

Sensitive Period Effects on the Acquisition of Language: A Study of Language Development

Stephanie Beth Berk, Ph.D.

University of Connecticut, 2003

A sensitive period for first language acquisition has been proposed and previously supported primarily by case studies of social isolates and studies with Deaf adults who were exposed to American Sign Language (ASL) during mid- to late- childhood. Although informative, case studies with hearing, social isolates are confounded by physical abuse experienced by the children. Studies with Deaf adults do not show the development of language acquisition under the condition of delayed input. There is now new evidence for sensitive period effects on first language acquisition from two unrelated children, MEI and CAL. MEI and CAL were not exposed to a first language until approximately 6 years of age. There is no history of physical abuse- just a misdiagnosis of mental retardation instead of deafness. MEI and CAL, once exposed to language, were immersed in ASL.

The results of filming MEI and CAL for 3 1/2 years, from the beginning of their language acquisition process, suggest that sensitive period effects are seen with at least one specific aspect of language- the formal syntactic features (Chomsky 1995). Formal syntactic features are found in different domains of language, including verb agreement, word- order changing mechanisms, and null

referents. Analyses of MEI's and CAL's naturalistic language production data, along with preliminary experimental results, reveal difficulties with precisely these domains. MEI and CAL have a higher overall percentage of errors per sample than the two native- signing Deaf comparison children. MEI and CAL made most of their errors with agreeing verbs. This class of verbs is the only one that marks syntactic features in ASL. MEI and CAL attempted fewer utterances with word order variations, suggesting a difficulty with the formal features that trigger some of the word order change mechanisms. Finally, MEI and CAL produced utterances with incorrectly null referents more often than the native signers, again implicating a difficulty with the formal features needed to trigger the syntactic licensing of null elements.

The results from this present study, combined with the results from the studies with Deaf, adult late- learners, suggest that sensitive period effects exist, are specific, and are long- lasting.

Sensitive Period Effects on the Acquisition of Language: A Study of Language
Development

Stephanie Beth Berk

B.S., Cornell University, 1996

M.A., University of Connecticut, 1999

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

at the

University of Connecticut

2003

UMI Number: 3118939

Copyright 2003 by
Berk, Stephanie Beth

All rights reserved.

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI[®]

UMI Microform 3118939

Copyright 2004 by ProQuest Information and Learning Company.

All rights reserved. This microform edition is protected against
unauthorized copying under Title 17, United States Code.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

Copyright by
Stephanie Beth Berk

2003

APPROVAL PAGE

Doctor of Philosophy Dissertation


Sensitive Period Effects on the Acquisition of Language:
A Study of Language Development

Presented by

Stephanie Beth Berk, B.S., M.A.

Major Advisor 
Diane C. Lillo-Martin

Associate Advisor 
Carol A. Fowler

Associate Advisor 
Donald Shankweiler

University of Connecticut

2003

Acknowledgements

This work was supported in part by National Science Grant #BCS-0078788, National Institutes of Health Grant #NIDCD DC 00183, and a grant from the University of Connecticut Research Foundation.

I want to thank Dr. Mish Shoykhet, my husband, best friend, and colleague, for his unfaltering support, love, and countless scientific discussions on many topics related to child language acquisition and sensitive periods.

I am honored to have trained with my advisor, Dr. Diane Lillo- Martin, whose commitment to nurturing the scientific and personal growth of her students is unparalleled. Willing to bridge academic departments, to attempt long-distance training, to be always available for one-on-one meetings (via phone, or in person), Diane has taught me more than just science. She has been an ideal role- model -- a teacher, an advisor, and a real- life mentor. Importantly, I want to thank Diane for believing in me from the start.

I am grateful to my committee members, Drs. Carol Fowler and Donald Shankweiler for their patience and support. Throughout the project, and more specifically with the writing of this dissertation, Carol and Donald have been more than just committee members. They have taught me about editing and precise writing. They have helped me evaluate my data from the perspective of other theoretical frameworks. For all of their instruction, and knowledge, I am thankful.

Additionally I would like to thank Mr. Ralph D' Ambrosio, for helping me find my love of research, and Dr. Barbara Lust for showing me that my specific research passion is in the field of language acquisition.

This project could not have been started, let alone completed without the support of the School for the Deaf, the families of MEI and CAL, and importantly MEI and CAL, themselves. They have all provided me with an opportunity like none other. I have been welcomed into their homes and the Deaf community. I hope to always maintain the friendships I have made over the past 4 1/2 years.

For all their countless hours of staring at video-tapes, and trying to write down, a language without a writing system, I thank my research assistants: Jamie-Leigh Saunders, Wilmonda McDevitt, and Amy Nelson. This dissertation could not have been possible without you. For 3 1/2 years of playing with MEI and CAL on tape, for helping me with finding and creating interesting activities, and for being a consultant when needed, I especially thank Shirley Fischer.

I would also like to express my gratitude to the faculty and staff of the Department of Psychology at the University of Pittsburgh. They have offered me a “home away from home” by providing me with an office, teaching experience, and interesting academic discussions. In particular, I would like to thank Drs. Anna Halechko, Celia Brownell, Mark Strauss, and Jennifer Ganger.

My friends have been a tremendous support for me during the many years of this project. It is my honor to thank Jenny Ganger, a friend and colleague, who helped me become situated here in Pittsburgh. Jenny has listened to numerous practice talks, and given me much advice, both academic and personal. If it were not for Jenny’s advice and insistence, Sam would likely have been born at home instead of at the hospital.

Another friend, and colleague, that deserves special mention is Natasha Rahklin. For all of my numerous trips from Pittsburgh, PA to Storrs, CT, Natasha and her family have welcomed me into their home for a week at a time, often on short notice. Natasha has listened to a practice version of every talk I have given, including my 46 minute long doctoral dissertation defense presentation. I feel truly lucky to have such wonderful colleague- friends.

I would also like to thank the following friends, who have helped me keep my sanity and a clear perspective on dissertation versus real life: Elaine Solomon, Amy Himmel, Amy Weiss, Laura Schneiderman, Carina Perilman, and Marnie Rudick.

In attempting to balance “being a mommy” and completing my dissertation, I would like to express my gratitude to three very special people, who have watched and taken care of Sam, while I worked: Megan Palmisano, Sabrina Dunn, and Aliza Reimer.

Finally, my family has been a tremendous source of support for me throughout my training. First and foremost, I would like to thank my parents, Sharon and Fred Berk, who actively encouraged my interest in ASL, supported my decision to go to school “forever”, and eagerly still try to understand what it is that I plan to do for a living. I want to thank my sister, Lauren Kline for all of her hours of typing my papers late into the night/morning and for making me laugh. I also thank Genya and Ilya Shoykhet for their support and encouragement.

Table of Contents

Chapter 1	Sensitive Period Effects on the Acquisition of Language: A Study of Language Development	1
Chapter 2	A Sensitive Period for Language	18
Chapter 3	ASL Structure and Native Language Acquisition	43
Chapter 4	Participants	54
Chapter 5	Methodologies	73
Chapter 6	Acquisition of ASL Under the Condition of Delayed Input	88
Chapter 7	Sensitive Period Effects on Verb Agreement	116
Chapter 8	Converging Evidence-Preliminary Data	145
Chapter 9	Discussion	156
Appendix A	Sample Verb Agreement Coding Screen	170

Appendix B	Sample Utterances from MEI and CAL	171
Appendix C	Verb Agreement/ Word Order Act-Out Task Stimuli	176
References		179

Chapter 1

Sensitive Period Effects on the Acquisition of Language: A Study of Language Development

Sensitive periods for different aspects of development in systems ranging from language acquisition to vision have been given much attention since at least as early as the 1920s (Bruer, 2001, Stockard, 1921). The hypothesis of a sensitive period for language, i.e. a period of time, after which language cannot be normally/ fully acquired, was first discussed extensively by Penfield and Roberts (1959), and made popular by Lenneberg (1967), in his scholarly book.

It was hypothesized that the sensitive period for first language acquisition is due to a loss of neural plasticity triggering the end of the period of normal language acquisition. However, acquisition of a second language was also argued to be affected (Lenneberg, 1967). Lenneberg (1967) proposed that the two hemispheres are equipotential at birth and through childhood, and that the left hemisphere dominance is fully established by puberty. He presumed that the decline in functional plasticity in language acquisition paralleled a physiological gradient.

The hypothesis that there is a sensitive period for first language acquisition has found support from case studies of language isolates, along with studies with adult members of the Deaf community who were exposed to a first,

accessible language at varying ages (Davis, 1940, 1947, Curtiss, 1977, Newport, 1984, Mayberry 1994).

However, for the cases of language isolates, there are confounding factors such as physical abuse and imprecise background information which leave many questions regarding the effects of a sensitive period for first language acquisition. Studies of Deaf adults can also be of limited interpretability, because the childhood background information is often incomplete, and because the developing language acquisition system has not been observed.

Results from studies of second language acquisition suggest that there is a decline in the ability to acquire a second language beginning in childhood with successful, native-like second language acquisition becoming impossible by the teen years (Krashen, 1973, Johnson and Newport, 1989, Patkowski, 1980, Birdsong, 1991). This declining window of opportunity has led many researchers to believe that there is a sensitive period for second language acquisition.

There are conflicting hypotheses that are currently being debated though, based on studies showing that much of language can be acquired after the supposed end of a sensitive period between 5 and 17 years of age. Evidence for this has been found for both first and second language acquisition (Mason, 1942, Flynn and Manuel, 1991, Birdsong and Molis, 1998, Bialystok and Hakuta, 1994). Some findings from both the study of first and second language acquisition that support modest sensitive period effects suggest areas of language acquisition that may be less susceptible to sensitive period effects, for example lexical

learning. The previous findings also suggest aspects of language that may be more susceptible, for example verb morphology.

The present work is based on the hypothesis that there are aspects of first language acquisition that will be affected by a sensitive period, in particular those involving formal syntactic features, and others that may not be affected, such as those involving semantic features. Lexical entries in the mental lexicon contain three collections of features: phonological features, semantic features, and syntactic features. Included in these features are purely formal features, such as [+N], [+/- plural]. The present hypothesis is that the purely formal, non-meaningful features are those most affected by a sensitive period. This work is also based on the assumption that there exists at least one ideal circumstance that allows the examination of sensitive period effects: deaf children with delayed linguistic exposure.

Universal newborn screening for deafness has not yet been adopted by all of the states in America. Therefore there is still variation in the timing of a diagnosis of deafness in children in some states. Although there has been a very recent implementation of intensive, early intervention to provide language input for children diagnosed with deafness and/or language delays, this was not the case even ten years ago. Hence it is still possible, although quite uncommon, to find a child who has profound levels of deafness, but is not exposed to a spoken language or sign language until later ages (GRI, 2000, Emmorey, 2002). When a child is diagnosed later in childhood and, even more rarely is then immersed in American Sign Language (ASL), there is an unparalleled opportunity for research

that addresses sensitive period effects, without some of the ambiguities that plague other sources, such as the cases of social isolation and abuse. This special circumstance allows the examination of language acquisition with delayed input, but without confounds of physical abuse, and/ or the imprecise nature of retrospective background information.

American Sign Language (ASL) is a natural human language that provides the opportunity to examine the acquisition of formal and semantic features within particular systems. One such system is the ASL verb agreement system. Although many systems incorporate both formal and semantic features, an ideal domain to study in ASL is verb agreement because it allows separation of purely formal features of agreeing verbs from semantic features in spatial verbs.

Both agreeing and spatial verbs express features using similar devices. In particular, they both involve morphology that employs the path of verb movement, although they are conveying different things. ASL has three defined and currently recognized categories of verbs (Fischer and Gough, 1978, Padden, 1983, 1990, Meir, 1984, Meier, 1984, Rathmann and Mathur, 2002, and Lillo-Martin, 2002). There are 'agreeing' verbs that mark agreement with their subject and/or object. There are 'spatial' verbs that indicate spatial location. And there are 'plain' verbs that show no agreement at all. The relevant difference between the agreeing and spatial verbs is in the interpretation of their markers. Whereas spatial verbs provide information about location, agreement marking is purely formal.

By comparing native versus delayed acquisition of the verb agreement system of ASL evidence can be found that addresses the question of whether a sensitive period exists for particular or general aspects of language acquisition, and if so, what these effects are.

The goal of this work is to clarify the effects of a sensitive period for language acquisition, whether they are quantitative or qualitative, minimal or extensive, and to trace the developmental course of language acquisition when the first accessible language input begins at approximately age 6 years.

Previous research with Deaf later-learners of ASL has found specific areas of language that are problematic, but as a whole these later-learners are able to use ASL as their dominant language and function fully in the Deaf community (Mayberry, 1993, among others). To date, there is no developmental study of language acquisition and more specifically the verb agreement system, in the conditions under which a child, not suffering physical abuse, goes from the absence of language exposure to full immersion in a natural language. The current study reveals what happens in the course of language acquisition between childhood and adulthood, when language exposure begins at the time that the proposed sensitive period is ending.

In order to accomplish this goal, I conducted a 3 1/2 year longitudinal study of two unrelated children, MEI and CAL, who were exposed to their first language, ASL, when they were 6 years old. Once immersed in language, they were both surrounded by and signed to, by people using ASL. That these two

forms of exposure occurred is an especially important issue for several theories of how language is acquired or learned.

Naturalistic language production was sampled twice per week, using both books and toys as language elicitors. For comparison, a native signing age-peer was filmed periodically using the same methods. A native signing younger child, potentially a language-experience peer, was also filmed using similar methods.

In addition to the naturalistic language production data, I conducted an experimental game designed to test the comprehension of sentences with verbs in the three categories that comprise the verb agreement system, and to test the interaction of verb agreement with grammatical ASL word order variations. This Act-Out task permitted comparison of the native signing children with MEI and CAL to see if there were similarities at the time of testing, between: 1) MEI and CAL, 2) MEI, CAL and the age-peer, and 3) MEI, CAL and the language-level peer.

Using the data from both the later learners and the native signers, I test for developmental trends in the acquisition of the three verb categories, as indicated by error rates and error types produced. Then I attempt to establish whether the effect of a sensitive period is delay and/or deviance. The comparison of these Deaf study participants also provides evidence as to whether sensitive period effects are qualitative or quantitative in nature. This line of research has been possible only because of the special circumstances regarding language in the Deaf community.

1.1 Deaf community in the United States and language experience

The Deaf community offers a special opportunity to examine the effects of differing ages of acquisition and consistency of language experience on language acquisition. It is estimated that only 5 – 10 % of the American Deaf population has Deaf parents and acquires ASL as a native, first language (Hoffmeister & Wilbur, 1980). The deaf children born to hearing parents virtually always do not have native input, even if ASL is provided as a first language. The vast majority of hearing parents must learn to sign at the same time their children do, providing often imperfect and limited linguistic input. Many of those children who are not exposed to ASL at an early age are exposed to spoken English, through lip reading and speech training. But as many researchers have discussed, (including Newport, 1990, Quigley & Kretschmer, 1982, and Wilbur, 1979) this exposure is not highly effective for the congenitally and profoundly deaf. English is not acquired in the same fashion or with the same proficiency as hearing children achieve.

In the recent past, many Deaf people did not have an opportunity to acquire ASL as children. Many attended oral schools and were not exposed to ASL until they were older than 15 years. Even deaf children who attended Deaf residential schools, were not exposed to ASL until they were about 5 years old, unless they had Deaf parents or relatives. In addition to the varying ages of exposure to ASL in the Deaf community, there is also enormous variation in the quantity and “quality” of ASL exposure, especially with deaf children of hearing parents. Upon choosing to have their child learn ASL, many of these hearing

parents themselves start to take classes in ASL. So unlike a typical language environment in which the parent is a fluent user of the language the child is being exposed to, in this situation the parent is as much a beginner as the child. This contributes to the enormous variation in language input among deaf children of hearing parents.

Many researchers interested in language acquisition, with help from the Deaf community, are currently studying two major questions. The first is how the quality of language input affects the ultimate acquisition of the language (e.g. Singleton, 1989, Singleton and Newport, 1987, 1999, among others), and the second is how the timing of language exposure affects acquisition (Lillo-Martin, et al 1996, among others).

This second question has been studied using both data from Deaf adults and acquisition data from children, spanning a range of linguistic properties, such as word order, morphology, and verb agreement. There are many studies of verbal morphology and the acquisition of verb agreement with native and later-learning Deaf signers. These studies suggest that when linguistic input is delayed there are verb agreement problems that persist even among adult signers who have been using ASL as their primary language for up to 40 years. Hence in this dissertation I study aspects of the developmental course of verb agreement for the two later-exposed children. (The verb agreement system of ASL will be discussed in detail in a separate section.)

Later- language- exposure used to be common in the United States, and there are many Deaf adults today who, despite late exposure, use ASL

intelligibly, although not natively. Hence, they must have acquired many aspects of the language. Perhaps, the differences between later- learning Deaf adults and native ASL signing adults, despite many years of language 'practice', reflect effects of a sensitive period on language mechanisms. Perhaps these same disparities from native fluency or even greater differences than these, can be seen in the developing language of the later-exposed children, as they start to figure out the details of the system. Comparison of the developmental course of ASL acquisition by later-exposed children and appropriate comparison groups may reveal the departures from native fluency that mark late acquisition. This type of comparison will also help in determining whether/how the language mechanisms compensate, such that the delay in language exposure does not prohibit the use of language, but instead has the outcome revealed by previous studies of late learners as adult users of ASL.

Previous research has shown that there are differences between native, early, and later learners of ASL as a first language. Of this, there is little controversy. However, it is a goal of this project, as well as of future research projects, to determine the nature of these differences, for example, what specifically the differences are, why the particular differences are such, and whether they are effects of a sensitive period for language acquisition. This goal will be addressed by examining the development of language by MEI over the course of 3 1/2 years as compared to a native signing younger child. Data from CAL will also be used, although the reported sessions are not as frequent.

1.2 MEI and CAL- A once common, but now rare situation

MEI was misdiagnosed as being low-functioning mentally retarded, but instead she is severely to profoundly deaf. CAL was diagnosed with a severe to profound hearing loss by about age 2 years. However, he was not exposed to an accessible first language at that point. Neither MEI nor CAL was exposed to an accessible first language before the age of about 6 years. Both children are of average to above-average intelligence. At about age 6 years both children were immersed in ASL at a residential school for Deaf children. I have video-taped the language development of these children to help fill the gap left in the field of language acquisition regarding sensitive periods and the course of language acquisition without physical abuse. The intent is to address the question: What is affected by a delay in language exposure? Can sensitive period effects be seen when language immersion begins as early as age 6 years?

1.3 Phrases and terms defined:

The definitions of terms such as *critical period*, *sensitive period*, *language acquisition*, *language attainment* and *language-use* differ across researchers. This has been noted to be particularly true in the child development literature (Bruer, 2001). Hence I offer the following definitions. Critical periods, as established by Lorenz (1937) have two defining features: 1) an animal's susceptibility to certain kinds of experience is restricted to short, well-defined periods in development, and 2) effects are permanent and irreversible.

Because decades of recent research has found that critical period effects are not necessarily permanent, many scientists now favor using the terms 'sensitive phase' or 'sensitive period'. This term 'sensitive period', carries the implication of long, ill-defined periods, when specific kinds of experiences have particularly pronounced effects on development, but effects remain modifiable or even reversible by subsequent experience (Bruer, 2001). According to Bruer (2001), child development researchers rarely use the term "sensitive period", because "qualified talk about ill-defined sensitive periods, with modifiable effects lack the same emotive and rhetorical force needed to prompt interest in policy reports, garner media attention, and engender public interest." (Bruer, 2001 p. 11).

The results of this research project will be presented in terms of sensitive period effects, due in part to previous research regarding the effects of delayed linguistic input on both endpoint attainment, and on what is affected during language acquisition. In reviewing background literature however, I will use the terms used by the respective researchers.

The next two terms to be discussed are "language attainment" and "language use". They differ in that "language attainment" refers to language competence, whereas "language use" refers to language performance. Despite this difference, these terms are often used interchangeably in the second language acquisition literature.

Another major difference though, appears to be in the criteria the researcher chooses for measuring adult language. In discussions of second

language acquisition, different benchmarks are used by different researchers. Some consider language to be fully acquired/learned only when there is native-like language attainment, whereby the later L2- learners are indistinguishable from native users on every test that can be given. Other researchers consider a language to be acquired when it has been used as the primary language for 8-15 years, and the later-learners are able to score within a range that is similar to that of native users on experimental tasks. For later learners, the methods of acquiring the language have been postulated as being different depending on age of acquisition. For example, younger learners are considered to learn implicitly whereas older learners require explicit instruction, according to some researchers (DeKeyser, 2000). Hence in the research to be presented here, the use of both the terms “native-like attainment” and “language- use” will be avoided, and replaced with a thorough and clear description.

1.4 Anecdote from Herodotus and more recent hypotheses for sensitive periods

Whereas today it is widely judged unethical to test experimentally what would happen if a child were isolated from language, Herodotus (ca.410 B.C./1942), recounts exactly such an attempt. He writes of the Egyptian king, Psammetichus, who in the quest to discover which culture was the most ancient of mankind, took “two children of the common sort and gave them over to a herdsman to bring up at his folds [...]”. Psammetichus instructed the herdsman not to let anyone utter a word in their presence, keep them in a sequestered cottage, introduce goats to their apartment, and take care of their other needs.

“His object herein was to know, after the indistinct babblings of infancy were over, what word they would first articulate.” Herodotus goes on to write that the herdsman one day walked in and the two children greeted him with a word that sounded like “becos”. After that time whenever he visited the children they would always say that word to him. He brought the children to the king, who upon hearing the word, asked around and found out that it was similar to the Phrygian word for bread. Hence he relinquished the claim of extreme antiquity to the Phrygians.

While it appears that Psammetichus believed that language is innate and that environmental influence is unnecessary, he had a theory of what would happen if children were isolated from language. That no language would be acquired, due to a sensitive period for language, was not a possibility to him.

Current thought on the topic is quite different. Many researchers today believe that a sensitive period for language either does, or could plausibly exist. This is how they interpret studies of second language acquisition and the reports of language and social isolates (although such isolates usually suffer physical abuse as well). There have been numerous accounts of potential mechanisms that underlie age-related declines in language learning ability, two of which are presented next.

One proposal is that there is a loss of neural plasticity in the brain that stems from the progressive lateralization of cerebral functions and the ongoing myelinization of the neurons in the brain (Penfield and Roberts, 1959, Lenneberg, 1967), making learning more difficult with reduced neural plasticity.

Supporting this hypothesis, from her work with language isolates, Curtiss (1982) suggests additionally that the language-specific learning mechanisms responsible for learning syntax in particular are no longer available after the sensitive period for language ends.

A second proposal, as reviewed by Birdsong (1999), is that there is a maladaptive gain for language acquisition, of processing capacity with maturation. Newport (1990, 1991) provides such a proposal with her “less is more” hypothesis. She suggests that cognitive immaturity is advantageous for human learning, including language learning. She hypothesizes that young children’s short-term memory capacity allows them initially to extract only a minimal amount of information, for example a few morphemes from the linguistic input. Hence working within these processing limits, children (younger than age 5 years) are more successful than adults, whose greater available memory allows for extracting more of the input, requiring everything to be dealt with at once. Newport specifically proposes that this is a general cognitive limitation, which includes tasks “(like language learning) which involve componential analysis” (Newport, 1990, p, 24).

1.5 The present study: Discussion of specific hypotheses

The present study provides a first step in documenting the differences in the developing language acquisition system that are potentially due to sensitive period effects. By using primarily the method of naturalistic language data collection with experimental games for focused, converging evidence on the

acquisition of the verb agreement/morphology system of ASL, this study seeks to answer the question of what happens to language acquisition when first exposure is delayed until childhood. Further, are sensitive period effects seen when the input that is finally provided is full immersion in an accessible language and when there are no complications of physical abuse and social isolation?

When first language exposure is delayed due to severe abuse suffered by isolated children, such as Genie, it is not straightforward to tease apart the effects of the isolation versus the effects of the abuse. MEI and CAL, while younger than Genie at the time of language immersion, come from homes where they are loved, fed, and cared for to the best ability of the parents. The home-life situation prior to age 6 years, in conjunction with profound deafness make MEI and CAL good candidates for providing evidence regarding whether the sensitive period effects on language acquisition can be seen if language exposure begins after age 6 years.

Depending on when a critical period for acquiring languages ends, whether it is age 5 years old or puberty, data from MEI and CAL should provide some insight into both the timing of the critical period and what is affected. Likewise, if a sensitive period is indeed a diminishing window of opportunity instead of a strict-cut off, as suggested by Doupe and Kuhl, (1999) for bird song, and Shoykhet (2003) for development of rat whisker neuronal barrels, then some aspects of language acquisition will be affected.

While the first proposals of a sensitive period for language acquisition hypothesized that after puberty a language could not be acquired (Penfield and

Roberts, 1959, Lenneberg, 1967), other proposals hypothesize (Flege & Fletcher, 1992, Newport, 1984) a more variable sensitive period window. Some of the current proposals have the diminishing window of opportunity beginning earlier and some later, than the age of four years as hypothesized by Lenneberg (1967). Current hypotheses (Neville, et al., 1992) are that the sensitive period ends earlier for acquiring particular aspects of language, and that effects can be seen if children have not been exposed to their first language, until ages 3 years to 13 years. Krashen (1973) suggested that if children are not exposed to a language before the age of 5 years, sensitive period effects can be seen in that these children will not fully acquire a language. Using event-related brain potentials (ERPs), Weber-Fox and Neville (1999) found potential sensitive period effects when children were not exposed to an accessible first language by the age of 7 years. And Curtiss (1982) reported the results of three case studies with hearing children, and one with an adult with a profound hearing loss, finding that, if a child is not exposed to a first language until age 13 years, sensitive period effects are observed.

If there is a sensitive period for language, but it has not ended by age 6 years, then MEI and CAL should not stay at the severely delayed level, but should continue acquiring many aspects of the language. However, if there are aspects of language needing to be acquired that are affected by a diminishing window of opportunity, perhaps MEI and CAL will not have normal acquisition of these aspects of language. Hence the acquisition of ASL by these two “special situation” children might continue developing over time, although on a shifted

time scale, but aspects of the language that may have been “closed off” would not develop normally or completely. It is in these respects that language development will differ from that of native or early acquiring language users.

1.6 Preview

The next two chapters provide detailed background information relevant to the research project. In Chapter 2, I present a review of sensitive/ critical period language acquisition research on hearing children and adults. In Chapter 3, I present previous research on American Sign Language acquisition by children who differ in their ages of exposure, with Deaf children, along with specifics regarding the language and verb agreement/ morphology. In Chapter 4, I describe the participants' home life, school life, academic and psychological testing reports, and pre-language immersion life (as recounted by the parents of the children). In Chapter 5, I explain and review the methodologies used for data collection, transcription, coding and analysis. In Chapter 6-8, I present the results of the naturalistic production data and the preliminary results from the piloted Act-Out, experimental task. In Chapter 9, I summarize the findings in both the contexts of sensitive period effects, and of the acquisition of ASL. I discuss the implications and limitations of the findings, and suggest directions for future research both for new studies, and continuing study of these two special-situation children.

Chapter 2

A Sensitive Period for Language

The literature addressing the possibility of a sensitive period for language acquisition encompasses many different, but related lines of study. Evidence from language isolates, second language acquisition, and Deaf adults exposed to ASL at different times, is all part of this literature. Further contributing to the discussion, although not as directly, are children's invention of language, such as their development of home sign systems, studies of children of late-learners of ASL, and the evolution of Nicaraguan Sign Language. This last line of study is relevant as background because it pertains to what children do when they are not exposed to language early. From these different areas of investigation, there are trends that suggest aspects of language that might be affected by a sensitive period.

As noted in Chapter 1, the concept of a sensitive period that I will be using refers to a time period, when specific kinds of experiences have particularly pronounced effects on development, but still allowing for the effects to be modifiable by subsequent experience. This is not necessarily the same usage of the term adopted in the literature that I review next. Some investigators have as their main hypotheses that the sensitive period for language has a strict cut-off (Birdsong, 1999, among others), and/or is not modifiable after a particular age (Lenneberg, 1967), Pinker, 1994, among others).

2. 1 Case Studies of Language Isolates

Throughout history, case studies of individuals acquiring language under unusual circumstances have captured the attention of researchers and the public alike. This is, perhaps in part, because such cases can address questions that are of considerable interest, but that are unethical to address experimentally. Questions like the one asked by the Egyptian king Psammetichus (Herodotus, ca.410 B.C./1942), discussed in the introduction, as well as the question of whether a child not exposed to language until later in childhood can indeed learn a language once exposed, still command much interest.

In Harlan Lane's comprehensive and exquisitely detailed documentation of the Wild Boy of Aveyron (Lane, 1976), there are at least two interesting case studies that pertain to this issue. One is the case of Victor, who was trained extensively by Jean-Marc Itard, from 1801 to 1806. This boy, captured from the woods in 1799 at about the age of 12 years, was not able to speak or comprehend language. He had no social skills and his senses were not as sensitive as they are in unimpaired children (Lane, 1976). Despite extensive socialization and language training, Victor never acquired spoken language. He managed to learn a very rudimentary communication system at best. He was not socialized, and he never learned to control his emotions and impulses.

Although this particular case has often been used as evidence for a critical period for language acquisition, there are numerous ambiguities that prevent a clear interpretation of Victor's failure to learn language. The three men who knew Victor and his story best, believed that Victor was left or lost in the woods at an

age ranging from 5 years to 10 years. Regardless of which age is accurate, he should have acquired language before he was abandoned. Likewise, had he indeed acquired language and lost it, he should have recovered quite a bit with the extensive training he received from Itard. Hence a question is whether the child was left in the woods because he was profoundly retarded, or whether his deficiencies were caused by his abandonment. Because no one claimed Victor as his/her child, this question can not be answered. Further, because his deficits were more than just in language, he seems to have had more general cognitive and perhaps neurobiological deficits. Lane reports that based on the “symptoms” detailed for Victor, he might today be diagnosed with autism.

A second case study on which there is considerable information, but which is largely ignored in current work, was that of Jean Massieu (Lane, 1976).

Massieu and his five siblings were born deaf to hearing parents. They used, what would today be called an extensive home sign system, that the parents understood and used with the children. Massieu writes: “Until the age of thirteen years nine months, I stayed in my region without receiving any sort of instruction. I was in the dark. I expressed my ideas by manual signs or gestures, which I employed to communicate with my parents and brothers and sisters. These signs were quite different from those of educated deaf-mutes.”

At the age of almost fourteen years, Massieu went to a school in Paris, directed by a hearing man named Roche-Ambroise Cucurron Siccard, who was a student of Charles-Michel Epee the founder of the profession of education of the deaf. Siccard worked extensively with Massieu to teach him not only a sign

language based on Epee's work and the vocabulary Epee used- which was comprised of created signs, and not the national sign language- but Siccard also used the national sign language to teach written French. Hence, in a report to the Society of Observers of Man, Massieu signs that "In a period of three months I knew how to write several words; in six months, I knew how to write several sentences. In one year's time, I wrote fairly well.... In four years I became like people who hear and speak.". Massieu was able to answer questions about his childhood memories, about the concepts of God and death, and other questions that he was asked.

This case is particularly important in that it shows that, with his 5 deaf siblings and his parents, Massieu was able to use a created home sign system. Of even greater import, it shows that starting formal education as late as almost 14 years of age, with the base of a home sign system, he was still able to acquire a fuller sign language as well as written French. This was documented by his many letters and talks at different societies.

Two cases reported in the early- to middle- part of the twentieth century also show the resiliency of aspects of language acquisition beyond the age of 6 years in cases of extreme isolation, and possibly abuse. Although the focus of these two studies has been on aspects of socialization and educational methodology, there is some information about the language acquisition of these children. Davis (1940, 1947) reports on a girl named "Anna".

Anna was born in early March of 1932 to an unwed woman with an IQ of 50 as measured by the Stanford/ Revision of the Binet-Simon Scale (1938),

indicating mental retardation. Anna was shifted from house to agency to house until she was 5 1/2 months old. She was then brought with her mother to her grandfather's house and kept in an "attic-like room" until she was a little older than 5 1/2 years. Her mother worked outside on the farm all day, and occasionally went out at night. Davis (1940) reports that "Anna received only enough care to keep her barely alive. ... She apparently had no instruction, no friendly attention".

Davis (1940) details the finding of this child and the beginning attempts at socialization. But he reports that by 1939, two years after Anna was discovered, she still did not speak. She could "walk, understand simple commands, feed herself, achieve some neatness, remember people, etc", but still not produce language.

Davis (1947) reports that tests of hearing, vision, and motor skills yielded normal results, and a clinical psychologist, Professor Francis N. Maxfield, was brought in to evaluate Anna. He noted that speech was in the babbling stage and "promise for developing intelligible speech later seems to be good". Anna remained in a school for retarded children until her death due to "hemorrhagic jaundice" on August 6th, 1942. In this 1947 paper, Davis details the last two updates on Anna from the school, focusing primarily on socialization advances such as her being a follower instead of a leader. She was reported as having normal food habits, being able to put her clothing on, but not being able to fasten the clothes, and being able to bounce and catch a ball. He also remarks that Anna had finally begun to develop speech. At 9 years, 4 months of age, he

found her most comparable to a child of about 2 years of age. He states that she “could call attendants by name and bring in one when she was asked to. She had a few complete sentences to express her wants”.

The last report Davis has for Anna was on June 22nd, 1942, 1 1/2 months before her death. He writes that there were only “slight advances” from the time before and that Anna was now able to “follow directions, string beads, identify a few colors, build with blocks, and differentiate between attractive and unattractive pictures. She had a good sense of rhythm and loved a doll. She talked mainly in phrases but would repeat words and try to carry on a conversation. ... (p.434).

In Davis’ discussion of the effects of extreme isolation on the development of “human personality” separated into “biogenic and sociogenic factors”, he considers the possibility that Anna is not the ideal case to look at. He writes that this is due to the possibility that Anna was “deficient” to begin with, because she did not receive the best training available, and because she did not live long enough. However, she was able to acquire some aspects of language.

Mason (1942) wrote about a girl named “Isabelle”, whose case is appropriate, but still not perfect. Isabelle was confined in a room, behind drawn shades with her mute, uneducated mother until she was 6 1/2 years old. The mother had sustained an injury at the age of 2 years, which supposedly destroyed the sight of the right eye and caused deafness. Isabelle’s grandparents had locked the mother and Isabelle in the room to prevent future pregnancies. Mason reports “ The mother could neither talk, nor read, nor write, but communicated with her family by means of crude gestures of her own

origination.” The mother, knowing that her child needed help, had been able to escape with Isabelle, and she was brought to Children’s Hospital of Columbus, Ohio on November 16th, 1938. It was written that, “Due to the lack of sunshine, fresh air, and proper nourishment, had developed in the child a rachitic condition which produced such extreme bowing of both legs as to make locomotion almost impossible”. (p. 296)

Following Isabelle’s admittance to the hospital for orthopedic surgery, Ms. Mason worked with Isabelle on her language and socialization. Mason wrote, “The first important problem to confront me in my endeavor to teach Isabelle to speak was the choice of some satisfactory method of procedure. Gesture was her only mode of expression. In her characteristic descriptive motions with which she tried to make clear what she wanted, I noted a similarity to the sign language used by deaf children.” (p. 299)

Mason exposed Isabelle to many toys, musical instruments, and foods and taught her with effort the spoken words for these items. By June 1940, Isabelle was reported to have had a vocabulary of between 1,500 and 2,000 words. She could ask questions, tell stories, recite short poems, sing, count to one hundred, do simple math, and make up stories. Mason concluded “Here is a little girl now eight years old, who, in a period of less than two years, has made striking social adjustments to a living and hearing world after six years in a world of silence, fear, and isolation; a child who can communicate with others in speech after six and a half years of primitive gesturing to a mute and deaf mother...” (p. 303)

Journal articles recount that both Anna and Isabelle were able to acquire aspects of language even after a 6 year period of isolation. However, due to the focus on socialization and education and the limited description of the linguistic errors that the children produced, it is impossible to determine what aspects of language were affected by the isolation. Furthermore in the case of Isabelle, it appears that her mother communicated with what would now be called a homesign gesture system, and Isabelle most likely used a more systematic version of the mother's homesign. This would be similar to the signers studied by Feldman, et al (1978) and Goldin-Meadow & Mylander (1984). It is important to note that Isabelle's success in learning a language well enough to be considered "recovered" suggests strongly that, whereas aspects of language might have been affected, they were indeed modifiable such that she was able to use language intelligibly, if not natively. Information on exactly which syntactic structures, if any, she failed to acquire, were not noted in any of the reports of her language development.

Another important case study that addresses the question of whether language can be acquired when exposure is delayed is that of "Genie". Curtiss (1977) reports on a 5 1/2 year study of this severely abused and neglected girl, focusing primarily on language knowledge and acquisition. Genie was born full-term, via C-section, with a normal birth weight. She showed all signs of normal development, including alertness, hand-to-mouth contact, and good head control until she was brought in for pneumonitis at 14 months. At around the age of 20 months, Genie was confined to a small room in the back of the family's home.

During the day, she was harnessed to a potty seat, and during the nights she was put in a straight- jacket type harness and placed in a crib. Whenever she made a sound or vocalization loud enough for her father to hear, he would beat her with a wooden plank he kept in her room. He did not talk to her, but just growled and barked like a dog. Genie suffered through the physical, emotional, and mental abuse until she was about 13 1/2 years old. At that point Genie's mother and Genie escaped to Genie's grandmother's house, and Genie was admitted to a hospital for extreme malnutrition soon after.

Curtiss (1977) writes, "This was Genie's life – isolated, often forgotten, frequently abused (many details of horrible abuse are omitted here), physically restrained, starved for sensory stimulation...". Upon discovery and treatment, it was reported that Genie could produce a few words, and comprehend several individual words, including a few names, "rattle", "bunny", "red", "blue", "green", and "brown" (Curtiss, 1977, p. 11). Genie was also able to comprehend from intonations, a question, a negative command, and a warning, not unlike a two-year old child.

Genie's treatment plan included constant lessons in spoken language, some signed language, socialization, and manners. This was similar to Victor, the wild boy of Aveyron. However, one main difference was that Genie had many people working with her, whereas Victor had only two. There is much discussion regarding the stability, or lack thereof, in Genie's life with the different therapists who took her into their homes and then passed her off to others.

Curtiss (1977) analyzed the results from many types of tests, including aspects of linguistic, neurolinguistic, and drawing development. Genie's language comprehension is purportedly drastically better than her language production, indicating that a substantial part of the English language was able to be acquired after 13 1/2 years of age. Genie was able to distinguish English phonemes, intonation, and could segment English words - after her isolation ended. Genie was able to count, read words, embellish on the truth, and answer questions. Curtiss writes in her summary and conclusions that Genie appears to be a "right- hemisphere thinker, better at abilities normally localized and primarily controlled by the right hemisphere, such as gestalt perception, tactile part-whole judgments" (p.231). Based on poor performance on nonverbal and visual tasks that tap left-hemisphere functions, including the Illinois Test of Psycholinguistic Abilities (ITPA) and the Knox Cube Test, Curtiss concludes that Genie uses her right-hemisphere for language and other cortical functions. However, despite all of the components of language that Genie was able to acquire, she never reached native-like language use. While this has been taken as evidence for a critical period for language acquisition past the point of puberty, there are other possible explanations. One is that in the beatings Genie received as a child, there was damage to the left-hemisphere causing irreparable consequences for language acquisition in the damaged areas. A second alternative explanation is that the trauma and stress suffered by Genie from the isolation, neglect, and abuse for her vocalizations caused a language production post- traumatic stress-related disorder that had permanent consequences.

There are significant questions about whether Genie provides “proof” of a critical period for first language acquisition with late exposure. Genie had normal early development until the age of about 2 years as reported in her medical charts, and she suffered severe physical abuse by her father. Despite this, she was able to acquire enough receptive language that she could follow detailed and complex commands, understand conversations around her, and learn to read words. She acquired enough productive language to make her wants and desires known, tell stories, and recount earlier experiences, albeit sometimes producing utterances typical of a person with Broca’s aphasia. The results of the studies of Genie’s language acquisition after puberty, suggest that there are some aspects of language that are permanently affected. The aspects that Genie never mastered included verb agreement morphology, complex word order, and closed class words.

2.2 Second Language Acquisition

The idea that there is a sensitive period for language acquisition has been discussed since Penfield and Roberts (1959) presented it, Lenneberg (1967) popularized it, and Johnson & Newport (1989) investigated it with their study of second language acquisition.

Some of the most compelling evidence that the acquisition of a second language may be affected by a sensitive period include the following. 1) The overwhelming majority of the human population acquires a first language similarly, both in regard to timing and competency, but the majority of people who

acquire a second language after childhood do not attain native or near-native fluency (Birdsong, 1999). 2) There is biological evidence for a loss of neural plasticity in the brain with increasing age (Eubank and Gregg, 1999). 3) Studies with people who have had a hemispherectomy performed at different ages, show that they have differing levels of success in acquiring language, in that the earlier the surgery, the better the outcome (Kennard, 1940, Thal et al., 1991, among others).

There is one experimental study in particular that is commonly cited as strongly suggestive of a sensitive period for second language acquisition.

Johnson & Newport (1989) report an experiment they performed with 46 Korean and Chinese learners of English who had all lived in the United States for at least 5 years. These participants provided yes/no grammaticality judgments on 276 English sentences presented on audio- tape. Specifically targeted were regular verb morphology, irregular noun morphology, subadjacency, and particle placement.

Johnson & Newport (1989) found an effect of age of arrival in the US on language acquisition. They found a linear decline in accuracy of grammaticality judgments that began after an age of arrival of about 7 years. At about age 17 years, the distribution of performance, measured by looking at the correlation between age of arrival and accuracy of grammaticality judgments, was random ($r = -.16$). Hence from this study's findings, Johnson and Newport concluded that there is a sensitive period for language acquisition, for which normal acquisition can occur up until age 7 years. From age 7 years to 17 years, there is a decline

in what can be acquired, with near- native- to native judgments not occurring after age 17 years.

New studies question the idea of a sensitive period for second language acquisition. In fact a multitude of new evidence strongly suggests that there is not a sensitive period for language acquisition. Birdsong (1992) examined whether particular aspects of grammar would be less subject to age effects than others, with 20 native speakers of English who began learning French as adults. Their age of arrival in France ranged from 19 –48 years, with a mean of 28.5 years

Birdsong found that 6 of the 20 participants' grammaticality judgments deviated very little from native norms, and the results of 15 participants fell within the range of performance of native controls. Birdsong (1992) also found that performance on the grammaticality judgment task was predicted by age of arrival in France, despite the fact that the participants had all moved to France as adults. He concludes, contrary to the hypotheses based on the idea of a critical period for second language acquisition, that age of arrival predicts success even when the age of arrival is later than the supposed end of the critical period.

The results from this study and others, including those of Bialystok & Hakuta (1994), Birdsong & Molis (1998), and Flege (1999) provide one line of argument against the existence of a sensitive period for second language acquisition. There is another line of new research that also provides evidence against the existence of such a sensitive period. This evidence assesses the rate of native-like attainment of a second language in post-pubertal learners. If there is a sensitive period for human language acquisition, then there should be

few to no instances of native-like second language acquisition after the end of the supposed sensitive period. And indeed as comprehensively reviewed by Birdsong (1999), there are a few studies that found virtually no instances of native-like second language acquisition (Coppieters, 1987, Johnson & Newport, 1989, and Patkowski, 1980). However, there are many recent studies that have found numerous cases of native-like second language acquisition. Van Wuijtswinkel (1994) found that 8 out of 26 Dutch-speaking participants who began learning English after age 12, and 7 out of 8 in another group, performed like native controls on grammaticality judgment tasks. Similarly, other recent studies including those of White and Genesee (1996), Birdsong (1992, 1997), Cranshaw (1997), and Bongaerts (1999), present rates of second language acquisition success ranging from 5% to 25%. They define success as having scores on grammaticality judgment tasks that are similar to those of native users of the particular language, on the same task. Birdsong (1999) writes, "Assuming a normal distribution, a 15% success rate corresponds to all of the area from roughly 1 standard deviation above the mean and higher, as such, these participants cannot be regarded as mere outliers in the distribution" (p.15).

This evidence suggests that the idea of a sensitive period for second language acquisition needs to be further investigated. Although there may be a correlation between age of language acquisition and native-like attainment of the syntax of a second language, there may be reasons for this other than that it is due to a sensitive period. These reasons include whether the methodology used

by the researcher is adequately testing native attainment, and whether other factors, like motivation, correlate with native-like attainment.

2.3 Deaf adults exposed to ASL at differing times.

Another source of study for sensitive period effects on language acquisition has been possible through the help of the Deaf adult community. Given the special circumstances surrounding Deaf education and the acceptance of ASL in the United States (presented in the Introduction), there is a large percentage of Deaf individuals who were not exposed to an accessible first language until later years. Although the course of their language development is not known because they are adults, and the retrospective backgrounds may not be entirely accurate, evidence is being obtained from current studies that suggest aspects of language that are affected by a sensitive period. Late acquisition of ASL as a first language is a uniquely superb way of testing the sensitive period hypothesis.

Emmorey, Bellugi, Friederici, and Horn (1995) conducted an experiment with adult signers who had been exposed to ASL at different ages, ranging from native to 20 years. They found that, in an on-line processing task, native signers were sensitive to errors in both verb agreement and aspect, but that early and late signers (age at initial exposure was from 4 to 20 years) were only sensitive to errors in aspect morphology. They found that, in a different type of test, an off-line grammaticality test, the three groups were equally able to detect the errors. Emmorey, et al. suggest that "late exposure to a primary language affects the on-

line integration of verb agreement information within a sentence, but does not affect sensitivity to semantic distinctions encoded by aspect morphology.” This will be discussed further in Chapter 9, after the results from MEI and CAL have been presented.

Newport (1984) hypothesized that language acquisition occurs “under internal, maturational constraints, operating successfully only during a maturationally bounded period”. She used 3 groups of participants: Native, Early learners (exposed to ASL from 4 –6 years old), and Late learners (exposed to ASL from 12 years old and up), on tests of basic word order and complex morphology of ASL, using elicited production and comprehension tasks. She found that there was no effect of age of acquisition on ASL basic word order; there were consistent effects of age of acquisition on ASL morphology; and there were differences in individual morpheme scores, error patterns, and qualitative analyses of responses for early vs. late learners. She found that late learners showed more “frozen forms” without internal morphological structure, more frequent omission of obligatory morphemes, and highly variable use of ASL morphology.

Mayberry (1994) discussed a series of three experimental studies of Deaf adults, who acquired ASL at varying ages, but for whom ASL had been the primary language for at least 40 years. These experiments were used to show the potential relationships between the age at which deaf individuals first acquire sign language and their ability to process it later as adults. Results from these experiments suggest that when ASL is acquired later in childhood (after age 5

years) there are problems with language processing, comprehension, and memory as opposed to difficulties with language production. She found that the longer an individual had used sign language the more likely he/she was to make lexical substitutions related to sentence meaning and less likely to make lexical substitutions related to sign form. Further, the later the exposure started, the more likely the individual was to make lexical substitutions related to sign form as opposed to sentence meaning. In addition, her findings showed that native learners made predominantly semantic lexical changes, but non-native learners made more phonological lexical substitutions, and Deaf signers who first acquired ASL in early childhood tended to alter bound morphology when recalling complex ASL sentences, but late learners tended to eliminate bound forms. Her conclusion was that the “efficiency with which language can be processed is established at a young age and is difficult to achieve when language is acquired after early childhood” (p. 13).

Together, these and new studies with Deaf adults with late language exposure suggest that there are problems with language processing, for example with phonological processing and processing of verbal morphology, as well as with comprehension. The results from these studies converge with the results of the social isolate studies.

2.4 Home sign: A child's invention

Homesign systems are used by deaf children of hearing parents who have not been exposed to a conventional sign language model. A homesign system

consists of spontaneously generated gestures that are for the purposes of communication (Fant, 1972, Moores, 1974, and Tervoort, 1961, among others). One of the most extensively researched questions in studies of homesigns is whether there is systematic organization in deaf children's sign systems (Feldman, et al. 1978, Goldin-Meadow & Mylander, 1990b, 1990, and Singleton & Newport, 1987.)

Goldin-Meadow & Mylander (1990) analyzed the mimetic gestures produced during 7 naturalistic play sessions by a deaf child of hearing parents. This child, David, was making little progress in acquiring oral language, despite attending a strictly oral pre-school. David's play sessions were recorded between the ages of 2;10 and 4; 10 (years; months). They found that David's gestures could be classified into handshape and motion combinations in a way similar to the analysis of the different components of ASL signs, like handshape and movement. In addition, David's gesture system was considerably more complex than the model provided by his hearing mother. Although he produced almost all of the handshape and motion combinations that his mother produced, he additionally produced another 34 combinations that were not found in the mother's sample. Goldin-Meadow and Mylander concluded from these results that, although David was able to filter and use the gestural input from his mother, he went well beyond the input. The "child's contribution to structural regularity at the intra-word level, [suggests] that such structure is a resilient property of language" (p.1).

Goldin-Meadow and her colleagues have filmed and analyzed the development of homesign systems in the United States as well as in various other countries. They have found that deaf children can and do systematize their gestures. The lexicon used by the children shows use of pointing gestures for objects that are both present and absent. The points refer to actions and attributes, not unlike signs in formal sign languages. The systematic organization used by the children shows consistent use of “word/gesture” order whereby both actor and patient appear before the act, with more patient-act structures than actor-act structures. An example of a patient-act structure is: Ball throw. In this structure what is meant is that someone throws the ball. An example of an actor-act structure is: John throw. In this structure, what is meant is that John throws something. The importance of this gesture ordering is two- fold. First it shows that the orally- trained deaf children of hearing, English-speaking parents, are not adopting the word order of English, which does not use primarily a patient-act ordering. And second, because this patient-act ordering occurs in all of the homesign systems studied, it seems that children are predisposed to create structures with a specific ordering that allows for semantic roles to be distinguished.

The homesigning of the deaf children that Goldin-Meadow and colleagues have studied, use recursion and obey the production –probability rules hypothesized by Goldin-Meadow to predict which of the 3 arguments would be most likely to occur if a child used primarily predicates that had only two of the three arguments. The children differentiate different semantic roles, and even

create a form of morphological structure. However, it is not clear that without exposure to a full, natural, accessible human language, these children would develop a full language as opposed to the communication system, homesign, that they use. When home signers are exposed to a natural signed language, they replace the home signs with the lexical signs and adopt the natural language (Emmorey, Ewan, & Grant, 1994, Morford, (1998), a necessity if they are to be understood by the larger community.

2.5 Children of late learners of ASL, e.g. Simon

Whereas the above section discusses linguistic systematization of gestures by deaf children who, while having intensive, but ineffective oral training, had limited gestural input, this section briefly reviews what happens when there is inconsistent linguistic input. Singleton & Newport (1987) asked whether children are “capable of organizing a natural language out of input data that are not representative of certain natural language principles” (p. 2). As discussed previously, members of the American Deaf community have various experiences of language acquisition in terms of modality choice, oral vs. signed language, and amount, timing, and quality of input. Singleton & Newport (1987) have studied the question of what happens in the process of child language acquisition when the linguistic input is inconsistent. They do this through the study of “Simon” and his parents.

Simon was a 7 year old Deaf child whose Deaf parents both learned ASL late, after age 15 years. Because Simon attended a public school that used

manually coded English simultaneously articulated with spoken English (SimCom), Simon's only ASL exposure was provided by his late-learner parents. Singleton & Newport analyzed the results of a productive morphology task performed by Simon, his parents, and a group of 8 age-matched native Deaf comparison children. The results from the analyses indicate that Simon was able to acquire a regular and orderly morphological rule system from the noisy and error-laden input from his parents. They conclude that Simon, like other language learners, is operating with innate constraints on the possible form of grammatical rules, rather than acquiring a probabilistic set of mappings like those in his input. They conclude this based on the data that suggests that "Simon imposed the type of regularity and orderliness of morphological rules that is characteristic of natural language systems". According to Singleton and Newport, the difference between Simon and his parents is that Simon was able to create a regular and structured morphological rule system, but his parents were not. The reason, they hypothesized, is that only children who are within a sensitive period for language can create language (cf. Bickerton, 1981). When Simon's parents started learning ASL, they were already past the sensitive period for acquiring language.

2.6 Nicaraguan sign language

Finally, but not exhaustively, there is another exciting line of research that focuses on the extent to which children create language. Kegl & Iwata (1989) describe a situation in Nicaragua that sets the stage for the discovery of what

children in a newly formed language community bring to the task of language creation. As reported by Senghas (1995), around 1980 the Sandinista party in Nicaragua formed the first public schools for education, which had a classroom for deaf children to be instructed orally. This was the first time large numbers of deaf children were brought together. Although they did not sign in the classroom, they did communicate with each other on the buses and on the playgrounds with their independent home sign systems (Senghas & Kegl, 1994). As more, and younger, deaf students entered the school, a language developed. Kegl, Senghas, Coppola, and colleagues have been examining what occurred when this group of deaf children and adults were brought together (Kegl, 1994, Senghas & Coppola, 2001, among others).

In her dissertation, Senghas (1995) discussed her study that examined the Nicaraguan deaf children's ability to create grammatical structure in this new sign language. Her goal was to determine whether the language is changing over time, and if so, whether the changes in the language started with the older or younger signers. She examined the morphology in signs produced in narratives stimulated by nonverbal cartoons. Her results suggest that the age at which signers first enter the Nicaraguan signing community best "predicts their ultimate ability to command some of its more complex structures" and that new language developments start with the youngest children in the community.

Senghas (1995) reported that, as new children enter the Deaf community of Nicaragua, they surpass their older peers in the fluency and complexity of their signing. "The younger signers have a more fluent command of the language.

They sign more rapidly and produce more complex, multi-morphemic signs than the older signers from whom they are learning the language. While the older signers tend to produce sequences of uninflected signs, the younger signers use a system of spatial inflection, embedding markers for subject and object into the movement of many of their verbs, and marking location and position on verbs of motion.” (p. 154-155)

Senghas attributed the children’s regularization and abstraction of the impoverished input to access to innate language constraints governing language. This is not the same process for the adults.

2.7 Summary

Taken together the studies reviewed in this chapter suggest that language acquisition, especially first language acquisition, may be affected by a sensitive period, regardless of language modality. Victor, and Genie, both immersed in a first language after childhood, acquired aspects of spoken language, such as lexical items and simple word orders, but did not acquire the language fully, exhibiting telegraphic characteristics in their sentences. Anna was immersed in language during middle-childhood and showed similar progress to Victor and Genie, but she did not live long enough to enable us to know whether she could have achieved native-like fluency. Finally Isabelle acquired language fully after immersion during middle-childhood, but she had been exposed to a homesign system from her deaf mother, who provided some linguistic input.

Simon, and more comparable, later-learning Deaf adults, also acquired lexical items, basic word orders and some verbal aspectual morphology. However Simon did not score as high on the tests as did the same- age native signers. And the later-learning Deaf adults showed long-lasting difficulties with verb agreement morphology, phonological processing, and other aspects of language acquisition.

From the body of research amassed to examine the effects of a sensitive period on language acquisition, it appears that some linguistic domains are more resilient than others to variations in age and intensity of exposure. For example, lexical learning and basic word order are resilient whereas verb agreement and complex word order are not. Because all of the studies reviewed here have found that verb agreement and verb agreement morphology is not mastered by late language learners, this is likely to be an area where effects can be found in the present developmental study of MEI and CAL.

This study of MEI and CAL is complementary to the studies of adult, late-learners in that it further contributes to understanding what is acquired and what is problematic from the very beginning of language acquisition, given later exposure. The study will reveal the developmental path of how MEI and CAL will become like some of the Deaf adult, later-language learners. It will show how the late- learners differ in their linguistic development from native language users along the course of the language acquisition process.

This study will examine whether, and how MEI and CAL fully acquire the complex verb agreement system and its relation to word order and other aspects

of ASL. It will provide insight into the details of what is being affected by late language input, and potential hypotheses for these differences. This study will examine the acquisition of ASL more generally, for example mean length of utterance (MLU) scores, and the normally found early stages of language development. This study will focus more specifically on the use of verb agreement, morphology, and word order in primarily naturalistic language production, but in an experimental game as well, that was piloted. This is done in order to test the child's knowledge of the verb types, basic word order, and derived word orders via the process of topicalization. In these domains of language, sensitive period effects will be sought.

Chapter 3

ASL Structure and Native Language Acquisition

This chapter provides background information on the morphology and syntax of the verb agreement system, the relationship between verb agreement and word order, and other relevant linguistic structures in ASL. I also summarize the results of other studies with Deaf children acquiring ASL as their native language to show the normal course of acquisition of these components. Finally, I document how the acquisition of language, more generally, is similar for signed and spoken languages.

3.1 ASL verb agreement

ASL has a rich verb agreement system that has been studied for its linguistic properties (Lillo-Martin, 2000, Mathur, 2000, Meier, 2000, and Padden, 1983, among others). It has also been studied for its acquisition path by native, signing children (Bellugi, et al. 1990, Lillo-Martin, et al. 1985, among others), and for its use in adulthood by later-learners of ASL (Emmorey, 2002, Mayberry, 1995, and Newport & Supalla, 1984). There are three different categories of verbs that have been proposed for ASL, although some investigators have suggested that some verbs cross the different categories (Hanel, to appear, Janis, 1992, Lillo-Martin, 2002, Rathmann and Mathur, 2002, Meier, 2002, Meir, 1994, 1998, and Padden, 1983, among others). As noted in Chapter 1, the three categories are plain verbs, spatial verbs, and agreeing verbs.

Plain verbs do not mark agreement. An example of this would be LIKE, as in JOHN LIKE MARY. LIKE is signed with body contact at mid-chest level and is signed the same way regardless of who likes whom. The sign itself does not differentiate whether John likes Mary or Mary likes John. With LIKE, word order provides the information of who is doing the liking. However, some plain verbs may be signed in a location, for example HURT. Hurt may be different from other plain verbs of this type in that it has the body to refer to. It is signed with two hands, each hand has the pointer finger out, from an otherwise closed fist. The palm faces in, toward the body and the tips of the two pointer fingers move in to touch each other. When signed near a body part, such as the nose, it means that the nose hurts. The same sign can be done in neutral space or near any other body part on one's self. It may not be signed on someone else however, with the exception of child-directed signing, whereby an adult is signing it on a child.

Spatial verbs have semantic features that require the marking of a location, either physically present, or not present but established in discourse. Spatial verbs are signed toward a location. Examples of spatial verbs include GO-TO and PUT. PUT requires an animate subject, an object, and a place/location for the object. Spatial verbs indicate the role of location with path of movement toward the location.

Agreeing verbs have at least two human participants (Janis, 1992, 1995, Meir, 1998, Rathmann and Mathur, 2002, among others). They have formal features that require the marking of both a subject and an object. They are

similar to spatial verbs in that the path of movement in set up space is used to show the agreement. However, for agreeing verbs the starting and ending points of the path of movement, and the direction the hand is facing, indicate who does what to whom. One commonly used example of this is the verb ASK, a picture of which is shown next.



'I ask her'



'He asks me'

ASK is signed with an index finger that hooks, and an otherwise closed fist. With the palm facing the person(s) being asked, the hand moves from the location of the subject of the sentence to the location of the object. Hence, in I-ASK-YOU the hand moves from the location of the signer, past neutral, toward the location of the addressee, while in YOU-ASK-ME, the hand starts in the

location of the addressee, palm facing the signer, and moves past neutral toward the signer's location. This can be done with HE-ASK-HER, THEY-ASK-ME, I-ASK-THEM, and so on.

3.2 Present and Non-present referents

In a visual language such as ASL a specific place in front of the signer's body can be assigned to represent a noun, usually a person for agreeing verbs and a location for spatial verbs. There can be as many assigned places as memory will allow. These loci then can be used throughout a conversation to represent the originally named people/locations. Place specification for referents can be established in a number of ways, including pointing to a location and "naming" it, and making use of eye gaze.

In cases with non-present referents, agreeing verbs can be used as long as the verb agreement morphology clearly shows the movement from one specified place to another. The hypothesis that non-present referents add a higher dimension of difficulty has led to the examination of whether non-present referents are acquired later by native signing Deaf children (to be reviewed in a later section). Non-present referents are proposed to be more difficult due to, among other reasons, the linguistic complexity required and the increased memory load (Hoffmeister, 1978, Lillo-Martin, Bellugi, Struxness, & O'Grady, 1985, Loew, 1982, 1984, and Meier, 1981, 1982, among others).

3.3 Word order in ASL

Early research on the linguistic properties of ASL found that the basic word order is Subject Verb Object (SVO) (Fischer, 1975, Lidell, 1980). From the earliest studies, however, it has been found that while SVO is the basic word order, it is not necessarily the most frequently used order in the language, by either adults or young children (Chen-Pichler, 2001, Emmorey, 2002, Padden, 1983, Wilbur, 1987, 1994). The basic word order can be changed by various order-changing operations, including topicalization. Topicalization is a linguistic process whereby an element of a sentence is singled out as the topic by the use of a marked construction, for example putting the topicalized element in the beginning of the sentence and using non-manual markers such as raised eyebrows, or backward head movement (Lidell, 1980). In ASL, topicalization commonly occurs with locations and objects.

Contributing to the variations in word orders is that, unlike English, but similar to Italian, ASL allows phonologically null subjects and objects. Therefore it is not uncommon to see VO or SV sentences. Lillo-Martin (1986) and Emmorey, and Lillo-Martin (1995) investigated and found evidence with Deaf adults that null pronouns in ASL are processed similarly to overt pronouns.

In the process of acquiring ASL, children must know how the basic word order can be manipulated, that the subject and/or object can be null, but still have agreement, and how verb agreement interacts with word order.

3.4 Spatial syntax acquisition by native signers

Deaf children need to learn that referents can be associated with locations, that the place specification is held throughout the discourse, and that different locations must be used for different referents. These characteristics of ASL are sometimes referred to as “spatial syntax”. Studies of native ASL acquisition by children report that the use of present referents occurs much earlier than the use of non-present referents.

Meier (1982) examined the acquisition of the verb agreement system by Deaf children with Deaf parents, concentrating on verb agreement with present referents. He followed three native ASL signing girls longitudinally for two years, observing them once per month. He also conducted an experiment with 10 children, ages 3 to 7. Although he found very few errors with verb agreement, the errors he did find were specific. His results suggest that there is a developmental trend whereby at the age of 2, children use uninflected forms without verb agreement, even in contexts where agreement is necessary in adult ASL. In a next phase of development children make 3 types of errors. There is still the problem of omission of verb agreement. In addition, they overgeneralize the verb agreement system and try to use agreement on plain verbs. During this time, they also use verb agreement incorrectly, by applying it to the wrong argument, for example, “giving” cake to the plates and not to the other girls at the party. By age 3;0 to 3;6, all of the children in Meier’s two studies were correctly producing verb agreement with present referents.

Loew (1982) investigated the use of indexing and shifting reference (e.g. referring to a character and changing characters) in the narratives of one native deaf child. Meier found verb agreement with present referents to be acquired by the age of 3;6, but verb agreement with non-present referents takes longer, according to Loew's results. At 3;1, the spatial syntax for non-present referents was absent. At around age 3;6, there was some indexing used, but the loci were not explicitly established, and several referents were "stacked" at the same locus point, which is ungrammatical in adult ASL. By around age 4;9, correct and consistent use of non-present referents was starting, and Loew considered it acquired by 5;0.

Lillo-Martin, Bellugi, Struxness, and O'Grady (1985) conducted a cross-sectional study of 43 children, ages 3 to 10 years to examine the acquisition of the spatial syntax system of ASL. They conducted multiple experiments to separately test, aspects of spatial syntax, namely nominal establishment, verb agreement, and consistency of reference. They used a "Nominal Establishment" comprehension task, a picture-choice test, an act-out task, and two short sequences of pictures, each telling a short story. Their results suggest, like Meier's and Loew's, that 3 year old children used almost all uninflected verb forms and did not establish nominals with loci. The 4 year old children used uninflected verb forms, and used word order to convey grammatical relationships for non-present referents; they were correct with present referents. At age 5 years, some overt nominal establishment occurred along with correct agreement

for non-present referents. Errors still occurred in both nominal establishment and agreement. By age 6, the children used verb agreement appropriately.

The investigation of children's knowledge of basic word order and allowable variations in that word order has recently received intensive focus. Schick (2002) found in a study of twelve 24-month old Deaf children with Deaf parents that the children's placement of 'agents' and 'themes' was not consistent in relation to the verb. She suggests that children assume that the word order of ASL is relatively free, and that children need to learn that variations in word order reflect pragmatic and discourse notions in ASL.

Chen-Pichler (2001) examined longitudinal naturalistic language production data provided by four Deaf children with Deaf parents from the age of about one and a half years to the age of approximately 3 and a half years. She found that the children used diverse word orders that could be accounted for by attributing to them both the canonical SVO order and several order-changing operations. The children's productions were adult-like when canonical orders were combined with correctly- marked derived orders. The derived orders included instances of Subject Pronoun Copy and morphologically- complex verbs that allowed for OV order. Similar to previous reports, Chen-Pichler found that the children did not use the adult non-manual markers for sentential topics, but she did find that one child used a prosodic break between the object and the verb in many of her OV utterances. Chen-Pichler suggests that these may be proto-topics, not yet fully marked forms of adult topicalization structures.

Hanel (to appear) studied the interaction of word order and verb agreement markings in German Sign Language (DGS), through a longitudinal study of two Deaf, native- DGS signing children, ages 2;2- 3;4. Hanel found two developmental “phases”. In the first phase, neither child demonstrated productive use of verb agreement morphology, and both children dropped more subjects with agreeing verbs, than they did with plain verbs. Both children also dropped more objects with agreeing verbs than they did with plain verbs. In the second phase, the two children began using non-present referents, and showed a higher rate of subject pronouns with agreeing and plain verbs. The errors of dropping arguments declined overall. From these results, Hanel proposed that the structural configuration may be accessible earlier than the verb movement and feature sharing mechanisms for the children.

3.5 Native ASL acquisition is similar to spoken language acquisition

Although ASL is a language produced in a different modality than spoken languages, according to the results from numerous studies, it follows the normal course of acquisition for native signers, that is, Deaf children born to Deaf, signing parents (D/D). Both D/D and hearing children pass through the same developmental stages at about the same time and make similar types of errors (as reviewed by Lillo-Martin, 1999, Newport and Meier, 1985, among others). The results suggest that the capacity for language acquisition is not specific to speech or audition.

Petitto and Marentette (1991) found that Deaf babies exposed to American Sign Language from birth went through a stage of manual babbling that is similar to the way hearing babies babble in spoken language. Just like vocal babbling, manual babbling was observed to have the characteristics of syllabic structure and reduplication.

Although the issue of whether there is an early advantage for sign language is still controversial, some recent research suggests that there is no true advantage. The advantage proposed for sign language is based on the hypothesis that first signs come in before first words. Typically, researchers have counted standard gestures that are seen with both hearing and Deaf children, e.g. “up”, as words. The studies have found that when these gestures (not signs) are removed from the category of first words, the timing of the one-word stage, in which lexical items are used symbolically, is similar for sign and speech (Bonvillian & Folven, 1993, Petito, 1992, Schick, 2000, and others).

Conlin, Mirus, Mauk, and Meier (2000) studied the early signs of D/D children from ages 7 months to 17 months and found that, similar to spoken language at these ages, babies’ and young children’s signs exhibit phonological errors. Nearly 80% of the early signs were produced with the correct place of articulation and about 45% had the correct movement. However, only 25% of these early signs were produced with the correct handshape. Instead children used handshapes that were easier to produce. That children first produce hand configurations that are easy to produce, easy to perceive, and are among the

most frequent in the language have also been noted by Boyes-Braem (1990), Marentette and Mayberry (2000), and others.

Other, slightly later stages in normal language acquisition of hearing children have been found in the signs of native Deaf children acquiring a natural signed language, for example a two-word stage, verb agreement morphology, and the appearance of questions. Taken together the results from these and other studies suggest that a natural sign language, such as ASL, has not only the linguistic structures and constraints found in spoken languages, but also follows the same developmental timetable of language acquisition.

Chapter 4

Participants

It is now rare that a child is diagnosed with profound deafness later in childhood, after age 3 years. It is even more unusual that such a child would then be immersed in ASL as opposed to an oral approach (GRI, 2000). However, this is what happened to two, unrelated children given the pseudonyms “MEI” and “CAL.” As I will describe below, attempts to communicate linguistically with either of these children were minimal prior to their entry into a residential school for the Deaf. This special circumstance provides an opportunity to address sensitive period effects on first language acquisition.

MEI and CAL were filmed regularly for 3 1/2 years. The longitudinal language samples obtained from MEI and CAL were compared to the longitudinal language samples obtained from both a native- signing Deaf age peer, and a native-signing Deaf younger child- a potential language-level peer. Periodic language samples were collected from two other older native signing children, GEN and NIE, for further comparison. The comparison cases will help to place MEI and CAL along a developmental course, and will provide the means to evaluate whether MEI and CAL follow the normal course of language acquisition, despite the delay in receiving language input.

Because I started filming approximately 6 months after immersion for MEI, and 8 months for CAL, I can examine the development of language acquisition

with delayed input, but without the confounds of physical abuse, and/ or the imprecise nature of retrospective background information.

In this dissertation, I do not focus on social factors that have been proposed as potentially affecting language acquisition (Bortfeld and Whitehurst, 2001). These include the following: 1) Input to a 6 year old is not typically the same as the input to an infant or even a young child; 2) Children who do not command a language at age six may not be afforded the social status of a child who does. If not, the child may have less signing directed to him/her than would others, which would then mean that the late- learners would receive less, and/or different linguistic input.

The goals of this chapter are: 1) to provide detailed information on the backgrounds of MEI and CAL, describing the social situation of their home life, the parents, the siblings, and school life; 2) to provide information on the Deaf, native comparison cases, 3) to provide information on the Deaf, fluent signer who played with the children for most of filming, and 4) to detail the comparisons that can be made between the native signing children and MEI and CAL. Every effort will be made to protect identifying information, for the benefit of both the families and the children

4.1. "MEI"

"MEI" was initially misdiagnosed as low-functioning mentally retarded. By age 5 1/2 years she was correctly diagnosed as profoundly deaf and not mentally impaired. Between the ages of 3 and 5 years she was enrolled in a Head-Start

program three times a week, for four hours per day. From the county's social services there was also a person sent to work with MEI on language development. However MEI's mother reports that, due to the misdiagnosis, only crayons and paper were given to MEI, and there were only minimal attempts to communicate with her linguistically, or engage her.

At age 5;9, MEI completed an intake evaluation at a residential school for Deaf children, and the school psychologist noted in her chart that "MEI's overall performance indicates that she has some well developed nonverbal cognitive abilities". She was able to produce 15-20 gestures, consisting mostly of communicating basic needs, e.g. "food", "eat", "drink", "sleep", etc. MEI was first immersed in ASL at age 6;1, upon starting school.

4.1.1 Initial language immersion and early input history

Upon arrival at the school, MEI had to be shown that things and people had names. School staff demonstrated to MEI that even basic things, like "table" and "chair" had labels. They showed her their sign names, and put MEI's hand in the sign configuration of the first letter of her name and asked her what her name was. She looked at her hand for a few seconds, and then started spiraling it in the air, above her head and to the right. At the same time she looked from her hand to the people, and then around the room, with no apparent recognition of what she was doing. This demonstrated that MEI had to learn that she, and even basic things had labels, further supporting the mother's account of MEI's previous lack of language exposure.

MEI started school that week, but had only 3 weeks of school before summer break. At home for the 3 months of summer vacation, there was no accessible language input, because the family did not sign and there was no available ASL intervention.

Six months after the start of the following school year, at the end of February, I started filming MEI. At first it was once per month, then twice per month, then beginning the following September, filming was twice per week while school was in session. During summer breaks, I drove to MEI's home once or twice during the three month period to film. This is also when I obtained information on the family history, the family home life, and the child's environment before she started school.

4.1.2 MEI's health history and family life

MEI is a female with bilateral sensorineural hearing loss. Her birth history notes slight complications. She was born 4 weeks early, by Caesarian section. Her weight was within normal ranges, at 7 lbs., 5 oz. Her developmental milestones were on the later side, within normal ranges. She sat by herself at 6 1/2 months, crawled at 9 months, and walked by herself at 20 months.

MEI's family lives in a three- bedroom trailer house in rural Pennsylvania. The mother stays at home and takes care of the house and MEI's older brother, who is about 2 years older than MEI. He has been diagnosed with Turrette's Syndrome and requires a lot of attention and care. The father works as a fireman and as a car mechanic.

During the summer visits MEI's mother said that MEI's hearing loss was misdiagnosed as a bad case of stubbornness in not wanting to talk and that she was mentally retarded. This was the evaluation told to MEI's parents from both MEI's doctors and her teachers from the local Headstart program MEI attended. As a result, at the Headstart program, MEI was put in a corner with her back to the other children, and given paper and crayons; so coloring and drawing were her main activities. In one of the school programs she attended next, she was put in the learning support class with mentally retarded children. The teacher's long-term goals were for MEI to write her name, color within the lines, and count to three. At home, her "stubbornness" was seen in her temper tantrums, when she did not getting the food she pointed to in the refrigerator, or a toy that she wanted, in her not talking to her parents, and in her ignoring their speaking to her. She spent most of the warmer days outside playing by herself, or inside coloring and playing by herself. She watched TV and played video- games. There are no neighbors nearby and hence few children that she played with at home. While her parents hugged her, kissed her, fed her, dressed her, and generally loved her, due to the misdiagnosis, they did not try to communicate with her much. No one in the family signs, and her mother reports that there are no ASL classes offered in the area where they live. MEI's dad taps and points to communicate with her. MEI's brother talks and punches. MEI's mother reports that the brother is a "normal older brother", and has not been physically abusive towards MEI. Since MEI began attending the residential school, her mother has learned about 25 signs, but she still primarily points and talks to MEI.

MEI's mother reports that before they enrolled MEI in a residential school for the Deaf, she used about 10 gestures and pointing. But there were not really any multi-gesture or point and gesture sentences that the parents noticed or paid attention to. Hence, it seems that a homesign system did not readily develop, probably due to the fact that in order for a communication system, like homesign, to develop, at least two willing communication partners are needed.

4.1.3 School psychologist evaluation and I.Q. tests

At the time of the intake evaluation, the school psychologist was unaware of MEI's previous background regarding language exposure and the misdiagnoses of mental retardation. Some of the tests of mental ability administered included the Kaufman Assessment Battery for Children {K-ABC}, the Developmental Test of Visual- Motor Integration {VMI}, and the Human Figure Drawing task. The psychologist also asked MEI to write the alphabet and the numbers from 1 through 10. She could do neither.

The results of the K-ABC Nonverbal Scale, taken directly from the psychologist's report, "suggest that MEI is functioning within the Average range of intelligence, compared to children her age". He goes on to discuss MEI's strengths on the test, which include: a subtest that required skills in developing nonverbal concept relationships, and a subtest that required short term visual sequential memory for non meaningful or non conceptual stimuli. He writes that MEI's strength "appears to be in the area of simultaneous processing." He reports that MEI showed weaknesses on a subtest for skills in short term visual

sequential memory for digits and sequencing. The reports of the visual-motor integration and visual perceptual skills, and the Human Figure Drawing tests say that she is slightly below average for her age.

The psychologist, unaware of MEI's linguistic deprivation, wrote: "This examiner is unable to explain at this time why MEI has not developed a more adequate receptive and expressive language base. Results of intelligence testing suggests that she has the aptitude to do so."

Further testing of MEI's intelligence and academic performance occurred at the school throughout the years of filming. Her most recent test report is the Stanford Achievement Test (Stanford 9). The Primary 1 level, administered in English, to MEI when she was 8;8, measures content commonly taught to hearing students in grades 1.5- 2.5. At the point of testing, MEI had been immersed in language for approximately 2 years and 8 months. MEI's results indicate a weakness in the language/verbal components of the test, including word study skills, word reading/vocabulary, reading comprehension, total language, and spelling. In these areas, she tested at grade levels ranging from K.8 to 1.6, placing on average in the 30th percentile of children her age, according to the deaf/hard of hearing age-based percentiles provided. MEI performed comparatively higher on the two math and cognitive components. For the component of problem solving, which still involves language, MEI tested at the grade equivalent 1.8 level and placed in the 51st percentile. For the component of math procedures, MEI tested at the grade equivalent level of 2.5 and placed in the 65th percentile. This suggests that her cognitive and math

abilities are within normal age ranges, and are more advanced than her language abilities, further indicating the effect of the limited language exposure she received before entering school.

4.1.4 School life throughout the time of filming

MEI started school on May 18, 1998, but was in school for less than a month before summer break began. She started school again on August 31, 1998. MEI was in a small class with other deaf children who had special needs, some due to attention problems and others to having below average language for their age. For the first two years, she resided in a dormitory with four age peers. Then three of the age peers were moved to the older children's dormitories, and MEI stayed in the same dormitory wing with one age peer and three younger children, average age 3 years, for the next few months. After that, MEI was transferred up to the girl's dormitory with her other age peers. The children live at the school from Sunday afternoon to Friday noon.

In the dormitories the layout was very "home-like" and comfortable. In the youngest children's dormitory, each bedroom had 4 beds and tables. The girl's room was painted pink with Disney characters. The main living room area had plush, child-sized armchairs for each child, a large screen TV, bookshelves with books, and other home amenities. There was a playroom area across from the living room area that had many toys and activities, as well as a computer. There was a second play area that had a mural of Disney characters and couches. This is where much of the filming of this study took place.

The older children's dormitories were similarly comfortable, but instead of small armchairs there were couches. In the dormitories there were adult assistants, some of whom were Deaf and some of whom were hearing. All people in the dormitories signed ASL. Throughout the dorms and in the school itself, are posted signs requesting that everybody use ASL. All of the teachers and staff at the school have had their ASL ability evaluated. If the evaluation is not high enough, the teacher/staff member attends in-house ASL classes taught by native and near-native ASL signers.

For the children, dormitory life entailed many Deaf Culture activities, such as watching older Deaf children and adults sign ABC stories. There were other activities as well, such as walks, sports, computer time, meals, etc. Dormitory life provided a large amount of native and near-native language exposure to ASL for the children.

During the school day, from the second year of filming on, MEI was in a classroom with approximately 6 other children, most of whom had special needs, with attention difficulties, language difficulties, or just not caught up to age peers. The teacher signed ASL and sometimes spoke. There were Deaf, ASL signing, teacher's aides in the classroom as well. The teacher covered typical subjects including math, language skills, spoken English, and reading. For lunch- time, the children were all together, and hence a lot of ASL exposure occurred during the lunch- time too.

Overall, the amount of ASL exposure during both the school day and the dorm time was extensive. Much of this input was from native Deaf signers.

Hence MEI went from almost no language exposure and input at home, to full immersion in ASL at her residential school.

4.2. "CAL"

"CAL" was correctly diagnosed with profound deafness by the age of 18 months, but he was not exposed to an accessible first language until later, due to personal problems at home and ineffective treatment at a county hospital program. Between the ages of 3 and 5 years, he participated in a county children's partial hospital program for behavioral problems. At this hospital, CAL attended a day program that tried to change undesirable behaviors. He then had a home tutor to teach him signed words. His mother reports that the tutor herself did not know more than 20 signs.

At age 5;9, CAL completed an intake evaluation at a residential school for Deaf children, and the school psychologist noted in his chart that "CAL's performance on the K-ABC Nonverbal Scale suggests he is functioning within average range of nonverbal intelligence". He was reported to know between 20 and 25 gestures, consisting mostly of communicating basic needs, e.g. "bathroom", "eat", "drink", "sleep", "sit", etc. CAL was then first exposed to ASL upon starting school. However there were only 4 months until the end of the academic year, and then a 3 month summer break, during which time no exposure to ASL was provided.

4.2.1 Early input history

CAL periodically attended the county children's partial hospital program for behavioral problems for a few weeks at a time. The program was run by the county hospital, and designed to prepare children with behavior problems for school. The program's staff signed about 10-20 signs to CAL. The staff either failed to understand the severity of the hearing loss, or they did not know what to do for Deaf children. The staff of this program wrote in their reports of CAL that most of the goals established for CAL behavior-wise were not reached. The staff wrote that they did not understand why, from the ages of 2 years 9 months until age 3 years 5 months, CAL would not sit in circle time for more than 20 minutes, especially because they had someone "use signs to tell him what to do". They wrote that CAL would touch everything that was given to him and also other people and their things to get their attention, which they attributed in part to his deafness. They note that it was peculiar that CAL liked the arts and crafts parts of the day the most, and would really focus and attend to these activities.

4.2.2 CAL's health history and family life

CAL is a male with a severe to profound bilateral sensorineural hearing loss. His hearing loss is congenital and of unknown etiology. His mother reports that she had a normal pregnancy and delivery. CAL was diagnosed with ADHD and has been taking Ritalin. His developmental milestones were within the lower portion of the normal range; for example he walked by himself at about 14

months. The normal age range for this is 11.3 to 14.3 months (Frankenburg & Dodds, 1967).

CAL lives with his mother and stepfather in a house that used to be the area's school house in rural Pennsylvania. CAL's mother works in a family deli/convenience store, and his stepfather is a construction worker.

Although CAL was diagnosed with a hearing impairment at 18 months, the severity was not realized until he was close to 2 years old. At that point he was fitted with hearing aids. Cal's mother reports that the hearing aids did not help him hear more than the sounds from doors slamming and the TV and radio when on extremely loud volumes.

CAL's father and mother divorced before he was four years old. The divorce was very bitter and CAL's mother says she was very affected by it. During summer visits to their house, CAL's mother spoke about both the relationship she has with her former husband as well as about the relationship that CAL has with his father. CAL's mother reported that during the time of the divorce and for some time both before and after, neither she, nor CAL's father really tried to communicate with CAL. She reports that she and CAL's father were constantly fighting and that her focus was on how to deal with the ADHD behavior. CAL's mother states that they did not "accept" the deafness and so the deafness and language were secondary problems.

CAL spent much of his days playing outside alone, inside watching TV, or inside playing video games or on the computer. While his parents (or at least the mother) loved him, fed him, hugged him, brought him to programs for help, and

took care of his basic needs, they/she did not provide much linguistic input. An extensive home sign system did not develop in this situation, most likely due to the few communication attempts made by the parents toward CAL, and with the parents not responding to CAL's gestures to them.

CAL used to see his father about one weekend a month. The father has a second wife, and CAL has a half-brother and a half-sister from that marriage. CAL's father does not sign, and refuses to learn any sign. He prefers to see CAL as little as possible, according to CAL's mother.

CAL's mother has learned about 25-50 signs, but many of them are phonologically incorrect and/or unrecognizable. There are no neighbors nearby, and no one that the family socializes with signs. There is one little boy that CAL's mother tells me CAL met who is learning some sign, albeit from CAL.

At the first summer filming visit, CAL's mother told me that before enrolling CAL at the school for the Deaf at the age of 6 years, CAL knew about 30 signs. The intake evaluation performed initially by the school confirmed this estimate, finding that CAL knew about 25 signs. However, CAL's mother's reports are not always accurate, as evidenced through her report to the school audiologist that CAL knew between 100 –150 signs.

4.2.3 School psychologist evaluation and I.Q. tests

In the intake evaluation report, the school psychologist wrote, " CAL's main mode of communication appeared to be sign language, which appeared

extremely limited. He initiated very little in the way of spontaneous language and responses to the examiner were in one word utterances and generally labeling.”.

Upon CAL’s arrival at the residential school for the deaf CAL completed the intake evaluation given by the school psychologist. He was unaware of CAL’s previous background regarding language exposure. However he did know about the ADHD. Some of the tests of mental ability that he administered included the Kaufman Assessment Battery for Children {K-ABC}, the Developmental Test of Visual- Motor Integration {VMI}, and the Human Figure Drawing task.

The results of the K-ABC Nonverbal Scale, taken directly from the psychologist’s report, “suggest that CAL is functioning within the Average range of nonverbal intelligence when compared to children his same age”. He notes that average performance was seen on all subtests, with the exception of the one subtest that was done before CAL’s Ritalin started working. The school psychologist writes of CAL’s strengths, which include “the ability to be adaptable when faced with novel nonverbal problem solving situations”, “productively utilizing his nonverbal reasoning, perceptual organization, and analytic and synthetic abilities”. The school psychologist wrote that the results of the visual-motor integration evaluation appear to be invalid due to CAL’s lack of ability to sit still or concentrate on the task. About 45 minutes after CAL took Ritalin, he was able to focus on the rest of the tasks presented to him in the intake evaluation.

The school psychologist, unaware of CAL’s family background and linguistic experiences, wrote, “ CAL needs extensive exposure to appropriate adult and peer language models. His limited language development suggests the need for

a program where he would have the opportunity to receive his education in an environment where he has access to peers and staff through a common communication system both in and out of the classroom at all times”.

CAL had not yet taken any of the achievement tests, such as the Stanford Achievement test given by the school. Therefore in order to see if his non-verbal ability could be assessed, three subscales of the Wechsler Intelligence Scale for Children-Revised (WISC-R) were completed when CAL was age 8;5. He completed the following components: Block Design, Picture Completion, and Object Assembly. He scored within normal ranges for his age on all three subscales, independently.

4.2.4 School life throughout the time of filming

CAL started school on February 4, 1998, and was in school for less than 4 months before summer break began. He started school again on August 31, 1998. CAL was in a small class with other deaf children who had special needs, some due to attention problems and others whose language development was below average.

For the first two years, he resided in a comfortable, home-like dormitory with four age peers. The boy's room was painted blue and had a sports theme. Then three of the age peers were moved to the older children's dormitories, and CAL stayed in the same dormitory wing with one age peer (MEI) and three younger children, averaging 3 years of age, for the next few months. After that, CAL was transferred to the boy's dormitory wing to be with his other age peers,

which was in another building. The children live at the school from Sunday afternoon to Friday noon. Many, including CAL, then take a long bus ride home to their parents.

During the school day, from the second year of filming on, CAL was in a classroom with about 6 other children, most of whom had special needs, either with attention difficulties, language difficulties, or otherwise behind their age peers. The teacher signed ASL and sometimes spoke. There were Deaf, ASL signing teacher's aides in the classroom as well. The teacher covered typical subjects including math, language skills, English, and reading. For lunch- time, the children were all together, and hence a lot of ASL exposure occurred during lunch time too.

Overall, the amount of ASL exposure during both the school day and the dorm time was extensive. Much of this input was from native Deaf signers. Hence CAL, similar to MEI, went from minimal language exposure and input at home, to full immersion in ASL at the residential school.

4.3. Native Deaf age peers

The closest age peer is "NAT". She is one month younger than CAL, and two months older than MEI. NAT is a female with a congenital, severe to profound bilateral sensorineural hearing loss. Both of NAT's parents are Deaf, as are her grandparents, and her older brother. ASL is her first language, and is the only language used at home. She started at the school for the Deaf when she was age 3 years, 2 months.

Slightly older, but still potential peers due to a shared dorm/mealtime environment are a set of twin girls - “GEN” and “NEI”. GEN and NEI are identical twin females with a congenital, severe to profound bilateral sensorineural hearing loss. They are almost 3 years older than MEI, CAL and NAT. Both of their parents are Deaf, as are the grandparents and older siblings. ASL is their first language. They started at the school for the Deaf when they were 2 years 5 months.

4.4 Potential language level peers

JIL is a female with a severe to profound bilateral sensorineural hearing loss. She is about 3 years younger than MEI and CAL. Her first language is ASL. Her mother is a sixth generation native ASL signer and her father is a fluent, but not native ASL signer. JIL is not at the same school as MEI, CAL, NAT, GEN, and NEI.

JIL has been filmed as part of a longitudinal study of native ASL acquisition over the course of approximately 3 years, starting around the age of 20 months. A similar naturalistic language production data collection methodology was used for JIL and the other children. One exception is that many of the sign interactions for JIL were between JIL and her parents, at home, whereas for MEI and CAL the interactions were not with family, nor were they at home.

4.5 Deaf research assistant background

SAF is a Deaf female, of about the age of 60 years. Her parents were hearing, but deafness ran in the family. Although she did not start residential school until the age of almost 5 years old, she did sign with her parents and her Deaf cousins. She does not consider her early use of gestures and sign to be true ASL, but she also claims that it is not English. Her husband is Deaf, as are two of her four children (a third is hard of hearing, and the fourth is hearing). SAF and her husband have always used ASL exclusively in the home, and are active in the Deaf community.

SAF works at the residential school for the Deaf, telling ASL stories to the youngest school children in the morning, and working in the dorms as a dorm assistant in the afternoon and evening. SAF played with MEI and CAL and elicited the naturalistic language production samples for all 3 1/2 years of data collection.

Every attempt was made to have the interactions between the children and the adult communication partner, occur in a comfortable, signing situation.

4.6 Hearing researcher background

Although my parents are hearing, I have been exposed to ASL, and signing since I was 2 1/2 years old. I became interested in signing and the Deaf community early, and my parents responded to this interest. They found, and gave me ASL video- tapes, hired a babysitter who signed with her Deaf family members and me, and allowed her to bring me to Deaf community activities. I

grew up signing with my Deaf friends and talking with my family. Although I am not a native signer, I am fluent in ASL.

4.7 Summary

Due to the six year delay in being exposed to a first language, MEI and CAL are able to provide us with crucial information regarding when the sensitive period for language acquisition, if any, ends, as well as what is affected. By making comparisons between these later-learners individually, from the beginning of filming to the end of filming, it is possible to understand what develops over time, given delayed input. By comparing MEI to CAL, it becomes possible to see if the sensitive period effects are generally due to the timing of language input or to individual variation. Further, the comparison between language samples from MEI and CAL and those from the native signers, make it possible to consider whether the course of development, is delayed or deviant.

The naturalistic language production samples from the native and later-learner signers in this study will be compared and analyzed for general language development, such as Mean Length of Utterance (MLU), expressed concepts, and developmental milestones. The naturalistic language production data will also, along with the preliminary data from an experimental task, be used to focus on the acquisition of the verb agreement and morphology system of ASL.

Chapter 5

Methodologies

In order to address the question of whether sensitive period effects can be seen throughout the language acquisition process when language immersion begins at age 6 years, I employed a longitudinal, case study method. To supplement these naturalistic data with more targeted data on verb agreement and word order in ASL, an experimental game was also designed and piloted. Once all of the data were collected, I chose the sessions to use, and then transcribed or had the data transcribed. All transcripts were checked for errors by a second person, a native- signer, who made corrections when necessary. Each session was then coded for verb agreement and related aspects, such as word order and present/non- present referents. This chapter 1) describes the techniques used to collect the naturalistic language data, 2) presents the details of the experimental design, 3) provides the criteria used in selecting the sessions to be analyzed, and 4) shows how the data were analyzed.

5.1 Naturalistic Language Production Method

Following the methodology established by Brown (1973), filmed sessions of mostly naturalistic language production samples were used, starting after MEI and CAL had about 6 months of active exposure to ASL (excluding summer and/or winter school breaks). This provided MEI and CAL time to get adjusted to school life.

The naturalistic language collection sessions had a Deaf signer, who was familiar to the children, interacting with each child individually, in a number of activities. The “naturalistic language production” activities included playing with toys and games, telling stories from books, coloring, and doing “arts and crafts” type activities. Previous studies using primarily one of these activities have reported advantages and limitations of each, as will be described in sections 5.1.2 and 5.1.3.

The toys brought to each session changed frequently, with the same toys rarely being used twice in a row. The bags of toys often had a theme, based on either a holiday, for example Halloween, or a type of toy, for example a yo-yo. The bag of yo-yo’s had 45 different kinds of yo-yos, of different sizes, shapes, colors, and designs. During the second and third year of filming, the children were often asked what they wanted to play with, or read about at the next session. Their requests were met within reason.

Advantages to using naturalistic, spontaneous data collection in general is that it is both informative and not forced. If a child produces utterances with a particular syntactic structure, one can conclude that the child has knowledge of most aspects of that utterance. A general limitation, however, is that it is not clear how to interpret failures to produce a particular structure type. The reasons might be that the child did not choose to produce a particular structure, the context did not facilitate the structure’s use, or the child does not yet know the structure type.

5.1.2 Narratives as elicitors

To obtain naturalistic language productions, toys, books, and games were used. The type of language sample that is produced has been shown to be affected by the types of stimuli used, even within the category of naturalistic language production (Bamberg, 1987, among others). Hence books and storytelling provide a different data set than playing with a ball, a puzzle, dolls, etc. In order to get a good approximation of MEI's, CAL's, and NAT's overall language knowledge the types of stimuli used were varied to include both toys and books. Approximately 50% of the data analyzed for this research project come from filmed sessions with narratives as elicitors.

Storytelling occurs commonly, regardless of culture or language (McCabe, 1997). Storytelling involves the use of all aspects of language, along with other cognitive skills such as memory, planning, and sequential organization. Storytelling also involves skills that are specific to narration such as the ability to adopt a perspective, to shift roles, and to use quotation. Hence a language sample that consists of a narrative, either personal or from a book, is very rich in the above- mentioned ways.

Research shows that there is developmental improvement in the ability to produce a well-organized and coherent narrative in native signers (Lillo-Martin, et al, 1985, Emmorey & Reilly 1998, among others). Previous research has also shown that using simple picture books and telling a story page by page, diminishes the memory load and provides an organizational framework, thereby eliminating some of the confounding factors that make story-telling difficult for

young children (Wimmer, 1980). Studies in which books and narratives have been used to generate language samples in learners have shown specific advantages and limitations over the use of toys and dolls.

In the field of language acquisition, narratives have provided data that address many issues in different languages. Issues relevant for language acquisition include for example, acquisition of questions, passives, use of classifiers, use of quotation, use of aspect and tense, and more. Narration has been used as well to address acquisition of other cognitive skills, like development of a theory of mind. One picture book in particular has been used in many studies across a large number of languages, namely “Frog, Where are You”, by Mercer Mayer (Slobin, 1985).

In addition to “Frog, Where are You?” and “A Boy, A Dog, A Frog, and A Friend” by Mercer Mayer, MEI, CAL, and the comparison children told stories from four other sources. They were 1) The Three Bears, author unknown, 2) Good Dog Carl, by Alexandra Day, 3) Paint story and Balloon story, developed by Bellugi, et al. (1985), and 4) a variety of books the children had in their dormitory.

5.1.3 Toys as elicitors

Traditionally, naturalistic language data have been collected with toys as elicitors. Sometimes the researcher has brought toys to the child to provide novel topics of conversation. In other situations, researchers have taken advantage of the toys that the child has at his/her home to create topics of

conversation. Whichever way it is done, toys often work very well to elicit nouns through naming items, verbs and full linguistic structures through imaginative play, and asking questions of the person the child is interacting with. Therefore, 40% of the data analyzed for the present research project come from filmed sessions with toys as elicitors.

5.2 Session filming

A Deaf, fluent signer, SAF, interacted with MEI, CAL, NAT, GEN and NIE. She played with the children, and conducted the filming sessions approximately 98% of the time. SAF worked at the school as one of the dormitory assistants in MEI's and CAL's dormitory. This Deaf assistant was rarely called away to do something else. I operated the camera, a battery- operated SONY, Digital Effect, Steadyspot, Hi-8 video camera with 72X digital zoom. I am a hearing fluent signer, who is well- known to the children.

5.2.1 Filming of MEI and CAL

Filming started in February of 1999. From February through June, filmed sessions occurred once per month. From June through August, 1999, there were two filming sessions each, at MEI's and CAL's houses. During the most intensive period of filming, from September 1999 through December of 2001, the filmed sessions occurred twice per week, during the school year. They ranged in length from 15 minutes to 30 minutes depending on the child's attention span. From December 2001 to June of 2002, the filmed sessions tapered off to once

per month. Throughout the years of filming, approximately two home visits were made per summer, to both CAL's and MEI's houses. There were occasional periods of absences for each child whereby there was no filming for 2 or more weeks due to illness, or other extenuating circumstances. In each of these cases filming quickly resumed.

5.2.2 Filming of NAT, GEN and NEI

Filming of NAT, GEN, and NEI (the age peers) started in May of 2000. Sessions with these children occurred much less frequently than those for MEI and CAL, averaging 4 sessions per year from May 2000 until June 2002. NAT, GEN, and NEI all told stories from the same books as MEI and CAL, played the same experimental games, and played with some of the same toys. They also periodically interacted with MEI and CAL during the years of filmed sessions. This interaction provides data relevant to questions of how MEI's and CAL's native- signing age peers interact with MEI and CAL socially and linguistically.

5.2.3 Filming of JIL

Filming of JIL was slightly different from the filming of the other Deaf children, as this was part of a separate, longitudinal study of early syntactic development, the Cross- Linguistic Early Syntax Study (CLESS), at the University of Connecticut. The early filming, from ages 20 months to 3 and a half years was conducted in a different state, with different participants, but with a similar longitudinal, naturalistic language production methodology. The majority of JIL's

sessions were filmed at her home or at her mother's workplace, interacting with a hearing signer who was familiar to JIL and JIL's mother. These regular sessions occurred once per week, for about one to two hours per session. The last session for JIL is at age 4 and a half years, one year after the end of the regular filming. This last session is at her home, and is with the same books, experimental games, and some of the same toys used by MEI, CAL and the others.

5.3 Experimental task

Although the naturalistic types of data collection sessions are invaluable with respect to the breadth of structures and information they provide, an experimental "game" using an Act-Out task was designed, to test for knowledge of specific aspects of the verb agreement system, word order, and topicalization. It has been played so far by NAT, GEN, NEI, JIL, MEI, and CAL. More participants are being recruited to enlarge the group of age- peer native signers, and create a group of younger, language- level native signers. While finding more children in the same situation as MEI and CAL is improbable, MEI and CAL will be tested again to see if development has occurred with the longer period of language immersion.

In this act-out task, each child individually watched a video- tape of a native Deaf signer signing short sentences with different ASL verb types and two different ASL word orders. The child then had to pick up the appropriate props and show the Deaf experimenter what had just been signed. This task was

designed to show how the children understood the different acceptable word orders and how verb agreement is expressed in ASL. (Details of this experimental task, as well as preliminary results, will be presented in Chapter 8).

5.4 Data transcription and coding

For MEI, approximately one session per month for the first 2 1/2 years, was chosen for detailed analysis. Following the first 2 1/2 years, and until the end of filming, approximately one session every six months was chosen. For CAL, approximately one session per month for the first 8 months was chosen, with some additional later sessions throughout the next year. For JIL, one session every six months on average, was chosen. And for NAT one session per year was chosen. Table 5.1 shows the full set of data analyzed, including the child's sessions, age, and length of exposure.

Table 5.1. Child session information

Child Session	Age at Session	Exposure amount at session*
MEI 1	6;6,26	7 months
MEI 2	6;7,28	8 months
MEI 5	6;8,24	9 months
MEI 6	6;9,1	9 1/2 months
MEI 12	7;0,5	9 1/2 months
MEI 16	7;1,26	13 months
MEI 17	7;2,1	13 months
MEI 18	7;2,3	13 months
MEI 24	7;3,27	15 months
MEI 26	7;4,19	15 1/2 months
MEI 27	7;4,26	16 months
MEI 28	7;5,00	16 months
MEI 43	7;7,9	18 months
MEI 51	7;8,31	20 months

MEI 56	7;11,18	22 1/2 months
MEI 59	8;0,26	24 months
MEI 63	8;1,18	24 1/2 months
MEI 67	8;2,14	25 1/2 months
MEI 72	8;3,18	26 1/2 months
MEI 81	8;6,3	29 months
MEI 98	9;1,10	36 1/2 months
MEI 110	9;9,11	44 1/2 months
CAL 1	6;10,6	10 months
CAL 2	6;11,6	11 months
CAL 5	7;0,2	12 months
CAL 8	7;1,15	13 1/2 months
CAL 10	7;4,06	16 months
CAL 11	7;4,13	16 months
CAL 17	7;5,4	17 months
CAL 53	8;0,0	24 months
Child Session	Age at Session	Exposure amount at session*
JIL 17	2;0	Native
JIL 34b	2;6	Native
JIL 35a	2;6	Native
JIL 41	3;0	Native
JIL 65	3;3	Native
JIL 75	3;6	Native
JIL 1 (S)	4;6	Native
NAT 1	7;11	Native
NAT 4	8;11	Native

*Exposure- meaning the approximate amount of time since language immersion, not first exposure

All selected sessions were transcribed using an annotated English gloss system with time codes entered in a Filemaker Pro database. The sessions were transcribed by one of 3 native, Deaf signers, or one hearing, native signer, or one hearing, fluent signer. One MEI session was transcribed by all of the study's transcribers independently, to check inter-rater reliability. There was 90% agreement among all of the transcribers. The most common differences were with establishing utterance boundaries and number of unintelligible utterances.

Most of these differences were resolved when two or more of the research group met together to view each problematic utterance. All transcripts were then checked in their entirety, either by me, or a native, Deaf signer. Following the transcription and checking, the sessions were each coded on a separate screen within Filemaker Pro, that was designed to examine specific aspects of each utterance relevant to verb agreement. A sample screen can be found in Appendix A.

The sessions for MEI were grouped into 3- month age ranges, starting from the first day of filming. This decision to group the sessions this way was done in order to better see trends, and to make comparisons with JIL's analyzed naturalistic language samples, which were not more frequent than every three months.

5.4.1 Language milestones and development

The transcripts were imported from File Maker Pro to Excel worksheets in order to tally utterance counts, such as MLU, number of codable utterances, word orders used, types of semantic relations, and overall error rates. For calculating the MLU, Brown's (1973) criteria were modified slightly to accommodate a visual language. All utterances were counted in the calculation with the exception of the following: unintelligible utterances, yes, no, or attention-getters, like HEY in isolation, direct repetitions of the adult, routines, such as HAPPY BIRTHDAY and HELLO, and stutter restarts.

For the calculation of MLU, one- word signs were counted as having one morpheme, if they were unmarked. A one- word sign was counted as having two or morphemes depending on whether it had aspect marking, was a classifier, or had facial expression marking a question. The MLU was calculated twice, one was the average of morphemes, and the other was the average of words.

For calculating word order use, only those utterances with a verb plus a subject or object were tallied. Utterances that either had only a verb, or a verb plus a location, adjective, temporal marker or any of the other possibilities were not counted in the analysis of the children's use of basic versus derived word order. This is discussed further in Chapter 6.

The naturalistic language samples were also coded for the semantic relations as proposed by Bloom, et al (1975). I used a subset of these semantic relations, based on the results from a similar analysis with native Deaf children reported by Newport and Ashbrook (1977). The semantic relations used are defined in Chapter 6 of this dissertation. The two- or more word utterances were coded in this semantic analysis, excluding unintelligible or incomprehensible utterances.

The naturalistic language samples of MEI, CAL, NAT, and JIL were also coded for overall percentage and types of errors, excluding phonological errors, per session or age range. The details and definitions of how these were coded can be found in Chapter 6 in the section on error types.

5.4.2 Verb agreement and morphology coding

Only those utterances with an overt verb were coded in the verb agreement and morphology analyses. As the sample coding screen in Appendix A shows, each utterance with a verb was coded for interpretation, word order, verb type, eye gaze, non-manuals used, agreement type, null or overt referents, present and non- present referents, and possible errors. The list of verb, agreement, and error types coded for is shown in Table 5.2.

Table 5.2. Verb agreement coding screen options

Verb types	Agreement types	Error types
Plain, body anchored	Subject agreement	Plain verb with agreement
Plain, not body anchored	Object agreement	Failure to use required agreement
Agreeing, transitive	Source/goal agreement	Using wrong location
Agreeing, di-transitive	Spatial agreement	Agreement with wrong argument or referent
Agreeing, backwards		Subject, object, indirect object, or location should not be null
Spatial, locative		other
Spatial, classifier		
Adjectival predicate (no verb)		

The classification of verb type was made as follows. A plain verb is a verb that does not mark agreement. It is body-anchored if it either has contact with the body, or can only be signed in one location near the body, for example HEAR. It is not body- anchored if it does not touch the body, or can be signed in a location, e.g. HURT.

An agreeing verb is a verb that marks agreement with two arguments, which are humans or anthropomorphized characters. An agreeing verb can be further coded as either transitive, or di-transitive, among other options.

A spatial, locative verb is a verb that marks the movement to a location of an object or person, for example GO-TO. A spatial, classifier is a verb that is signed using a classifier handshape, for example WALK-TO, signed with the first and middle-fingers pointing down, like legs, and being moved to a location.

One verb in particular was difficult to classify. SEE has different forms. One form fits the defining characteristics of a plain verb. This SEE is made with a one-hand, K- handshape. The middle finger touches under the eye with a double tap. Other forms of SEE were not able to be clearly classified into a verb type despite repeated viewing by me and two native signers. These forms of SEE were not coded at all in the analyses, and will be left for future research.

The establishing of present and non-present referents for much of the naturalistic language production data was straightforward. The referent was either physically there, or not. However in the case of storytelling from books, the decision was made to consider a referent present if the referent was present on the book page. If the referent was not on the book page, and not in the immediate environment, it was coded as being non-present.

The other aspects were coded as follows. The referents were coded as overt if they were either named or pointed to. They were coded as null if they were not. Word order was coded with all of the word types used, including location, adjectives, nouns, subjects, verbs, and objects, among others. The

child's eye gaze was coded, either exactly or approximately based on what was clear from the video- tape. Whether the child's showed verb agreement was decided based on the movement put on the sign, regardless of verb type. For example, MEI signs YOU-WIN to SAF. WIN is a plain verb that does not get signed in a location. However, MEI leans over and makes the sign in SAF's sign space. This utterance was coded as having subject agreement, and the error, plain verb with agreement.

Some of the coding decisions I made are relatively straightforward, and found in other studies reported in the literature for analyses of children's naturalistic language, and more specifically ASL data. Other decisions, like classifying a verb on an individual basis rather than as always the same verb type, are more controversial.

5.5 Summary

The benefits of a case study design include the ability to focus on issues that could not be addressed by ethical experimental designs, and the ability to obtain a detailed history and knowledge of each participant. However, the limitations include that a "population" is not being adequately sampled and that longitudinal case studies generate large quantities of data that must be managed and formatted for data analyses.

Given this, the data from the two different elicitation methods presented here should provide results that converge on an accurate description of each participant's language competence at the time of the particular session.

Unfortunately there are still many aspects of the language development of these later- learning, special- situation children that the methods employed here will not be able to address. These include investigation of brain activation patterns, of language processing, and of final attainment of language in adulthood.

However, the narratives provide a rich source of information regarding each participant's knowledge of verb agreement and morphology, utterance length, word orders, and uses of narrative discourse functions, among other aspects of language. Data from the naturalistic language production sessions with toys as elicitors will provide an extensive database for use of nouns, word order, verb agreement and morphology, non-manuals, such as facial expression and shoulder-shift, and aspects of play, among other domains of language and development. Finally, the preliminary results from the experimental "game" will provide focused insight into the specifically targeted aspects of verb agreement, including comprehension of verb agreement, and basic versus derived word order.

Chapter 6

Acquisition of ASL Under the Condition of Delayed Input

6.0 Introduction and Background

Regardless of their IQ, language, language modality, ethnicity, or parenting style, most children acquire language comparably, achieving major language milestones along a similar developmental timetable (Slobin, 1972). By the age of 6 years, children have passed through a babbling phase, followed by a one-word phase, a two-word phase, and a telegraphic phase, with good knowledge of their language's grammar, including basic word order.

The early language development is often measured by an increase in mean length of utterances (MLU) and syntactic complexity. By the age of 6 years, children have also acquired among other aspects of language, the morphology of their verb agreement system, the syntax for forming questions, and knowledge of colors and numbers, among other things (DeVilliers and DeVilliers, 1979). By the age of 6 years, they have adult-like grammar, and an increased memory capacity as compared to younger children (Pascual- Leone, 1989).

This chapter aims to address the question: What is language like when a 6 year old child started acquiring a first language at an age when most other children are linguistically quite adult-like?

6.1 Mean Length of Utterance (MLU)

Since the 1970s, calculation of mean length of utterance (MLU), has replaced chronological age as an index of language development and maturity (Brown, 1973). MLU is the average number of morphemes per sentence a child produces in a sample of about 50 to 100 utterances. Changes in MLU with language experience led Brown (1973) to propose five stages of language acquisition that correlate loosely with a child's first five years of age.

In order to try to assign a stage of language development for MEI and CAL, their MLUs were calculated starting from the first filmed sessions. This was approximately six months after they first became immersed in language. Brown's (1973) criteria were followed as closely as possible in the calculation of the MLUs for MEI, CAL, NAT, and JIL to see if development over time could be seen for each child. Given that ASL allows subjects and objects to be null, does not have auxiliary verbs or the copula *be*, and commonly lacks overt prepositions, it is unclear that calculating an MLU for ASL as compared to English, will be the optimal way of indexing language development. Calculating the MLUs for JIL and NAT, the native signers, allows both an age comparison, and also an informal test of the MLU index itself.

If the language acquisition process is speeded up due to MEI's and CAL's chronological age and cognitive ability, then the MLUs for MEI, CAL and NAT should pattern similarly, since NAT is about the same chronological age as MEI and CAL. If the language acquisition process is normal speed, then MEI and

CAL should pattern similarly to JIL, since JIL has had approximately the same number of years of language exposure. If the language acquisition process is completely different for the later-learners, then MEI and CAL might pattern similarly to each other, but different from both JIL and NAT.

If the calculation of MLU is not representative of the knowledge of ASL, then a different result might be seen. The MLU scores might not increase over time, be consistent with the age patterns found by Brown (1973), or differ systematically for MEI, CAL, JIL, and NAT.

MLUs were calculated for all of the coded sessions for MEI, CAL, JIL, and NAT. The sessions for MEI and CAL were divided into three- month intervals, with the data combined for those periods of time. Table 6.1 below shows a summary of the MLU data.

Table 6.1 Mean Length of Utterance Summary

Child	Age Range	Lowest MLU	Highest MLU
MEI	6;6- 9;11	1.98	2.65
CAL	6;10- 8;0	1.7	2.42
JIL	2;0- 4;6	1.73	2.18
NAT	7;11- 8;11	2.91	3.07

In general, the MLU scores for MEI and CAL seem similar in that the scores cover approximately the same MLU range over the time spans reported, and increase over the time period. However, upon examining the MLU patterns more closely, a number of problems can be seen. First, MEI and CAL do not have their highest MLUs at the later sessions. MEI's MLU, 6 months after ASL

immersion, during the age range of 6;6- 6;8 is a little under 2, at 1.98. Her MLU goes to a high of 2.7 during the age range of 9;0- 9;2, and dips back down to 2.57 during the last filmed age of 9;9. CAL has many fewer data points, but the pattern found is similar to that of MEI's. Eight months after language immersion, CAL's MLU ranges from a low of 1.7 and goes to a high of 2.4, at age 8;0. Preliminary coding of MLU for his sessions after age 8;0, appear to dip, similar to what was found in MEI's sessions.

Second, the slight increase seen in MLU is not nearly as large as what would be predicted if the language ability was improving and the MLU was growing with language ability, as found by Brown (1973) for normally developing, hearing, English- speaking children.

Third, examination of the MLU scores for JIL and NAT also suggest that MLU is not a good indicator of language ability for the acquisition of ASL- not even for native- ASL signing, Deaf children. JIL's age range is from 2;0 to 4;6, which should, according to Brown (1973), show an MLU range of approximately 1.5 to 4.5, given JIL's normal language acquisition and development. Similarly, NAT, at ages 7;11 and 8;11 should have a higher MLU and should not have shown a decrease in MLU if it is language productivity that is being measured.

6.2 Acquisition of ASL by MEI and CAL

If MLU is a poor indicator of language productivity and knowledge for both the native signers and the later-learner signers, and age is not a good correlate, then there must be another way to study MEI's and CAL's language acquisition

and competence. Examining the naturalistic production of MEI's and CAL's language for those properties that are specific to ASL, versus English (the surrounding spoken language for MEI and CAL) for example, would suggest that MEI and CAL are acquiring the accessible natural language they have become immersed in. As such, the course of language development of MEI and CAL can be compared to that of native signers to see if and where differences or problems might be. The language samples from MEI and CAL were examined for the use of specifically ASL word orders, null arguments, and verb agreement. These areas of language are different from English, they are correctly used early on in native, signing children, have a relatively high level of grammatical complexity, and can be examined through naturalistic language production data. The errors that MEI and CAL made in their language were also studied.

6.2.1 Word order use over time

ASL allows a wide range of word orders. Although the basic word order is Subject, Verb, Object (SVO), there are grammatical mechanisms that allow derived word orders, such as topicalization whereby the word order becomes \bar{O}_t SV, for example. (These mechanisms will be further explained in Chapter 8.)

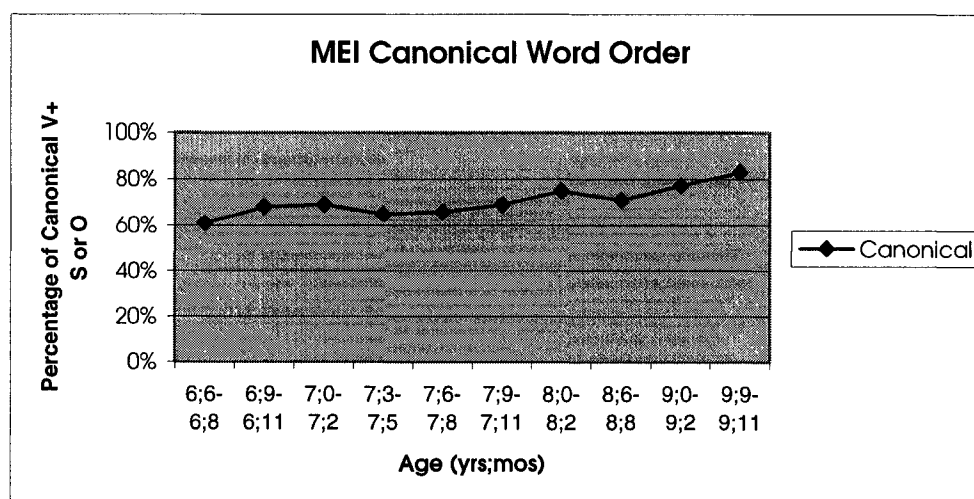
A focus of investigation in the field of ASL language acquisition has been children's use of the different word orders throughout the course of acquisition. The research has shown that young, Deaf, native- signing children use a wide range of ASL word orders from at least as young as 1;11, soon after they begin

combining signs (Chen Pichler, 2001). In order to see if this same path of early use of different word orders in ASL acquisition is followed by late-learners, MEI's use of canonical and derived word orders were examined over time and compared to those of JIL's and NAT's. Data from CAL are not presented here because more of his data still needs to be transcribed and analyzed. The only utterances that were counted in this analysis were those with a verb plus either a subject, an object, or both, in whichever orderings they appeared. Not counted in this analysis were utterances that consisted of either a verb alone, or a verb plus a location, a temporal sign, or an adjective. These utterances were not counted because it would have been impossible in those utterances to determine the word ordering, given the null arguments. Canonical, that is, typically grammatical, word orders included SVO, SV, and VO. Non-Canonical orders in this analysis include those that are grammatical in adult ASL only when they are appropriately marked, as well as those that are ungrammatical, for example OSV, VS, SOV, OV, OVS, and VSO. A more detailed analysis of the grammatical versus ungrammatical derived word orders will be saved for future work. Of current import is whether MEI uses both canonical and non-canonical word orders, and whether this changes over time.

As seen in Figure 6.1, although MEI does use some non-canonical word orders (39%) in the early sessions, there is a gradual, but steady increase in the percentage of her analyzable utterances that have more canonical word orders. A linear regression of canonical word order as a function of age shows a significant and positive increase over time ($r^2 = .78$; slope = .004; 95%CI .002-

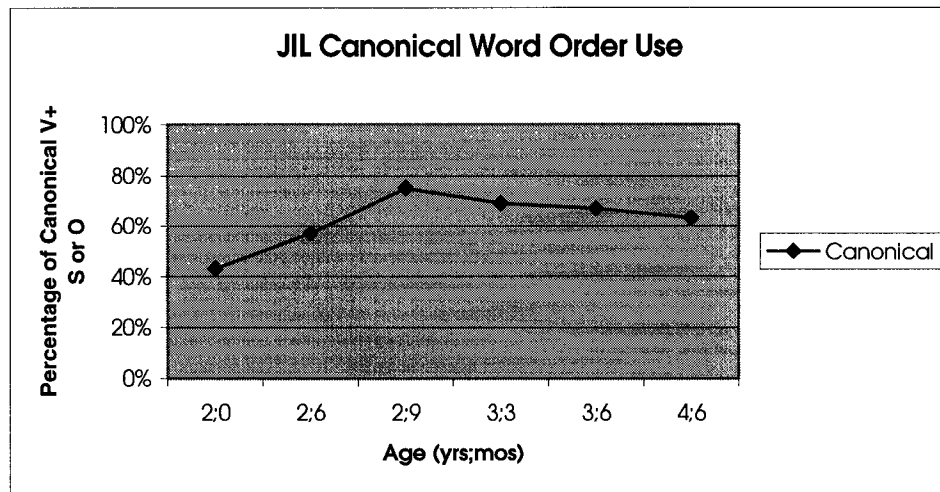
.006). In session 110, at age 9;9, MEI used canonical word orders 83% of the time.

Figure 6.1 MEI's Word Order Use



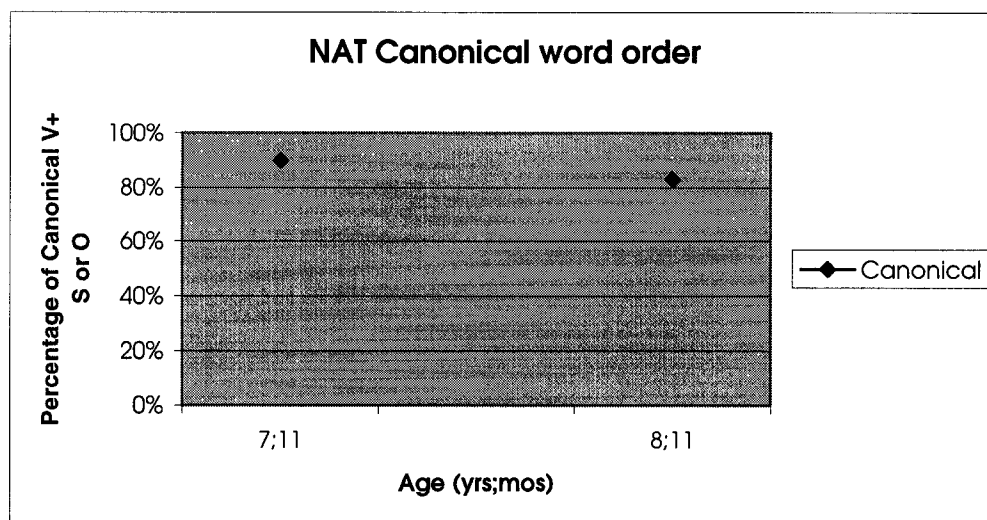
The pattern for JIL looks quite different, as shown in Figure 6.2. JIL's use of utterances with canonical word order increases drastically and quickly, from 43% at age 2;0 to 74% at age 2;9. It then appears to decrease to 63% by age 4;6. The structures with non-canonical word order that were used were grammatical.

Figure 6.2 JIL's Word Order Use



Data from NAT are not as informative because only two data points, one year apart are represented, however NAT does use different percentages of canonical and non-canonical word orders in the two sessions.

Figure 6.3 NAT's Word Order Use



The three sets of data, as depicted in the figures above present three different patterns of canonical word order use. Figure 6.1 suggests that MEI uses basic ASL word order productively, similar to what is reported from studies with Deaf later-learner adults (Newport, 1984). However, the non-canonical word orders used by MEI (and late- learner adults) still need to be investigated to determine which aspects of ASL word order present difficulty for later- learners.

Figures 6.2 and 6.3 show the results for JIL and NAT. NAT uses surprisingly infrequent variations of word order. This is likely the case because the two language samples analyzed thus far were the telling of stories, right from the books. The session at age 7;11, consisted of NAT's looking at three book and telling the stories as she went through the pages. The session at age 8;11 consisted of a personal narrative and then more stories from books. In this session, most of the utterances with non-canonical word orders occurred during the personal narrative. Perhaps had I asked NAT to put down the books and tell the stories, a more typical pattern of varied word order use would have occurred. As more of NAT's sessions are analyzed, with other types of data collection, it is expected that more non-canonical word orders will be found.

The data from JIL reflect what has been previously reported in the literature for native- signing adults. Native- signers use a wide variety of word orders, even at young ages (Chen-Pichler, 2001).

6.2.2 Null arguments are allowed in ASL

ASL, like Spanish, Italian, and Chinese, among others, allows null

arguments. In ASL, either or both the subject and object may be null in particular contexts. A correlation between the child's use of subjects and various properties of the inflectional system has been found in the acquisition of ASL, by native Deaf signers (Lillo-Martin, 1986). Lillo-Martin (1986) reported that children who used verb agreement in ASL, used null arguments licensed by agreement. The same children did not use such null arguments, when agreement was not used. It would be predicted therefore, that if a language allows both a null subject and object, many verb- only utterances would be used.

A closely related area is the Pro-Drop literature with spoken languages. There has been much discussion and debate surrounding why hearing, English-speaking children often omit subjects, in contexts where it is not allowed in the adult grammar. Studies such those of as Bloom (1990), and Hyams and Wexler (1993), examined null arguments in English and found that English- speaking children drop subjects more frequently than objects, and produce very few verb-only utterances. Although the proposed hypotheses differ vastly for why this is the case, the data are generally agreed upon.

Given that verb- only utterances are not frequently produced as an error in languages that do not allow null arguments, but are predicted in a language that allows null arguments, the verb- only utterances were examined in JIL's and NAT's naturalistic language production sessions. MEI's and CAL's verb- only utterances were also analyzed. Because ASL allows null arguments, a high percentage of verb- only utterances is predicted for JIL and NAT. It is also

predicted that if MEI and CAL are acquiring ASL, they too will produce a high percentage of verb- only utterances.

The utterances with a verb were grouped based on whether a subject and/or object were overt. All of the utterances with a verb, but with neither a subject nor an object were tallied as verb- only. Some of these verb- only utterances have a location specified, or an adjective, or a temporal marker. The data for all four children are presented in Tables 6.2 through 6.5.

Table 6.2 JIL's use of verb-only utterances

JIL Age	Session	% V only
2;0	JIL 17	65%
2;6	JIL 34b	67.60%
2;6	JIL 35a	57.10%
2;9	JIL 41	55.60%
3,3	JIL 65	60.60%
3;6	JIL 75	45%
4;6	JIL 1 (S)	62.70%

Table 6.3 NAT's use of verb- only utterances

NAT Age	Session	% V only
7;11	NAT 1	33.50%
8;11	NAT 4	46%

Table 6.4 MEI's use of verb- only utterances

MEI Age	Session	% V only
6;6- 6;8	1,2,5	49.20%
6;9- 6;11	6	45.40%
7;0- 7;2	12,16, 17,18	52.50%
7;3- 7;5	24,26, 27, 28	49%
7;6- 7;8	43,51	53.50%
7;9-7;11	56	60.00%
8;0- 8;2	59,63, 67	67.40%

8;6- 8;8	81	63.50%
9;0- 9;2	97, 98	38.70%
9;9- 9;11	110	44.40%

Table 6.5. CAL's use of verb- only utterances

CAL Age	Session	% V only
6;9- 6;11	1,2	45.70%
7;0- 7;2	5,8	56.80%
7;3- 7;5	10,11, 17	60%

The results show that JIL produced very high percentages of verb-only utterances, ranging from 45% to 67.6%, of those utterances with a verb. Similarly, MEI and CAL also produced a high percentage of verb- only utterances, ranging from 44.4% to 67.4% of those utterances with a verb. However, while NAT produced many verb-only utterances, they ranged only from 33.5% to 46% for the two sessions analyzed. This difference between NAT and JIL could be due to the developmental differences between, and the linguistic complexities expressed by, a 4 1/2 year old and an almost 8 year old child.

Although ASL allows null arguments, there are contexts in which the null arguments are not allowed. Some of these contexts are pragmatic, while others might be syntactic, and related to formal syntactic features. MEI and CAL appear similar to JIL in their high percentages of null arguments. A topic for future work will be a more detailed analysis of the instances where null arguments are and are not grammatical. Additionally, I will re- examine the instances of null arguments used by JIL, NAT, MEI and CAL to see if they are grammatical, developmentally- linked, and/ or linked to the syntactic formal features. For the

present, it is important to note that MEI and CAL are showing a pattern of null argument use that is similar to that of younger, native signers of ASL.

Although MLU is a poor indicator of ASL knowledge and acquisition, the combination of the word order data with the null argument data suggests that MEI and CAL are acquiring ASL with potential differences from, and/ or more difficulty than, native signers.

6.3 Cognitive ability versus Linguistic ability: A dissociation

Another way to study MEI's and CAL's language knowledge and the complexity of the language forms they use, given that MLU does not provide an adequate description, is through the examination of semantic relations used as a function of age and cognitive ability.

The development of cognitive capacity and the development of language have often been assumed to be closely related (Clark, 1983, Carey, 1994). Under normal circumstances of language acquisition and development, these two occur at the same time, making them inextricably linked. In the normal situation, there are few ways to test whether there is independence of cognitive capacities such as understanding and conveying semantic relations, theory of mind, temporal relations, etc. from language development

Since the early 1970s, researchers including Bloom (1970, 1973), Brown, (1973), Braine (1976), and Newport and Ashbrook (1977) have examined the semantic relations that children express in their earliest multi-word utterances, in the two- and three- word stages. The results suggested that in general, the sorts

of meanings children encode in these earliest utterances parallel the concepts they have about the world at that age. Therefore at older ages, a child might encode and discuss more complex concepts, possibly due to the greater capabilities of an older child, ultimately a circular argument. Bloom, Lightbrown, and Hood (1975) examined the emergence of semantic relations in the acquisition of English and found that certain relations appeared earlier than others, for example “existence” relations appeared before “actions”, which appeared before “datives”, “causation”, and “intentions”. These results have been found cross-linguistically by both Bloom, et al for hearing children, and Newport and Ashbrook (1977) for Deaf children. The question often raised is whether the knowledge of the syntactic devices of the target language limits the complexity of what the child can express. For example, if a child does not know how to ask a question in his/her language, does the child question anything yet?

This issue can be addressed by comparing child late- language learners to child native language learners. The two- or more morpheme utterances of MEI were compared to those of both the younger, native signer, JIL, and the same age, native signer, NAT, to see whether MEI’s cognitive concepts and semantic relations have developed along a “normal” time course, even though her language has not. The sessions from JIL, NAT, and MEI have been analyzed for semantic relations, following Bloom’s (1970) and Newport and Ashbrook’s (1977) labels and criteria.

I hypothesize that while MEI’s language use is more similar to that of a native younger child of about three and a half years old, the concepts and

semantic relations she tries to express are cognitively age-appropriate, because she was able to acquire them extralinguistically.

The following semantic relations were coded and grouped further into Early, Mid, and Late appearance based on the results of the studies conducted by Bloom, et al (1975) and Newport and Ashbrook (1977). The early appearing group of semantic relations consists of Existence, Actions, States, and Locations. The mid- appearing group consists of Possession, Attribution, Negation, and Wh-Q. The late appearing group consists of Datives, Instruments, Action-Place, Intentions, Causation, and Manner. The definitions of these groups are shown in Table 6.6.

Table 6.6 Semantic Relations

Semantic Relation	Defining characteristics	Example
Existence	Pointing out and naming an object or person.	PT-APPLE APPLE (*)
Action	Action performed by an actor.	OWL FLY
State	Transitory state	BOY TIRED
Location	Either 1) action involving movement of an object from one location to another, or 2) static location of an object	1) PICK-UP FROG 2) TREE OUTSIDE
Possession	Declaring ownership	MY DOG.
Attribution	Descriptive characteristics	RED BALLOON
Negation	Making an utterance negative	NOT-WANT BOWL
Wh-Q	A question that starts with a Wh-word	WHAT PT-TOY?
Dative	Action involving movement of an object from one person to another.	GIVE CUP.
Instruments	Action performed with an instrument	SCISSORS CUT.
Action-Place	Action performed at a location	PLAY OUTSIDE

Intention	Action to be done in the future	WILL LEAVE
Causation	Shows a cause and effect	SUPPOSE CRY, MUST GET TISSUE.
Manner	Shows how the action is performed	TWIST-OPEN JAR

*PT = point

Table 6.7 shows the use of the different semantic relations groups over time. Each row of the table presents data from one child at one age or during one age range. The three percentages are the percentages of early, mid and late learned semantic relations (as proposed by Bloom, et al 1975, and Newport and Ashbrook, 1977) that the child produced at that age or during that age range.

The table shows percentage data from all of JIL's sessions. It shows the percentages from MEI during the age ranges 6;6 to 7;2 and then at ages 7;11 and 9;1. And it shows the percentage use of the semantic relations by NAT age 7;11.

Table 6.7.

Child	Ages	Total rel	% early	% mid	% late
MEI	6;6- 6;8	210	50%	35%	15%
MEI	6;9- 6;11	104	64.40%	16.40%	19.20%
MEI	7;0- 7;2	319	60.20%	21.90%	17.90%
MEI	7;11	37	54.10%	5.40%	40.50%
MEI	9;1	110	70.10%	6.30%	22.70%
JIL	2;0	31	87.10%	12.90%	0
JIL	2;6	110	54.60%	40.90%	4.50%
JIL	2;9	27	74.10%	25.90%	0
JIL	3;3	48	56.30%	39.60%	4.10%
JIL	3;6	130	60.80%	26.90%	12.30%
JIL	4;6	209	60.80%	19.10%	20.10%
NAT	7;11	242	58.70%	9.50%	31.80%

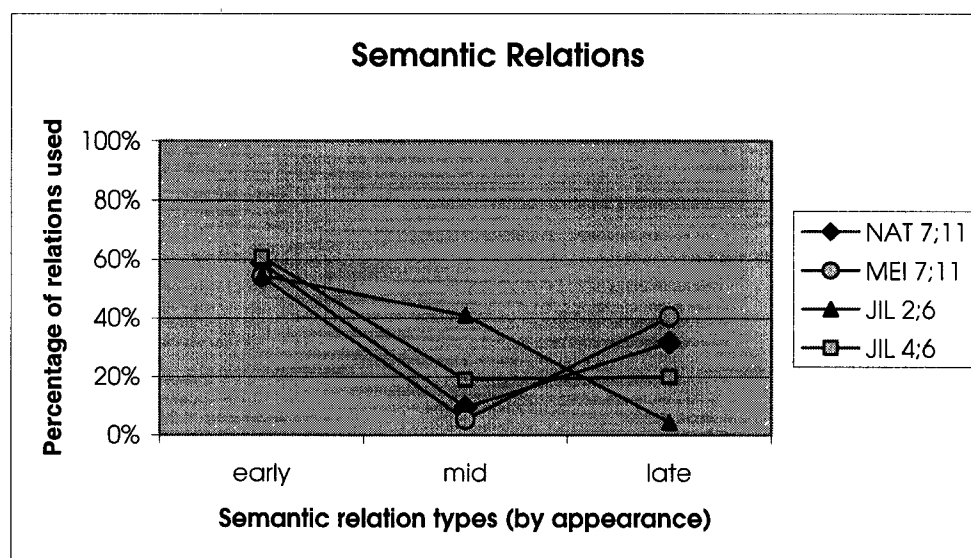
The table shows that all three children use a high percentage of the early appearing semantic relations, throughout all of the sessions coded. However it is only the later sessions for JIL that have a higher than 10% use of the later-appearing semantic relations. MEI consistently uses 15% or more of the later-appearing semantic relations. 32% of the semantic relations that NAT produced were in the late learned category.

To show more directly that MEI's use of semantic relations is more similar to that of an age peer than a language- level peer, Figure 6.4 shows MEI at age 7;11 compared to NAT at age 7;11, thus the age peer comparison. It shows the comparison of MEI to JIL at age 2;6, which is approximately the same number of years of exposure for both JIL and MEI. And additionally, it shows the results for JIL at age 4;6 for validity, since JIL should be using more later appearing semantic relations at this age, according to the results from Newport and Ashbrook (1977). If the hypothesis that MEI has age- appropriate cognitive abilities as seen through semantic relations is correct, MEI and NAT should pattern similarly, but differently from JIL at age 2;6. If the hypothesis that the percentage of the semantic relations changes with age then JIL at age 4;6 should pattern differently from JIL at age 2;6, and more similarly to NAT and MEI.

Figure 6.4 shows exactly these trends. MEI and NAT pattern together. JIL at age 2;6 patterns very differently from MEI and NAT. JIL at age 4;6 patterns differently from JIL at age 2;6, but more like MEI and NAT. Preliminary analyses of the sessions from CAL indicate a pattern similar to MEI's. What this

figure does not show is language ability, as measured through errors and/or linguistic measures such as utterance length.

Figure 6.4



As noted, Figure 6.4 shows the use of semantic relations, apart from the grammatical use of language and errors. The figure shows that for all four children/ sessions, the largest percentage of semantic relations are of the early appearing types. For MEI, NAT and JIL, age 4;6 and older, there is a relatively high proportion of late- appearing semantic relations. Whereas for JIL, age 2;6, there are few examples of late- appearing semantic relations, and many more of the mid- appearing ones. These results converge with those reported by Newport and Ashbrook (1977).

If there is a dissociation between cognitive semantic relations and language development, it would be predicted that while there would be many late

appearing semantic relations and more cognitively complex topics of conversations for MEI and CAL, MEI and CAL should also have more errors in their language. Their cognitive abilities will have been developing longer than their language abilities. For JIL, it would be predicted that there is no dissociation, that is, less complex topics of conversation, and few to no language errors.

Examples of the general topics signed about are shown in Table 6.8. Intuitively, MEI's and CAL's general topics discussed are more complex and cognitively more advanced than are JIL's.

Table 6.8 General Topics

MEI age 6;6-6;8	MEI age 9;9	CAL age 6;10	JIL age 2;0	JIL age, 3;6
Color, not here & now, time, conditional, counting, losing/ winning	Marriage, personal narratives, future, causation	Counting, colors, present and future, here & away, negotiating	Drinking, keys, hitting, present only	Sleeping, cat, farm life book, chocolate milk

Examples of utterances used by MEI, CAL, and JIL are shown in Table 6.9. The “*” indicates that there is an error with that utterance. A more detailed analysis of the errors made by the children will be shown in the next section of this chapter.

Table 6.9 Early language example Utterances

MEI 6;6-6;8	<ul style="list-style-type: none"> * PLAY WATER GROW. * CAT <EAT^ FLOWER ..SICK > * TWO ME OTHER TWO. * THINK THROW-AT-ME. THINK GOLD THINK INSIDE EGG. ME DON'T-WANT. 	<p>I want to play with the thing that when you put in water, it grows. If cat eats flower, will get sick. I want to do another two. I thought she would throw it at me. I think there is gold inside the egg. I don't want that.</p>
CAL 6;10	<ul style="list-style-type: none"> * CAN YES<hn> PT-TOYBAG. PT-WALL TURN-OFF-SWITCH YOU. * PT-SBB SAY FIVE. 	<p>We can play more with the toys. I want you to turn off the light. SBB says I can have five</p>
JIL age 2;0	<ul style="list-style-type: none"> PT-keys THROW PT-apple APPLE CRY CRY CRY CRY 	<p>Brother threw the keys That's an apple. I cry and cry.</p>
JIL age 3;6	<ul style="list-style-type: none"> DIRTY IX(CHALKBOARD) DIRTY. ME UPSTAIRS PLAY MOTHER O-K? ME DONT-WANT. 	<p>The chalkboard is dirty. I'm playing upstairs Mom, okay? I don't want it.</p>

The results presented here seem to indicate that while language and cognitive ability are connected, in that without the use of language, semantic relations can not be expressed, the two may not develop in parallel. For MEI, and likely CAL, once language acquisition started, the concepts and semantic relations expressed were more advanced than their linguistic ability. This is shown primarily by Figure 6.4 that compared the use of late- appearing semantic relations for MEI versus NAT and JIL, and also supported by the topics of conversation, with the examples of utterances with errors. MEI's and CAL's language itself includes grammatical, phonological, and discourse- related errors that are not reported to be typical of native learning children when they express later learned semantic relations.

6.4 Percentage of Errors per sample

Previous studies of language acquisition report that native signers make few errors during language acquisition, and the errors made are specific, e.g. phonological errors, optional infinitive errors, and subject confusion errors (DeVilliers and DeVilliers, 1979). A benchmark, although arguably too high, in many studies of specific linguistic constructions is that up to a 10% error rate still suggests mastery of that structure (Brown, 1973 McDaniel, McKee, and Cairns, 1998).

To assess the overall error rate in the naturalistic language samples from the later-learners, the 22 sessions from MEI, and 3 sessions from CAL were coded for percentage of errors from the total usable number of utterances. If one utterance had more than one error type, two errors were counted. This happened primarily with one error type, namely failure to set up or use space. The same coding method was used on data from the 7 sessions from JIL and the 2 sessions from NAT. Phonological errors were not included in the counts, but may be analyzed in future work.

Shown below are the tables for MEI, CAL, JIL and NAT. Tables 6.8 through 6.11 show that, JIL and NAT make no- to few errors, whereas MEI and CAL have a much higher percentage of errors.

Table 6.8 MEI's errors

MEI Age	# Usable utts	Total # errors	% errors
6;6- 6;8	326	39	11.96%
6;9- 6;11	121	15	12.40%

7;0- 7;2	515	97	18.80%
7;3- 7;5	579	48	8.30%
7;6- 7;8	174	35	20.10%
7;9- 7;11	60	17	28.30%
8;0- 8;2	395	48	12.20%
8;6-8;8	183	26	14.20%
9;0- 9;2	143	13	9.10%
9;9- 9;11	280	28	10%

Table 6.9 CAL's errors

Age	# Usable utts	Total # errors	% errors
6;10.6	105	7	6.70%
6;11.6	67	7	10.50%
7;4,13	81	11	13.60%

Table 6.10 JIL's errors

Age	# Usable utts	Total # errors	% errors
2;0	60	4	6.67%
2;6	111	0	0%
2;6	101	0	0%
2;9	54	1	1.85%
3;3	75	0	0%
3;6	303	2	0.66%
4;6	358	10	2.79%

Table 6.11 NAT's errors

Age	# Usable utts	Total # errors	% errors
7;11	231	0	0%
8;11	217	0	0%

The tables show that MEI's percentage of errors range from a low of 8.3% to 28.3%. Likewise for CAL, the lowest percentage is 6.7 %, and the highest is

13.6%. In contrast the lowest percentage of errors for JIL is 0%, with the highest percentage occurring at her youngest session of 2 years- 6.7% errors. NAT has no coded errors in either session.

Consistent with the findings of previous studies, NAT and JIL make few errors in their naturalistic language data. However, MEI and CAL make a high percentage of errors; higher even than the 10% benchmark. In order to investigate this further, I grouped the errors into general categories, as will be presented in the next section.

6.5 Types of errors per sample

Errors fall into six general categories grouped by topic similarity. For example the category “Verb Agreement Errors”, includes 1) failure to use required agreement, 2) agreement added when not allowed, and 3) agreement with wrong argument. The category of “Word Order errors” is a very general grouping of errors that either are basic and/or derived word order errors. Some errors in this category were not word order errors per se, but were related to word order errors, for example, sentences in which whole clauses are missing, so that the apparent word order is not correct. An example of this latter case is provided by the utterance by MEI: PLAY WATER GROW. The interpretation of this utterance is “I want to play with the thing that when you put it in water it grows.”. Therefore from looking at the interpretation, it is apparent that entire clauses are missing.

The following table lists the error categories their description and some examples of each kind. All of the errors were grouped and coded.

Table 6.12 Error Categories

Error Category	Composition	Example
Word Order Errors	A very general grouping of errors that either are basic and/or derived word order errors, or related to word order errors	1) TURTLE GREEN DARK GLOW to mean turtle glows green in the dark. 2) PLAY WATER GROW meaning, I want to play with the thing that when put in water it grows.
Verb Agreement Errors	1) Failure to use required agreement, 2) agreement added when not allowed, 3) and agreement with wrong argument.	I-GIVE-YOU, but with referents present, GIVE is signed in neutral space.
Missing Lexical items	1) Null subject or object when it is obligatory for it to be overt, 2) Missing verb, when clearly needs to be present.	READ, when it is not clear from context, eye gaze, earlier discourse, or other markers who the subject is.
Space Errors	1) Failure to set up space, 2) failure to use space, 3) "Stacking", whereby one space is used for many referents	BEE CHASE DOG, whereby neither BEE nor DOG are set up in space.
Wrong Lexical Choice	Failure to use the correct choice of lexical item, e.g. a plain verb instead of a spatial verb, or wrong classifier.	Verb GROW, instead of verb EXPAND, for a pill sized capsule that expands in water.
Other	Most other errors, including pronoun confusion,	ME BOOK, instead of MY BOOK.

The percentage of errors found in each of these categories in the sessions of MEI, CAL, JIL and NAT are presented in the following tables. The

percentages are the ratio of the number of the errors in a particular category to the total number of errors in a session multiplied by 100.

Table 6.13 MEI's errors in each category

MEI Age	# Usable utts	Total # errors	Word order errors	verb agreement errors	missing lex items	space errors	wrong lex choice	Other
6;6- 6;8	326	39	20%	30%	20%	8%	10%	12%
6;9- 6;11	121	15	0%	40%	27%	0%	13%	20%
7;0- 7;2	515	97	8%	30%	23%	29%	4%	6%
7;3- 7;5	579	48	19%	21%	33%	13%	8%	2%
7;6- 7;8	174	35	5%	22%	27%	32%	3%	11%
7;9- 7;11	60	17	6%	0%	41%	53%	0%	0%
8;0- 8;2	395	48	4%	13%	50%	21%	0%	12%
8;6-8;8	183	26	8%	27%	15%	35%	8%	7%
9;0- 9;2	143	13	38%	0%	46%	0%	15%	1%
9;9- 9;11	280	28	21%	36%	21%	21%	0%	1%

Table 6.14 CAL's errors in each category

CAL Age	# Usable utts	Total # errors	Word order errors	verb agreement errors	missing lex items	space errors	wrong lex choice	Other
6;10.6	105	7	0%	14%	43%	14%	29%	0%
6;11.6	67	7	0%	43%	28%	29%	0%	0%
7;4,13	81	11	0%	9%	18%	45%	27%	1%

Table 6.15 JIL's errors in each category

JIL Age	# Usable utts	Total # errors	Word order errors	verb agreement errors	missing lex items	space errors	wrong lex choice	Other
2;0	60	4	0%	0%	50%	0%	0%	50%
2;6	111	0	0%	0%	0%	0%	0%	0%
2;6	101	0	0%	0%	0%	0%	0%	0%
2;9	54	1	0%	0%	0%	0%	0%	100%
3;3	75	0	0%	0%	0%	0%	0%	0%
3;6	303	2	0%	0%	50%	50%	0%	0%
4;6	358	10	0%	20%	20%	30%	0%	30%

Table 6.16 NAT's errors in each category

NAT Age	# Usable utts	Total # errors	Word order errors	verb agreement errors	missing lex items	space errors	wrong lex choice	Other
7;11	231	0	0	0	0	0	0	0
8;11	217	0	0	0	0	0	0	0

These tables suggest that there are specific areas of difficulty for MEI and CAL. They make the majority of their errors in the categories of Verb agreement errors, Missing lexical items, and Space errors, as might be expected from the errors made by adult late- ASL signers reviewed in Chapter 2. NAT has no problems, and JIL's errors are few and vary widely across the table, with many "Other" errors.

6.6 Summary

The four children, MEI, CAL, JIL, and NAT were followed for varying periods and filmed for the purpose of addressing a specific question: What is language like when a 6 year old child starts acquiring a first language at an age when most other children are linguistically quite adult-like? The calculation of MLU, originally planned to help place MEI and CAL within a language development continuum, appears to be a poor measure of ASL, because MLU does not increase for Deaf signers as it does for English learners, among other reasons.

The findings on the use of basic and derived word orders by MEI and the native signers provides a way to examine the early acquisition of a first language given different timings of input. It also starts to separate what might and might not be affected by a sensitive period for language. The increased use of basic word orders compared with derived word orders by MEI and CAL suggests that MEI and CAL may not have the knowledge of the mechanisms or the triggers for the mechanisms that allow for word-order change operations. Further, a closer examination of the correct derived orders compared to those that are incorrect because they do not have the non- manual grammatical markers versus those that are incorrect because they are never allowed by the language will aid in the specification of sensitive period effects.

The findings from the analysis of the use of cognitively complex utterances by MEI and CAL serves two purposes. It shows, along with the cognitive tests conducted by the school psychologist and the results from the achievement tests, that MEI and CAL function within normal age-appropriate cognitive levels. The results also suggest that language can be limited, when the knowledge of semantic relations is not. Hence the standard “two- word stage” can be found syntactically for the late- learner children as evidenced by the average number of words used, but the semantic relations expressed by the late learners are not the ones normally found during the standard two- word stage.

The last two sections of this chapter discuss the errors found in the naturalistic language samples of MEI and CAL versus the native-signing children, JIL and NAT. As I show, although the percentages of errors made by MEI and

CAL are higher than by JIL and NAT, they are still far less than 50%. Therefore there is much that MEI and CAL sign correctly. A list of example utterances both with and without errors can be found in Appendix B.

The last data- related section of this chapter reveals areas of language in which MEI and CAL show particular difficulty. From the studies with adult later-learners (Newport, 1984, Emmorey, et al. 1995, Mayberry, 1994, among others), it is not surprising that MEI and CAL should show great difficulty with verb agreement or use of space. From understanding the interaction between word order, verb classes, and verb agreement, it can be predicted that MEI and CAL would have difficulty with word order. I have pilot tested this experimentally and will present the preliminary results in Chapter 8 of this dissertation. The next chapter seeks to address the specific difficulty that MEI and CAL have with verb agreement morphology. It also addresses how verb agreement relates to both overt/null subjects and/or objects and whether the referent is present or non-present.

Chapter 7

Sensitive Period Effects on Verb Agreement

7.0 Introduction and Background

Evidence from previous studies of people with brain damage, social isolates, and adult Deaf community members suggest that there is a sensitive period for first language acquisition. Since the results from the study of language acquisition by MEI and CAL converge with those from the previous studies, then what needs to be determined next is what specifically is affected linguistically by the end of such a period. The combined results from the previous studies suggest a potential starting point.

Three relevant, previous studies will be summarized here briefly. These and other works are more thoroughly reviewed in the Background chapter of this dissertation. Emmorey, et al. (1995) conducted experiments with Deaf adult signers exposed to ASL from birth to age 20 years. In one of the experiments, a processing task, Emmorey, et al (1995) found that the native signers were sensitive to errors in both verb agreement and aspect. Early and late signers (initial exposure between 4 and 20 years) however, were only sensitive to errors in aspect morphology, but not errors in verb agreement. Therefore the late signers were not recognizing verb agreement errors, suggesting a particular difficulty with verb agreement morphology. In another of the experiments, a grammaticality judgment task, this result was not duplicated. From this,

Emmorey, et al suggest that “late exposure to a primary language affects the on-line integration of verb agreement within a sentence, but does not affect sensitivity to semantic distinctions encoded by aspect morphology”.

Although Emmorey, et al (1995) note this finding of a difference between the two morphological types, they hypothesize that it is due to the experimental task itself, and problems with the task type. There is another study, however that suggests their finding may be more robust than originally claimed. A study conducted prior to that of Emmorey et al (1995) also finds verb agreement morphology to be susceptible to sensitive period effects. With a different group of Deaf signers, including native signers, early learners (exposure age 4-6 years), and late learners (exposure age 12+ years), Newport (1984) conducted an elicited production task and a comprehension task for knowledge of basic word order and complex morphology in ASL. Newport (1984) reports that the late-learners showed more “frozen forms” without internal morphological structure, more frequent omission of obligatory morphemes, and highly variable ASL morphology. Although the results from Newport’s (1984) study do not resolve the question of why Emmorey, et al. found differences between agreement and aspect, they do support the general finding that late-learners have problems with verb agreement morphology.

One potential hypothesis for why later-learners show differences compared to native learners, is that due to the different type of linguistic experience, there has been some kind of “brain atrophy”, not dissimilar to a type of brain damage. Therefore the third, and last body of literature briefly reviewed

in this chapter is work with native Deaf signers who have had aphasia due to brain damage. This separate, but relevant area of interest has also focused on ASL verb agreement errors. Poizner, et al (1987) conducted a production task, and reported that native Deaf signers with aphasia due to left-hemisphere damage (LHD), showed a patterning of mistakes with spatial and agreeing verbs. However, those who did not have aphasia, but did have right- hemisphere damage (RHD), made mistakes with using space topographically, but did not make mistakes with the grammatical aspects of verbs.

The results from the studies conducted by Emmorey, et al (1995) and Newport (1984) predict that general problems with verb agreement will be found for late-learners of ASL, and potentially that there may be a specific effect for morphological type. The results from the studies conducted by Poizner, et al (1987) would predict that if the late-language learners are like the native Deaf signers with left hemisphere damage, then problems will be seen with both spatial and agreeing verbs. If they are like the native Deaf signers with right hemisphere damage, the late learners will not have problems with the verb morphology.

7.1 Hypotheses

Results from the previous, studies of Deaf adults suggest testable hypotheses for a longitudinal, developmental study of language acquisition with children who have had delayed first language input. The hypotheses to be tested here, are the following: 1) Sensitive period effects can be found when first-

language exposure begins well before puberty. 2) The effects on language acquisition of a sensitive period are not global. They are not completely incapacitating with regards to language use. 3) Early language exposure is necessary for the acquisition of specifically linguistic information, like some formal features, as in the verb agreement system and other systems as well.

Formal features are the features that appear in the mental lexicon's entry of a word, that are accessible in the course of the grammatical construction of an utterance, for example, *book* [+N], [+/- plural] (Chomsky, 1995). The lexical entry for *book* would contain three collections of features: phonological features, semantic features, and formal features. The difference between formal and semantic features is that semantic features convey semantic meaning, and formal features convey purely grammatical relationships between arguments.

While there is no clear prediction from generative syntax, of which formal features should be affected if a sensitive period for first language acquisition is passed, evidence from typically developing young children suggest that formal features associated with verb agreement may be susceptible. The verb agreement system of ASL is especially well- suited for examining this possibility.

7.2 ASL Verb Agreement System and Specific Hypotheses

The verb agreement system of ASL has been extensively investigated and discussed, with regard to the number, manner, and type of verb categories differentiated. ASL has three verb categories- plain verbs, spatial verbs, and agreeing verbs (Fischer and Gough, 1978, Padden, 1983). Plain verbs, for

example LIKE, do not mark agreement with a subject. Plain verbs can be signed with either/both animate and inanimate subjects and objects. They are often, but not always body- anchored signs.

Spatial verbs, for example PUT, require marking of agreement with locations. This agreement has semantic consequences. Spatial verbs are signed toward a location, either present or non- present but established in space.

Finally, agreeing verbs, for example, GIVE, require formal agreement marking, which is a process that is triggered by purely formal features of the subject and object. Agreeing verbs require both the subject and object to be animate (or anthropomorphized) arguments. Spatial and agreeing verbs are nearly identical in how they express agreement; that is, both use path of movement between end points set up in space, and the facing of the hand. However the features expressed by spatial agreement are semantic- they convey meaning about location, while those expressed by agreeing verbs are purely formal.

One potential difficulty with this categorization is that some ASL verbs seem to align with different verb type categories based on the context, e.g. SEE, SEARCH, and FIND. Many verbs have different forms that reliably align with the different verb categories, and so do not cause a problem. However, for the purpose of differentiating verbs by category, I judge each verb use in its context against the characteristics given for the different types. In this way I classify verbs differently from Rathmann and Mathur (2002), who classify each verb based on its typical usage. This means that for a small percentage of verbs, a

single verb may be classified into two different verb types. Though my type of verb grouping may be unaesthetic from a neat classification standpoint, it does not seem to create problems with the syntactic hypotheses and predictions that stem from the verb category definitions. Perhaps, these “single verbs” actually are slightly different, even like homophones, and therefore can have different lexical entries and verb categories, e.g. SEARCH-FOR versus SEARCH-THERE. This will be investigated further in future studies of MEI, CAL and the native signers.

With the verb categories being based on the types of agreement required and the sets of features assigned, for example, semantic versus purely formal, the following specific hypothesis can be tested. If exposure to a first language occurs past the sensitive period for language acquisition, and it affects acquisition of the purely formal features of language, then late-learners should show problems with agreeing verbs, but not plain or spatial verbs.

Another potential hypothesis, predicted by ideas of general abstractness or “intuitions of difficulty”, is that all learners, including late-learners should show the least problems with plain verbs, the most with agreeing verbs, and some number of errors with spatial verbs. This would be because plain verbs, with no marking of agreement would be easiest, whereas the agreeing verbs would be the most difficult because the morphology marking occurs from the recognition of the pure formal features. The spatial verbs would be easier than agreeing verbs, but more difficult than plain verbs, because while there is marking required, it is based on semantic features that are connected with the real world.

7.3 Participants and Methods

In order to test the above hypotheses, naturalistic language sessions from MEI and CAL were compared with those of two native signers, JIL and NAT. The following tables show the sessions used, and the number of months of language exposure at the time of the session, for each child.

Table 7.1 Session Information for MEI and CAL

Child Session	Age/Range at session	# Sessions/ age range	Exposure amount at session*
MEI 1-5	6;6 -6;8	3	7-9 months
MEI 6	6;9-6;11	1	9 1/2-11 1/2 months
MEI 12-18	7;0-7;2	4	12-14 months
MEI 24-28	7;3- 7;5	4	15-17 months
MEI 43- 51	7;6 - 7;8	2	18- 20 months
MEI 56	7;9-7;11	1	21- 23 months
MEI 59- 67	8;0- 8;2	3	24- 26 months
MEI 72	8;3- 8;5	1	27- 29 months
MEI 81	8;6 - 8;8	1	30- 32 months
MEI 97-98	9;0-9;2	2	36- 38 months
MEI 110	9;9- 9;11	1	45- 47 months
CAL 1-2	6;9- 6;11	2	10-11 months
CAL 5-8	7;0 - 7;2	2	12- 14 months
CAL 10-17	7;3- 7;5	3	15- 17 months

Table 7.2 Session Information for JIL and NAT

Child Session	Age at Session	Exposure amount at session*
JIL 17	2;0	Native (24 mos)
JIL 34b	2;6	Native (30 mos)
JIL 35a	2;6	Native (30 mos)
JIL 41	3;0	Native (36 mos)
JIL 65	3;3	Native (39 mos)
JIL 75	3;6	Native (42 mos)
JIL 1 (S)	4;6	Native (54 mos)

NAT 1	7;11	Native (95 mos)
NAT 4	8;11	Native (107 mos)

*Exposure- meaning the approximate amount of time since language immersion, not first exposure.

The above sessions are part of a larger data set that is currently being transcribed, checked and coded. The data above are from the longitudinal, naturalistic language production study. As presented in Chapters 4 and 5, MEI, CAL and NAT were each filmed playing individually with SAF, a Deaf adult dorm assistant. JIL was filmed separately, as part of the University of Connecticut CLESS project. All of the children played with toys, signed stories from books, and signed personal narratives. Each session ranged in duration from 15 to 45 minutes, depending on the day and mood/ attention span of the child.

All of the sessions were transcribed and checked by a native signer or a fluent signer. The sessions were then coded for verb agreement and related aspects on a Filemaker Pro screen designed for examining specific issues of verb agreement. A picture of this coding screen can be found in the appendices.

7.4 Results

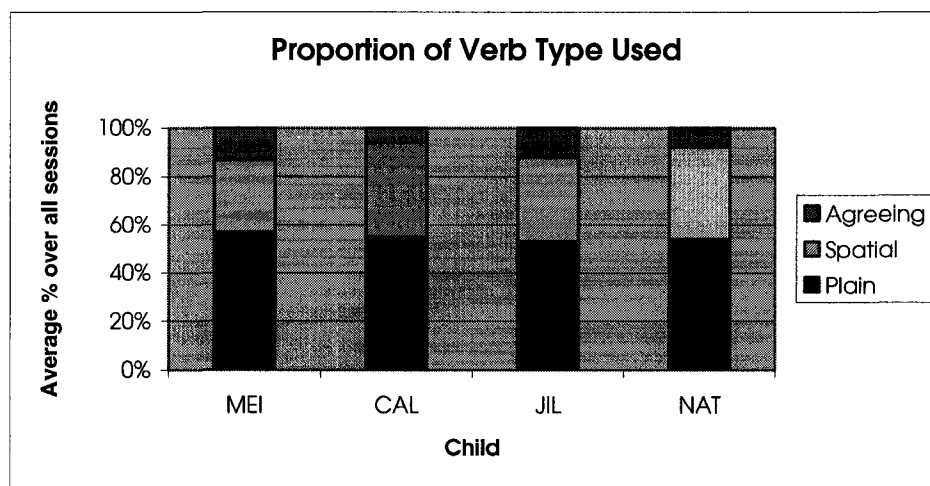
This section will provide the results from 1) analyses of proportion of verb type use, 2) the overall types of verb agreement errors, and 3) the percentage of errors per verb type. Further, analyses of the data that address the issues of difficulty with using space, using null referents, and the use of two or more animate arguments will be provided.

7.4.1 Verb type use

The use of the three different verb types was analyzed to establish whether there were any differences in the use of the three verb types. If there were any differences found, were they specific to the late-learners? Could a difference in verb type use account for the verb agreement errors? If the late-learners and the native signers are receiving similar input, one hypothesis is that the native and late-learner children would pattern similarly in this type of analysis.

Averaging all of the sessions per child for the entire time span coded provided the data in Figure 7.1. The figure shows the average percentage of occurrence of a particular verb type over the total number of verbs. This includes verbs with and without errors.

Figure 7.1 Verb type use per child



This figure shows a clear difference in the percentage of verbs per verb type used. All four children use more plain verbs than spatial verbs, and more spatial verbs than agreeing verbs.

From a further, more detailed examination, Figures 7.2 and 7.3 show the data for MEI and JIL broken down over one year intervals. This is not done for CAL and NAT since CAL has only one year analyzed at this point, and there are just two sessions from NAT, one year apart. The two sessions from NAT are nearly identical, with the biggest difference being only 1.3% between the two years' sessions.

Figure 7.2. MEI's verb type use per year

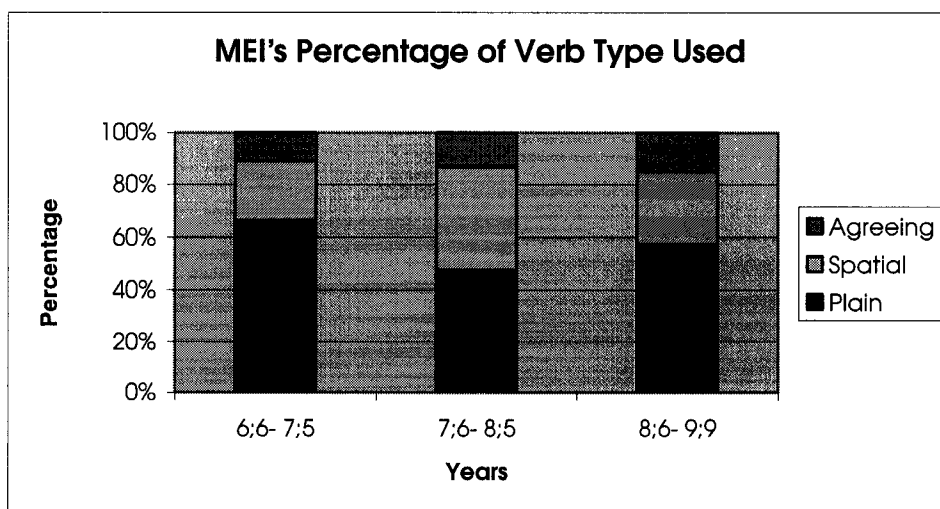
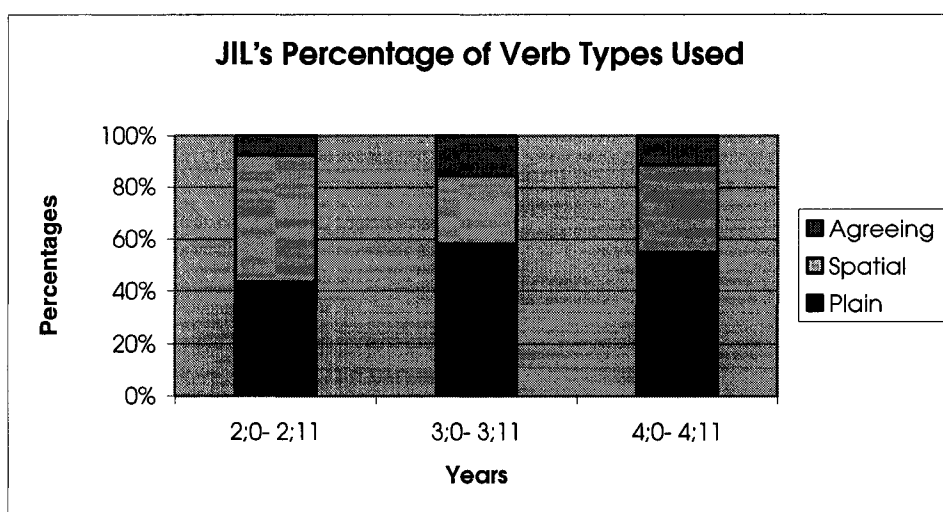


Figure 7.3. JIL's verb type use per year



As the figures show, with the exception of JIL ages 2;0- 2;11, the children produced more plain verbs than spatial verbs, and more spatial verbs than agreeing verbs in every session. This is the case for all four children at all ages studied.

7.4.2 Verb Agreement Error Types

The types of verb agreement errors found from MEI, CAL, and JIL can be grouped into four categories. The first category is errors of omission. This category consists of agreeing or spatial verbs in which the required agreement morphology is absent, but the space has been set up and/or used in discourse. The second two categories are errors of commission: agreement with the wrong argument or referent, and spatial/agreement put on something that can not have it. These last two occurred with plain, spatial, and agreeing verbs, as well as with

nouns. The fourth category, a type of omission error in most cases, consists of utterances with spatial and/or agreeing verbs, whereby space was not set up and/or was not used. This category of error often occurred with another error, for example, “not using required agreement”. But it also occurred with examples of commission errors. Some examples of all four of these errors are provided in Table 7.2 below.

Table 7.2. Examples of Agreement Errors

Child	Verb type	Utterance	Interpretation	Error type
MEI 1	spatial	THROW.	She threw it at me.	Did not set up space, but did use it.
MEI 6	Agree	TELL BEAR.	Someone tells bear or Bear tells someone	Did not set up space, and Subj and Obj not marked
MEI 17	Plain	YOU- WON	You won this game.	Commission-Subj over-marked as part of verb
MEI 24	Agree	NOT-YET GIVE-GIFT NOT-YET.	I didn't give you the gift yet	Omission-agreement morph not shown
MEI 51	Spatial	WALK	Frog walked to window.	Omission- Loc not marked
MEI 110	Agree	PT-CHILDREN FEED FOOD.	The children feed the hamster food.	Omission- agr not shown
CAL 1	Noun	RABBIT-HOP HOP.	The rabbit hops.	Commission-verb morph put on N
CAL 2	Plain	PT-SBB SMELL-HER.	SBB, you smell SAF.	Commission-Obj over-marked, as part of verb
JIL 1(S)	Agree	BEE-FLY CHASE	Bees chase the dog.	Omission- agr morph not shown

The percentage of verb agreement errors with all three verb types combined, in MEI's and CAL's sessions, ranged from 2% to 11.1%. In contrast, for JIL there was a high of 1%, and for NAT, there were no errors. As seen in Figures 7.4- 7.6, there was little change over time for any of the children.

Figure 7. 4 MEI

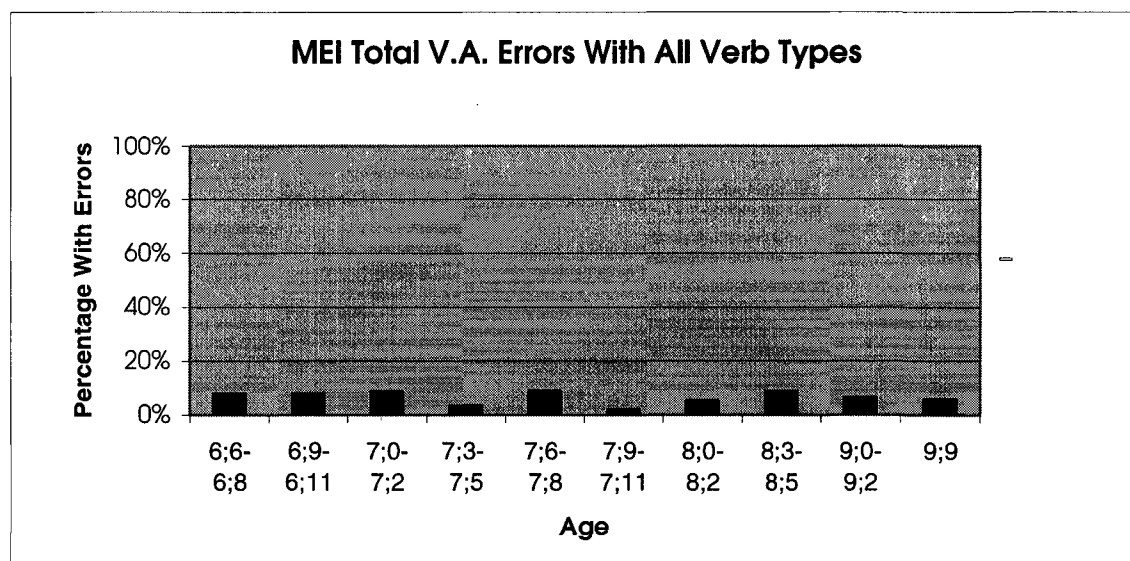


Figure 7.5 CAL

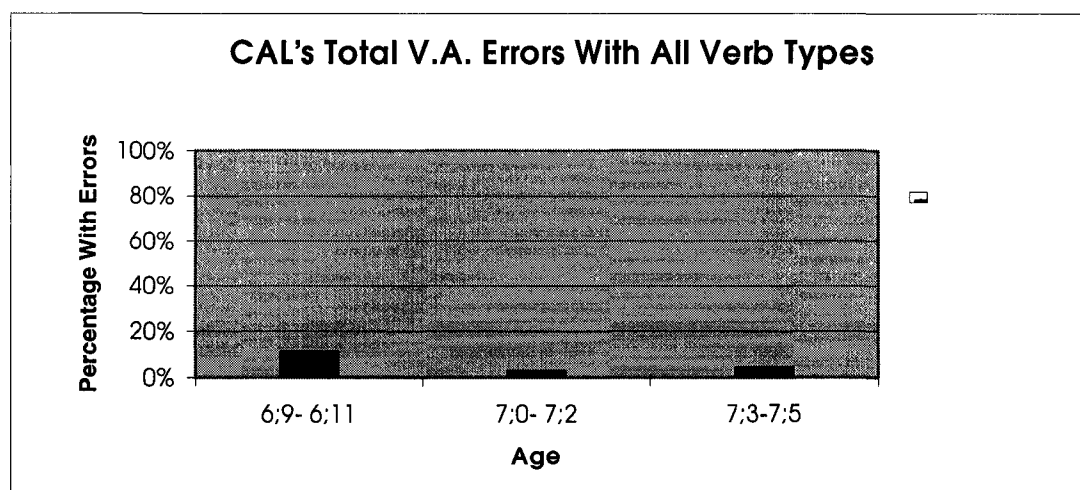
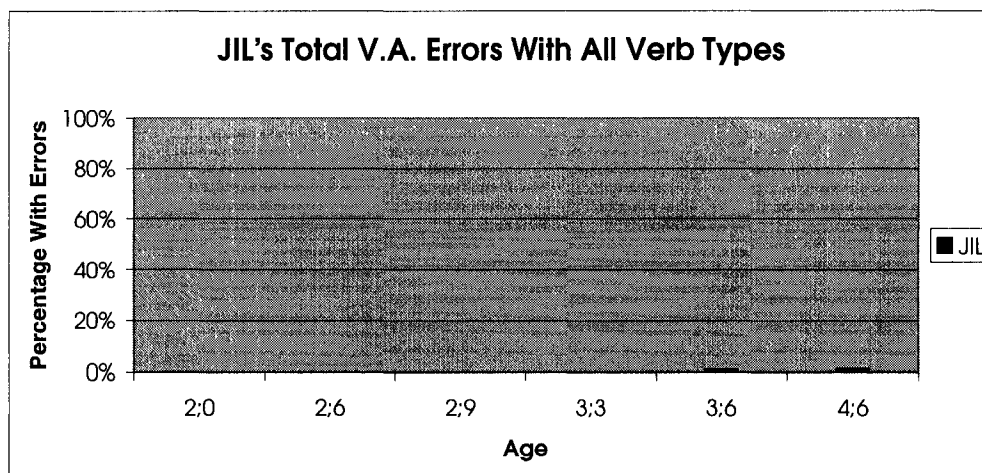


Figure 7.6 JIL



A complete breakdown by error category, of all of the errors found, excluding phonological errors, in the data samples is shown in Table 7.3. Table 7.3, unlike Figures 7.4- 7.6, additionally shows the number of other errors found in the sample, including wrong lexical choice of verb, subject/ object should not be null, non- adult-like signing on the book or toy, and the other errors discussed in Chapter 6 of this dissertation. Regarding the verb agreement errors specifically, one of the most striking differences is that neither of the native signers had any commission errors, while both MEI and CAL did, up to 21.4% for CAL and 7.7% for MEI. For MEI, CAL, and JIL omission errors occurred in greater number than commission errors, with the few errors JIL did make being of this category.

Table 7.3 Sessions' breakdown for # Errors Per Category

MEI Age range	Total # Utts w/ verb	# Omission Errors	# Comission Errors	# Space not set up or used	Total # errors
6;6- 6;8	128	9	3	3	40
6;9- 6;11	76	5	1	1	15
7;0- 7;2	245	21	8	27	101
7;3- 7;5	242	9	1	6	48
7;6- 7;8	126	6	2	12	37
7;9- 7;11	51	0	0	9	17
8;0- 8;2	213	6	0	15	48
8;6- 8;8	128	5	2	7	26
9;0- 9;2	173	8	2	11	37
9;9	174	10	0	6	28
CAL Age range	Total # Utts w/ verb	Omission Errors	Comission Errors	Space not set up or used	Total # errors
6;6- 6;8	36	3	1	3	14
6;9- 6;11	109	2	2	2	10
7;0- 7;2	142	2	1	6	23
JIL Age range	Total # Utts w/ verb	Omission Errors	Comission Errors	Space not set up or used	Total # errors
2;0	17	0	0	0	5
2;6	59	0	0	0	0
2;9	16	0	0	0	4
3;3	32	0	0	0	1
3;6	101	1	0	0	2
4;6	197	2	0	3	17

7.4.3 Verb types: Agreeing, Spatial, Plain

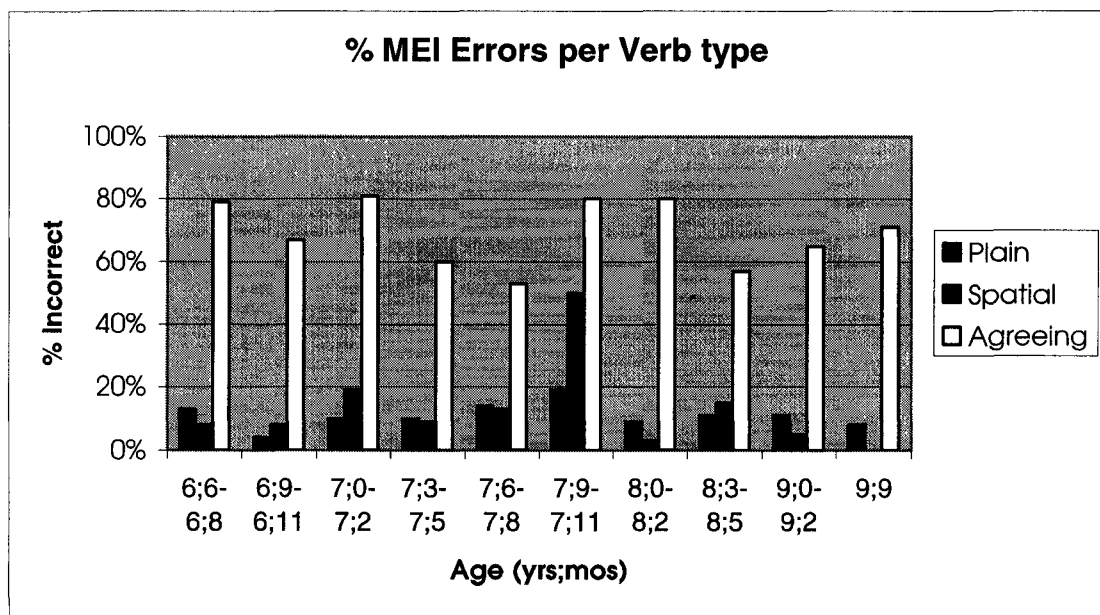
While it may not seem that an error percentage of 7.7% is very high if the problems are global and spread out over all of the verb types, it may be considered more of a problem if the errors are specific. My earlier prediction that the late-learners have a problem with some of the formal features of language would predict a difference in error rate between agreeing versus spatial and plain

verbs. More precisely MEI and CAL should have difficulty primarily with agreeing verbs. JIL and NAT should have few to no problems, spanning the verb types.

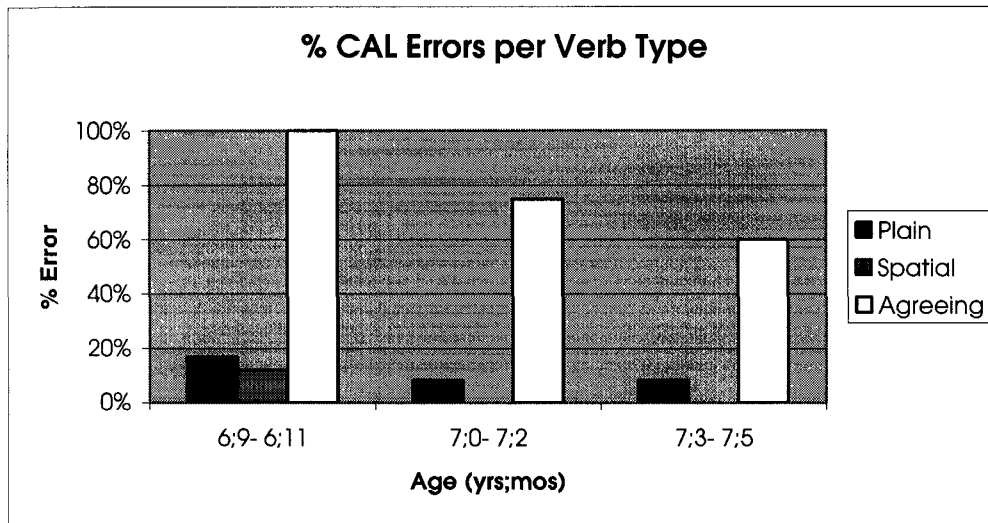
The alternative hypothesis that was presented earlier in this chapter was that due to degree of difficulty between the three verb types, there would be a consistent difference between all three verb types for all of the children, not just the late- learners.

Figures 7.7 through 7.9 show the results from MEI, CAL, and JIL, broken down by verb type.

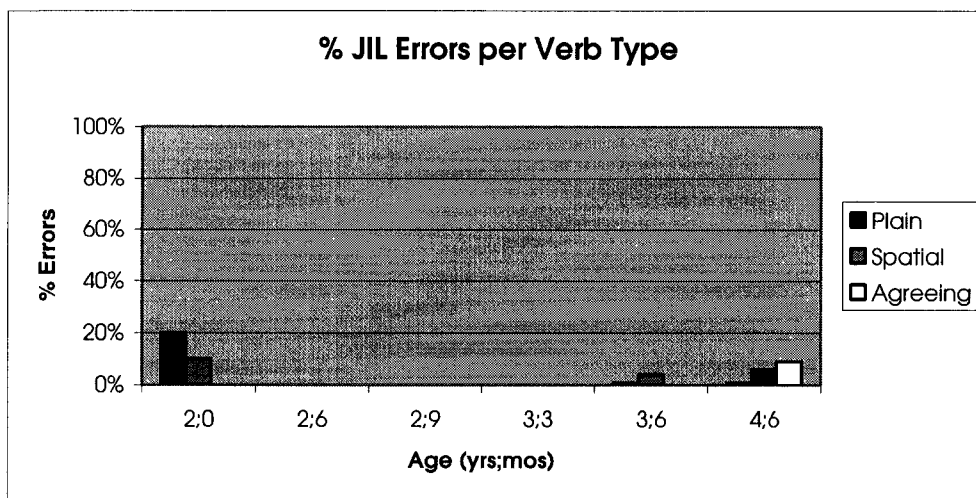
Figure 7.7 MEI's Errors with the Three Verb Types



7.8 CAL's Errors With the Three Verb Types



7.9 JIL's Errors With the Three Verb Types



As the figures show, MEI and CAL have clear difficulty with agreeing verbs, but not with spatial or plain verbs. This pattern does not seem to change over time. JIL shows few problems with any of the verb types. When there are

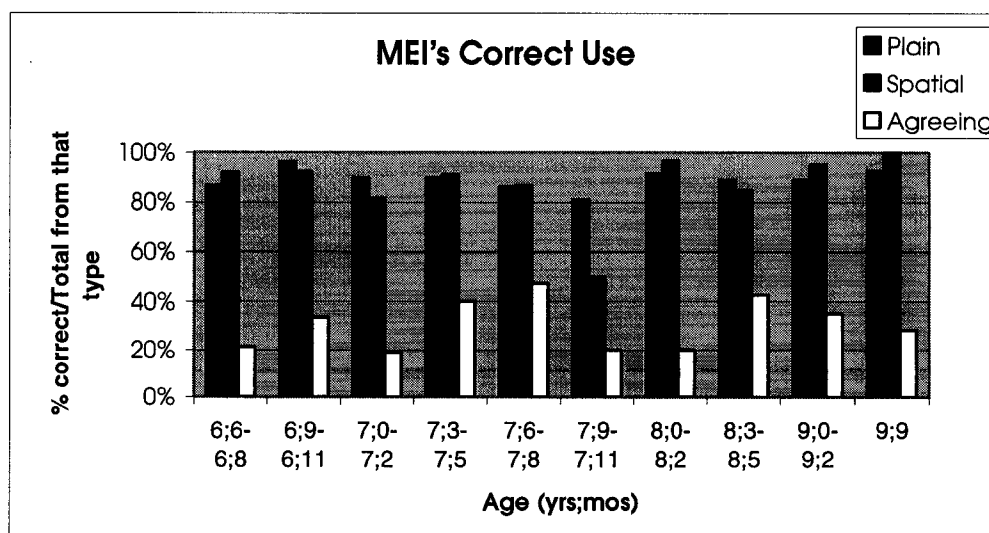
errors, they are not specific to agreeing verbs. NAT at the ages of almost 8 and almost 9 years old made no errors with any of the verb types.

7.4.4 Possible hypotheses for the verb type differences

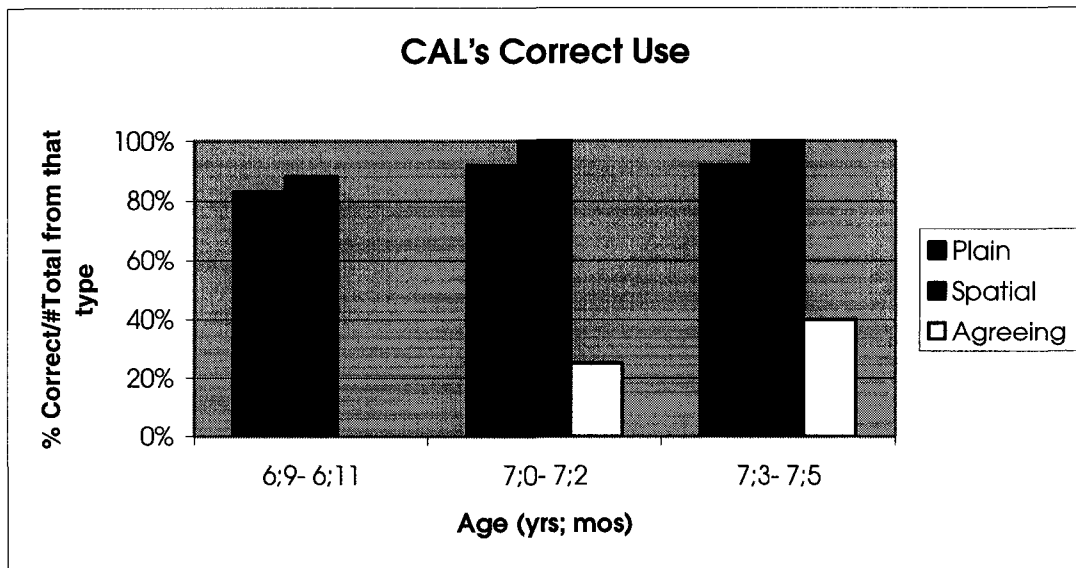
Possible alternatives that can be proposed for the differences with the verb types include 1) The later-learners have problems using space, 2) Later learners have difficulty with abstract referents, and 3) Later-learners do not know how to use two animate arguments.

If using space grammatically is problematic, there should be many errors with spatial verbs, as well as with agreeing verbs. Figures 7.10 through 7.12 reveal that there is little difference between plain and spatial verbs with regard to the percentage correct.

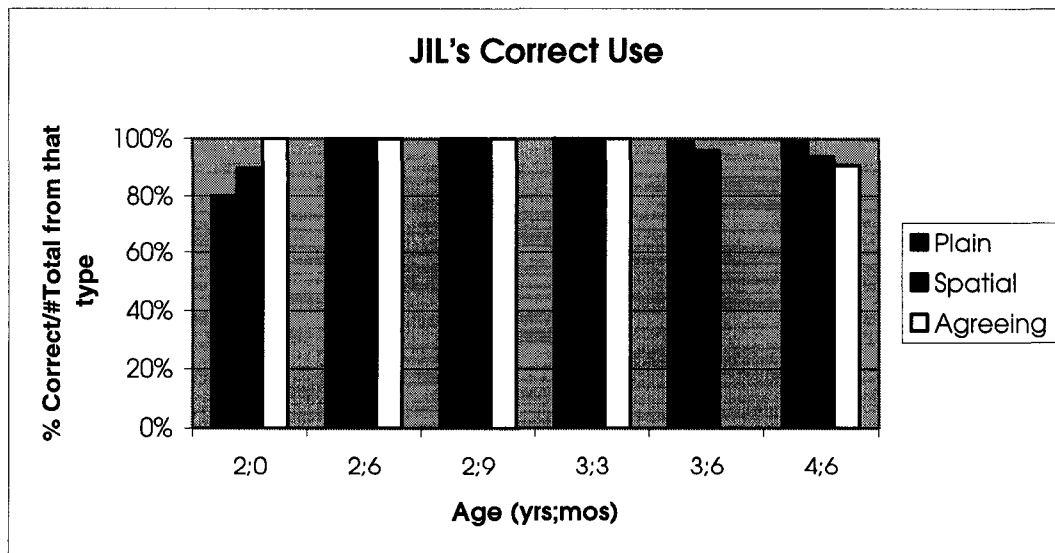
7.10 MEI's Correct Utterances With the Three Verb Types



7.11 CAL's Correct Utterances With the Three Verb Types



7.12 JIL's Correct Utterances With the Three Verb Types



Some of the correct examples of MEI and CAL using space with Spatial verbs can be found in Table 7.4. As can be seen from the data summary and examples, MEI and CAL use space grammatically for spatial verbs.

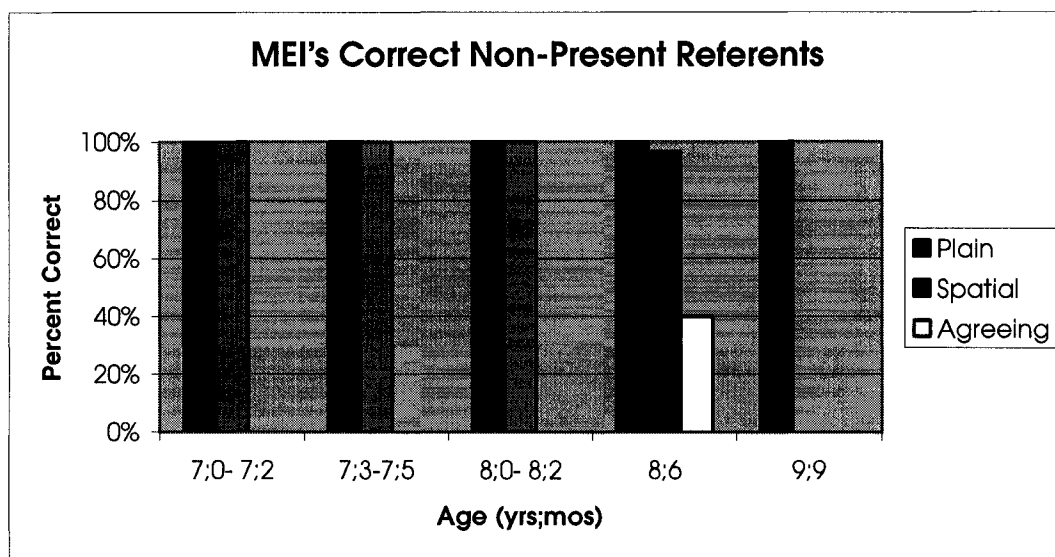
Table 7.4 Examples of Correct Uses of Spatial Verbs

Child/ Sess#	Age	Utterance	Gloss
MEI 1	6;6- 6;8	CLIMB- DOWN.	Spider climbs down
MEI 1	6;6- 6;8	PUT-THERE.	You put it there
MEI 1	6;6- 6;8	OPEN-EGG.	Open the egg
MEI 1	6;6- 6;8	WRONG WALK-HERE WRONG.	It's wrong of you to walk here.
MEI 12	7;0- 7;2	ANTLER-FALL-OFF	Boy falls off the deer's antler.
MEI 24	7;3- 7;5	ALOT GRASS SPREAD- OUT	Someone spread out a lot of grass.
MEI 63	8;0- 8;2	BALLOON CL:(HOLDING A BALLOON STRING)	Someone is holding a balloon by its string.
MEI 67	8;0- 8;2	FROM-TREE WATCH- HOUSE.	From the tree, the bear watched the house.
MEI 110	9;9- 9;11	WITH BOY GIRL BOTH- WATCH.	With boy and girl both watching
CAL 1	6;9- 6;11	PT-WALL TURN-OFF- SWITCH YOU.	Over there you turn off the lightswitch.
CAL 2	6;9- 6;11	AIRPLANE AIRPLANE- TAKE-OFF.	The airplane takes off.
CAL 8	7;0- 7;2	LEAVE-THERE	Leave them there.
CAL 10	7;3- 7;5	TREE TREE-FALL- OVER.	The tree fell over.
CAL 11	7;3- 7;5	PT-PICTURE FALL-OFF- TREE.	The boy falls off the tree.
CAL 17	7;3- 7;5	MOVE-BACK LET-GO MAYBE LATER <hn>.	Maybe later, I move the car back and let it go.

Another hypothesis to be considered is whether there is a general difficulty with use of abstract references for the late learners. Figure 7.13 shows data

from those sessions from MEI that have both agreeing verbs and non-present referents.

Figure 7.13 MEI's Correct Non-Present Referents



As Figure 7.13 shows, MEI uses non-present referents correctly for both Plain and Spatial verbs. The problems with agreeing verbs are still noted in this analysis.

A third hypothesis is that late- learners have difficulty with using two animate arguments. Examples from the data samples including those in Table 7.5 suggest that MEI and CAL produce utterances with two or more animate arguments. This is so even from the earliest data collection sessions.

Table 7.5 Two or More Animate Arguments

Child/ sess	Age	Utterance	Gloss	Verb Type
MEI 1	6;6	LIZARD, SNAKE PT-SELF DON'T-LIKE.	I don't like lizards or snakes.	Plain
MEI 2	6;7	ME FROG HOME I- WATCH.	At home I watched a frog.	Agreeing
MEI 6	6;9	COP BEAR WALK	The cop and the bear are walking to there.	Spatial

7.5 Discussion

The results from the first analysis of whether there are differences in percentage of use of the three verb types indicate that indeed Plain verbs are used more than Spatial verbs. Further, Spatial verbs are used more than are Agreeing verbs. This is consistent for all 4 children, and is almost exclusively the pattern for every session analyzed. This has yet to be tested in the adult sessions to see if this is a general pattern in ASL as a language, or is particular to child language.

The results from the second analysis, an analysis of the verb agreement errors, show that MEI, CAL, and JIL made errors of omission. JIL, however made many fewer errors than what has previously been reported, even recently, for young native signers (Casey, 2003, Meier, 1982, Hanel, to appear, among others).

Although not a focus of this dissertation, the reasons for why JIL seemed so different from other young, native signers, in regards to the number of verb agreement errors she made during the sessions are unclear. Re-

examining the existing literature, there are some studies however, that found that native signers make few errors with verb agreement (Lillo- Martin, Quadros, and Mathur, 1998, Quadros, Lillo- Martin, and Mathur, 2001). My coding was independent from the coding completed by Lillo- Martin, et al. (1998), and Quadros, et al (2001).

Possible explanations for the disparity in the findings regarding the number of verb agreement errors that occur with native signers will be discussed further in Chapter 9. These include: coding differences of what counts as marking verb agreement, which verbs count as agreeing verbs, and the actual number of errors versus the percentage of errors.

Overall, in the field of language acquisition, reports of omission errors are not uncommon. For young, native language users, regardless of language modality, verb agreement problems are often attributed to a proposed Optional Infinitives (OI) stage (Poeppel & Wexler, 1993). With this (OI) model, the verb agreement errors found in young children's speech occur during a stage of language development in which the children know the underlying syntax of verbal inflection, its connection to the overt verbal morphology, and the particular morphological endings. The problem the children have is that using inflectional endings- the whole mechanism, seems to be optional for them. This model makes many linguistic predictions including 1) children should make many errors of omission, but few to no errors of commission, and 2) when a language uses both verb movement and inflection, children will frequently fail to apply either.

While this might be the case with the errors made by JIL, I suggest that this does not explain, or explain fully, MEI's and CAL's verb agreement errors for two reasons. First, MEI and CAL make numerous errors of commission. Errors of commission are not predicted to occur by the OI model. Second, MEI and CAL use agreement morphology correctly for spatial verbs, but not agreeing verbs. The OI model would most likely predict that the morphology would be used correctly, with both verb types, or that the morphology marking would be absent from both verb types. The OI model does not explain the pattern of errors found in the language samples of MEI and CAL.

The third analysis in the Results section clearly showed a difference in the percentage of errors as a function of verb type. There was a distinct pattern of errors for both MEI and CAL, whereby plain and spatial verbs patterned similarly, and the majority of errors occurred with agreeing verbs, despite there being tremendous similarity in the grammatical use of space and agreement for spatial and agreeing verbs. There was no such pattern found for JIL or NAT. While JIL did make some errors, they were not primarily with any one verb type.

This set of patterns would be predicted by the proposed hypothesis, that the acquisition of some of the formal features of language are not accessible if a sensitive period for acquiring language has been passed by the time of first exposure to language. Two other reasonable hypotheses for how the errors should have patterned are as follows. One would be that spatial and agreeing verbs should pattern similarly with high error percentages, with plain

verbs having few to no errors. The other would be that like the proportional use of the verb types, plain verbs should be easier than spatial verbs, which should be easier than agreeing verbs. The data, however, do not support either of these potential hypotheses, in that the problems with verb agreement for MEI and CAL seem to lie primarily with the agreeing verbs.

Aside from how the errors should pattern, hypotheses for why verb agreement errors might happen include the following. First, late- learners might have a problem using space grammatically. Second, late-learners might have a problem using non-present referents. And, third, late- learners might have difficulty with two or more animate arguments.

The results showed that MEI and CAL used both plain and spatial verbs correctly most of the time, in almost all of the sessions. This means that MEI and CAL had no difficulty using space grammatically for spatial verbs. Therefore since MEI and CAL used space grammatically for spatial verbs, but not for agreeing verbs, there does not seem to be a general problem with using space. The problems with agreeing verbs must be due to something else.

If the problem with verb agreement is due to non- present referents, all three verb types should have a problem with abstract referents. The results from MEI's data indicate clearly that given the opportunity for errors with all three verb types and non-present referents produced in the naturalistic language sample, MEI had no difficulty using non- present referents with plain or spatial verbs. She did however have many errors with agreeing

verbs. Therefore, since MEI is able to correctly use non-present referents with plain and spatial verbs, the general use of non- present referents is not the difficulty.

If the problem with verb agreement is due to the potential difficulty with producing and managing two or more animate arguments, MEI and CAL should not produce such utterances. The data though, does indeed include utterances from all three verb types with two or more animate arguments, suggesting that this issue is not the source of difficulty with agreeing verbs in particular.

7.6 Conclusion

There are various theories and theoretical frameworks that have been proposed to account for the differences seen between late- learners and native language users, without invoking a sensitive period for language acquisition. One such theoretical framework would be an input-driven one, as Tomasello (2000) proposes. In this framework, assuming that cognitive abilities test within normal ranges, language acquisition should occur quickly once exposure has begun. Errors should be few, but similar to those of younger, native acquiring children. The errors should also disappear quickly. This theory does not account for the pattern of results found with MEI and CAL. It also does not account for the previous studies with adult late-learners of ASL.

Another theoretical framework, one that does not employ a biological sensitive period for language acquisition, focuses instead on the interaction of the social aspect of language with the linguistic aspect of language (Bortfeld and Whitehurst, 2001). If the social interactions are not normal, the linguistic interactions may not be either, thereby affecting the language acquisition process. Bortfeld and Whitehurst (2001) write, "Effects on language learning at some later exposure to linguistic input might reflect the effects of abnormalities in socialization or thinking on the children's attention to language, rather than the closing of a biological window for language learning per se." (p. 178).

While the appearance of a sensitive period would exist, the interpretation of the differences between late- language learners and native language users would not be clear. Bortfeld and Whitehurst (2001) suggest interpretive difficulties for the evidence typically cited as showing sensitive period effects for first language acquisition. They claim that the primary problem with the situation of social isolates, for example Genie, is that the effects of the children's deprivation of language input is confounded with those of the deprivation of other forms of experience. The primary problem for the results from studies of deaf children exposed to accessible language input later in life, studied as adults, is that the children may have suffered social or cognitive consequences from the lack of early linguistic input which in turn affected their ability to acquire language.

The situations that MEI and CAL experienced differ from the typical language isolate in that MEI and CAL were not locked in a closet, nor were they physically abused. They were exposed to most other forms of experience. As for the concern regarding the “social or cognitive consequences” from the lack of early linguistic input, the results from MEI’s and CAL’s non-verbal cognitive ability tests were within normal range, and their social interactions throughout the language acquisition process have been filmed. These can be analyzed in a future study.

Although Bortfeld and Whitehurst (2001) raise interesting concerns, it would have to be explained how MEI’s and CAL’s particular pattern of errors found with the verb agreement system and morphology could be predicted.

In a generative, Chomskian theoretical framework for language acquisition, a sensitive period for first language acquisition can easily be adopted and incorporated. With this, if the problems with the use of language from MEI and CAL are due to the existence of a sensitive period for first language acquisition, the cut-off for this period is much earlier than age 13 years, as previously hypothesized by Lenneberg (1967) and others. Sensitive period effects would be noticeable if first language acquisition occurs at least as late as age 6 years. These effects on language acquisition would not be linguistically globally incapacitating, but instead targeted and theoretically motivated, affecting formal features. The affected domains potentially would be predictable and testable.

One area in which this has been tested in this research project is the acquisition of the verb agreement system. The ASL verb agreement system allows for the examination of agreement errors based on two verb types that appear to differ fundamentally on whether there are purely formal features (agreeing verbs) versus semantic features (spatial verbs).

The results show that MEI and CAL have difficulty with agreeing, but not spatial or plain verbs. This error pattern not only addresses the hypothesis regarding sensitive period effects on formal features, but also provides further evidence for the breakdown of the 3 verb categories for ASL.

Chapter 8

Converging Evidence-Preliminary Data

Syntactic structure is common to all natural, human languages. In ASL, the basic word order is S (Subject) V (Verb) O (Object) as noted in pragmatically neutral contexts and as the grammatical answer to a yes/no question (Liddell, 1980, Padden, 1983, among others). However that order is not necessarily the most frequent one used by adults, or children (Chen Pichler, 2001). Variations in the basic order are acceptable in particular discourse/ pragmatic contexts and when a sentence is linguistically marked with topicalization prosody breaks, or non-manuals. Certain verb types also are associated with variants of the basic word order.

Fischer (1975) examined the relation between verb type and word order in ASL. She wrote that, with agreeing verbs, more flexible word orders are permitted, because it will be clear who the subject and object are, based on the morphology and movement of the verb. Other cases where this is found, she reported, are with non- reversible subjects and objects, for example:

_____t
ICE CREAM, BOY EAT.

Fisher proposed that several derived word orders are due to topicalization (Fischer, 1975, Liddell, 1980).

Liddell (1980) defined topicalization as a specific rule that allows NPs to be fronted. He claims that topicalization is marked by a specific timing, facial

expression, and head position. Further, he showed prosodic differences between topic and non-topic sentences, in that topic NPs are held longer than NPs in other parts of the sentence, and even in comparison with non-topic sentence-initial NPs. Topicalization is also marked in adult signing with specific non-manuals such as the head being tilted slightly back, with the eyebrows raised slightly.

The interactions between verb agreement and word order, and word order and topicalization have been studied in various spoken and signed languages. Meier (2002) provided a detailed summary of recent work on verb agreement, and its interaction with word order, in signed languages. In his summary, he wrote that signed languages manifest a strong preference for object agreement over subject agreement, as noted from cross-linguistic sign language research. And that agreement is largely limited to transitive verbs, and to spatial verbs. Spoken languages, however, strongly favor subject agreement. This, he wrote, is a surprising difference between signed and spoken languages (Newport & Supalla, 2000; Supalla & Webb, 1995; Aronoff et al., 2002; Rathmann & Mathur, (2002).

Specifically looking at cross-linguistic sign language data, Quadros, Lillo-Martin, and Chen (2000) found that there are several syntactic differences between sentences with plain and non-plain verbs in both Brazilian Sign Language (LSB) and in ASL. Since spatial verbs and agreeing verbs share the manner of expressing features, Quadros, et al. groups them together as non-plain verbs, arguing for only two verb types (as opposed to the three types

discussed in earlier chapters of this dissertation). Quadros, et al. (2000) asserts that the two verb types project different structures depending on their categorization.

Given the complexities of the interaction of verb type and flexibility of word order, children might have difficulty acquiring the specifics of these systems. However, as discussed by Brown (1973) for spoken language and Newport and Meier (1985) for ASL, one of the earliest observed forms of structure acquired correctly by children is basic constituent word order and allowable variations. There has been some debate, recently, regarding the timing of Deaf children's acquisition of word order. Hence researchers are again studying how and when the various ASL word orders are acquired by young, native-signing children. Chen Pichler (2001) found that in the naturalistic language samples of four young, native- ASL children, the children used a variety of word orders, and that the word orders could be accounted for by attributing to the children both the canonical SVO order and several order- changing operations. Among these were instances of Subject Pronoun Copy, as well as morphologically- complex verbs that allowed OV order. Chen- Pichler found few errors with word order.

Schick (2002) however, questioned the consistency of SVO order use by young, native-signing children. She conducted a naturalistic language production study, video- taping twelve, native- signing 24 month olds for approximately 5 to 6 hours. Schick claims that her results suggest no, to minimal, reliance on word order at the age of 24 months, nor much use of ASL morphology. Schick states that the only way of disambiguating some of the utterances the children produced

was from the contextual information, as opposed to the word order or morphology.

Although the debate continues, the finding that there were very few errors produced by young children with word order and verb type, had been noted in the children studied by Newport, and Meier (1985), Meier, (2001); and others, as well as cross-linguistically by Quadros, et al. (2001). Therefore, given the early and largely correct occurrences of flexible word orders and correct use of verb agreement with present referents by age 3 years in many native signers, my research asks how MEI and CAL compare.

Recall from Chapter 2 that late learners show a difference between basic and derived word orders (Newport, 1984, 1999). Also recall that late learner adults have problems with verb agreement morphology. Since some derived word orders are related to verb agreement, I expect that there might be more problems with particular word orders, namely those that are related to verb agreement. It has also been noted in studies of early child ASL acquisition that some of the word order errors observed may be due to difficulty with the non-manual markings of topicalization (Chen Pichler, 2001). Therefore in order to test the effects of word order, agreement, and topicalization on sentence comprehension, an experiment was designed and run on some of the total number of participants in this project. More native children need to be run in this experiment, so findings presented here are preliminary.

Based on the previous findings with both late- learner adults, and native, signing children, one would expect for the native, signing children, little difference

in errors for agreeing versus plain verbs, a small difference in errors on SVO versus OSV word order, and minor problems with topicalization. However for the later- learning children, MEI and CAL, the basic word order should be accurate, but verb agreement errors and derived word order errors might be expected.

8.1 Hypotheses

If a sensitive period affects acquisition of word order, MEI and CAL should make more errors involving derived word order than native signers, both age peers and younger children. Further, if a sensitive period affects the acquisition of the verb agreement/morphology system aside from word order, then more errors with one verb type than another would be expected, for example, more errors with agreeing verbs than with other verbs.

8.2 Method and participants

An Act-Out task was designed to test the comprehension of sentences that varied two word orders, SVO versus OSV(topicalized O), with primarily two transitive verb types, namely plain verbs and agreeing verbs. All of the OSV word orders use topicalization as the mechanism to front the object. There was one spatial verb used in each of the two word orders. There were five training sentences and 28 test sentences. All five training sentences had intransitive, plain verbs. Of the 28 test sentences, there were nine plain, two spatial, and 17 agreeing verbs. As for word order, of the 28 test sentences, 12 were SVO and 16

were OSV, as seen in examples A. and B. below. The stimulus sentences, separated into verb type categories are provided in Appendix C.

A. Stimulus sentences with plain verbs

SVO: GIRL PUNISH BOY.
"Girl punishes boy".

_____^t
OSV: BANANA, BATMAN EAT.
"Batman eats the banana".

B. Stimulus sentences with agreeing verbs

SVO: BATMAN CATCH SUPERMAN
"Batman catches superman".

_____^t
OSV: KING THERE (LEFT), BOY (RIGHT) TAP.
"Boy taps the king".

A native, Deaf ASL signer was filmed signing each sentence, with a five-second pause before the start, and after the end of each item. To start the experimental game, the Deaf research assistant, SAF, set up all of the toy props on the space in front of the child. She and each child individually identified the names of the toys, and SAF explained how to play the game. Then SAF turned on the TV and the VCR, and started the task. The child was instructed to watch each signed sentence, and then use the toys to show what had been signed. Each child was allowed to see the sentence up to three times, if requested. The children were filmed doing this task, while at the same time, the child's responses and any other comments were written down by a hearing, fluent signer, familiar to the children.

The participants tested so far, as presented in Table 8.1, were MEI, CAL, and 4 native signers- 3 age peers and one language- experience peer.

Table 8.1. Experimental study participants

Child	Age	Status
MEI	7;6	Later-exposed
CAL	7;7	Later-exposed
JIL	4;6	Native, Experience peer
NAT	7;11	Native, Age peer
NIE	11;1	Native Older-age peer
GEN	11;1	Native, Older-age peer

8.3 Results

The sessions were coded for the sentence, its verb type, the number of times the child viewed the sentence, how the child acted out the sentence, whether the actions were correct, and whether there was a substitution or there were additional comments. All 28 test sentences were coded, but only the sentences with a verb that the child attempted to act out were analyzed. Table 8.2 shows the raw numbers for attempts and incorrect responses. A response was considered a non-attempt if no verb was acted out. Lexical substitutions were not counted as errors as long as the subject and/or the object were correct, The only errors analyzed as errors were those that expressed incorrect verb agreement and/ or word order. For example:

Non-attempt: Stimulus: _____^t
 PICTURE, FISHGIRL SHOW SNOWWHITE
 CAL's response: CAL picked up the Snow White,
 Ariel, and picture toys, but did not act out the
 sentence.

Lexical substitution: Stimulus: ELEPHANT EAT EGG.

JIL's response: Snow White eats egg.

Analyzable error: Stimulus: GORILLA CHASE LION.

MEI's response: Lion chases gorilla.

Table 8.2. Child response summary

Child	# total stimuli	# attempted	# wrong
MEI	28	25	6
CAL	28	25	8
JIL	28	28	4
NAT	28	28	1
NIE	28	28	2
GEN	28	28	3

Previous studies suggest that young, native signers do not make more errors than older, native signers on basic word order, and make few errors with derived word orders (Chen Pichler, 2001). Once more native- signing 4 to 5 year old children are run in this experiment, the younger, native group data will be compared with the older native group's data to assess whether there is a significant difference between the younger and older native signers. For now, given the results reported in the previous literature, JIL will be grouped with the other native signers.

Examination of the current data finds that MEI and CAL have a higher percentage of errors, ranging from 0% to 50%, than does the native- signing group, whose percentages of errors range between 0% and 20%. A summary of the data is presented in Table 8.3.

Table 8.3. Percentage of errors per category

Group/W.O & Agr	SVO agree	SVO plain	OSV agree	OSV plain
Natives	7%	0	10%	20%
MEI	33%	0	37%	20%
CAL	50%	0	37%	40%

The percentages calculated were of the number of errors made per category over the total number of attempts made in that category. There were no errors made by any participant on SVO sentences with plain verbs. However, on the other items, the four native- ASL children had a total of 10 errors out of the 112 stimulus sentences (that is, 28 x the four participants), whereas MEI and CAL had a total of 14 errors out of 50 (that is, 25 attempts each). These results suggest that SVO word order with plain verbs was comprehended without difficulty. The table also provides insight into the effects of verb agreement and topicalization on comprehension. As stated earlier, having verb agreement should facilitate comprehension of the topicalized object in the derived word order. In the native group, the OSV agreeing sentences had only 10% errors while the OSV plain had 20%, consistent with expectations. This is not the case for MEI and CAL. For MEI, the agreeing verbs caused more difficulty than plain verbs in the OSV sentences, and for CAL the sentence types were of equal difficulty.

In order to determine whether word order presented challenges to the comprehension of the stimulus sentences, the four categories were collapsed across verb type into two categories- SVO versus OSV (topicalized O). This is seen in Table 8.4.

Table 8.4. Word order errors

Child-group / W.O	S V O	O S V
Natives	7%	13%
MEI	33%	31%
CAL	50%	38%

Table 8.4 shows that neither the basic, nor the derived word order causes great difficulty for the native signers, who have somewhat more errors with the OSV word order, as expected. MEI, whose overall error rate was higher than that of the native signers, has a small difference in the percentage of errors across the two word orders. However CAL finds both word orders difficult, and differentially so. The preliminary results presented in Tables 8.3 and 8.4 combined, suggest that the native signers have little difficulty with the derived word order in particular. They also suggest that MEI has greater difficulty with agreeing verbs and not word order in general, and CAL has difficulty with everything tested except for basic word order with a plain verb.

Table 8.5 below collapses across word order to examine the effects of verb type, specifically plain versus agreeing. As can be seen, the natives again have no difficulty, whereas both MEI and CAL do.

Table 8.5. Verb agreement errors

Child-group/ V.A.	Agreeing	Plain
Natives	9%	20%
MEI	36%	20%
CAL	43%	40%

8.4 Discussion

The results from the preliminary analysis of this comprehension task indicate that with delayed exposure to a first language, some aspects of language acquisition may be prolonged or even deviant. While MEI and CAL appear to have good knowledge of the basic word order of ASL with plain verbs, and some knowledge that another word order is acceptable, they have particular difficulty with the agreeing verbs, but not so much the plain or spatial verbs.

On the other hand, although the native signers produced a few errors on the task, they appear to have a good understanding of the flexibility of ASL word order, topicalization, and verb agreement morphology.

Although this task design has a number of problems that will need to be fixed before more data can be collected, the preliminary results from this experiment are still informative. They suggest that for MEI, CAL, and the native signers, there is a similar pattern in that there are both instances of correct SVO and OSV stimuli. However MEI and CAL do show differences from the native signers. MEI had more errors on agreeing SVO and OSV stimuli. And CAL had errors on stimulus sentences with agreeing verbs, in addition to the errors on the OSV plain stimuli.

Chapter 9

Discussion

The goal of this dissertation project is to investigate the developmental aspects of language acquisition when first language exposure begins well after the age that most children begin to acquire their first language. Differences between the language of late first- language learners and that of native language learners can be used to address the issue of whether there is a sensitive period for first language acquisition. If the answer is that there is most likely a sensitive period for first language acquisition, a closer examination of the differences between late and early learners can also address the issues of when these effects occur, whether they are permanent, and what more precisely is affected. Since it is unethical to experimentally test for sensitive period effects on first language acquisition, researchers must wait for naturally- occurring situations to present themselves.

One such situation has led to the completion of this dissertation. Effects of acquiring a first language after the age of approximately 6 years, were studied with two unrelated children. MEI was misdiagnosed as low- functioning mentally retarded, but instead is deaf, with average to above average intelligence as measured by tests of cognitive ability. CAL, while diagnosed correctly by the age of 2 years, was also not exposed to a first language until after age 5 1/2 years, due to personal family problems. He too, tests within average ranges on tests of cognitive ability.

This longitudinal, primarily naturalistic language production study of the language acquisition process for both MEI and CAL used a case- study design that spanned a period of 3 1/2 years. The children were filmed on average once per week, starting about 6 months after the children were immersed in language. This is discussed more thoroughly in Chapter 5 of this dissertation.

As presented in Chapter 2, previous studies with social isolates, including Victor, Massieu, Genie, Anna, and Isabelle, are regularly cited as evidence for a sensitive period for first language acquisition. Although the results from the studies, when taken together suggest that there is a sensitive period for first language acquisition, the evidence is highly equivocal for reasons discussed in Chapter 2. MEI and CAL however, provide an unparalleled opportunity to study the effects of delayed language input on the developing language system.

The results from the studies of Victor and Genie suggest specific areas of language that were more adversely affected than others. Both Victor and Genie learned lexical items. But neither Victor nor Genie was able to learn the word order of the target language. This is despite intense teaching and practice by adult, native speakers and teachers of the target language. Both Victor and Genie learned to understand sentence types that differed in intonation, for example a question could be distinguished from a declarative sentence, but neither learned to use verb agreement morphology correctly. The results from the study of language acquisition by social isolates show that while there was much of language that could be acquired when linguistic input occurred later in childhood, there were still particular aspects of language that were not learned.

Also discussed in Chapter 2 of this dissertation is the linguistic situation of Deaf people in the United States and parts of Canada, and its relevance to the issue of sensitive period effects on first language acquisition. Studies that examined the use of ASL verb agreement morphology as a function of age of exposure to ASL, such as those of Emmorey, et al (1995), Mayberry (1994), and Newport (1984) found that later learners of ASL did not score as well on various tasks as did native, or even early learners. These studies all used Deaf adults who had used ASL as their primary language for at least 20 years, but who were exposed to ASL at different ages during childhood. These studies provide evidence of what has been affected, but can not show the developmental course of acquisition given the delayed input.

Chapter 3 presents the verb agreement system of ASL, as well as previous studies of native Deaf children's acquisition of the verb agreement system and verb agreement morphology. To review, ASL has three verb types (Fischer and Gough, 1978, Padden, 1983). Plain verbs do not mark agreement. An example of this is LIKE, as in JOHN LIKE MARY. LIKE is signed with body contact at mid-chest level and is signed the same way regardless of who likes whom. The sign itself does not differentiate whether John likes Mary or Mary likes John. With LIKE, word order provides the information of who is doing the liking. However, some plain verbs may be signed in a location, for example HURT. HURT is signed with two hands, each hand has the pointer finger out, from an otherwise closed fist. The palm faces in toward the body and the tips of the two pointer fingers move in toward each other. When signed near a body

part, such as the nose, it means that the nose hurts. The same sign can be made in neutral space or near any other body part on one's self. It may not be signed on someone else however, with the exception of child-directed signing, for example when an adult is signing it on a child, a book page, or a toy.

Spatial verbs have semantic features that require the marking of a location, either physically present, or not present but established in discourse. Spatial verbs are signed toward a location. Examples of spatial verbs include GO-TO and PUT. PUT requires an animate subject, an object, and a place/location for the object. Spatial verbs indicate the role of location using the path of the verb's movement toward the location.

Agreeing verbs have at least two arguments that specify human participants. They have formal features that require the marking of both a subject and an object. They are similar to spatial verbs in that the path of movement in set up space is used to show the agreement. However for agreeing verbs the starting and ending points of the path of movement indicate who does what to whom and the path that the hand takes between the loci shows the agreement between the subject(s), verb, and object. An example of an agreeing verb is HELP.

The present work is based on the hypothesis that there are aspects of first language acquisition that will be affected by a sensitive period, in particular those involving purely formal syntactic features, and others that may not be affected, such as those involving semantic features. Lexical entries in the mental lexicon contain three collections of features: phonological features, semantic features,

and formal features. The present hypothesis is that the purely formal, non-meaningful features are those most affected by a sensitive period, as seen with the contrast between agreeing verbs and spatial verbs in ASL.

Studies of native signing Deaf children acquiring the verb agreement system of ASL have found seemingly disparate results. Some studies report that Deaf children make errors with the verb agreement morphology of ASL, up until the age of about 2 1/2 to 3 years (Fischer, 1973, Hoffmeister, 1978, Hanel, to appear, and Meier, 1982, among others). The most common error reported is one of omission, whereby the young children sign agreeing verbs in the plain, citation form, showing no or minimal agreement. This is similar to the studies of hearing children acquiring the verb agreement system of a spoken language, and making errors in which they leave off inflectional endings. As more thoroughly discussed in Chapter 7, this stage of not using inflectional endings in spoken language is often attributed to an Optional Infinitives stage model (Poeppel and Wexler, 1993, Wexler, 1994). While this stage might or might not account for data from native ASL signers, I argued that it does not explain the results found for MEI's and CAL's data.

While many studies find agreement errors in the data from young native signers, other studies of the acquisition of ASL, show that native, Deaf children do not have difficulty with verb agreement morphology (Lillo- Martin, Quadros, and Mathur, 1998, Quadros, Lillo- Martin, and Mathur, 2001). The data they analyzed contained fewer than 5% errors with verbs. This result is mirrored by

the analysis of JIL's data from age 2;0 to age 4;6 (as presented in Chapter 7 of this dissertation).

As discussed in Chapter 7, the results from the studies that report agreement errors, and those from the studies that do not report many agreement errors are not extremely different when the following points are taken into consideration. First, while there were actually few errors reported in the previous studies, these are often cited by others as being a subset of the total set of errors, making it seem that there are many more errors that occurred than actually did. Second, the various studies use different categories of verbs, and different ways of classifying them. If a verb now classified as plain (optionally signed in a location) was classified as agreeing, an error of omission would be incorrectly coded. Third, there is little information in the previous studies regarding how many verbs were used per session. A session that has only one agreeing verb, and that one is incorrect, is less convincing than a session that has ten agreeing verbs with only one that is incorrect. Finally, the coding, in particular, of verb agreement errors varies with the different studies. Meier (1982) was conservative in not coding cases where movement was potentially ambiguous, for example, if the child was sitting directly in front of the adult. He did not look at other possible markers of agreement, like eyegaze and other non-manuals. When these other markers are used in conjunction with the movement, some of the ambiguity can be resolved, and those tokens can be counted as agreeing in the coding.

Therefore, there may not be as large a discrepancy between the earlier and the later studies with regard to the acquisition of the verb agreement system. This will have to be a topic for future research.

Chapter 4 of this dissertation discusses the participants used in this new study of sensitive period effects on first language acquisition. The longitudinal language samples obtained from MEI and CAL, the later- learners, were compared to the longitudinal language samples obtained from native- signing Deaf children. One child, NAT, is a native- signing Deaf age peer who lives in the dormitories with MEI. The other, JIL, is a native- signing Deaf younger child who is a language- experience peer. JIL has had approximately the same number of years of language exposure as MEI and CAL. Periodic language samples were collected from two other older native signing children, GEN and NIE, for further comparison. The comparison cases were to help place MEI and CAL along a developmental course, and to provide the means to evaluate whether MEI and CAL follow the normal course of language acquisition, or deviate from it.

Chapter 5 of this dissertation presents the description of the techniques used to collect the naturalistic language data. It presents details of the experimental design. It also provides the criteria used in selecting the sessions to be analyzed, and shows how the data were analyzed. All of the sessions transcribed and analyzed thus far for MEI, CAL, NAT, GEN, and NIE have been with a Deaf signer who is familiar to the children, interacting with the children.

All of the above- mentioned sessions were video- taped, and only those signs that are clearly visible and intelligible to a native signer who does not know the children were used. This clarity is essential for examination of the grammatical ASL non- manuals.

The naturalistic data from MEI, CAL, NAT, and JIL were examined, as presented in Chapter 6, for general trends, like MLU, errors of different types, ASL word order, and the use of semantic relations. The results can be briefly summarized as follows.

The calculation of MLU, originally planned to help place MEI and CAL within a language development continuum, appears to be a poor measure of ASL, because, among other reasons, MLU does not increase for native Deaf signers as it does for English learners.

The findings on the use of basic and derived word orders by MEI and the native signers provides a way to examine the early acquisition of a first language given different timings of input. The increased use of basic word orders compared with derived word orders by MEI and CAL suggests that MEI and CAL may not know the mechanisms or the triggers for the mechanisms that allow word-order change operations.

The findings on the use of cognitively complex utterances by MEI and CAL serve two purposes. They show, along with the cognitive tests conducted by the school psychologist and the results from the achievement tests, that MEI and CAL function within normal age-appropriate cognitive levels. The results also suggest that language can be limited, while knowledge of semantic relations is

not. Hence the syntactic properties of the two word stage (Brown, 1973) were found in language samples from MEI and CAL at the age of approximately six years, but for the same sessions, the semantic relations were comparable to age peers.

There are many hypotheses regarding the parallel development of cognitive ability and language, with little data to address the dissociation of the two. While the extent of the dissociation evidenced by MEI and CAL will be left for future study, preliminary results suggest that a dissociation between language acquisition and the acquisition of more general cognitive knowledge can occur. Given that both MEI and CAL test within average to above- average ranges on non-verbal cognitive ability tasks, I am not saying that a parent can provide minimal linguistic input and the child will necessarily be unaffected. However in the cases of MEI and CAL, the parents loved the children and tried to provide everything they thought they could for the growth of the child. As a result, both MEI and CAL had experiences outside playing by themselves, playing inside with toys, and interacting with adults, albeit with minimal linguistic input. MEI and CAL saw the trees, the grass, the sun, and cars moving. Inside each of the homes, there was TV, a computer, digital clocks, and other technological devices. The parents also hugged the children, dressed them, fed them, and interacted normally around them. The primary aspect of life that was different and impoverished, was the linguistic interaction between the child and the family. While language use is a huge aspect of human life, its absence does not necessarily have to preclude the development of cognition more generally. One

hypothesis that can be proposed is that MEI and CAL had the “normal” number of years of seeing everything that surrounded them for normal cognition to occur, and because communication was so limited, the children picked up more of what they saw. This is not to say that vision is essential for normal cognitive development, only that MEI and CAL were still able to experience the world through their other senses. A second hypothesis is that MEI and CAL were not able to develop cognitively without the language to express what they were experiencing. And the third hypothesis would be something in between, whereby MEI and CAL would take everything in, but not fully because they could not express what they were experiencing and learning. But once language acquisition started, they caught up quickly. These and other hypotheses may be tested in the future.

The last two sections of Chapter 6 discuss the errors found in the naturalistic language samples of MEI and CAL versus the native-signing children, JIL and NAT. Although the percentage of errors made by MEI and CAL is higher than by JIL and NAT, there is much that MEI and CAL sign correctly.

The last data- related section of Chapter 6 reveals an area of language in which MEI and CAL show particular difficulty. From the studies with adult later-learners (Newport, 1984, Emmorey, et al. 1995, Mayberry, 1994, among others), it is not surprising that MEI and CAL would show great difficulty with verb agreement and use of space.

Therefore, Chapter 7 focuses on the acquisition of the verb agreement system of ASL. A detailed examination of the errors made by MEI and CAL with

verbs and verb agreement morphology provided results that were clear and specific. The results showed that MEI and CAL had difficulty with agreeing, but not spatial or plain verbs. This did not improve over time for MEI, nor did it seem to with CAL. This pattern is also very different from that of the native signers. The youngest native signer made few errors, and these were spread out over the different verb types.

The hypothesis I accepted is that agreeing verbs have purely formal features, and it is these features that MEI and CAL lack access to. Spatial verbs have semantic features, which MEI and CAL have no problem with, therefore MEI and CAL do just as well with spatial verbs as they do with plain verbs. Alternative hypotheses for why MEI and CAL showed this pattern of errors with primarily agreeing verbs, such as difficulty with the use of space, and difficulty with the use of present versus non- present referents were rejected.

The overall results presented in Chapter 6, and the specific results of the verb agreement analyses presented in Chapter 7 led me to conclude that there is a sensitive period for first language acquisition. These effects on language acquisition are not linguistically globally incapacitating, but instead are specific and theoretically motivated, affecting purely formal features. Additional affected domains can be predicted and tested in future work.

There are other theories and hypotheses that can be proposed to account for the differences between late- learners and native language users, without assuming a sensitive period for language acquisition. One such theory would be an input-driven one, as Tomasello (2000) discusses. In this theory, assuming

that cognitive abilities are within normal ranges, language acquisition should occur quickly once exposure has begun. A stage akin to a linguistic two- word stage would not be predicted to occur because this theory assumes that the stage is due to cognitive limitations of a 2 year old child, like memory limitations. The errors should also disappear quickly after linguistic input begins. This theory does not account for the pattern of results found with MEI and CAL in regard either to the patterning of errors or to the limited number of words per utterance as compared to the semantic relations expressed. It also does not account for the previous studies with adult late- learners of ASL.

Another hypothesis that can be proposed is that agreeing verbs are generally more difficult than spatial verbs, and spatial verbs are in turn generally more difficult than plain verbs. Therefore MEI and CAL, as well as the native signers, should make fewest errors on plain verbs, more errors on spatial verbs, and most errors on agreeing verbs. This was not found to be the case for any of the children. JIL and NAT made few errors on any verb type. MEI and CAL made errors on agreeing verbs, but nearly none on either spatial or plain verbs. This patterning together of the plain and spatial verbs was not the break- up predicted by this theory.

Another theoretical framework, one that does not employ a biological sensitive period for language acquisition, focuses instead on the interaction between the social aspects of language and the linguistic aspects of language (Bortfeld and Whitehurst, 2001). If the social interactions are not normal, the

linguistic interactions may not be either, thereby affecting the language acquisition process.

The theory is based on the following hypothesis. If social interactions are not normal, the linguistic interactions will not be either, thereby affecting the language acquisition process. Therefore, children who have not had normal social interactions at the appropriate early times, may not receive appropriate social interactions in the future, including decreased amount of linguistic input, and potentially mismatched linguistic input for the more general ability. An explanation for differences seen more broadly between late- language learners and native language users would be due to a mismatch of social and linguistic interactions.

While this theory is very interesting, the hypothesis will not be tested here, but saved perhaps for future work. One way of testing the hypothesis is to examine the social interactions between the adult Deaf signer and MEI and CAL as compared to the interactions between that same adult Deaf signer and a younger dorm mate. This analysis could be done based on the video- taped sessions I have collected over the past 3 1/2 years. Other relevant interactions can also be analyzed, such as between MEI and CAL playing together, and MEI or CAL playing with NAT, GEN, or NIE.

Although the above- mentioned analysis is important for understanding socio- linguistic interactions, a clear hypothesis for why MEI and CAL should show the specific problems with agreeing verbs versus spatial verbs would still

need to be proposed. In the absence of a proposal that would account for this particular pattern of results, I will adopt the sensitive period hypothesis.

To conclude, the results from this study contribute to our knowledge of language and language acquisition in two ways. First, on the linguistic aspect, the error pattern on agreeing verbs versus plain and spatial verbs provides evidence for the breakdown of the three verb categories for ASL.

Second, the difficulty with the use of language by MEI and CAL is due to the existence of a sensitive period for first language acquisition. Curtiss (1977, 1989), Johnson and Newport (1989), Lenneberg (1967), and others have proposed that the effects of passing a sensitive period for language acquisition get gradually more severe the older the child is at first input, with puberty being the cut-off age. However, this claim that puberty is the cut-off for severity may be too prolonged. Sensitive period effects are noticeable in the cases of MEI and CAL (who were not physically abused), when first language acquisition occurred at age 6 years. The aspects of language that are problematic for MEI and CAL seem to be the same ones reported for adult Deaf signers who were exposed to ASL after the age of 5 years. Therefore, these sensitive period effects appear earlier than puberty and are long- lasting. These effects on language acquisition are not linguistically globally incapacitating, but instead are specific and theoretically motivated, affecting purely formal features and potentially other domains- domains that are predictable and testable.

Appendix A

Sample Verb Agreement Coding Screen

ASL new coding template Clone

☐ Not analyzed because:

Verb Analy...

Records: 0

Unsorted

Time of original: _____ Word Order: _____

Gloss: _____

Interpretation: _____

☐ command

Verb Type: _____

Book Title: _____ Page #: _____

Facial Expression Analysis: ☐ eye gaze:

	1st instance	2nd instance	3rd instance
[] Head	_____	_____	_____
[] Brow	_____	_____	_____
[] Eyes	_____	_____	_____
[] Nose	_____	_____	_____
[] Mouth	_____	_____	_____
[] Shoulder	_____	_____	_____

Errors: ☐ plain verb with agreement ☐ _____ should not be null

☐ failure to use required agreement ☐ other _____

☐ using wrong location _____

Child's sign:

☐ subject agreement

☐ object agreement

☐ source/goal agreement

☐ spatial agreement

Sentence Analysis:

☐ subject overt

☐ direct object overt

☐ indirect object overt

☐ location overt

☐ subject null

☐ direct object null

☐ indirect object null

☐ location null

Pragmatic Analysis:

☐ subject present

☐ direct object present

☐ indirect object present

☐ location present

Comment: _____

Browse

Appendix B

Sample Utterances from MEI and CAL

Plain verbs: Correct instances

Child/ Sess #	Age	Utterance	Gloss
MEI 1	6;6- 6;8	CAT EAT NOTHING	The cat is eating nothing.
MEI 2	6;6- 6;8	THINK GOLD THINK INSIDE EGG.	I think there is gold in the egg.
MEI 6	6;9- 6;11	MOTHER PT-BOOK WANT MONEY	The woman in the book wants money.
MEI 12	7;0- 7;2	HAVE HOME SMALL HAVE.	I have a small frog at home.
MEI 18	7;0- 7;2	D-namesign SEW	Donna sewed the costumes
MEI 28	7;3- 7;5	HERE WHAT THINK?	What do you think is over here?
MEI 67	8;0- 8;2	MY TEACHER CALL-ON PT-SPACE-ON-LEFT.	My teacher called on CAL.
MEI 98	9;0- 9;2	AND FROG SIT	And the frog sits.
MEI 110	9;9- 9;11	START MAKE MOUSE.	Boy starts to make a mouse.
CAL 1	6;9- 6;11	HEAR PT-BAG?	Do you hear what's in the bag?
CAL 2	6;9- 6;11	PLAY GAME YES<hn>.	Yes, let's play a game.
CAL 5	7;0- 7;2	ME HAVE STICKERS	I have stickers.
CAL 8	7;0- 7;2	BOY CRY.	The boy cries
CAL 11	7;3- 7;5	PT- BOOK LOVE HIS DOG LOVE	The boy loves his dog.
CAL 17	7;3- 7;5	PT-PAGE WALK.	The boy is walking.

Child/ age range	Total # plain verbs	Total # completely correct
MEI 6;6- 6;8	89	76
MEI 6;9- 6;11	54	52
MEI 7;0- 7;2	166	148
MEI 7;3- 7;5	148	133
MEI 7;6- 7;8	59	50
MEI 7;9- 7;11	20	17
MEI 8;0- 8;2	105	96
MEI 8;6- 8;8	73	64
MEI 9;0- 9;2	92	82
MEI 9;9- 9;11	119	110
CAL 6;9- 6;11	18	15
CAL 7;0- 7;2	72	66
CAL 7;3- 7;5	71	66

Spatial verbs: Correct Instances

Child/ Sess#	Age	Utterance	Gloss
MEI 1	6;6- 6;8	CLIMB- DOWN.	Spider climbs down
MEI 1	6;6- 6;8	PUT-THERE.	You put it there
MEI 1	6;6- 6;8	OPEN-EGG.	Open the egg
MEI 1	6;6- 6;8	WRONG WALK-HERE WRONG.	It's wrong of you to walk here.
MEI 12	7;0- 7;2	ANTLER-FALL-OFF	Boy falls off the deer's antler.
MEI 24	7;3- 7;5	ALOT GRASS SPREAD- OUT	Someone spread out a lot of grass.
MEI 63	8;0- 8;2	BALLOON CL:(HOLDING A BALLOON STRING)	Someone is holding a balloon by its string.
MEI 67	8;0- 8;2	FROM-TREE WATCH- HOUSE.	From the tree, the bear watched the house.
MEI 110	9;9- 9;11	WITH BOY GIRL BOTH- WATCH.	With boy and girl both watching
CAL 1	6;9- 6;11	PT-WALL TURN-OFF- SWITCH YOU.	Over there you turn off the lightswitch.
CAL 2	6;9- 6;11	AIRPLANE AIRPLANE- TAKE-OFF.	The airplane takes off.
CAL 8	7;0- 7;2	LEAVE-THERE	Leave them there.
CAL 10	7;3- 7;5	TREE TREE-FALL-OVER.	The tree fell over.
CAL 11	7;3- 7;5	PT-PICTURE FALL-OFF- TREE.	The boy falls off the tree.
CAL 17	7;3- 7;5	MOVE-BACK LET-GO MAYBE LATER <hn>.	Maybe later, I move the car back and let it go.

Child/ age range	Total # spatial verbs	Total # completely correct
MEI 6;6- 6;8	26	24
MEI 6;9- 6;11	13	12
MEI 7;0- 7;2	54	44
MEI 7;3- 7;5	79	72
MEI 7;6- 7;8	48	39
MEI 7;9- 7;11	25	8
MEI 8;0- 8;2	93	87
MEI 8;6- 8;8	33	28
MEI 9;0- 9;2	61	58
MEI 9;9- 9;11	41	40
CAL 6;9- 6;11	16	14
CAL 7;0- 7;2	33	33
CAL 7;3- 7;5	61	61

Agreeing verbs: Correct instances

Child/ Sess #	Age	Utterance	Gloss
MEI 2	6;6- 6;8	SEE ME	I see you.
MEI 5	6;6- 6;8	KILL	You kill the snake.
MEI 6	6;9- 6;11	PT-BOOK BEAR SEE	Bear sees the person in the book.
MEI 6	6;9- 6;11	PT-BOOK WAVE- GOOD-BYE.	He waves goodbye to the girl.
MEI 16	7;0- 7;2	AND-THEN TURTLE BITE-PAW.	And then the turtle bites the dog on the paw.
MEI 17	7;0- 7;2	GIVE-ME	You give me the fish.
MEI 51	7;6- 7;8	COME PT-PAGE	Come to me dog.
MEI 63	8;0- 8;2	METOLD-YOU	I told you that would happen.
MEI 98	9;0- 9;2	WATCH-ME SAM.	You watch me, Sam.
MEI 110	9;9- 9;11	PT-PICTURE+ MAN GIVE FISH.	There the man gives fish to the seal.
CAL 8	7;0- 7;2	PT-BOOK BOY+ PT- BOOK GIRL POUR-ON	The boy pours on the girl.
CAL 10	7;3- 7;5	PT-PICTURE GRAB FISH.	Here you grab the fish.
CALL 11	7;3- 7;5	CATCH.	Boy catches the frog.

Child/ age range	Total # agreeing verbs	Total # completely correct
MEI 6;6- 6;8	13	2
MEI 6;9- 6;11	9	3
MEI 7;0- 7;2	25	4
MEI 7;3- 7;5	15	6
MEI 7;6- 7;8	19	9
MEI 7;9- 7;11	6	1
MEI 8;0- 8;2	15	2
MEI 8;6- 8;8	22	9
MEI 9;0- 9;2	20	7
MEI 9;9- 9;11	14	4
CAL 6;9- 6;11	2	0
CAL 7;0- 7;2	4	1
CAL 7;3- 7;5	10	4

Plain verbs: Some of the Utterances with Errors

Child/ Sess #	Age	Error Type	Utterance	Gloss
MEI 1	6;6- 6;8	Complex thought, too few words	PLAY WATER GROW	I want to play with the thing that grows when you put it in water.
MEI 2	6;6- 6;8	Word order problems	TURTLE GREEN DARK GLOW.	The turtle glows green in the dark.
MEI 5	6;6- 6;8	Word order problems	HORSE BIRTHDAY DIE ME.	The horse that was coming for my birthday died.
MEI 28	7;3- 7;5	Word order problems	INSIDE NONE HAVE BOWL.	Inside the bowl there is no porridge.
MEI 51	7;6- 7;8	Wrong lexical choice	SAY OWL "WHAT-DO YOU WHAT-DO?"	Boy says to owl, "what are you doing?"
MEI 81	8;6- 8;8	Subject should not be null.	THINK CREEP-UP	Someone thinks the men were creeping up.
MEI 98	9;0- 9;2	Wrong lexical choice.	LOOK PT-SAM	Sam is looking.(Not the agreeing form of LOOK.)
MEI110	9;9- 9;11	Word order problems	START BOOK WALK SLOW.	He starts to walk slowly with the book.
CAL 1	6;9- 6;11	Wrong lexical choice	BREAK UH-OH	The clothing fell-off the rabbit.
CAL 2	6;9- 6;11	Subject should not be null.	PT-THERE HAVE FLOWER.	Over there, someone has a flower.
CAL 5	7;0- 7;2	Put on spatial morphology.	JUMP PT- UP	Frog jumps up.
CAL 17	7;3- 7;5	Word order problems	DOG FROG LICK	The dog licks the frog.

Spatial verbs: Some of the Utterances with Errors

Child/ Sess #	Age	Error Type	Utterance	Gloss
MEI 1	6;6- 6;8	Wrong location used.	THROW	She threw it.
MEI 12	7;0- 7;2	Did not set up space.	SEARCH	They searched for the frog.
MEI 24	7;3- 7;5	Lexical substitution	SANTA TREE GO-DOWN.	Santa goes down the tree (should have been chimney).
MEI 51	7;6- 7;8	Signed without morphology-omission error	PT-PAGE BITE NOSE.	Gopher bites the boy's nose. (should have been signed with movement towards the nose.)

MEI 81	8;6- 8;8	Subject should not be null.	RUN+ asp	Someone runs.
MEI 110	9;9- 9;11	Did not set up, or use space.	BABY WALK, THIRSTY	Baby walks to mom because she is thirsty.
CAL 1	6;9- 6;11	Did not set up or use space.	ALLIGATOR BITE-BAG	Alligator bites the bag.

Agreeing Verbs: Some of the utterances with errors:

Child/ Sess #	Age	Error Type	Utterance	Gloss
MEI 2	6;6- 6;8	Agreement with wrong argument	FROG SEE ME	I saw a frog
MEI 2	6;6- 6;8	Failure to use agreement. Did not set up space. Word order.	ME FROG HOME I-WATCH.	At home, I watched a frog.
MEI 12	7;0- 7;2	Did not set up/ use space. Failure to use agreement	CHASE DOG	Bee chases the dog
MEI 17	7;0- 7;2	Did not set up space. Used space randomly.	MOTHER SPANK.	Mother spanked the dog.
MEI 43	7;6- 7;8	Sets up space, but fails to use agreement	MAN GIVE ALLIGATOR FISH	Man gives the alligator a fish.
MEI 81	8;6- 8;8	Subject and object should not be null. Fail to use agreement.	FOLLOW.	Someone follows someone.
MEI 81	8;6- 8;8	Fail to use agreement. Did not set up space	GIRL WATCH BOY CHILDREN.	Snow White watches the dwarves.
MEI 110	9;9- 9;11	Fail to use agreement. Did not set up/use space.	C-namesign GIVE RING.	Chad gave me a ring.
MEI 110	9;9- 9;11	Fail to use agreement	PT-CARD FEED FOOD.	Kids feed the hamster food.
CAL 2	6;9- 6;11	Did not use space. Did not use agreement.	ME TEASE YOU.	I am teasing you.
CAL 2	6;9- 6;11	Did not use space. Did not use agreement.	YOU WATCH	You (snake) watch me.
CAL 8	7;0- 7;2	Using wrong location.	GET-ATTENTION PT-OFF-CAMERA	Tap my mother to get her attention.
CAL 11	7;3- 7;5	Did not use space. Did not use agreement.	LITTLE-FROG SEE.	They see the little frog.
CAL 17	7;3- 7;5	Did not set up or use space. Did not use agreement. Subject and object should not be null.	HELP+.	Someone helps someone.

Appendix C

Verb Agreement/ Word Order Act-Out Task Stimuli

PRACTICE ITEMS:

- 1) SUPERMAN JUMP-UP-AND-DOWN.
Superman jumps up and down.
- 2) SNOW WHITE WALK HOME.
Snow White walks home.
- 3) BOY GIRL RACE.
The girl races the boy.
- 4) MOTHER RUN-FAST.
Mother runs fast.
- 5) CLOWN LAUGH.
The clown laughs.
- 6) BATMAN SLEEP.
Batman sleeps.

Battery A:

- 1) GIRL PUNISH BOY.
The girl punishes the boy.
- 2) BOY (THERE) TAP GIRL (THERE).
The boy taps the girl.
- 3) FATHER SHOW MOTHER PICTURE
The father shows the mother a picture.
- 4) ELEPHANT EAT EGG.
The elephant eats the egg.
- 5) GORILLA CHASE LION.
The gorilla chases the lion.
- 6) BOY FEED DOG APPLE.
The boy feeds the dog an apple.

- 7) *BALL*, SUPERMAN THROW JOKER.
Superman throws Joker the ball.
- 8) *MOTHER THERE* FATHER PUNISH.
The father punishes the mother.
- 9) *MONKEY THERE*, LION DROP.
The lion drops the monkey.
- 10) *TV*, BUG-BOY WATCH.
The bugboy watches TV.
- 11) *BEAR (THERE)*, LION (THERE) CAPTURE.
The lion captures the bear.
- 12) *BOOK*, BATMAN GIVE SUPERMAN.
Batman gives Superman a book.
- 13) *ICE CREAM BOY* FEED GIRL.
Boy feeds girl ice cream.
- 14) *PICTURE FISHGIRL* SHOW SNOW WHITE.
Ariel shows Snow White a picture.

Battery B:

- 15) *NUT GIRL* FEED ELEPHANT.
The girl feeds the elephant a nut.
- 16) *KING*, BOY TAP.
The boy taps the king.
- 17) *FISH GIRL* CLOWN FIND.
The clown finds Ariel.
- 18) *BOY*, GIRL CHASE.
The girl chases the boy.
- 19) *SNOW WHITE* SEND FISH GIRL LETTER.
Snow White sends Ariel a letter.
- 20) *BANANA*, BATMAN EAT.
Batman eats a banana.

- 21) GIRL GIVE BOY BOOK.
The girl gives the boy a book.
- 22) BATMAN FIND SUPERMAN.
Batman finds superman.
- 23) *LETTER* BOY SEND GIRL.
The boy sends the girl a letter.
- 24) BEAR WATCH TV.
The bear watches TV.
- 25) *FRISBEE*, MONKEY-BLACK TOSS-TO MONKEY -BROWN.
The black monkey tosses a frisbee to the brown monkey.
- 26) BATMAN CAPTURE SUPERMAN.
Batman captures superman.
- 27) BOY DRINK MILK.
The boy drinks milk.
- 28) BEAR DROP LION.
The bear drops the lion.

References

- Aronoff, M., Meir, I., & Sandler, W. (In submission). *Universal and particular aspects of sign language morphology*. Unpublished manuscript.
- Bamberg, M. G. W. (1987). *The Acquisition of Narratives: Learning to Use Language*. Berlin: Mouton de Gruyter.
- Bellugi, U., O'Grady, L., Lillo-Martin, D., O'Grady, M., vanHoek, K., & Corina, D. (1990). Enhancement of spatial cognition in deaf children. In V. Volterra & C. J. Erting (Eds.), *From Gesture to Language in Hearing and Deaf Children* (pp. 278- 298). New York: Springer- Verlag.
- Bialystok, E., & Hakuta, K. (1994). *In Other Words: The Science and Psychology of Second- Language Acquisition*. New York: Basic Books.
- Bickerton, D. (1981). *The Roots of Language*. Ann Arbor, MI: Karoma Publishers.
- Birdsong, D. (1991). On the notion of "critical period" in UG/L2 theory: A response to Flynn and Manuel. In L. Eubank (Ed.), *Point- Counterpoint: Universal Grammar in the Second Language* (pp. 147- 165). Amsterdam: John Benjamins.
- Birdsong, D. (1992). Ultimate attainment in second language acquisition. *Language*, 68, 706- 755.
- Birdsong, D. (1997). Intransitivity and SE in French: Aspects of late L2 learnability.
- Birdsong, D. (1999). *Second Language Acquisition and the Critical Period Hypothesis*. New Jersey: LEA.
- Birdsong, D., & Molis, M. (1998). *Age and maturation in L2A: A replication of Johnson and Newport (1989)*. Unpublished manuscript.
- Bloom, L. (1970). *Language Development: Form and Function in Emerging Grammars*. Cambridge, MA: MIT Press.
- Bloom, L. (1973). *One Word at a Time: The Use of Single Word Utterances Before Syntax*. The Hague: Mouton.
- Bloom, L., Lightbrown, P., & Hood, L. (1975). Structure and variation in child language. *Monographs of the Society for Research in Child Development*, 40(2), 97.
- Bloom, P. (1990). Subjectless sentences in child language. *Linguistic Inquiry*, 21, 491- 504.
- Bongaerts, T. (1999). Ultimate attainment in L2 pronunciation: The case of very advanced late L2 learners. In D. Birdsong (Ed.), *Second Language Acquisition and the Critical Period Hypothesis* (pp. 133- 160). New Jersey: LEA.
- Bonvillian, J. D., & Folven, R. D. (1993). Sign language acquisition: Developmental aspects. In M. Marschark & D. Clark (Eds.), *Psychological Perspectives on Deafness* (pp. 229- 265). Hillsdale, NJ: LEA.
- Bortfeld, H., & Whitehurst, G. J. (2001). Sensitive periods in first language acquisition. In D. B. Bailey & J. T. Bruer & F. J. Symons & J. W. Lichtman (Eds.), *Critical Thinking About Critical Periods* (pp. 173- 192). Baltimore: Paul H. Brookes Publishing Co.

- Boyes- Braem, P. (1990). Acquisition of the handshape in American Sign Language. In V. Volterra & C. J. Erting (Eds.), *From Gesture to Language in hearing and deaf children* (pp. 107-127). New York: Springer- Verlag.
- Braine, M. (1976). Children's first word combinations. *Monographs of the Society for Research in Child Development*, 41(1), 104.
- Brown, R. (1973). *A First Language: The Early Stages*. Cambridge, MA: Harvard University Press.
- Bruer, J. T. (2001). A critical and sensitive period primer. In D. B. Bailey & J. T. Bruer & F. J. Symons & J. W. Lichtman (Eds.), *Critical Thinking About Critical Periods* (pp. 3- 26). Baltimore, MD: Paul H. Brookes Publishing Co.
- Carey, S. (1994). Does learning a language require the child to reconceptualize the world? In L. Gleitman & B. Landau (Eds.), *The Acquisition of the Lexicon* (pp. 143- 168). Cambridge, MA: Elsevier/ MIT Press.
- Casey, S. (2003). Relationships between gestures and signed languages: Indicating participants in actions. In A. E. Baker & E. M. van den Bogaerde & O. Crasborn (Eds.), *Crosslinguistic Perspectives on Sign Language Research: Papers from TISLR 7*. Hamburg, Germany: Signum Press.
- Chen Pichler, D. (2001). *Evidence for early word order acquisition in a variable word order language*. Paper presented at the The 25th Annual Boston University Conference on Language Development, Boston, MA.
- Chomsky, N. (1995). *The Minimalist Program*. Cambridge, MA: MIT Press.
- Clark, E. V. (1983). Meanings and concepts. In P. H. Mussen (Ed.), *Handbook of Child Psychology* (Vol. 3). New York: Wiley.
- Conlin, K., Mirus, G. R., Mauk, C., & Meier, R. (2000). Acquisition of first signs: Place, handshape, and movement. In C. Chamberlain & J. Morford & R. Mayberry (Eds.), *Language Acquisition by Eye* (pp. 51- 70). Mahwah, NJ: LEA.
- Coppieters, R. (1987). Competence differences between native and near- native speakers. *Language*, 63, 544- 573.
- Cranshaw, A. (1997). *A study of Anglophone native and near- native linguistic and metalinguistic performance*. Unpublished doctoral dissertation, Universite de Montreal, Montreal.
- Curtiss, S. (1977). *Genie: A Psycholinguistic Study of a Modern Day "Wild Child"*. New York: Academic Press.
- Curtiss, S. (1982). Developmental dissociations of language and cognition, *Exceptional Language and Linguistics* (pp. 285- 312): Academic Press.
- Curtiss, S. (1989). *The case of Chelsea: A new test case of the critical period for language acquisition*. Unpublished manuscript, Los Angeles.
- Davis, K. (1940). Extreme social isolation of a child. *American Journal of Sociology*, XLV, 554- 565.
- Davis, K. (1947). Final note on a case of extreme social isolation. *American Journal of Sociology*, 52, 432- 437.
- Dekeyser, R. M. (2000). The robustness of critical period effects in second language acquisition. *SSLA*, 22, 499- 533.

- DeVilliers, P. A., & Devilliers, J. G. (1979). *Early Language*. Cambridge, MA: Harvard University Press.
- Doupe, A. J., & Kuhl, P. K. (1999). Birdsong and human speech. *Annual Review of Neuroscience*, 22, 567- 631.
- Emmorey, K. (2002). *Language, Cognition and the Brain*. Mahwah, NJ: LEA.
- Emmorey, K., Bellugi, U., Friederici, A., & Horn, P. (1995). Effects of age of acquisition on grammatical sensitivity: Evidence from on- line and off- line tasks. *Applied Psycholinguistics*, 16(1), 1- 23.
- Emmorey, K., Ewan, B., & Grant, R. (1994). A new case of linguistic isolation: Preliminary report.
- Emmorey, K., & Lillo-Martin, D. (1995). Processing spatial anaphora: Referent reactivation with overt and null pronouns in American Sign Language. *Language and Cognitive Processes*, 10(6), 631- 664.
- Emmorey, K., & Reilly, J. (1998). *The development of quotation and reported action: Conveying perspective in ASL*. Paper presented at the The Twenty-Ninth Annual Stanford Child Language Research Forum, Stanford.
- Eubank, L., & Gregg, K. R. (1999). Critical periods and (second) language acquisition: Divide et impera. In D. Birdsong (Ed.), *Second Language Acquisition and the Critical Period Hypothesis* (pp. 65- 100). Mahwah, NJ: LEA.
- Fant, L. J. (1972). *Ameslan: An introduction to American Sign Language*. Silver Spring, MD: National Association of the Deaf.
- Feldman, H. S., Goldin- Meadow, S., & Gleitman, L. R. (1978). Beyond Herodotus: The creation of language by linguistically deprived deaf children. In A. Lock (Ed.), *Action, Symbol, and Gesture*. New York: Academic Press.
- Fischer, S. (1973). Two processes of reduplication in American Sign Language. *Foundations of Language*, 9, 469- 480.
- Fischer, S. (1975). Influences on word order change in ASL. In C. Li (Ed.), *Word Order and Word Order Change* (pp. 1- 25). Austin: University of Texas Press.
- Fischer, S., & Gough, B. (1978). Verbs in American Sign Language. *Sign Language Studies*, 18, 17- 48.
- Flege, J. E. (1999). Age of Learning and Second Language Speech. In D. Birdsong (Ed.), *Second Language Acquisition and the Critical Period Hypothesis* (pp. 101- 131). Mahwah, NJ: LEA.
- Flege, J. E., & Fletcher, K. (1992). Talker and listener effects on degree of perceived foreign accent. *Journal of the Acoustical Society of America*, 91, 370- 389.
- Flynn, S., & Manuel, S. (1991). Age- dependent effects in language acquisition: An evaluation of 'critical period' hypotheses. In L. Eubank (Ed.), *Point/Counterpoint: Universal Grammar in the Second Language* (pp. 117- 145). Amsterdam: John Benjamins.
- Frankenburg, W. K., & Dodds, J. B. (1967). The Denver developmental screening test. *The Journal of Pediatrics*, 71, 181- 191.

- Goldin- Meadow, S., & Mylander, C. (1984). Gestural communication in deaf children: The non- effects of parental input on early language development. *Monographs of the Society for Research in Child Development*, 49(3-4, serial no 207).
- Goldin- Meadow, S., & Mylander, C. (1990). The role of parental input in the development of a morphological system. *Journal of Child Language*, 17, 527- 563.
- Goldin- Meadow, S., & Mylander, C. (1990a). Levels of structure in a language developed without a language model. In K. Gibson & A. Peterson (Eds.), *The Brain and Behavioral Development: Biosocial Dimensions*. Hawthorn, NY: Aldine Press.
- Goldin- Meadow, S., & Mylander, C. (1990b). The role of parental input in the development of a morphological system. *Journal of Child Language*. (GRI), G. R. I. (2000). Population Demographics. Report by Gallaudet University.
- Hanel, B. (to appear). *The acquisition of agreement in DGS: Early steps into a spatially expressed syntax*. Unpublished manuscript, Hamburg.
- Herodotus. (ca. 410 B.C./ 1942). *The Persian Wars, book 2, chapter 2*. New York: Rawlinson.
- Hoffmeister, R. J. (1978). *The development of demonstrative pronouns, locatives, and personal pronouns in the acquisition of American Sign Language by deaf children of deaf parents*. Unpublished Doctoral dissertation, University of Minnesota.
- Hoffmeister, R. J., & Wilbur, R. B. (1980). The acquisition of sign language. In H. Lane, L. & F. Grosjean (Eds.), *Recent Perspectives on ASL* (pp. 61- 78). Hillsdale, NJ: Erlbaum.
- Hyams, N., & Wexler, K. (1993). On the grammatical basis of null subjects in child language. *Linguistic Inquiry*, 24(3), 421- 459.
- Janis, W. (1992). *Morphosyntax of the ASL verb phrase*. Unpublished Doctoral dissertation, State University of New York at Buffalo, Buffalo.
- Janis, W. (1995). A crosslinguistic perspective on ASL verb agreement. In K. Emmorey & J. Reilly (Eds.), *Language, Gesture, and Space* (pp. 195- 223). Hillsdale, NJ: LEA.
- Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*, 21, 60- 99.
- Kegl, J. (1994). The Nicaraguan Sign Language project: An overview. *Signpost*, 7, 24- 31.
- Kegl, J., & Iwata, G. (1989). *Lenguaje de Signos Nicarguense: A pidgin sheds light on the "creole" ASL*. Paper presented at the The Fourth Annual Meeting of the Pacific Linguistics Conference, University of Oregon, Eugene.
- Kennard, M. (1940). Relation of age to motor impairments in man and subhuman primates. *Archives of Neurology and Psychiatry*, 44, 377- 397.
- Krashen, S. (1973). Lateralization, language learning, and the critical period: Some new evidence. *Language Learning*, 23, 63- 74.

- Lane, H., L. (1976). *The Wild Boy of Aveyron*. Cambridge, MA: Harvard University Press.
- Lenneberg, E., H. (1967). *Biological Foundations of Language*. New York: Wiley.
- Lidell, S. (1980). *American Sign Language Syntax*. The Hague: Mouton.
- Lillo-Martin, D. (1986). Two kinds of null arguments in American Sign Language. *Natural Language and Linguistic Theory*, 4, 415- 444.
- Lillo-Martin, D. (1999). Modality effects and modularity in language acquisition: The acquisition of American Sign Language. In W. C. Ritchie & T. K. Bhatia (Eds.), *Handbook of Child Language Acquisition* (pp. 531- 567). San Diego: Academic Press.
- Lillo-Martin, D. (2000). *Modality and modularity: Where are the effects?* Paper presented at the Texas Linguistics Society meeting: The Effects of Modality on Language and Linguistic Theory, Austin, TX.
- Lillo-Martin, D. (2002). Where are all the modality effects? In R. Meier & K. A. Cormier & D. Quinto- Pozos, G. (Eds.), *Modality and Structure in Signed and Spoken Language* (pp. 241- 262). Cambridge: Cambridge University Press.
- Lillo-Martin, D., Bellugi, U., Struxness, L., & O'Grady, M. (1985). The acquisition of spatially organized syntax. *PRCLD*, 24.
- Lillo-Martin, D., Boster, C. T., Halbert, A., Matsuoka, K., Nohara, M., Schley, S., & Simon- Marques, D. (1996). *Effects of different early input on the acquisition of ASL syntax by deaf children*. Paper presented at the The Fifth International Conference on Theoretical Issues in Sign Language Research, Montreal.
- Lillo-Martin, D., Quadros, R., & Mathur, G. (1998). *Acquisition of verb agreement in ASL and LIBRAS: A cross- linguistic study*. Paper presented at the Sixth International Conference on Theoretical Issues in Sign Language Research, Gallaudet University, Washington, D.C.
- Loew, R. (1982). Roles and reference. In R. Caccamise & M. Garretson & U. Bellugi (Eds.), *Teaching American Sign Language as a Second/ Foreign Language* (pp. 40- 58). Silver Spring, MD: National Association of the Deaf.
- Loew, R. (1984). *Roles and reference in American Sign Language: A developmental perspective*. Unpublished Doctoral dissertaton, University of Minnesota.
- Lorenz, K. (1937). The companion in the bird's world. *The Auk*, 54, 245- 273.
- Marentette, P. F., & Mayberry, R. (2000). Principles for an emerging phonological system: A case study of early ASL acquisition. In C. Chamberlain & J. Morford & R. Mayberry (Eds.), *Language Acquisition by Eye* (pp. 71- 90). Mahwah, NJ: LEA.
- Mason, M., K. (1942). Learning to speak after six and one-half years of silence. *Journal of Speech Disorders*, 7, 295- 304.
- Mathur, G. (2000). *Multiple levels within the verb agreement morphology of signed languages*. Paper presented at the The 7th International Conference on Theoretical Issues in Sign Language Research, Amsterdam.

- Mayberry, R. (1993). First- language acquisition after childhood differs from second- language acquisition: The case of American Sign Language. *Journal of Speech and Hearing Research*, 36, 1258- 1270.
- Mayberry, R. (1994). The importance of childhood to language acquisition: Evidence from American Sign Language. In J. C. Goodman & H. C. Nusbaum (Eds.), *The Development of Speech Perception: The Transition from Speech Sounds to Spoken Words*. Cambridge, MA: MIT Press/Bradford Books.
- Mayberry, R. (1995). Mental phonology and language comprehension or What does that sign mistake mean? In K. Emmorey & J. Reilly (Eds.), *Language, Gesture, and Space* (pp. 355- 370). Mahwah, NJ: LEA.
- McCabe, A. (1997). Developmental and cross- cultural aspects of children's narration. In M. G. W. Bamberg (Ed.), *Narrative Development: Six Approaches* (pp. Chapter 4). Mahwah, NJ: LEA.
- McDaniel, D., McKee, C., & Cairns, H. S. (1998). *Methods for Assessing Children's Syntax*. Cambridge. MA: MIT Press.
- Meier, R. (1981). Icons and morphemes: Models of the acquisition of verb agreement in ASL. *Papers and Reports on Child Language Development*, 20, 92- 99.
- Meier, R. (1982). *Icons, analogues, and morphemes: The acquisition of verb agreement in American Sign Language*. Unpublished Doctoral dissertation, University of California, San Diego, San Diego.
- Meier, R. (1984). Sign as Creole. *Behavioral and Brain Sciences*, 7, 201- 202.
- Meier, R. (2000). Shared motoric factors in the acquisition of sign and speech. In K. Emmorey & H. Lane, L. (Eds.), *The Signs of Language Revisited: An Anthology to Honor Ursula Bellugi and Edward Klima* (pp. 333- 357). Mahwah, NJ: LEA.
- Meier, R. (2002). The acquisition of verb agreement: Pointing out arguments for the linguistic status of agreement in signed languages. In G. Morgan & B. Woll (Eds.), *Directions in Sign Language Acquisition* (pp. 115- 141). Amsterdam: Benjamins.
- Meir, I. (1984). *Verb agreement in ISL*. Unpublished Doctoral dissertation, University of Jerusalem, University of Haifa.
- Meir, I. (1994). *Explaining backwards verbs in ISL: Syntactic- semantic interaction*. Paper presented at the The Fourth European Congress on Sign Language Research, Munich.
- Meir, I. (1998). Syntactic- semantic interaction in Israeli Sign Language verbs: The case of backwards verbs. *Sign Language and Linguistics*, 1(1), 3- 37.
- Meir, I. (1998). Syntactic- semantic interaction of Israeli Sign Language verbs: The case of backwards verbs. *Sign Language and Linguistics*, 1(1), 3- 37.
- Meir, I. (2002). A cross- modality perspective on verb agreement. *Natural Language and Linguistic Theory*, 20, 430- 450.
- Moore, D. F. (1974). Nonvocal systems of verbal behavior. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language Perspectives: Acquisition, Retardation, and Intervention* (Vol. 377- 418). Baltimore: Baltimore University Park Press.

- Morford, J. (1998). Gesture when there is no speech model. In J. M. Iverson & S. Goldin-Meadow (Eds.), *The Nature and Functions of Gesture in Children's Communication* (pp. 101- 116). San Francisco, CA: Jossey-Bass.
- Neville, H., J., Mills, D., & Lawson, D. (1992). Fractionating language: Different neural subsystems with different sensitive periods. *Cerebral Cortex*, 2, 244- 258.
- Newport, E. L. (1984). Constraints on learning: Studies in the acquisition of American Sign Language. *Papers and Reports on Child Language Development*, 23, 1-22.
- Newport, E. L. (1990). Maturational constraints on language learning. *Cognitive Science*, 14, 11- 28.
- Newport, E. L. (1991). Contrasting conceptions of the critical period for language. In S. Carey & R. Gelman (Eds.), *The Epigenesis of Mind: Essays in Biology and Cognition* (pp. 111- 130). Hillsdale, NJ: LEA.
- Newport, E. L. (1999). Reduced input in the acquisition of signed languages: Contributions in the study of creolization. In M. DeGraff (Ed.), *Language Creation and Language Change: Creolization, Diachrony, and Development* (pp. 161- 178). Cambridge, MA: MIT Press.
- Newport, E. L., & Ashbrook, E. (1977). The emergence of semantic relations in American Sign Language. *Papers and Reports on Child Language Development*, 13, 16- 21.
- Newport, E. L., & Meier, R. (1985). The acquisition of American Sign Language. In D. Slobin (Ed.), *The Cross- Linguistic Study of Language Acquisition* (pp. 881- 938). Hillsdale, NJ: LEA.
- Newport, E. L., & Supalla, T. (2000). Sign language research at the Millennium. In K. Emmorey & H. Lane, L. (Eds.), *The Signs of Language Revisited: An Anthology to Honor Ursula Bellugi and Edward Klima* (pp. 103- 114). Mahwah, NJ: LEA.
- Padden, C. (1983). *Interaction of morphology and syntax in American Sign Language*. Unpublished Doctoral dissertation, University of California at San Diego, San Diego.
- Padden, C. (1990). The relation between space and grammar in ASL verb morphology. In C. Lucas (Ed.), *Sign Language Research: Theoretical Issues* (pp. 118- 132). Washington, D.C.: Gallaudet University Press.
- Pascual-Leone, J. A. (1989). Constructive problems for constructive theories: The current relevance of Piaget's work, and a critique of information processing simulation psychology. In H. Sprada & R. Kluwe (Eds.), *Developmental Models of Thinking*. New York: Academic Press.
- Patkowski, M. S. (1980). The sensitive period for the acquisition of syntax in a second language. *Language Learning*, 30, 449- 472.
- Penfield, W., & Roberts, L. (1959). *Speech and Brain Mechanisms*. New York: Atheneum.
- Petitto, L. A. (1992). *Modularity and constraints in early lexical acquisition: Evidence from children's early language and gesture*. Paper presented at the Minnesota Symposia on Child Psychology.

- Petitto, L. A., & Marentette, P. F. (1991). Babbling in the manual mode: Evidence for the ontogeny of language. *Science*, 251, 1493- 1496.
- Pinker, S. (1994). *The Language Instinct: How the Mind Creates Language*. New York: Morrow.
- Poeppel, D., & Wexler, K. (1993). The full competence hypothesis of clausal structure in early German. *Language*, 69, 1- 33.
- Poizner, H., Klima, E. S., & Bellugi, U. (1987). *What the Hands Reveal About the Brain*. Cambridge, MA: MIT Press.
- Quadros, R., Lillo-Martin, D., & Chen Pichler, D. (2000). *A little change goes a long way: Capturing differences between Brazilian Sign Language and American Sign Language*. Paper presented at the The 7th International Conference on Theoretical Issues in Sign Language Research, Amsterdam.
- Quadros, R., Lillo-Martin, D., & Mathur, G. (2001). O que a aquisição da linguagem em crianças surdas tem a dizer sobre o estágio de infinitivos opcionais? *Letras de Hoje: Estudos e Debates de Assuntos de Lingüística, Literatura e Língua Portuguesa*, 36(3), 391- 397.
- Quigley, S. P., & Kretschmer, R. (1982). *The Education of Deaf Children: Issues, Theory, and Practice*. Baltimore, MD: University Park Press.
- Rathmann, C., & Mathur, G. (2002). Is verb agreement the same cross- modaly? In R. Meier & K. A. Cormier & D. Quinto- Pozos, G. (Eds.), *Modality and Structure in Signed Language and Spoken Language* (pp. 370- 404). Cambridge: Cambridge University Press.
- Schick, B. (2000). *Early language development: An advantage for sign?* Paper presented at the AAAS, Washington, D.C.
- Schick, B. (2002). The expression of grammatical relations by deaf toddlers learning ASL. In G. Morgan & B. Woll (Eds.), *Directions in Sign Language Acquisition* (pp. 143- 158). Amsterdam: Benjamins.
- Senghas, A. (1995). *Children's contribution to the birth of Nicaraguan Sign Language*. Unpublished Doctoral Dissertation, MIT, Cambridge, MA.
- Senghas, A., & Coppola, M. (2001). Children creating language: The emergence of linguistic structure in Nicaraguan Sign Language. *Psychological Science*, 12(4), 323- 328.
- Senghas, R. J., & Kegl, J. (1994). Social considerations in the emergence of Idioma de Signos Nicaraguense. *Signpost*, 7(1), 24- 31.
- Shoykhet, M. (2003). *Functional development and critical periods in the rodent somatosensory system*. Unpublished Doctoral dissertation, University of Pittsburgh, Pittsburgh, PA.
- Singleton, J. L. (1989). *Restructuring of language from impoverished input: Evidence for linguistic compensation*. University of Illinois at Urbana- Champaign, Urbana- Champaign.
- Singleton, J. L., & Newport, E. L. (1987). *When learners surpass their models: The acquisition of American Sign Language from impoverished input*. Paper presented at the Society for Research in Child Development, Baltimore, MD.

- Singleton, J. L., & Newport, E. L. (1999). When learners surpass their models: The acquisition of American Sign Language from inconsistent input. *Cognitive Psychology*.
- Slobin, D. (1972). *Bibliography of Child Language*. Bloomington: Indiana University Press.
- Slobin, D. (1985). *The Cross-Linguistic Study of Language Acquisition, Vols 1 and 2*. Hillsdale, NJ: Lawrence Erlbaum.
- Stockard, C. R. (1921). Developmental rate and structural expression: An experimental study of twins, "double monsters", and single deformities and their interaction among embryonic organs during their origins and development. *American Journal of Anatomy*, 28, 115- 275.
- Supalla, T., & Webb, R. (1995). The grammar of international sign: A new look at pidgin languages. In K. Emmorey & J. Reilly (Eds.), *Language, Gesture, and Space* (pp. 333- 352). Hillsdale, NJ: Erlbaum.
- Tervoort, B. T. (1961). Esoteric symbolism in the communication behavior of young deaf children. *American Annals of the Deaf*, 106, 436- 480.
- Thal, D., Marchman, V., Stiles, J., Aram, D., Trauner, D., Nass, R., & Bates, E. (1991). Early lexical development in children with focal brain injury. *Brain and Language*, 40, 491- 527.
- Tomasello, M. (2000). First steps toward a usage- based theory of language acquisition. *Cognitive Linguistics*, 11(1-2), 61- 82.
- Van Wuijtswinkel, K. (1994). *Critical period effects on the acquisition of grammatical competence in a second language*. Unpublished B.A. thesis, Katolieke Universiteit, Nijmegen, Netherlands.
- Weber-Fox, C. M., & Neville, H., J. (1999). Functional neural subsystems are differentially affected by delays in second language immersion: ERP and behavioral evidence in bilinguals. In D. Birdsong (Ed.), *Second Language Acquisition and the Critical Period Hypothesis* (pp. 23- 38). Mahwah, NJ: LEA.
- Wexler, K. (1994). Optional infinitives, head movement and the economy of derivations. In D. Lightfoot & N. Hornstein (Eds.), *Verb Movement* (pp. 305- 350). Cambridge, England: Cambridge University Press.
- White, L., & Genesee, F. (1996). How native is near- native? The issue of ultimate attainment in adult second language acquisition. *Second Language Research*, 12, 238- 265.
- Wilbur, R. B. (1979). *American Sign Language and sign systems: Research and application*. Baltimore: University Park Press.
- Wilbur, R. B. (1987). *American Sign Language: Linguistic and applied dimensions, 2nd Edition*. Boston, MA: College- Hill.
- Wilbur, R. B. (1994). Eyeblinks and ASL phrase structure. *Sign Language Studies*, 84, 221- 240.
- Wimmer, H. (1980). Children's understanding of stories: Assimilation by a general schema for actions of coordination of temporal relations? In J. Wilkening & J. Becker & T. Trabasso (Eds.), *Information Integration by Children*. Hillsdale, NJ: Erlbaum.