapes by chance, and still others have greater difficulty in responding correctly. In the following chapter we will discuss these results and evaluate the findings of this chapter in relation to the former chapters.

Chapter 6 – Discussion

6.1. Introduction

In this chapter we present the results of the use of handshapes in verbs of motion and verbs of location in Deaf children. The results are discussed in relation to the four hypotheses that were tested in this study, which are restated here:

(1) Quality of exposure to language models is a significant factor in determining language output – this examines the influence of parentage in the results;

(2) Length of exposure to language models has a significant effect in determining language knowledge, but it cannot fully compensate for late acquisition or quality of input – this examines the influence of length of exposure in the results;

(3) Chronological age has a significant effect in the production of language knowledge; and finally,

(4) Children with high quality and/or longer length of exposure will produce language output within the linguistic system to which they are exposed, while children who have less exposure, or are exposed to a low quality of input will rely on output taken from outside the linguistic system – this area examines the children's production of responses outside of the input language to which they are exposed. The responses selected are not classifier handshapes.

Section 6.2 discusses the general results according to parentage, separately evaluating the results of the DCDP and DCHP. Section 6.3 discusses the influence of age and length of exposure, focusing on the results of the DCHP according to lexical categories in the task. In section 6.4 a comparison of DCDP and DCHP results is presented. Section 6.5 presents an evaluation of specific handshapes and the pattern of handshapes used. In section 6.6 an analysis of handshape errors follows, showing the strategies the children used trying determine the best handshapes to represent the stimuli. Section 6.7 examines classifiers and gestures, providing a brief discussion of the alternate strategies used by the children to represent the stimuli when not using classifier handshapes. Finally, section 6.8 presents the conclusions of the study, and section 6.9 considers the implications of this study and further research.

6.2. Evaluating general results

Eighty percent of all DCDP responses consisted of classifier handshapes. These results suggest that the DCDP have a closed inventory of handshapes that enables them to respond to the task using mostly classifier handshapes. They may not choose the correct classifier but they do choose classifier handshapes. This strategy is within the language system they are exposed to: they prefer to use a classifier (correct or incorrect) handshape to represent a stimulus rather than a non-linguistic response. A small proportion of responses by the younger DCDP may use strategies other than classifiers such as naming or mimicry.

In general the tasks the children were given challenged the DCDP. The oldest (9 years old) DCDP have not mastered the classifier system since the maximum individual results was 67% of correct responses. The results indicate that age is a primary factor since the older (with more exposure) children produced better results than the younger (less exposed) children.

Fifty two percent of the DCHP responses consisted of classifier handshapes. These results indicate that the DCHP do not have as concise a classifier handshape inventory as the DCDP. The DCHP do not know how to represent a stimulus almost half of the time. The DCHP then have to rely upon strategies other than classifier handshapes, such as pointing, naming and mimicry, or they may refuse to respond (15%).

The responses of the older DCHP indicate that classifier handshapes are chosen more often than non-classifier handshapes. This is confounded by the fact that the older children are also exposed to a signed language for a longer period of time. The results according to length of exposure indicate that there are three qualitatively different stages in the response patterns of the DCHP. Every two years the children showed similar production pattern in their correct and incorrect responses. When the DCHP reach 7-8 years of age there is a significant jump in the use of classifier handshapes to represent stimulus items. There is also a corresponding increase in the use of classifiers after children have been exposed to a signed language for more than 2 years (25-36 mos. and up). These results suggest that by 8 years of age and after 2 years of exposure the Brazilian Deaf children who have hearing parents start to use significantly more classifiers and produce them more correctly; however, the highest mean of DCHP correct responses (52%) was among the children who are exposed for up to 60 months (the oldest children, mean age 10.2) who produced better results than the children exposed for more than 61 months (mean age 9:6).

To evaluate these results statistically, a linear regression analysis was conducted in order to assess the effect of age and length of exposure on the test scores. The results indicate that 55% of the variance in the total score can be accounted for by the linear combination of age and length of exposure. This suggests that an increase in both age and exposure is strongly related to the increase in total score. These results confirm the hypotheses that both age and length of exposure would have significant effects in the production of output.

In the next sections we discuss how the DCHP responded to each of the 6 response categories (correct, inaccurate attempt, pointing, naming, mimicry, and no response) to see if there are differences in the response pattern when compared to the DCDP.

6.3. Evaluating DCHP results according to response categories

In this section, the influence of age and length of exposure in the DCHP responses that consisted of classifier forms (correct responses and inaccurate attempts) are evaluated in the subsection 6.3.1, and in the responses that consisted of non-classifier forms (pointing, naming, mimicry, and no response) are evaluated in the subsection 6.3.2.

6.3.1. Responses using classifier forms

Multiple regression analysis was conducted to evaluate the influence of age and length of exposure in the DCHP correct and inaccurate responses. The results of the multiple regression indicated that the combination of both age and length of exposure accounted for most of the variance in the correct and inaccurate. In particular, the length of exposure is somewhat more correlated to the increase of correct responses (46% of variance) than age (42% of variance). This suggests that as the children gain more exposure to a signed language they tend to produce more correct classifier handshapes. It is also true that as they age their scores improve. Older children who are exposed to a signed language for shorter durations and begin at older ages possibly suffer from the consequences of the critical period for acquiring language (Mayberry & Eichen, 1991; Mayberry & Lock, 2004). On the other hand, the younger children who were exposed at an early age performed better in the language tasks. It is important to recognize that the DCHP, who are exposed mostly to non-native signers, tend to perform better when they have increased exposure. As children tend to regularize the input they receive (Singleton, 1989; Singleton & Newport, 2004), it is better to have children exposed to non-proficient signed language users than no exposure at all.

In contrast, age is somewhat more correlated to the increase of inaccurate attempts (32% of variance) than length of exposure (21% of variance). This result also points to the consequences of the critical period for acquiring language. As already stated above, younger children with more exposure (such as the DCDP and the DCHP with 2 or more years of exposure), tend to produce more correct responses. Older children with less exposure tend to produce more incorrect classifier handshapes than younger children who have less exposure. This results from the fact that when the younger children do not know how to respond using a classifier handshape, if they respond they opt to respond using other strategies. This point is addressed in the following subsection.

6.3.2. Responses using non-classifier forms

This section examines the implications of the linear regression analysis performed to determine the influence of age and length of exposure on the production of non-classifier responses (pointing, naming, mimicry, and no response). The results indicate that as both variables increased, the proportion of responses that consisted of non-classifier forms decreased. This confirms our hypotheses that age and length of exposure to a signed language results in a decrease in the use of non-classifier representations.

Although age and length of exposure is related to a decrease in name and mimicry there is no corresponding decrease in the use of pointing. This suggests that as children gain in their knowledge of a signed language they are more likely to use the appropriate class of forms for representation even though they might choose an incorrect form, it will be from the same class. In addition, pointing is also related to pronominals and the use of tracing in signed languages, hence, we should not see a decrease in these forms since they are also a core component of the language. In contrast, these results also indicate that the younger children make more use of non-classifier forms than classifier handshapes. These results will be better discussed in a later section (6.7), where the production of classifier handshapes and non-classifier forms are compared.

6.4. Comparing DCDP and DCHP results

In this section the results of the DCDP and the DCHP are compared to verify the influence of parentage in the results. The results indicated that the RO task was challenging for the DCDP, since the highest mean of correct responses was 67% for the oldest child. Since the DCDP are exposed to signed language from birth, it is expected that they would produce a higher proportion than the actual results obtained in this study. Other factors may have influenced the results. One factor is chronological age. As seen in the DCHP and the DCDP results, age is strongly influential in the proportion of correct responses produced. The older subjects performed much better than the younger ones suggesting a hierarchy of acquisition in handshape representation, non-classifier forms first and then classifier forms. Aging also implies cognitive maturation.

Another factor regarding input is that the DCDP are also exposed to the same impoverished input as the DCHP in school. As stated earlier, all the adults in the Deaf children's environment except for one Deaf child are hearing. The hearing teachers produce a signed language that is learned as a second language. In fact, it is learned when they are adults as it is rare to find hearing people who use a signed language as a child (except for hearing children of Deaf adults). This results in 3 out of 4 DCDP who attend schools where there are either no good language models or extremely impoverished language models. The youngest DCDP is the only DCDP enrolled in a school where there are Deaf adults who work in the school.

The language interaction occurs among the students and with the hearing signed language users. The range of signed language skill in the hearing teachers could present a confusing and contradictory model for the children to establish parameters of correctness. As second language users the adult models may select inaccurate and inappropriate (wrong form class) handshapes to represent objects in the environment. The

Deaf children are in the process of developing language and may be confused by the contradictory input they receive (at home and at school). As a result they may choose inaccurate or inappropriate handshapes rather than the correct one.

Making matters more difficult, the DCHP may be exposed to an impoverished language at school, but at home they have almost no input at all. Most of the parents of Brazilian Deaf children do not know how to communicate with their children using a signed language (Bernardino, 1999). When there is someone at home who is willing to learn how to communicate with them, it is the Deaf child who teaches them further confounding the language model process. In the families with Deaf parents the situation should be different. Deaf parents typically sign to their children, providing an adult model; however, Deaf parents are products of the school system and their signed language my reflect many of the issues of late and second language learners. The model of language may be impoverished but is clearly much more intact than the model of the DCHP. The DCDP's language input is quantitatively and qualitatively better than the DCHP's input.

The complicated input problem is reflected in the DCHP's results. By 11 years of age, the average proportion of DCHP's correct responses is similar to the youngest DCDP, who is 5 years old. The situation is slightly better when we look at the DCHP's results according to exposure. When we examine the oldest group of DCHP tested after 5 years of exposure (mean age 10.2) the results appear similar to the 7-year-old DCDP. Also the group of DCHP after 3-4 years of exposure (mean age 9.4) had similar results to the 5-year-old DCDP. This suggests that the DCHP are on average at least 3 years delayed in comparison to the DCDP.

The task appeared to be an even greater challenge for the DCHP than for the DCDP. Most of the DCHP (89%) have no contact with a proficient adult signer. The lack of a language model makes it difficult for them to internalize the parameters of the LSB handshapes required to represent specific objects using classifiers. The fact that DCHP do not have a large inventory of handshapes to rely upon creates a problem in their ability to correctly represent the stimuli. This will be discussed in the succeeding sections.

6.5. Evaluating the production of specific handshapes

This section analyzes the Deaf children's production focusing on the handshapes that were used to represent the stimuli shown in chapter 5. Instead of separately discussing each of the handshapes used in response to each stimulus, the handshapes are grouped according to their similarities in representing objects. The discussion will include examining different handshapes that are used to represent similar objects and the same handshapes that are used to represent different objects.

Some of handshapes that the Deaf adults used were not found in the children's representations. For example, the Deaf adults used the "curved V" handshape with palm down to represent cars (Bernardino, Hoffmeister & Allen, 2004; Bernardino & Hoffmeister, 2004); however, it appears that the "B" handshape (palm down or palm side) to represent cars is preferred by Deaf adults. The Deaf children's primary handshape for "cars" is the "B" palm side handshape.

The DCDP appear to have mastered the representation of feet using the “B” palm-down handshape, but they had difficulties representing legs using the “B” palm-down +arm handshape. These two handshapes differ in their phonology. The B palm-down representation for “feet” uses only the “hand” as part of its phonological makeup. The “B” palm-down +arm uses the extension of the arm as part of its phonological construction. The Deaf adults preferred the “B” palm-down +arm to represent legs. The form occurred in less than half of the DCDP representations of legs.

It seems that the DCDP overextended the “B” palm-down +arm handshape to all references with legs. This is not permissible when referring to legs when the person is standing. Here, the appropriate form is the “1” pointing down handshape. The use of the “B” palm-down +arm handshape is a possible case of overgeneralization of the use of the sign. The DCHP show a similar pattern to the DCDP to represent these two body parts, but with less accuracy. Both DCDP and DCHP appear to operating on the language input to derive generalizations.

The “B” palm-down handshape was also used to represent cars, the bed of the dumptruck (with +arm), books/videotapes, elevator doors and stacks of paper. The “B” palm-down handshape, used in reference to cars, functions as a semantic classifier (SCL). In the other items, however, the “B” handshape in different spatial orientations functions as a size and shape specifier (SASS). The DCDP and the DCHP use the “B” handshape as a SCL in the majority of their responses to represent cars. This use of the B palm down handshape for cars appears more appropriately in the DCHP with 61 months or more of exposure. Three of the four DCDP all boys used the “B” handshape to represent cars 100% of the time. The oldest DCHP only used this handshape 55% of the time suggesting that a wider variation in representing cars was available and that a preferred handshape has not yet been decided upon.

The children's representation of SASSes shows no consistent hierarchy of production that might indicate SASSes are acquired before or after SCLs. The DCHP group outperformed the DCDP in the representation of the bed of the dumptruck and books/videotapes using the correct "B" handshape. However, the DCDP reached the ceiling representing elevator doors and came close to ceiling for stacks of paper while the DCHP had difficulty representing the elevator doors and the stacks of paper.

It is clear that the DCDP acquired the "B" handshape to represent flat rectangular shapes early, yet they did not use this form to represent books/videotapes as handling classifiers. This suggests that the DCDP were not representing the objects' orientation in space (a VoL), but how the objects ended up in that arrangement, (i.e., each book is put on the shelf). On the other hand, the DCHP exposed for more than 5 years seem to be taking advantage of the shape of the objects in some stimuli (as an influence of iconicity), but in other situations they are not able to do this (such as to represent elevator doors).

The Deaf adults also used an "F" handshape to represent eyes, which shows the shape of the eyes. None of the children in this study used the "F" handshape to represent eyes. Instead of focusing on the shape (choosing a BPCL and a size and shape specifier), they preferred to focus on the lines of sight or the more common form to indicate the functioning of the eyes, using the "V" and "1" handshape.

The representation of STACKS OF PAPER using the target "G" handshape plus variations in size is difficult for both the DCDP and the DCHP. One difficulty is that the adults represent the size of the stacks by varying the handshape "G" but also use non-manual features (inflated cheeks). None of the Deaf children used the non-manual feature to represent the "stacks of paper." The DCDP, who have access to Deaf adults, may not yet have acquired these non-manual features by 9 years of age, so they choose the easier representation, the shape of the object, a SASS classifier. The DCHP, who have little or no contact with Deaf adults, may not have the models to help them select the appropriate classifier handshapes.

Most of the children had no difficulty representing the hand. The fact that the younger children could imitate the tapping hand using their own hand was a great facilitator. For older children, however, it seemed that some of them were looking for some linguistic frame to represent the stimulus. This may explain why some of the older/more exposed children decided to show their own hands and did not imitate or reference the scene.

Another handshape that many of the Deaf children had no difficulty producing was the "C" to represent cans. The fact that this handshape is unmarked, and is also used in handling verbs to represent someone holding a cup (or a can) to drink may have influenced the results.

The children with greater exposure to signed language used both the "V" and "1" handshapes to represent "eyes." Both the DCDP and the DCHP preferred to use the "1" handshape rather than the "V" handshape to represent eyes. The "V" handshape is used to represent the line of sight and is the same handshape in the verbs LOOK, SEE, WATCH, LOOK-AT-ME. These forms are clearly used by the hearing teachers to attract the children's attention in school. This was expected to facilitate the children's acquisition of the "V" handshape. Yet the children preferred to use the "1" handshape instead. Maybe it is because "tracing" may be acquired earlier and is a more general form to represent small objects. Tracing using the two hands to represent the two eyes (with an unmarked handshape) may be easier than using only a one handed lexical item (with a marked handshape). Another important point is that the representation of the stimulus requires a classifier handshape to represent the shape of eyes and then add the movement represented in the item. It is possible the focus of the children is on the movement and not the object. It is also possible that the more complex "F" handshape is more difficult to produce when combined with the movement for eyes. It is easier just to mark the movement by tracing than to represent the movement of the eyes. Additionally, the stimulus does not represent the verb SEE, but a person moving his eyes without looking specifically at anything. The children seem to be sensitive to this difference, but they are not aware of the correct way to describe it. For some of them, the same handshape used in the verb may be not appropriate for representing a noun.

The picture changes when the stimuli represent the act of looking. The children were able to use form of the verb "LOOK"; the "V" palm-down handshape to represent the action depicted using the eyes (in the second part of the stimuli elevator and window opening). In this case, the handshape "1" is not acceptable to represent the verb LOOK.

The DCDP and the DCHP responded using the “V” palm-down handshape. This form was used even among the DCHP with the least amount of exposure.

When comparing the use of the same handshape in different grammatical functions (in a classifier form as opposed to used in a verb), it is clear that the children are able to distinguish the difference. Many of them recognized and used the “V” handshape that is commonly used in a familiar verb (LOOK), but hesitated to use the same handshape in an unfamiliar construction (as a classifier handshape to represent eyes).

The “1” handshape is also used to represent legs, a BPCL, and pencils, a SASS. It is important to recognize that the “1” handshape representing “eyes moving” is a tracing process while the “1” handshape representing “legs,” “pencils,” etc. are noun classifications. It seems that the children have difficulty in producing the “1” handshape to represent a noun category for objects even though it is the least marked and one of the most common handshapes and possibly highly iconic in certain representations. It does not matter if the object to be represented is similar to the handshape (small and thin as a finger to represent the shape of pencils) in the real world, or if it is not so similar (much bigger than the fingers as in the representation of legs), the Deaf children did not use the “1” handshape in their responses.

The Deaf adults used the “4” handshape to represent persons in line as a mass noun referring to individual persons in an arranged pattern. A relatively small number of Deaf children used this handshape as mass noun. The Deaf children tended to represent the individual subjects path (they traced the path using the “1” and “B” handshape) as opposed to using a classifier that could represent the group of objects (see handshape errors).

Another target handshape that was used in the representations is the “S” palm-up to represent the opening of the window. This handshape is used in handling verbs for holding (“S” “grasping an object with control,” see Figure 2.5, Supalla, 1986). The DCDP did not use the “S” palm-up handshape, which is used by the adults to represent a person holding the window and opening it similar to the adults. They chose other handshapes that portrayed the handling action, which cannot be accepted as correct responses. The analysis of the results of this study indicates that the Deaf children (mostly the DCHP, but also the DCDP) have problems in producing handshapes to represent some stimuli. It seems that when the children do not know how to produce a classifier, they have some strategies for choosing the best handshape to use. This conclusion is reinforced in the next section, where the handshape errors are evaluated.

The Deaf children in this study were able to categorize different uses of handshapes. Handshapes could function as handling of objects (VoM), or in the tracing of the object’s movement (VoM), as the objects themselves (VoL) or tracing the objects shape (VoL). Even though the input varies tremendously the Deaf children appeared to be moving towards a categorization process that established the parameters of how handshapes could be used to designate objects and their paths.

6.6. Evaluating the production of handshape errors

The most common errors occur in the use of “tracing” in place of a handshape to represent any of the objects, except BPCL and People classifiers. When the Deaf children did not know which hand to use to represent an object, they used a “B” or “1” handshape for tracing not only the path in verbs of motion, but also created paths for the arrangement of objects in verbs of location. Both the DCDP and the DCHP used the tracing process. One error that many of the children exhibited was combining a handling classifier handshape with tracing. For example, they would use two flat “C” handshapes, palm down and then trace the shape of “pencil” (long, thin) with this handshape. This combination of classifier forms, the tracing and handling handshapes is not permitted in signed languages. Either tracing of an object’s movement (eyes) or the shape of the object is permitted but not the combination of the two.

Another error in tracing is when they used a general handshape (such as “B” or “1”) to trace the path of the shape of the spatial arrangement of the objects (such as tracing a “Z” in the air to represent the arrangement of “cars in a zigzag pattern”). Finally, another tracing error is the separation of the path from the objects that are operating on the path. In the stimuli where the path of people walking is supposed to be combined with the handshape to represent “persons in line” the Deaf children separated this item into two parts. The first part represented the people with the “4” handshape and then used a “B” fingertips down or “1” palm down handshape to represent the path.

The “general substitution error” where the “B” handshape becomes a substitute for all other handshapes is another common error (after “tracing”) for all ages of children.

The “B” handshape is used to represent a large variety of objects, regardless of their shape. The “B” handshape is one of the least marked handshapes (Boyes-Braem, 1990) and it is among the first acquired (Marentette and Mayberry, 2000). This error indicates that when Deaf children do not know which handshape to use they represent the object using a less marked handshape.

Another high proportion of errors among all the Deaf children was “internal handshape variation.” When uncertain of which handshape to use, the children modified the classifier, but these handshapes lacked important information, such as depth. An example is the use of the “open.9” handshape to represent cans. This handshape consists of a round shape made by the index finger and thumb, in the open hand (as if someone holding a can using only these two fingers, see appendix). The round shape is depicted, but the depth of the object is lost in the representation. This kind of error suggests that the children tried to represent the stimulus based on its shape, but without knowledge of the important features such as depth in the handshape’s choice. In this particular example, the “open.9” or “open.8” could possibly function as a handling verb. In another example, to represent “eyes,” the errors made by the children were in the shape category. Some of the Deaf children modified an internal component of the classifier the handshape; for example, one of the subjects modified an “F” handshape for “eyes” by inappropriately changing an “R” handshape by curving the middle finger and the index finger to create a “circle” (see appendix, modified “R”). The subjects in this study appear to use the modified form as a SASS, perhaps suggesting that shape is easier to refer to than function of an object (Schick, 1986).

Interestingly, none of the children used the "F" handshape to represent the shape of the eyes. When the Deaf children used the "F" handshape, it was restricted to a handling classifier used inappropriately to represent the shape of the pencils. For the Deaf children in this study the "F" handshape appears to be restricted to represent the handling of objects and not as a SASS.

The "1" handshape is used in three different forms in LSB, as a trace form, as a BPCL, and as a SASS. All of the Deaf children had difficulty using this handshape to represent legs and pencils and very little problem using this handshape as a tracing form. It seems that it is easier for the children to use a "1" handshape to trace the objects' shape than to choose a handshape to represent the category (cans, pencils, etc.).

Some of the children used a target handshape to represent the stimuli, but combined this with a different orientation of the fingers or the palm. Since finger orientation and palm orientation are important aspects of representing the stimuli correctly, these handshapes were considered errors. Children who made this type of error do not seem to be aware of the correct handshape to use and its relation to the referent category. In the representation of books/videotapes, for example, some children used the "B" palm-side handshape (fingers pointing to front, instead of pointing up) incorrect finger orientation, to represent "books on a shelf." The youngest DCDP (5 years old) was able to represented upright books and videotapes correctly using the "B" side-fingers pointing up handshape. He appeared to see this handshape as an entity (SCL) that can be maneuvered a variety of ways in space such as in an upright, sideways or palm down position as is used in the stimulus "videotapes, one down." The children who used the

“B” palm-side handshape seem to be representing a set of flat objects placed next to each other. These objects could be books or compact disks on a shelf, or even plates in a dish drainer. The position of the objects was not taken into account, or the children may be unaware of how to represent them.

Some children used handshapes that are combined with handling verbs to represent objects as if they were holding them. Supalla (1982) reported this type of error in young DCDP’s acquisition of ASL. Some children “handled” the objects and marked their location using a “tracing” (these handshapes already identified as “tracing” above), others “handled” the objects (such as books/videotapes) as if they were putting them on the shelves inserting the handshape for a verb of location into the “handling verb” form. They also used this type of handshape to substitute for the target as in “S” palm-up for window opening, and to handling the elevator’s doors opening (as if they were helping the automatic doors to open). It seems that using a “handling verb” instead of a verb of location suggests that the Deaf children have difficulty representing objects that are not moving. Representing stationary objects in space is difficult for these children. In their minds the representation of the object and the representation of the action that manipulates the object appear to have the same function. This type of representation may be easier to produce than using noun classifiers within verbs of motion and verbs of location.

Another common error representing a person's legs (legs, feet, persons in line) was the “modification in a lexical item,” which consists of an alteration of a known LSB sign (see figure 5.2 for an example). These signs cannot generally be internally modified.

This modification was typical of the younger DCDP, but some older DCHP also produced this error type; these errors were also observed by Supalla (1982) in DCDP. For the children who performed this alteration, I considered this error type a "proof" of familiarity with the language, in the sense that the children know the lexical items and extend their knowledge to new forms. This error type looks like the common error in hearing children learning the irregular past form of English (substituting "*goed*" for "went," for example). When Deaf children produce a "V.point.down" handshape that is used to represent a person standing and shake their entire hand to represent the stimulus "shaking legs," they are changing a sign by violating a linguistic rule (that a frozen sign cannot be internally modified). Similarly, when they represent a kicking motion by moving the index finger up and down while the middle finger still touches the palm of the secondary hand (representing the "leg lifting up and down"), they insert a movement rule into a lexical item, which is an internal change and is not accepted in the adult productions (this is not accepted in ASL and it appears that the LSB adults also do not allow modification of their lexical forms in this manner, although further research is needed to verify this observation). To produce the correct form, the child would have to represent a "leg" on each hand hence "splitting" each finger of the "V.point.down" handshape into "1.point.down" on both hands (resulting in two classifier forms), and adding the motion for the shaking-of-legs or the up-down (kicking) movement rule creating a new form. It seems that the DCHP who committed this type of error are reanalyzing the language in a similar way as the DCDP who are younger than 7 years old.

Another type of error present in the children's responses is in "SASS substitution," which consists of substituting a handshape that represents the size and shape of the object in the stimulus for the target handshape. For example, instead of representing a hand opening the window by pushing it up ("S" handshape palm up), a "B side with palm towards the back" represents the window moving up by itself is substituted. This strategy indicates that the child has other resources to tap into while using this language, and further demonstrates that many of the children know alternate ways of representing the stimuli.

It is possible that there is a relationship between complexity of the stimulus item and ability to represent objects using the correct handshape. That is, the overall complexity of the stimulus may constrain the child's ability to accurately depict all the necessary components. The Elevator stimulus item is the only item of the Complex constructions that the DCDP were able to produce correctly. Less than half of the DCHP were able to respond correctly for all ages and length of exposure. This stimulus item requires representing the doors of an elevator opening ("B" palm-out handshape on both hands, figure 5.14) and then a sign produced to represent a person looking out and to the left, using "V" palm-down handshape, to represent the verb LOOK-TO-SIDE. What makes this more complicated is that both parts of the signed construction are supposed to be performed at the same time. That is, the handshape for "elevator" should be held by the left hand (secondary hand) while the right (primary) hand produces the second part of the sentence. This construction has been referred to as a "Same/Time While" construction or temporal adverbial (Greenwald, Hoffmeister & Kourbetis 1985: Allen, Greenwald, &

Hoffmeister, 2000). These complex construction stimuli essentially require that the handshapes must be embedded into two sentences. One handshape from one sentence is held and the second sentence is produced simultaneously. Both hands are using different handshapes to represent two different classifiers in each of the verbs in the two sentences.

The other complex constructions (window opening and dumptruck) were also challenging for the children, since both stimuli also required the same complex and simultaneous use of both hands as the example above. The Deaf children who attempted to respond to the complex constructions (the DCDP or the DCHP) mostly represented only one part (one verb). Typically they represented the moving part of the stimulus suggesting that was more salient for them.

In many instances the children appeared to focus on those parts that were highly salient (easily visible, moving, etc.). Salience is clearly a factor that motivates the children's handshape choice. Some also take advantage of the iconicity that exists between an object and the handshape that is used to represent it, such as in the stimulus for hand in this study. Iconicity may trigger some constructions involving classifier handshapes, but not always. This is the topic that is discussed in the next section.

6.6.1. Iconicity

Iconicity is an issue that has motivated many discussions about signed languages and in particular its relationship to the production of classifiers. Slobin et al. (2003), for example, claim that iconicity is an important factor in the acquisition of classifier handshapes in Deaf infants (first language learners) and their hearing mothers (second language learners). Some productions by the children support the issue of iconicity related to the handshape choices, but other responses contradict the iconic relationship as motivation for the choice of a handshape in classifier constructions.

The data in this study suggest that the "B" handshape, which represents a flat wide object, may be more iconic in relation to feet than the "1" handshape ("1" represents a straight, thin one). Most of the children in this study choose the "B" handshape to represent "feet;" however, since some of the children replaced "1" for "B." It may be that there is a conflict between the iconicity of the stimuli and the cognitive/linguistic concept that involves the representation of feet using the hands. Some children had difficulty using the B handshape to refer to a foot. They choose another unmarked handshape ("1") to represent either the position of the feet (as in the stimulus "duck feet," represented using a "1" palm-down handshapes at an angle on each hand), or the movement of a foot (as in a "tapping foot,") by using the "1" handshape and tapping the palm of the other hand. This production is using the "tracing" handshape and tracing the movement of the foot, not the shape of the foot. This represents only the movement using an unmarked handshape. It is possible that the "1" handshape is over-generalized to refer to movement.

Another handshape error that challenges the iconicity issue is the use of the "B" palm-side handshape to represent feet. The children who chose this handshape were not seeing the shape of the hand involved in the representation of feet, so that even though they are using a flat hand, it is the side of the hand that "touches" the ground. This "B" handshape is not indicating the wideness of the foot but is used as a place or location marker for the feet. They chose the "B" handshape, an unmarked handshape, to represent only the location/position of the feet in the stimulus.

The children's representation of pencils is another handshape error that questions the iconicity issue. The Deaf adults represented pencils using the "1" palm-down handshape (long thin objects). None of the DCDP used this handshape, and only a few DCHP made use of it. Markedness cannot account for the difficulty in acquisition since the "1" handshape is one of the less marked handshapes. Iconicity must not play a role either, as this handshape is highly iconic with respect to representing pencils. An issue that may have affected negatively the children's choice of the "1" handshape is the complexity of the stimuli. The three stimuli had pencils in differing arrangements that may be too complex for the children to represent. They had to use both hands, holding one in place while the other hand moved to indicate the arrangement of the objects in the scene (see picture 5.10). The children did choose to represent the pencils by tracing them in different locations. This may have been influenced by the iconicity of the stimulus but resulted in an incorrect handshape choice and movement. Here, iconicity influenced the production of the sign in the negative direction.

If the iconicity of the object influenced the children's choice, the "B" side-up handshape that was the target for books/videotapes should have been chosen more often. The "B" handshape is very iconic as it represents a thin flat object such as a book. It may also be the case that since both books and videotapes may be present in the hearing teachers' discourse, the children may be exposed to conflicting input, in which the "B" handshape may not be used side-up/fingertips up. On the other hand, many children chose the incorrect "B" palm-side handshape to represent books/videotapes (fingers pointing to the front). It could be the case that the children were referencing books/videotapes using an “iconic” gesture using the “B” side handshape.

There are other stimulus items such as the eyes, in which some children may resort to iconicity to represent them. Iconicity clearly influenced the child who created a new handshape, for example (modified R for eyes). This child was clearly taking advantage of the iconicity to respond to the task, but as his inventory of handshapes seems to be small, he was not able to find a handshape that was suitable for representing eyes. Ironically, he initially attempted the correct handshape (an “F”), but he did not accept it, preferring the “O” handshape that is used to represent a circle.

These results support the iconicity that is claimed in children’s choice of handshapes (Slobin et al. 2003). Iconicity of these components does appear to be fundamental to the children’s learning, and may play a role in the adult Deaf population in referencing this type of signs. Iconicity appears to influence handshape choices when the Deaf child has a reduced inventory of handshapes. If the Deaf children are not able to obtain appropriate adult language models, they will make decisions on their own. These decisions will be influenced by a number of factors, iconicity being one of them.

6.7. Evaluating classifiers, gestures and other forms

All of the Deaf children used strategies other than handshape production (pointing, naming, and mimicry) to represent stimuli. Some children used their bodies in pantomime fashion to indicate what they saw on the video. For example, they crossed their legs to represent the stimulus “crossed legs,” or moved their eyes up and down to represent “eyes up-down,” without including any hand representation.

The children who used the mimicry strategy were mostly the DCHP. Only one of the older DCDP used this strategy and this occurred in only 2% of their responses. The younger DCDP did not use this strategy at all. It seems the DCHP are using this strategy as a non-linguistic gestural response.

Another strategy the children used is to name the central object in the stimuli using an LSB lexical item or a homesign, which is referred to as naming in this study. The DCDP used this strategy in 8% of their responses, while the DCHP used it in 15% of their responses. None of the older DCDP used this strategy. This type of response indicates that the children recognized the object but they were unable to represent it using a handshape, so they only named it. Recognizing the object and naming it is an activity that precedes the insertion of classifiers into verbs of motion and verbs of location. The DCHP are beginning to acquire and produce the language piece by piece.

“Pointing” to the TV screen, to objects in the room, or to their body parts is another strategy that the DCHP used when they did not know how to represent the stimuli in noun form or classifier form. The DCDP did not use this strategy. The mean of DCHP’s use of pointing is 3%. Pointing was used more by the younger DCHP (17% of their responses) than by the older DCHP (4% of their responses). The use of “pointing” decreases gradually with age, since the younger, 4-6 years old, DCHP produced more pointing than the 7-year-old DCHP. It seems than when Deaf children are presented with the challenge of identifying a referent, when they do not know how to name it, they point to the object first, and later they name the object.

These three strategies are classified in this study as being gesture-like. Mimicry is clearly gestural. One could argue that naming is not a gesture, as well as pointing, which functions as a pronominal in signed languages; however, when the children saw the stimulus on the TV and only pointed to it on the screen or pointed to a similar object in the testing room, they did so because they did not know how to represent it lexically. Goldin-Meadow (2003) identified pointing in the Deaf children she analyzed as gestures that sometimes had a verbal function, and sometimes a noun function. Some of the children in our study appear to use pointing in the same manner as the children in the Goldin-Meadow study.

As for naming, the children named the objects in the scene mostly because they did not know how to represent them. A large number of the children who named the objects used homesigns.

We claim that these three strategies emerge as prelinguistic forms that were used when the children did not know how to use a linguistic form. These strategies were mostly used by the younger subjects (DCDP and DCHP younger than 8 years of age) and the children with lower length of exposure to a signed language (younger and older DCHP). It seems that as the children have more contact with a signed language, there is a significant reduction in the use of prelinguistic forms.

Emmorey (2002) argues that the conclusion regarding the continuity between the use of prelinguistic and linguistic forms is being modified by recent work on the acquisition of classifiers. Slobin et al. (2003) also claim that the development of the Deaf child's gesture into sign flows in a continuum that needs more study. The use of body parts that back up the BPCL signs (i.e., move the eyes when signing the eyes are moving) in LSB as a linguistic form in Deaf adult use is different from the use of mimicry in this study. The younger DCHP used mimicry in responses such as "window opening" and "man upside down" using their whole bodies in the constructions. Some of these children almost fell to the floor to represent "man upside down." This behavior was also reported in other studies (Supalla, 1982; Goodhart, 1984; and Mounty, 1986). In this study there were cases in which the children's only effective responses consisted of mimicry, the other responses were limited to "pointing" and "no response."

Even some of the handshapes that the children used were more gestural than linguistic. The handshapes that were used as a generic form to represent any object ("B" and "1"), for example, seem to be forms that may be placed in an intermediate stage between gestures and classifier forms. Also some of the handshapes used as tracing ("B," "1"), representing the path of the object in verbs of motion, or the arrangement of objects in verbs of location may also be placed in an intermediate stage. The fact that these two handshapes could function within one frame, "tracing," suggests that these two handshapes have a more gestural base than the others.

Clearly the "B" and "1" handshape errors differ from errors that involve modification of a lexical item, such as the ones represented in Figure 5.2. The modified handshapes were evidently used as a linguistic device to represent a stimulus that the children did not know how to represent. The children who created these handshapes were re-analyzing a lexical item they knew into a new form, although in an incorrect manner.

Other handshape errors that can be placed more into a linguistic structure than a gestural one are the representation of object shapes. For example, the children who used “open.8,” “open.9,” and “small.C/3” handshapes to represent cylindrical objects depicted the round shape of the object, but they did not appear to know how to represent depth, using all the fingers for extent. As they have no language model to learn from, they took advantage of the most salient characteristic of the object (roundness) and represented it using a handshape that best fitted the round characteristic in their handshape inventory. The handshape inventory for “cans” could also co-exist with gestural processes to “drink-from-a-glass” where the handshape is a handling classifier inserted into a verb of motion. Here the use of a gestural frame suggests that initially Deaf children resort to processes that demonstrate their range of communicative competence.

6.8. Conclusions

The use of handshapes that function as classifiers in verbs of motion and verbs of location appear to be a complex process in the acquisition of signed language in Brazilian Deaf children. The current study suggests that the process is dependent upon both maturation and length of exposure to a signed language. The linguistic complexity of the language clearly plays a role in this developmental process. All of the handshapes were acquired and used by the DCDP, some early and some late. Some handshapes in LSB do not appear until the Deaf children of hearing parents have contact with good language models. This is seen in the younger DCHP's lack of handshape inventory, suggesting that their exposure to non-proficient hearing teachers and schoolmates is not a sufficient condition for internalizing the parameters of language resulting in fluency.

As already reported by Supalla (1982) and Schick (1987), the children in this study did not seem to be acquiring LSB as "holistic pantomime," but they seem to be acquiring each language component one at a time. They start by using primary and less marked handshape forms first. The handshapes most used in this study are "B," "C," "A," "S," "1," and "5," all of which are reported to be present in the first and second stages of sign language acquisition (Boyes-Braem, 1990: McIntyre, 1994). The handshape "O" was not used very often. This is probably due to the limitations of the stimulus items, so that the "O" handshape was not necessary to represent any of the objects. The classifier handshapes used by DCHP are among the least marked handshapes, and are included in some of the earliest handshapes acquired by DCDP (Boyes-Braem, 1990; Marentette & Mayberry, 2000). These unmarked handshapes also appear to be the default handshapes used when a more specific handshape is not known. The Brazilian Deaf children appear to over-generalize the classification of objects that these handshapes may be applied to.

Deaf children who use gestures to communicate make their own associations of handshape to stimuli. When this handshape coincides with the ones used in conventional signed language, they acquire the language easily (Goldin-Meadow, 2003). If the gesture conflicts, the children have more difficulty in re-setting parameters, or they may have difficulties in creating new parameters in their own inventory of handshapes. For example, a young child whose homesign for car (hands holding the car's steering wheel) is similar to the LSB lexical sign for CAR may acquire the LSB sign easily. Having only a few months of contact with the conventional signed language, a Deaf child will not be able to establish an extensive handshape inventory for representing more than one car, which requires a classifier form. When this Deaf child is presented with a stimulus item such as “cars in pairs in a zigzag arrangement,” he/she may over generalize the capability of their sign for CAR by producing this sign in different locations. In this response, the lexical sign for CAR is produced in 3 different locations. The form of this sign does not mean that each hand as an “S” handshape represents a car, but the child means to suggest that there is a car at each of these three different locations. The child has acquired the knowledge of how to represent the “location,” which appears to be easier because the child can rely on the cognitive representation of the location of objects with reference to his/her own body (Marentette and Mayberry, 2000). When confronted with the “B” handshape as classifier used in conventional signed language, it should take more time to relate the new handshape as a classifier form in his own handshape inventory. This may make the acquisition process of DCHP longer than the acquisition process of DCDP, since the latter have full language models to learn from, and do not have to “create” a language from their own experiences (i.e., with impoverished input).

The DCHP, despite the lack of models, demonstrated that they were able to attain some proficiency in the use of handshapes as classifiers even with a tremendously impoverished language model, which provides evidence supporting partially Bickerton’s Language Bioprogram Hypothesis (LBH) (Bickerton, 1981, 1984, 1990).

These results indicate that the DCHP did not create language “from scratch.” They show a pattern of handshape use similar to the pattern of handshapes produced by babies who are exposed to proficient language models, such as Deaf mothers. These results suggest that the least marked handshapes would be the first to be present in the Deaf children’s list of preferred settings of the bioprogram. Children choosing these handshapes assume them to be appropriate for representing most of the stimuli in the absence of contrary evidence, as would be suggested by the LBH.

Since the DCHP start to have contact with a signed language only after they enter school, they take time to set the acquisition process in motion: they have to substitute conventional signs for homesigns and gestures, as well as start using the handshapes coherently and cohesively, which may not be easy since they are not exposed to good language models and will receive conflicting input. Even so, as long as they have more contact with signed language, and use it to communicate, they start regularizing it, as other studies about impoverished input have shown (Singleton, 1989; Singleton & Newport, 2004).

Despite the fact that the DCHP show improvement according to length of exposure, the improvement is not normally distributed among the children. It may be the case that some children start school earlier than others, and the groups reflecting different lengths of exposure include children from different chronological ages, which may have influenced the results; however, as in most of the DCHP results, there is little to show that the DCHP who are exposed longer have better results. It may be that those DCHP performed better because they have more contact with DCDP, Deaf adults, or they are older.

The DCHP seem to be improving not necessarily as a consequence of their exposure to the input, since there is no regular pattern of improvement (as seen in many individual results); but because they have more contact with a signed language, and as they interact more using this language, they attempt to produce more classifiers and actually they regularize their language (as Simon, whose parents were not good language models) (Singleton, 1989; Singleton & Newport, 2004). The DCHP's results do not equal the DCDP's. We claim that these DCHP are at least 3 years delayed in relation to the DCDP in this study. Mayberry & Lock (2004) discuss the linguistic plasticity claim that language may be an ability that is genetically specified, but its growth crucially depends upon early experience to achieve full development. In other words, it seems that the DCHP in this study will never be able to acquire language at the same fluency level as the DCDP, since they were not exposed to language early enough.

The four hypotheses presented in this study were all confirmed. The first hypothesis stated that quality of exposure is a significant factor in determining output. Clearly the results showed that the children who are exposed to a natural signed language in the normal process (DCDP) benefit from this input in the acquisition process. These children made their handshape choices within the language and according to their language models, they did not resort to any gestural forms in their productions. On the other hand, the DCHP's language models are not proficient signers (non-proficient teachers and schoolmates), so their language choices reflect their own way of seeing the world.

The second hypothesis stated that the quantity of exposure has a significant effect in determining output, but it cannot fully compensate for quality of exposure. The results have shown that the DCHP who have longer exposure to a signed language performed better than the other children who have less exposure time; however, their mean proportion of correct responses equals the younger DCDP's responses, indicating a delay of about 3 years in their acquisition when compared to the DCDP.

The third hypothesis stated that age has a significant effect in the production of output. The results confirm the third hypothesis: younger children (both DCDP and DCHP) performed more poorly than older children, as a consequence of their developmental process.

The fourth and last hypothesis stated that the children with high quality and/or quantity of exposure would produce output within the linguistic system, while children with low quality/quantity of input would produce output based on processes outside the linguistic system. Both the DCDP and the DCHP who have more time of exposure produced more classifier handshapes in both their correct and inaccurate attempts. This result indicates that the children who may not have known how to represent a stimulus attempted to choose a handshape from their linguistic inventory. Sometimes they were able to guess well and choose a handshape within the same class as the correct classifier handshape, sometimes not, but they attempted to draw upon their language system. The less exposed DCHP choose their handshapes from a smaller inventory of handshapes.

When that inventory was not sufficient, they created their own handshapes to achieve the intended meaning. The children were very creative, sometimes they modified elements of the signs that were not allowed to be modified suggesting that they knew that modifications were permitted. This requires knowledge of the language system to be acquired and the ability to make predictions and generalizations. All of these linguistic devices are available but sometimes the language models may mislead the children and result in the wrong predictions, a language acquisition process found in all children. Even though these Deaf children are presented with impoverished and conflicting input, they seem to rely on a language acquisition process which takes advantage of analyzing the input, making predictions and modifying output. When the younger children exhausted their linguistic inventory they resorted to gestures, such as mimicry and pointing to represent what they intended to describe. This suggests that the desire to acquire a language is incredibly strong and functions even in the face of significant obstacles.

6.9. Implications and further research

This study about the acquisition of handshapes functioning as classifiers used in verbs of motion and verbs of location by Brazilian Deaf children has a number of implications. The first thing to consider is the importance of this study to other linguistic research in language acquisition. The majority of Deaf children studied here (89%) do not have contact with proficient users of LSB, yet many of them use a signed language in their daily interactions. This study addresses the issues of impoverished input, reliance on gestural processes and other strategies that children rely on to communicate with limited language knowledge. Since the DCHP lack good language models, they have difficulty internalizing the parameters of the LSB handshapes. For this reason, they acquire language more slowly and make more errors when compared to children who have regular contact with a structured language, such as DCDP and hearing children. The fact that these children acquire a signed language at a slower pace will negatively influence their development of knowledge at school. The period when a Deaf child is exposed to a language, and the length of time it takes to process that language and become fluent in it, clearly impacts what we know about critical period research. The impact of late exposure, between 6 and 10 years of age, to a language is not precisely known. This study suggests that the initial age of exposure, the quality of the input and rate of acquisition will impact the final outcome of level of language fluency. The children in this study are clearly on their way to acquiring a signed language but may not be able to close the gap in fluency and language knowledge possessed by their DCDP peers. This issue needs further investigation to determine the impact on language acquisition and more clearly define the critical period time frame.

This study indicates that there are differences that go beyond parenting. Maturation and length of exposure to good language models are two factors very influential in Deaf children's language acquisition and development. Further research is needed to shed light on the implications of these two factors in the acquisition of LSB.

The possible impact of exposure in the acquisition of signed languages is an issue that needs more study. Since many children are exposed to non-proficient language models, or to those sign models who are using adapted versions of signed language, there are some issues that definitely need more study. They are:

a) The critical period in the acquisition of classifiers – what are the consequences of acquiring a first language later and attempting to acquire that language while being exposed to an impoverished and conflicting language model, a model that "does not make sense"? More study is needed to shed light on this critically important issue.

b) The impact of impoverished models – there are a few studies such as Singleton (1989) and Singleton and Newport (2004) that deal with impoverished language models. The language models in these studies were late learning Deaf parents. It will be important to examine the production of hearing learners of a signed language as a second language. It should be very revealing to have a study about the use of classifiers that tests the production of second language models (such as hearing teachers in schools for the Deaf) and Deaf adults and Deaf children from different ages using the same battery of tests. How is the performance of Deaf children in the production of classifiers affected by impoverished models? What differences will we encounter when we compare the output of hearing second language learners and late signed language learners in Deaf adults, and Deaf children acquiring language from these models?

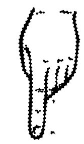
c) The impact of incorrect input – Deaf children are exposed not only to impoverished language models, but many are also exposed to incorrect and conflicting input. The use of simultaneous communication systems that are used to teach Deaf children usually favors the spoken language, to the detriment of the signed modality (Johnson, Liddell & Erting, 1989). The resulting language sometimes presents contradictory and incorrect information to Deaf children. The same type of studies proposed for impoverished language models that evaluates both the performance of language models and compares them to the language performance in Deaf children will provide a better understanding of the consequences of incorrect input.

The results of this study indicate that the language input at an earlier age produces better language knowledge. This timing of language acquisition affects a child's linguistic, cognitive, and social development for the rest of their lives. There is an urgent need, especially in Brazil, of an educational program introducing Deaf adults into schools so that adequate language models are accessible to the Deaf children. It is crucial to teach LSB as a subject in the curriculum for Deaf children so that they may use their knowledge of a first language to learn a second language, Portuguese. This will provide them with the necessary tools for their linguistic development and consequently will facilitate their academic development.

Appendix: handshapes used and their respective denomination[19]


1

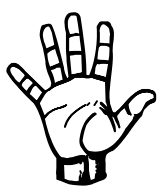

1 palm-down

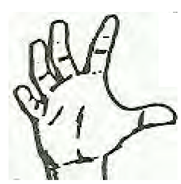

1.point.down


3


4

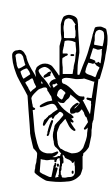

4 palm-side


5


curved.5


curved.5 palm-up


curved.5 palm-down

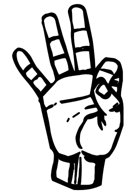

7


8

[19] The denomination is according to MacLaughlin, Neidle & Greenfield (2000), but the conventions palm-up, palm-down, palm-front, palm-back, palm-side, and "x.pointing.down" (fingers point down) were established in this study to facilitate comprehension. All denominations cited in this work are exemplified in this appendix. In some instances, certain denomination names have been modified to reflect the sample of handshapes.


open.8

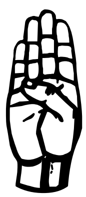

8o


9


open.9


A

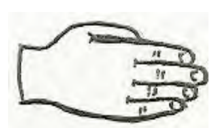

A palm-down


B

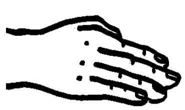

B palm-out

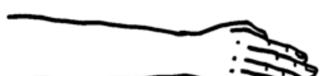

B side fingers up


B palm-side

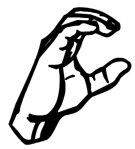

B side, palm-back


B palm-up


B palm-down

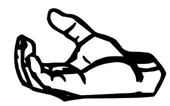

B palm-down +arm


curved.B palm-up

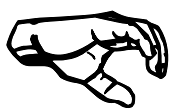


C

C palm-side

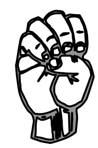


C palm-up



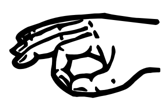
C palm-down

D

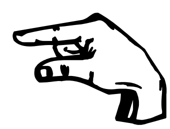


E

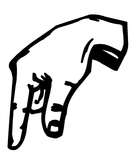
F



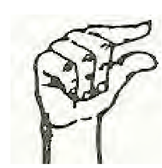
F palm-down



G

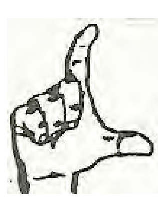


G palm-down



G palm-side

small.C/3 (sml.C/3)

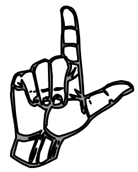


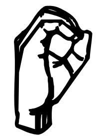
large.C/3 (lrg.C/3)

H

I


K


L

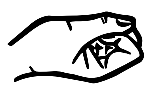

O

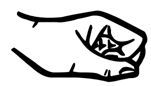

baby.O (bO)

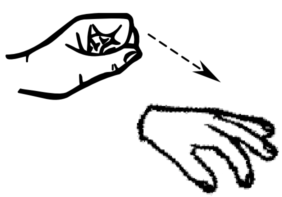

R


Modified R

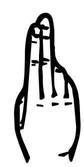

S

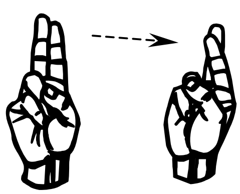

S palm-up


S palm-down

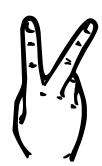

S to-crv.5 palm-down


U (f = palm-front)

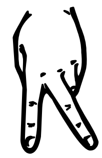

U (b = palm-back)


U-R

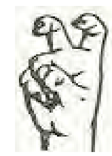

V (f = palm-front)


V (b = palm-back)

V palm-down



V.pointing.down



Curved.V

W

X (1h)

Y

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