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From Homesign to ASL: Identifying the Influences of a Self-Generated Childhood Gesture System Upon Language Proficiency in Adulthood

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1. Introduction

In 1967 Eric Lenneberg hypothesized that there is a critical period for language acquisition. The notion of a critical period has been debated for years, but it is only in the last decade that there has been direct evidence from a large population bearing on this issue. The evidence comes from studies of the acquisition of American Sign Language (ASL) by deaf individuals. Due to a variety of biological, social and educational factors, deaf people are exposed to ASL at widely varying ages, and in many cases, without prior mastery of a spoken language. Thus, it is possible to assess the effects of age of exposure on language acquisition in this population.

Newport (1990) reports evidence supporting the notion of a critical period from a study comparing three groups of deaf individuals on their use of ASL verb morphology. All three groups had been exposed to spoken English from birth, but none of them had acquired more than a limited knowledge of English. The three groups differed in the age they were first exposed to ASL. One group had been exposed to ASL from birth. The second group acquired ASL at the age of 4 or 5. The third group, referred to here as the late learners, were not exposed to ASL until after 12 years of age. At the time of the study, all of the participants used ASL, not English, as their primary form of communication. Moreover, these individuals had considerable experience with ASL -- between 37 and 69 years. Nevertheless, their performance on the ASL task differed according to the age at which they had first been exposed to ASL. There was a gradual decline in ASL skills across the three groups; the later in life the participants had acquired ASL, the more likely they were to omit or confuse obligatory verb morphemes.

Additional evidence for age of acquisition effects comes from the work of Rachel Mayberry, who has begun to elucidate why late learners produce errors even after years of using ASL as their primary language. Through a variety of tasks that tap language processing skills, Mayberry has found that the problems late learners have are primarily associated with memory and comprehension of phonological, morphological and lexical structure. Recently, Mayberry (1993, 1994) has contributed an additional insight to this issue by investigating the performance of late deafened adults. These individuals did not acquire ASL until late childhood, but they had acquired and used a spoken language from birth. Thus, ASL was their second language rather than a late first language. By matching these subjects to a group of late learners by age of exposure to ASL, Mayberry has demonstrated that late learners have significantly more difficulties processing language than second language learners do.

In this paper we ask how using an idiosyncratic communication system in childhood affects the acquisition of a conventional language in adulthood. It is not uncommon for deaf children with no exposure to sign language to generate a communication system based on gesture. We call these communication systems homesign. Homesign is distinct from both sign language and gesture. Unlike gesture, homesign is characterized by levels of structure independent of speech; but unlike sign language, that structure has developed only over the lifetime of a single child and not over multiple generations. One of the authors of this paper (SGM) has published extensively on the structure of homesign (e.g., Goldin-Meadow & Mylander, 1984, 1990a). In general, this research provides evidence that homesign utterances are structurally similar to the utterances of young hearing children at morphological, lexical and syntactic levels.

Given the structural similarities of homesign and conventional language, it is perhaps surprising that late learners of ASL exhibit more processing difficulties than second language learners of ASL. We would like to suggest that homesign does indeed facilitate the acquisition of ASL in adulthood, but not to the same degree that a first language facilitates second language learning. We will support our position in three steps. First, we provide evidence that the subject of our study used homesign throughout childhood. Second, we verify that his adult mastery of ASL resembles that of other late learners. Finally, we investigate how the subject's homesign system influenced his acquisition of ASL.

2. Subject

The data we present are from a case study of a deaf subject whom we have followed across the lifespan. The subject, whom we refer to by the name of "David," participated in a longitudinal study between the ages of 2 and 5. The structure of his homesign communication system was determined from these early observations (Goldin-Meadow & Mylander, 1984). Two additional observations, at age 9;5 (years;months) and at age 23, form the data for the present study.

David was born deaf with a profound bilateral hearing loss. His hearing parents raised him according to the oral method of education, using only speech and no sign language. As a child, he relied extensively on homesign for communication. He was first exposed to American Sign Language at the age of 9, when he and his parents attended a summer course on Cued Speech at

Gallaudet University. Although he didn't interact with anyone using sign language, he observed many people signing. The subject reported that a classmate taught him some signs in high school, which he used only outside of school and home. After high school, the subject attended a college program for deaf students that brought him into contact with many other deaf people for 2 years. This was the most consistent exposure to ASL reported by the subject.

3. Procedure

In order to evaluate David's acquisition of ASL, we collected data twice using the same task as Newport (1990). David performed the task first in middle childhood before he had acquired sign language, and second, as an adult with more than five years of sign language experience. Each time, we evaluated his performance with respect to homesign and with respect to ASL.

The experimental task is a part of the Test Battery for American Sign Language Morphology and Syntax developed by T. Supalla, Newport, Singleton, S. Supalla, Metlay and Coulter (1993). The task was designed to elicit the morphology of ASL verbs of motion. Verbs of motion require the simultaneous production of several morphemes. The morphemes encode the class of the objects, the path of movement, the manner of movement, the relationship between the objects, and so forth. In the present study we consider only the use of handshape classifier morphemes to encode object information. The subject watches 120 short videotaped vignettes of toy people, animals, objects and vehicles performing various actions, and then responds by describing the event - in ASL or homesign or gesture. We analyze what handshape the subject uses to represent the objects. For example, one vignette shows a tractor backing up to a block. A subject might represent the tractor by forming the hand into the flat palm, or into a fist. The correct ASL handshape involves extension of the thumb, index and middle fingers.

We showed these videotaped vignettes to David one at a time, and asked him to describe the scene. At age 9;5, the test was administered in gesture by Ted Supalla, and at age 23, the test was administered in ASL by one of the authors (JS). David's videotaped responses were later coded by a native signer and a trained non-native signer. There were a total of 174 handshape responses across the test. Intercoder reliability for transcribing handshape was 95%.

There are two types of handshape classifiers in ASL that are elicited by this task: semantic classifiers and size-and-shape classifiers (See Supalla, 1982, 1986 for a more complete description of the classifier system in ASL). Semantic classifiers represent classes of objects that do not necessarily look similar. For example, the tree classifier is used to represent all trees: pines, maples, weeping willows -- regardless of whether they look alike. Size-and-shape classifiers, on the other hand, represent objects according to shape. Thus, the same type of object could be represented by two different handshapes. For example, a narrow role of tape would be represented by one handshape, but a wide role of tape would be represented by another. Table 1 lists the nine classifier handshapes that are elicited in the verbs of motion production task.

TABLE 1: Handshape Classifiers in ASL

	MEANING	
	SEMANTIC	SIZE-AND-SHAPE
FORM[1]		
3-fingers	vehicle	
ILY-hand	plane	
5-hand	tree	
λ-hand	animate	
Palm		straight, wide object
2-fingers		straight, medium object
Index		straight, narrow object
C-4-fingers		deepcylinder
C-1-finger/C-F		shallow cylinder

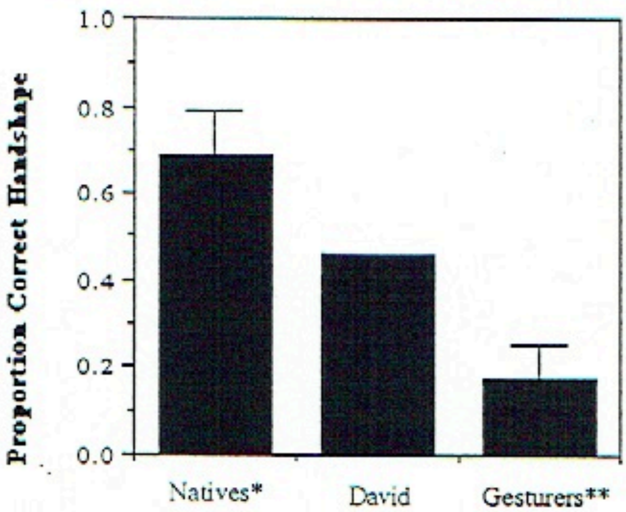
4. Results

When David described the video at age 9;5, he had not yet learned ASL. Nevertheless, we scored his responses according to the ASL targets to see how closely the handshapes he used at that time corresponded to ASL. Figure 1 compares David's handshape responses to the performance of a group of 8 native signing children, previously reported by Singleton & Newport (1992), and the performance of a group of 5 hearing children with no knowledge of sign language who used gesture without speech to respond to this task in a study reported by Singleton, Morford & Goldin-Meadow (1993).

Forty-six percent of David's handshape responses on the task were the expected handshapes for ASL. This score fell more than two standard deviations below the mean score of the native signers, and more than two standard deviations above the mean score of the hearing children who had no knowledge of sign language. Although David was not using ASL in many of his responses, he also didn't look like the children who knew nothing about sign language.

We hypothesized that David might be responding to the test in a consistent manner, but according to a system of handshape-object classification that was different from ASL; however, the system did have some overlap with ASL. Presumably, this alternative system was his homesign. In order to test this hypothesis, we needed an independent means of generating the expected responses to the verbs of motion task for David's homesign. Recall that Goldin-Meadow had found morphological regularities in young children's spontaneous homesign utterances (Goldin-Meadow & Mylander, 1990b). We turned to the data she had analyzed from David's homesign as a young child to predict how David would respond to the task if he were still using homesign.

FIGURE 1: Child ASL Handshape Production: Native signers, David & Hearing Gesturers



*Data from Singleton & Newport (1992)
**Data from Singleton, Morford & Goldin-Meadow (1993)

Table 2 shows the handshape classifiers that David used between the ages of 2;10 and 4;10 to describe the types of objects included in the video task. David's homesign system classified objects primarily by shape. He used one handshape that functioned more like a semantic classifier, namely, he used the palm hand-

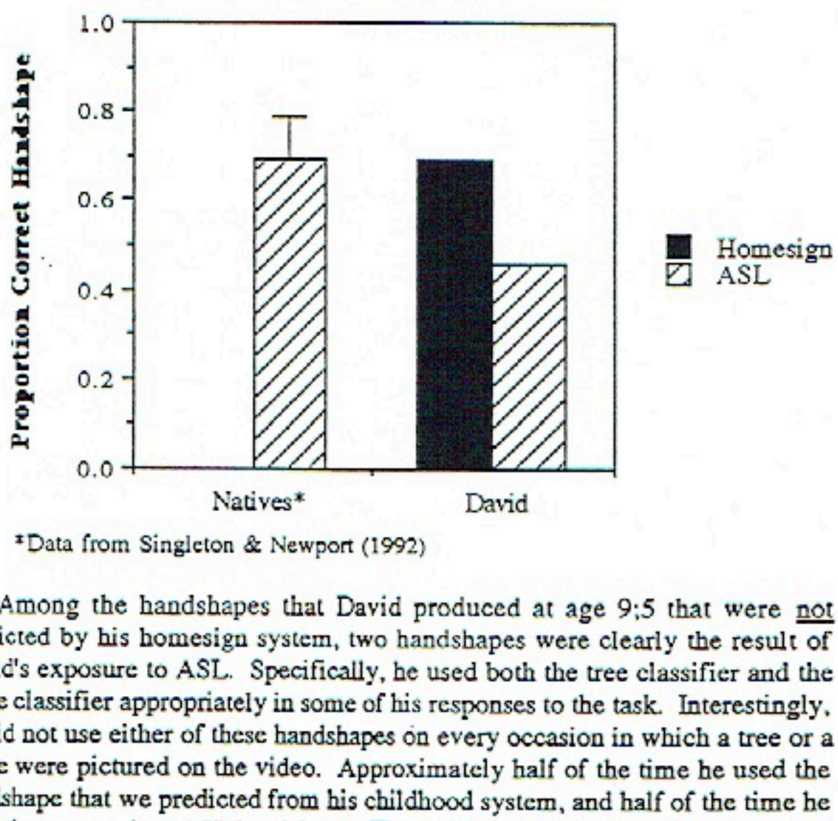
TABLE 2: Handshape Classifiers in David's Homesign

	MEANING	
	SEMANTIC	SIZE-AND-SHAPE
FORM[1]		
Palm	vehicle or animate	straight, wide object
λ-hand		object with 2 appendages
Index		straight, narrow object
C-4-fingers		curved object
O-4-fingers/O-F		round object

shape to represent self-propelling objects, such as cars, animals, people, airplanes and boats. Using this new set of handshape targets based on David's childhood homesign system, we reanalyzed the same dataset: David's 174 handshape responses to the video task at age 9;5.

When we compared David's responses to the homesign targets, we found that 69% of his responses were consistent with his early childhood homesign system (see Figure 2). His performance on his own targets was remarkably similar to the performance of the native signing children on ASL targets. Thus, we conclude from this part of the data that David was still using his homesign at the age of 9;5, and that he used his homesign classifiers as consistently as native signing children use ASL handshape classifiers.

FIGURE 2: Homesign vs. ASL Handshape Production: Natives and David

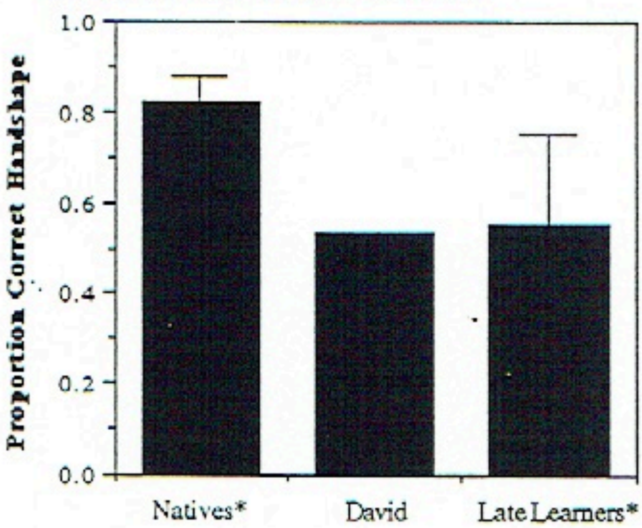


*Data from Singleton & Newport (1992)

Among the handshapes that David produced at age 9;5 that were <u>not</u> predicted by his homesign system, two handshapes were clearly the result of David's exposure to ASL. Specifically, he used both the tree classifier and the plane classifier appropriately in some of his responses to the task. Interestingly, he did not use either of these handshapes on every occasion in which a tree or a plane were pictured on the video. Approximately half of the time he used the handshape that we predicted from his childhood system, and half of the time he used the appropriate ASL handshape. Thus, although his handshape production was best accounted for by his childhood homesign system, we also found the initial hints of a transition to using ASL handshapes.

We now turn to the results from David's performance on this task as an adult who had used ASL with regularity for several years. We first analyzed David's responses according to the ASL targets, and compared his responses to those of the late-learners studied by Newport. In Figure 3, David's performance is compared to that of 8 native signing adults and 8 late learners of ASL (as reported in Singleton & Newport, 1992). David's performance falls more than two standard deviations below that of the native signers, but it is very close to the middle of the distribution of late learners' performance. These data verify that David is similar to other individuals who were not exposed to ASL in early childhood. He has not completely mastered ASL verbs of motion morphology despite his elaborate homesign experience.

FIGURE 3: Adult ASL Handshape Production: Natives, David & Late Learners



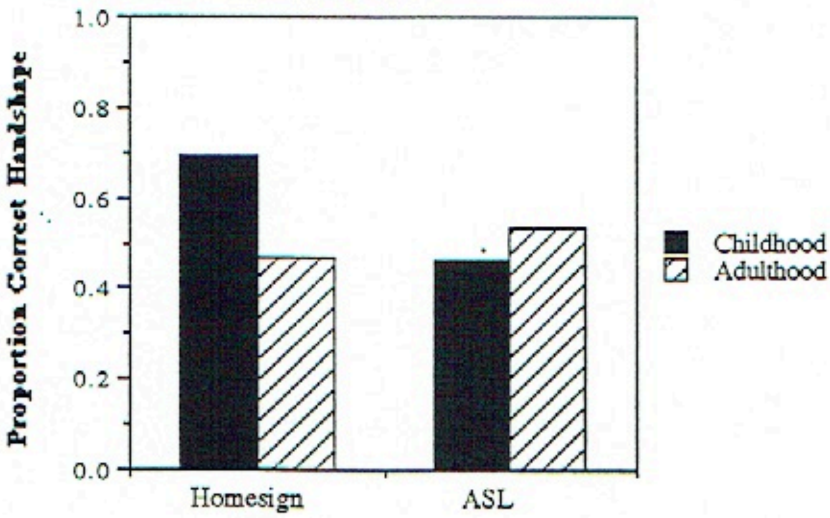
*Data from Singleton & Newport (1992)

Previous studies of late learners have stopped at this point, concluding that the poorer performance of late-learners with respect to native signers is evidence that early exposure is essential for language mastery. But our unusual data set allows us to go a step further. We now know that even with an elaborate homesign system in childhood, an individual may have difficulties mastering the structure of a conventional language in adulthood. The next question is whether there is nevertheless some influence of homesign on the acquisition of ASL in adulthood. Is there a sort of transfer effect, but one that is perhaps not as strong as the transfer effect we would expect from a conventional language (i.e., permitting the level of mastery that has been documented in studies of second language learners of spoken languages, and of late deafened adults as reported by

Mayberry, 1993)? Alternatively, it may be the case that homesign interferes with the acquisition of ASL. Perhaps the structural similarities in homesign and ASL act as a barrier to the late-learner's ability to recognize the distinctiveness of the ASL structures.

In order to address this question, we analyzed David's adult responses to see how closely they corresponded to his childhood homesign morphology. Forty-seven percent of his responses were consistent with his homesign. The hatched bars of Figure 4 show that David's adult responses to the task could be predicted almost as well by his childhood homesign system as by the ASL targets. However, by comparing the bars on the left, we see that he has lost a good deal of the previous consistency he showed in homesign. In contrast, the bars on the right show only a modest gain in ASL.

FIGURE 4: David's Homesign and ASL Production in Childhood and Adulthood



A comparison of the form and meaning categories that appear in ASL and homesign was necessary to explore whether David's homesign system had an impact upon his acquisition of ASL. Table 3 lists all of the categories of meaning represented in ASL and David's homesign. The two systems overlap for about half of the categories. Thus, approximately half of the vignettes in the ASL task presented objects that David had previously represented with a specific homesign handshape as a child. For other categories of meaning, such as cylindrical objects and trees, he did not have a specific handshape prior to his exposure to ASL. He was able to represent objects in homesign belonging to these categories, but only by focusing on different semantic features than those encoded in ASL. For example, he represented a cylinder as either a curved object or a round object, and a tree as a straight, narrow object.

TABLE 3: Inventory of Meanings in ASL & David's Homesign

ASL & Homesign	ASL Only	Homesign Only
straight, wide object	straight, medium object	round
straight, narrow object	tree	curved
vehicles	deep cylinder	object with 2 appendages
animates	shallow cylinder	
	plane	

Table 4 lists the handshape forms that appear in the two systems. Again, about half of the forms used as ASL classifiers were also used in David's homesign morphology. Thus, David had experience as a child producing nearly half of the handshape forms that were elicited in the ASL task, but he had used some of these handshapes to refer to different meanings than their meanings in ASL. When we compare the form-meaning mappings in the two systems, they pattern into four categories. We can describe David's attempts to learn ASL according to these four categories of form-meaning mappings.

TABLE 4: Inventory of Forms in ASL & David's Homesign[1]

ASL & Homesign	ASL Only	Homesign Only
Palm	3-fingers	O-4-fingers
Index	ILY-hand	O-F
λ-hand	5-fingers	
C-4-fingers	2-fingers	
	C-1-finger	
	C-F	

Table 5 lists the four types of form-meaning mappings. The top half of Table 5 shows that David's performance is quite good when he previously represented the elicited category of meaning in his homesign system. In the best cases, he encountered an ASL form-meaning mapping in which both the form and the meaning are the same as in his homesign. Not surprisingly, these were the easiest mappings to acquire (74%).[2] In some cases, he encountered a new form that is used in ASL to represent a meaning that he previously represented by a different form. Here, his performance is poorer than in the first category, but he is using the ASL handshape on the majority of his responses (66%). In the bottom half of the table, we see what happens when David encounters categories of meaning that he did not represent in homesign. His performance is markedly poorer whether the meaning is associated with a handshape he has used before (36%) or not (38%).

TABLE 5: Form-Meaning Mappings in ASL and Homesign

MEANING	FORM	David's Adult Accuracy on ASL Targets
ASL Meaning Represented in David's Homesign	ASL Form Used For This Meaning in David's Homesign	.742
	ASL Form NOT Used in David's Homesign	.66
ASL Meaning NOT Represented in David's Homesign	ASL Form Used For a Different Meaning in David's Homesign	.36
	ASL Form NOT Used in David's Homesign	.38

In the past, late learners have been portrayed as acquiring language with no prior linguistic experience. In other words, we have assumed that when late learners were exposed to ASL for the first time, they were faced with both new categories of meaning and new handshapes. From the data in Table 5, we see that this type of form-meaning mapping was indeed among the most difficult for David to acquire (38% correct). If we assume that this type of form-meaning mapping is a baseline for late acquisition of a language, we reach two further conclusions.

First, note that there is little difference between David's performance in the last two types of form-meaning mappings. We might have expected that learning to associate a handshape form previously used for a different meaning with a new category of meaning would have been much more difficult than acquiring a new form for a new meaning. Not only must David master something new, he must "unlearn" something from before. However, David's performance on these two types of mappings is remarkably similar, suggesting that his homesign experience is not interfering with his acquisition of ASL.

Second, by comparing David's performance in the top half of the table to his performance in the bottom half, we see that his homesign system may well have facilitated his acquisition of ASL. Where David has experience representing a category of meaning, he shows much greater success acquiring the ASL handshape forms.

5. Conclusion

In summary, we have described an individual, called "David," who did not acquire a conventional language until quite late in life. Prior to his acquisition of a conventional language, he had developed a homesign system that exhibited certain structures similar to those found in conventional languages. In particular, Goldin-Meadow & Mylander (1990b) found that the homesign utterances he produced between the ages of 2;10 and 4;10 exhibited some morphological structure, though not as complex as the morphological structure found in conventional languages. The evidence presented here demonstrates that David was still using his homesign system at the age of 9;5, and that he used it as consistently as deaf children of deaf parents use ASL at this age.

Despite (or perhaps because of) his extended use of a well-structured gestural system as a child, David's adult performance on an ASL task was not good. Indeed, his performance was similar to the performance of other late learners of ASL and therefore significantly worse than the performance of native signing adults on the task. The question we focused on was whether David's early homesign system influenced in any way his acquisition of ASL later in development.

We compared the form-meaning mappings in David's childhood homesign system and in ASL, and found that David was much more successful acquiring the ASL classifiers for meanings that he represented in his homesign system than he was acquiring the ASL classifiers for meanings that he did not represent in his homesign system. These findings suggest a transfer effect from homesign to the acquisition of ASL. Unfortunately, the evidence also suggests that homesign experience is not sufficient to offset the deleterious effects of linguistic isolation in childhood on subsequent language learning. Nevertheless, the pattern of acquisition from one individual we have studied here indicates that homesign experience does not interfere with, and indeed to a certain extent may facilitate, the acquisition of a conventional language in adulthood.

Notes

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1. The form descriptors refer either to the number and orientation of extended fingers or to the form of an ASL fingerspelling handshape.
2. Given that the handshapes in this category don't require "learning", we might have expected the subject to use the correct ASL handshape more often.

However, we have argued previously that homesign is a system in which the forms are related not only to their referents but also to each other. Extracting a single form from this system of contrasts may not be a straightforward process.

References

Goldin-Meadow, Susan & Carolyn Mylander. 1984. Gestural communication in deaf children: The effects and non-effects of parental input on early language development. *Monographs of the Society for Research in Child Development* 49: 1-121.

Goldin-Meadow, Susan & Carolyn Mylander. 1990a. Beyond the input given: The child's role in the acquisition of language. *Language* 66: 323-55.

Goldin-Meadow, Susan & Carolyn Mylander. 1990b. The role of parental input in the development of a morphological system. *Journal of Child Language* 17: 527-563.

Lenneberg, Eric H. 1967. *Biological Foundations of Language*. New York: John Wiley & Sons.

Mayberry, Rachel I. 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, Rachel I. 1994. The first language timing hypothesis as demonstrated by American Sign Language. Child Language Research Forum, ed. by Eve Clark. Chicago, IL: University of Chicago Press.

Newport, Elissa L. 1990. Maturational constraints on language learning. *Cognitive Science* 14: 11-28.

Singleton, Jenny L., Jill P. Morford & Susan Goldin-Meadow. 1993. Once is not enough: Standards of well-formedness in manual communication created over three timespans. *Language* 69: 683-715.

Singleton, Jenny L. & Elissa L. Newport. 1992. When learners surpass their models: The acquisition of American Sign Language from impoverished input. Champaign, IL: University of Illinois, MS.

Supalla, Ted. 1982. Structure and acquisition of verbs of motion and location in American Sign Language. La Jolla, CA: University of California at San Diego dissertation.

Supalla, Ted. 1986. The classifier system in American Sign Language. *Noun Classification and Categorization*, ed. by C. Craig. Philadelphia: Benjamins North America.

Supalla, Ted, Elissa L. Newport, Jenny L. Singleton, Sam Supalla, Don Metlay & Geoffrey Coulter. 1993. *Test Battery for American Sign Language Morphology and Syntax*. San Diego, CA: DawnSignPress, in press.