The Emergence of Grammatical Categories in Home Sign: Evidence from Family-based Gesture Systems in Nicaragua

by

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Dedication

I dedicate this dissertation to my grandmother, Mary Filomena Faraco Eibel, who always patiently answered my many questions and instilled in me a love of learning. Her models of generosity and dedication will be with me always.

Curriculum Vitae

Marie Coppola was born in Philadelphia, Pennsylvania on December 4, 1968. She attended the Massachusetts Institute of Technology from 1986 to 1990 and graduated with a Bachelor of Science degree in 1990. She came to the University of Rochester in the fall of 1995 and began graduate studies in the field of Brain and Cognitive Sciences. She received a Graduate Research Fellowship from the National Science Foundation in 1996. She pursued her research in the acquisition of sign languages under the direction of Professor Elissa L. Newport and received the Master of Arts degree in 2000.

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Abstract

Language ordinarily emerges in young children as a consequence of both linguistic experience (for example, exposure to a signed or spoken language) and innate abilities (for example, the ability to acquire certain types of patterns and/or regularities). One way to discern which aspects of language acquisition are controlled by experience and which arise from innate factors is to remove or manipulate linguistic input. However, experimental manipulations that involve depriving a child of language input are impossible. The present work examines the communication systems resulting in natural situations of language deprivation and thus explores the inherent tendency of humans to build communication systems of particular kinds. We examined the gesture systems of three isolated deaf Nicaraguans (ages 9-24) and their mothers and family members. These deaf individuals have had no contact with any conventional language, spoken or signed, and are referred to as "home signers." Their mothers, while fluent in spoken Spanish, have had no contact with a conventional signed language; however, they do gesture with their deaf children. We found that each home signer developed his own gestural system featuring systematic, language-like devices to mark semantic role contrasts, and that these systems were stable over time. In particular, we showed that one of these syntactic devices (word order) is used to mark the abstract grammatical category of Subject. As in other languages, this device applies uniformly over noun phrases bearing a range of semantic roles, but is not a pragmatic device used to mark discourse topic. Its properties therefore match the linguistic criteria for Subject. Finally, we found that each deaf participant's gestural system differed from that used by his mother. Thus, these gesture systems appear to be developed by the deaf individuals themselves, and not learned from their mothers. Our findings indicate that abstract linguistic structure – particularly the grammatical category of Subject – can emerge in the gestural modality without linguistic input.

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Chapter 1: Introduction

Normal language development clearly involves contributions from both the linguistic environment and the highly constrained learning abilities of the human child. In many domains, animal research is used to distinguish the contributions from each of these sources, by removing or reducing the environmental input and observing what remains of normal development. However, because language occurs exclusively in humans, this technique cannot be used. The present work provides one approach to this problem, by examining the development of communication in individuals who, through natural events, have grown up without access to normal linguistic input. The present studies investigate whether such individuals are capable of developing basic features of syntax, especially the syntactic concept of *grammatical subject*, without ordinary linguistic input.

1.1. Language acquisition and linguistic input

Many lines of research have attempted to address what information learners can extract from their input. For example, in artificial language learning studies, researchers finely control the linguistic input to discover what can be learned. The current research takes the converse approach, asking what can be learned given no standard linguistic input. Occasionally, cases arise in which the relevant manipulations of language development occur naturally, and their outcomes can be observed. One potentially informative situation is that of hearing children who receive no exposure to a spoken language. However, this situation rarely occurs without substantial deprivation in other areas, such as food, shelter, and socialization. No cases have been reported of hearing children who grow up without spoken or signed language input, yet who suffer no other types of deprivation. Thus, we have little to no information regarding the language abilities of such hearing isolates (though see, for example, Curtiss (1977) for a description of language acquisition from normal input after isolation during childhood).

However, some deaf children are normally socialized and normally developing but lack access to any conventional linguistic input. In particular, some congenitally and profoundly deaf children who are otherwise healthy are raised in hearing families and communities in which no one knows a sign language. In such cases the children's profound hearing loss prevents them from acquiring a spoken language naturally; at the same time, because they are not exposed to any signed language, they may also not acquire a signed language. In some of these cases, parents choose not to expose their child to a sign language; in other cases, as in the current study, no local deaf community of signers may exist, or the deaf person may not encounter other signers prior to testing. Deaf children who grow up in such circumstances will nonetheless gesture with their family and friends, creating idiosyncratic gestural communication systems called "home sign" (Goldin-Meadow & Feldman, 1977; Feldman, Goldin-Meadow & Gleitman, 1978; Tervoort, 1961; Padden & Humphries, 1988; for a review see Morford, 1996).

A substantial body of work by Susan Goldin-Meadow and her colleagues has shown that very young deaf children who are not exposed to any conventional language input can create gesture systems that are structured at multiple levels of linguistic representation: lexical, morphological, syntactic, and discourse (Goldin-Meadow & Mylander, 1984; 1990a,b). In these ways, home sign systems are similar to sign languages. However, in contrast to the complex and rule-governed structure found in established languages, the syntactic structure found in these spontaneous gesture systems thus far is simple and probabilistic. This limitation may be due to the young age of the home signers studied by Goldin-Meadow, but the paucity of data gathered on older home signers precludes drawing such a conclusion. The small number of users of a home sign system (typically just the deaf person and possibly his or her family members) and the lack of complex linguistic input from which to learn might also limit the complexity that may be developed within it. The relatively short amount of time in which home sign systems are developed (typically one generation, that is, the lifetime of the home signer) might also constrain the development of

structural complexity. In this dissertation, I report a series of studies that systematically investigate the linguistic structure that can be developed by older deaf individuals in the absence of linguistic input. In these experiments, we characterize the nature of the basic syntactic structures used by older home signers and consider the potential sources of this structure. Our focus is on the gesture systems of deaf people who have continued to use their home signs as primary communication systems beyond the childhood years, and particularly in beginning to ask how systematic and abstract the grammatical structure of such systems may become.

One factor to consider in studies of home sign is the methodology used. Some researchers rely entirely on analyses of spontaneous gesturing, some use non-verbal materials to elicit gestures with constrained meanings, and some combine the two. Each technique comes with advantages and disadvantages. The major benefit to analyzing spontaneous gesturing is that it is naturalistic, and most likely to reflect how the deaf individual typically uses his or her gestures. One drawback is that researchers must infer the intended meaning of a spontaneous utterance from the context, which may be vague or ambiguous. A second drawback is the difficulty of coding gestures that are completely unconstrained in their topic, and of comparing gestures and patterns across participants. Finally, analyzing only spontaneous gesturing provides very little control over the kinds of utterances that may be collected, or the kinds of structures that might be expressed in a given session, potentially limiting the conclusions that could be drawn about how complex home signs can become. An alternative is to use methods of elicitation to examine the structures home signers are capable of producing. Of course, using only elicitation paradigms to test hypotheses raises converse issues: asking participants to respond to a series of similarly-structured items may induce them to create a strategy for responding that is not representative of their everyday, natural gesturing. Another issue is ensuring that participants and experimenters arrive at the same interpretations of stimuli. For example, a drawing convention as simple as using an arrow to indicate the direction of movement of an action is transparent to most American

adults, and even children. However, that convention may likely be misunderstood or ignored by a Nicaraguan villager who cannot read and whose experience with books and printed matter is extremely limited. The best approach is to use both techniques to achieve converging results.

Another factor to keep in mind when evaluating the studies conducted with young deaf children is the deaf child's environment, in particular the family's attitude toward gestural communication. The parents of deaf children attending oral education programs in the United States (including the children studied by Goldin-Meadow) are advised to refrain from gesturing with their child, because this would purportedly reduce their child's motivation to learn to speak. In contrast, in some other countries or in parts of the world (as in Nicaragua) where deaf children and their families may not be receiving any education or intervention, the families may more readily engage in gestural communication with their deaf children. Thus, we might expect cultural or other differences in the attitudes of the hearing community and family members to affect the amount and quality of gesturing they make available to a deaf individual creating a home sign system (1). A subset of these issues will be considered in greater depth later in the present work.

1.2. Home sign: Previous research

Home sign systems have been studied from a variety of perspectives, with varying emphases placed on their form and function. Other aspects of home sign systems that have been investigated include their developmental course, the influence of the surrounding gestural input, and how they compare across cultures. The form of home signs has been investigated at many levels of structure, including the lexical, morphological, syntactic, and discourse levels. Home signers' gestures have also

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1 Though DeVilliers et al. (1993) found that the richer input provided by the increased gesturing of oral deaf parents to their deaf children did not substantially or qualitatively change the properties of their children's gesturing.

been studied from the perspective of the linguistic functions they serve, e.g., descriptions of objects and events, reference to non-present objects, and narrative. Another aspect of this research focuses on the time course of the development of home sign systems, and the extent to which their developmental patterns parallel those found in typical language acquisition. The perspectives of form, function, and development often overlap in home sign research. Related issues include determining the source of the structure found in home sign, the influence of gestures in the environment on the forms and functions found in home sign, the role of iconicity in the development of a primary gestural system, and parallels to established sign languages. Finally, home signs have been studied in many cultures, and at least two cross-cultural studies exist comparing home signers in the United States (an English-speaking culture) with those in Taiwan (a Chinese-speaking culture). In the sections below I review this body of work.

1.2.1. Form

A great deal of research on home sign stems from a longitudinal study of the spontaneous gesturing of ten deaf children enrolled in oral schools that was conducted by Goldin-Meadow and her colleagues (Goldin-Meadow & Mylander, 1984; 1990a). The experimenters visited each deaf child at home approximately every two months from about age 2 to age 5. Data were collected by filming the deaf child's gesturing during free play sessions with his or her mother or the experimenter. All gestures produced during a session were transcribed and analyzed, with meanings assigned based on the context of the utterance and its form. This procedure allowed the experimenters to categorize gestures and to discern patterns (or lack thereof) in the gesture combinations of the deaf children and their mothers. Goldin-Meadow and her colleagues first observed three basic gesture types: points; characterizing gestures, which use an attribute of an object or an action to convey its meaning (e.g., bringing a cup-shaped hand to one's mouth and tilting it to indicate drinking); and markers. Markers modify the meaning of a gesture or a gesture string (e.g., as in negation), and may appear at the beginning or at the end of a gesture combination (Feldman et al.,

1978; Goldin-Meadow, 1979). The lexical forms and the mappings onto meaning produced by the home signers were stable over a period of years (Feldman et al., 1978; Goldin-Meadow et al., 1994).

A major finding of this work is that the children all produced combinations of gestures in sequence to form gesture utterances. Goldin-Meadow et al.'s analyses revealed that the children's gesture strings reflected ordering preferences based on a gesture's meaning or its semantic role in the event. This consistent ordering of elements allowed researchers to identify a gesture's form class based on distributional information: Goldin-Meadow found that one home signer, David, produced both noun and verb gestures from the same lexical root by age 3;3 (years; months) (Goldin-Meadow, et al., 1994), and that he distinguished these classes grammatically and lexically. These two form classes were distinguished by systematic variations in their form (like morphological marking), as well as by their positions in a sentence (like syntactic marking). David's productions of noun gestures were reduced in handshape or in motion, while verbs were not. For example, he would produce a typically two-handed verb gesture with only one hand when it was used to refer to an object. Verbs were sometimes distinguished from nouns by variations in their places of articulation; these variations carried inflectional information about the noun or nouns associated with the verb. For example, a gesture like "twist" typically produced in neutral space (i.e., in front of the chest) would be produced toward an object in the room (e.g., a jar) in order to augment its meaning (in this case, to indicate that the jar was the patient of the "twist" action). A noun-verb distinction is considered a universal of language, and has also been described in at least one sign language, ASL (Newport & Supalla, 1978). While David used the same dimension (repetition) to distinguish nouns from verbs as does ASL, his distinction takes a slightly different form (reduced articulation vs. repeated, restrained articulation).

Beyond the lexical level, Goldin-Meadow and her colleagues observed systematic treatment of sublexical units that formed a simple morphology. Extensive analyses of

David, the deaf child mentioned previously, showed that his gestures from the ages of 2:10 to 4;10 exhibited both derivational and inflectional morphological contrasts (Goldin-Meadow & Mylander, 1990b). He used a limited set of five handshapes and nine motion forms that occurred in combination with each other to form verbs of motion, as do the various morpheme types in signed languages like ASL (Supalla, 1982). David's handshapes were organized such that a given handshape referred to a particular semantic class, and it was not used to refer to non-members of that class. For example, he used a fist-hand to refer to handling a small, long object, and a C-hand to refer to handling a large object of any length. Examples of the motion morphemes include a short arc motion that mapped to the act of repositioning an object a small distance through space, and a circular motion that mapped to moving an object in a circle. This organization is quite sophisticated, as it reflects relationships among forms in a system, as opposed to merely relationships between forms and meanings. This type of form-form organization is similar to the noun classifier systems found in many signed languages (Supalla, 1987). In addition to this derivational morphology, David also occasionally varied the placement of his gestures, articulating some in neutral space, and displacing others towards objects to indicate their role in the predicate (usually the patient or recipient of an act gesture) (Goldin-Meadow et al., 1990).

As mentioned previously, the deaf children studied by Goldin-Meadow concatenated their gestures into strings that displayed simple structure. These strings functioned much like the sentences of early child language. For example, they expressed the semantic relations typically expressed by young children's sentences, especially action and attribute relations. In these sentences, characterizing gestures represented the predicates, while pointing gestures represented the arguments of these predicates. Their predicates were also comparable to those of child spoken language in terms of the number (1, 2, or 3) and types (actor, patient, or recipient) of arguments they took. Underlying Goldin-Meadow's analyses is the concept of an utterance's underlying structure vs. its surface structure. In accord with researchers of typical child language

(e.g., Bloom, 1970), Goldin-Meadow posited that home signers' gestured utterances may have had a fuller, more complex underlying structure than was overtly given by the surface forms. Over the course of their observations, Goldin-Meadow and colleagues observed each home signer producing gestures associated with all of the argument types associated with action and attribute predicates, indicating their knowledge of these underlying frames (Goldin-Meadow & Mylander, 1984; Goldin-Meadow, 1985). Further evidence for predicate structure comes from the relative probability of a particular argument type to be expressed given the number of arguments that can be expressed with a given predicate. For all ten deaf children studied, Goldin-Meadow and colleagues predicted and then observed that, for example, the actor in a 3- argument predicate like "give" would be gestured less frequently than the actor in a 2-argument predicate like "eat." Likewise, the actor in "eat" would appear less often than the actor in a 1-argument predicate like "dance," reflecting a kind of "competition" among arguments for expression (Goldin-Meadow, 1979; Goldin-Meadow, 1985).

The structure of the children's gesture strings was characterized by two main features: differing probabilities of being produced given the thematic role a gesture played in the utterance (that is, its argument type as described above), and particular tendencies to order gestures according to these thematic roles. Most of the children's sentences contained only two gestures; thus, not all of the arguments that could be associated with a given predicate were always expressed. However, the children did not express these thematic roles randomly, that is, with equal likelihood. Comparing the roles expressed across predicates taking the same number of arguments, say, a 2-argument predicate like "eat," Goldin-Meadow & Mylander (1984) found that all ten of the children produced a "patient" gesture more often than an "actor" gesture (e.g., "cheese" vs. "mouse" in an event like "mouse eat cheese"). Nine of the 10 children were as likely to produce a gesture for the intransitive actor in a 1-argument predicate ("mouse" in "mouse run to hole") as they were to produce a gesture for the patient in a 2-argument predicate ("cheese" in "mouse eat cheese"). The children produced

both intransitive actors and patients far more often than they produced transitive actors ("mouse" in "mouse eat cheese"). This pattern is similar to the case-marking pattern found in ergative languages, in which the patient is treated like the intransitive actor (as opposed to patterning with the transitive actor, as in accusative languages).

The deaf children's gestures also tended to be ordered in ways that reflected these thematic roles. Many, but not all, of the children's 2-gesture sentences followed one of three ordering patterns: **patient-act** (e.g., CHEESE EAT); **patient-recipient** (e.g., HAT COWBOY'S-HEAD); or **act-recipient** (e.g., MOVE-TO TABLE). While many of the children did not produce enough sentences containing actors to discern a pattern, two of them did, ordering the gesture for the actor (usually intransitive) before the gesture for the act (e.g., MOTHER GOES).

Goldin-Meadow & Mylander studied young deaf children's production probabilities and ordering tendencies in the United States and Taiwan. They found that across these two very different cultures, whose spoken languages are structured very differently, and in which mothers may interact differently with their deaf children (see summary of Goldin-Meadow & Saltzman in a later section), deaf children tended to produce gestures in the same order: **patient-act** (Goldin-Meadow et al., 1990; Goldin-Meadow & Mylander, 1998). Consistent with Goldin-Meadow's findings in young deaf children in the United States and in Taiwan, Morford (1996) notes in her review of the home sign literature that consistency in constituent ordering is a characteristic of seventeen home sign systems from six cultures. She posits that the overwhelming use of **patient-act** ordering (true of all except one of these 17 systems), combined with the common occurrence of **actor-act** , constitute evidence for a strong universal bias towards these patterns in home sign systems. As mentioned earlier, this overall pattern is reminiscent of that found in ergative-type languages.

1.2.2. Function

The deaf children studied by Goldin-Meadow and her colleagues initially produced single gestures and points, much like the single words produced by typically developing children in very early acquisition. As development progressed, these home signers began to combine their gestures to convey the same kinds of semantic notions expressed by typical children's two-word combinations. Over time, children in both groups produce longer utterances, and they begin to encode more propositions. Further along the course of development, home signers, like typically developing children, begin to use their gestures for a variety of functions, though the home signers are often delayed in their use of gestures to express certain functions.

Butcher, Mylander, & Goldin-Meadow (1991) found that David (the well-studied home signer previously mentioned) used his gestures for the function of displaced reference, that is, to refer to objects and events not in the here and now. The frequency with which David used his gestures to refer to non-present objects and events increased over time, in accord with other studies of displaced reference in home sign (Mohay, 1990; Morford, 1993; and Morford & Goldin-Meadow, 1996). However, David developed this ability later than hearing children acquiring spoken language (at the age of 3;3, compared with about 2;2 to 2;6). Butcher and colleagues suggest two ways in which this delay could be attributable to the lack of a language model: first, because the deaf child must invent his own symbols, he may have a more limited set of symbols to work with. Second, it might take longer for a deaf child to distance himself from self-created gestures in order to begin to see them as symbols, and thus as potential tools with which to refer to the non-present. Butcher et al. found that David's mother rarely used her gestures to refer to non-present objects or actions, suggesting that David's ability to use his gestures for displaced reference was not learned from her.

Morford (1994) investigated the function of narrative in the gesturing of two deaf adolescents who had been exposed to ASL for less than 10 weeks, and who had had no other exposure to a conventional language, signed or spoken. In analyzing their

spontaneous and elicited narratives, she found that, similar to typically developing young children, these home signers were able to produce narratives about past personal experiences. She also found that these narratives conformed to the hierarchy of event encoding laid out by Berman & Slobin (1984) in their characterization of referential structure in the narratives of typically developing children. While the home signers followed the same developmental pattern displayed by typically developing children, their stories did not include all the narrative components that native-speaking or -signing children of the same age would ordinarily include. Morford also notes that these home signers omitted reference to noun-like entities, particularly to agents. Thus, while the two home signers have mastered the semantics of narrative, their narratives differ from those of children who have exposure to a conventional language in important ways.

Where did the structure observed in these studies originate? Goldin-Meadow's research indicated that the gestures produced by the home signers' mothers could not have been the source of the syntactic or morphological structure produced by the home signers (Goldin-Meadow & Mylander, 1990b). While mothers did gesture with their children, their gestures did not exhibit the concatenation of gestures into strings, the patterned ordering of constituents, or the complex form-form mappings characteristic of their children's gesturing. The deaf children did, however, produce gesture forms in general that were similar to those produced by their mothers (e.g., common cultural gestural form-meaning mappings, a rudimentary handshape inventory). These results suggest that while mothers may provide their deaf children with raw materials with which to begin constructing a communicative gestural system, they do not provide the structure itself. (The relationship of mothers' gestural input to their children's gesturing will be more fully explored in Chapter 4 of the dissertation.)

In sum, early in development, the gestures produced by deaf children who receive no linguistic input parallel the patterns found in the language production of typically

developing children. At first, the deaf children produced single gestures and points, much like the single words produced by typically developing children. As development progressed, the home signers began to combine their gestures to convey the same kinds of semantic notions expressed by typical children's two-word combinations. Over time, children in both groups produce longer utterances, and they begin to encode more propositions. As noted above, however, deaf children who have no exposure to a language model are sometimes delayed in using their gestures for particular functions or in the amount or complexity of the information encoded in them relative to typically developing children (as in the narrative case).

1.2.3. Gestures produced by home signers beyond childhood

Few studies have examined deaf individuals who continue to use their home sign systems as their primary communication system over many years, and those that exist are not nearly as extensive as the analyses of young deaf children's gestures conducted by Goldin-Meadow and her colleagues. Three studies of spontaneous and elicited narratives produced by adolescent home signers ranging in age from 9 to 16 years suggest that ordering preferences persist beyond childhood (Scroggs, 1981; Emmorey et al., 1994; and Morford, 1996). However, these older home signers, unlike their younger counterparts, did not all prefer the same gesture order. Two preferred a **patient-agent-act** order (like Object-Subject-Verb) and the third preferred an **agent-act-patient** order (like Subject-Verb-Object). These orderings were not entirely rule-governed, but appeared more frequently than other orderings. That is, these older home signers produced elements in a number of ordering patterns; the orderings reported here appeared more often than others in their gesturing.

A handful of studies have examined home sign systems used by adults (MacLeod, 1973; Kendon, 1980; Kuschel, 1973); unfortunately, the data sets are not extensive. Previous research with older adolescent and adult home signers has either focused on the lexical and semantic aspects of their gestures, or it has not systematically

investigated how complex these systems can become. MacLeod studied the gestures of a British deaf man named Billy, and found that he could distinguish nouns, verbs, and adjectives based on sign form, co-occurrence of different constituents, and sign order, similar to the properties of young home signers described by Goldin-Meadow. Also in accord with Goldin-Meadow et al.'s findings, MacLeod and Kendon observed the following ordering tendencies in the individual home signers they studied: Gestures for Actions and States follow those for agents, patients, sources, and goals. Time specifiers and negation can occur in either utterance-initial position, utterance-final position, or in both positions. Kuschel studied the gestures of one adult male home signer who had a lexicon of 250 gestures; his study focused on a hierarchy of sign decipherability and did not treat the structure of gesture combinations.

More recent work by Coppola, Newport, Senghas, & Supalla (1997) with home signers who were older (ages 9 to 18) than those studied by Goldin-Meadow reinforces some of her findings, i.e., that home signers' gestures contain regularities not found in their gestural input. However, this work also adds evidence that the gesture preferences and tendencies observed by Goldin-Meadow in young deaf children can perhaps mature into more stable and more complex systems over time. These deaf individuals were no longer young children, and they had used their home sign systems all their lives. Using a structured gesture elicitation paradigm, Coppola and her colleagues found that these older home signers had developed consistent means of marking the roles of arguments in their gesture productions (2). Each of the three home signers they studied used a consistent gesture order, consistent spatial grammatical devices, or a combination of these to indicate the roles of nouns in sentences. Similar to the earlier studies of adolescent home signers, but in contrast to Goldin-Meadow and Mylander's findings with young American and Chinese deaf children, these older Nicaraguan home signers differed from each other in the means they used to mark contrasting roles. Their preferred word orders differed, as did the

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2 See Chapter 2 for detailed descriptions of their participants, methodology, and procedure.

grammatical devices they used. This variation in gesture order preference is consistent with the results reported above from adolescent home signers, who also did not share a preferred gesture order. While the word orders and devices differed among the three home signers studied by Coppola et al., they are each among those found in the world's spoken and signed languages.

In contrast to these results, Morford & Kegl (2000) found no evidence that the gestures produced by older home signers were segmented or componential. From their work with 11 Nicaraguan home signers ranging in age from 7 to 18, they argue that these gestural communication systems are characterized by holistic, imagistic gestures with no internal structure. Such a characterization, if accurate, would preclude the existence of ordering preferences based on semantic roles.

1.1.1.1. The role of iconicity in word formation

The study of created gesture systems has been fruitful for learning about word formation processes in the absence of linguistic input. Because young gesture languages (both home sign systems and young sign languages) are in the visuo-gestural modality, iconicity is a natural feature to exploit in creating forms to map onto meaning. A recurrent finding, however, is that forms of gesture systems are built from parts relating to other forms, as opposed to a more superficial iconic mapping between forms and referents. Kendon (1980) reported on the gestures used by an adult deaf woman living in the Enga province of New Guinea. His analysis focused on the relationship between the features of the intended referent and the features of the base of the gesture. He considered the base to be the object or action depicted by a gesture, either by presenting, pointing, or characterizing. The second part of his analysis examined the relationship between the base and the form of a gesture (i.e., which features of the base are represented in the form). Kendon concluded that while word formation processes in gestural systems exploit iconicity, the mapping between a referent and its base can occur in multiple ways, and is not predictable based on only one dimension or property of the referent.

1.2.4. Home sign in other cultures

Torigoe et al. (1995) conducted a field survey of 38 deaf people from the islands of Okinawa, Japan who had very little formal education. They found that most of these deaf people used a gestural communication system with their hearing families and the immediate community; also, most had limited contact with Deaf users of Japanese Sign Language (JSL). This study focused on their social lives and the degree of interaction each deaf person had with other deaf and hearing people. The authors also collected samples of their gesture systems, but these linguistic analyses are not reported here.

Torigoe (2000), however, does provide a linguistic analysis of a home sign system used by two deaf Japanese women (71 and 68 years of age) which emerged without conventional signed or spoken language models. Torigoe focused on two elements of structure in the home sign system: points and mouthings. Points were used frequently and for multiple functions, referring to both present and non-present persons, objects, and places. Occasionally multiple points within a sentence indicated the same referent. Other points occupied fixed positions, appearing phrase-, clause-, and sentence-finally, organizing the utterance hierarchically. Torigoe also found that oral movements (mouthing) were used frequently with manual signs. Although some mouthings originated in the local spoken dialect, others appeared to have developed spontaneously and could be classified into one of three types: lexical, adjectival/adverbial, and grammatical. These grammatical uses included indicating aspectual information (e.g., perfectivity) on verbs. The patterns of points and mouthings observed by Torigoe suggest that the home sign is in a process of grammaticalization, and that these grammatical components are similar to those found in conventional sign languages. However, the complexity of this home sign system is somewhat difficult to assess, as the paper provides only example-based evidence, rather than a data set. Further, no information is provided about the methodology used by Torigoe, nor is there an explicit comparison of the gestures produced by each of the women. They might share a gesture system, or they might be

very proficient at communicating with one another in the absence of a shared and consistent gesture system.

1.2.5. Summary

In sum, the three home signers studied by Coppola et al. (1997) displayed linguistic consistency and complexity not previously seen in the very simple home signing of very young deaf children. Apparently, then, deaf children do continue past these early stages to produce more complex linguistic systems. However, not every deaf individual deprived of linguistic input will necessarily create a highly complex gesture system (cf. Morford & Kegl, 2000; Coppola, unpublished data). Many factors come into play in the formation of home sign systems. These systems are constructed as part and consequence of the complex communicative interactions home signers have with their parents, siblings and friends. Young home signers produce very simple linguistic devices: they use one common word order, and they do not use morphological devices or function words to mark subject and object. There is not sufficient evidence to evaluate whether grammatical categories like *subject* and *object* exist.

In contrast, the older Nicaraguan home signers in the Coppola et al. study and the elderly Japanese home signers studied by Torigoe produced complex gesture sentences, with structure at both the sentence and phrase levels. The home signers in the Coppola, et al. study also produced more varied types of patterns, within and across signers. Because their home sign systems are more complex and generate more complex utterances, continuing to work with them provides access to a wider range of data than previously available. We can use these data, then, to ask questions about the limits on the development of structure in home sign systems; specifically, we can seek evidence for more abstract grammatical categories and greater syntactic complexity than what has been observed thus far. The remainder of the dissertation focuses on the nature and source of such structure. The next chapter describes the participants and the methodology of the current studies.

Chapter 2: The paradigm and methodology

2.1. Rationale

Typical language acquisition clearly involves learning from input. By comparing the patterns found in children's language production to specific patterns in the raw material they have been exposed to (parental input), acquisition researchers have learned much about children's abilities to learn words, create word classes, acquire grammatical categories, and form rules. In the current work, however, we look at learners who do not have the benefit of a rich linguistic environment. Because the participants in this series of studies are deaf, they are unable to access the spoken language in their environment. Because they do not live near a Deaf community or have any contact with signing Deaf people (3), they do not receive any conventional linguistic input in the visuo-gestural modality. Looking at the communicative output of an individual who has no exposure to a conventional language should therefore reveal the internal tendencies of humans to organize their language production. If we discover evidence of structure in these created gesture systems that is not present in home signers' environments, we can attribute this structure to the home signers themselves.

2.2. Lack of contact with signing deaf people or a Deaf community

The data for this project have been collected in Nicaragua for two reasons. First, it is difficult to find deaf adults in the United States who have had no contact with any established sign language or invented manual code, and no substantial contact with a spoken or written language. Many deaf children in the United States are exposed to ASL. Even those who are not exposed to ASL often receive instruction in one of the

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3 The term "deaf" written with a lowercase "d" refers to an individual's audiological status. In contrast, the term "Deaf," with a capital "D," refers to an individual's membership in the Deaf community, which indicates the likely use of the local sign language, as well as cultural identification with and social interaction with other members of the community (Woodward, 1974).

forms of Manually Coded English (MCE), which borrow ASL lexical items and structure them according to the grammar of English. In contrast, while there is a large Deaf community and a newly emerging indigenous sign language in Managua, the capital city, few schools for deaf children exist in Nicaragua, especially in rural areas. Outside Managua and its surrounding communities, few deaf individuals have contact with other deaf people and none have contact with a signing community (4). Furthermore, due to large gaps in social services, even in or near densely populated areas like Managua, some deaf individuals are not referred to local schools for the deaf and may not have met other signers. Deaf people in these situations develop gestures in order to communicate with hearing family members and friends, with substantial variation across individuals with respect to gesture complexity and communicative ability.

Second, investigating the nature of home sign systems in Nicaragua can play an important role in understanding the genesis of Nicaraguan Sign Language, a developing community sign language which began emerging in the late 1970s at a large special education school in Managua. The first students who came together at that school did not have prior contact with any signing deaf people; like the participants in the present research, each had presumably used an idiosyncratic home sign gesture system with their families prior to arriving at the school. Understanding the nature of the devices used in home sign systems, as well as how consistently they are used within and across individuals, can shed light on how that first group of students might have converged on a common, rudimentary community sign language.

2.3. Scope of the project

This work is one part of a larger project investigating how complex a home sign system can become when it is used as a primary communication system over an

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4 A few special education classrooms and small schools serving deaf children exist outside Managua (e.g., in Estelí, Condega, and Ciudad Darío, and on the Atlantic coast in Bluefields).

individual's lifetime. We ask whether the gestures used by home signers display consistency in their use and structure; what kinds of meaning contrasts are consistently expressed by these gestures, and the types of devices that are used to express these contrasts. If home signers use their gestures in a consistent and structured way, this structural consistency should be most apparent in very basic grammatical and semantic contrasts. Below I describe how evidence from previous research on language informed our expectations of the kinds of contrasts that might be expressed by home signers.

Most of the data collected thus far have been elicited using structured materials designed to examine systematic contrasts in form and meaning, if any exist in the home sign system. This strategy allowed us to form generalizations about consistency and contrasts across multiple items of the same type. Data have been collected pertinent to many aspects of structure (5); the current work focused on a subset of these, namely, how home signers marked *basic argument structure* and *grammatical relations*, and how they distinguished "topic" from "subject." We have also examined the relationship between these home sign systems and the gestures used by hearing people in the environment by systematically eliciting gesture productions from each home signer's mother.

2.4. Methodology

The methodology employed in the current research can be best described as a hybrid of field work and laboratory research. While all data are collected in the field, it is for the most part collected using laboratory techniques and equipment that are brought into the field, as opposed to using traditional fieldwork methods involving

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5 The range of structures and devices we have investigated, in addition to basic argument structure, grammatical relations, and distinguishing topic and subject, includes: lexicon; aspect and number; case and number; verbs of motion; simple narratives; and spontaneous productions.

free recordings or informant studies. Though we work in the field and not in a laboratory environment, we attempted to control the environment as much as possible. In this section I provide capsule biographies of the participants and an overview of our methods and procedures.

2.4.1. Participants

A brief description of each participant follows. The participants' socioeconomic level and the lack of infrastructure in Nicaragua limit the quantity and quality of the formal documentation of participant characteristics that would typically be provided in behavioral studies, such as their medical history, cause and degree of deafness, results of tests of cognitive abilities, etc. The capsule biographies below are based on interviews with the participants, with their mothers and other family members, and on our own observations.

2.4.1.1. Home Signer 1, "Javier"

Home Signer 1 (pseudonym Javier) is a very reserved boy who was 9 years old at the beginning of this study, and was 15 years old at the time of running the most recent analyses. Javier lives with his mother, father, one older brother, and two younger siblings, all hearing, in a small rural village about a 2-hour drive from Managua. His mother realized he was deaf around the age of 8 months. He appears to be profoundly deaf, with little to no usable residual hearing. His mother does not know the cause of his deafness, but speculated that it might have resulted from an infection (he was born during Nicaragua's civil war). Untreated ear infections are a common cause of childhood deafness in Nicaragua (Polich, 1998). Javier's mother has three older aunts and uncles with probable Usher's syndrome (they were born deaf and began to lose their sight in their twenties, progressively becoming almost completely blind). Though they live in the same village, Javier has no contact with these deaf

relatives (6). Javier saw a speech-language pathologist twice a year from the ages of 4 to 7. His mother reports no cognitive deficits, nor were any observed by the experimenters. She reports that Javier began to gesture at the age of two, and that while he can say a few Spanish words clearly, he cannot pronounce any Spanish beyond this. He has never attended school, and his written Spanish abilities are limited to copying his given names, which he does laboriously. In short, he knows essentially no Spanish or other conventional linguistic system.

Javier plays with the hearing children in his neighborhood. He knows a deaf boy from another village, but has had very infrequent contact with him. Like Javier, the other deaf boy has not had any contact with a conventional sign language. Javier helps his mother with household duties; at the time of our last visit, when he was 11, it did not appear that he worked a significant amount outside the home. He is quite shy, and interacts the most with his mother and older brother. His mother tends to speak Spanish to him, accompanied by the kinds of gestures that normally accompany speech. She occasionally will produce one or two gestures that carry meaning along with her spoken Spanish, but she rarely spontaneously concatenates gestures when communicating with Javier. Javier's comprehension of his mother's spoken Spanish and her gestures, in the absence of other overt pragmatic cues, appears extremely limited. While his brother's gesturing is more proficient than their mother's, in both production and comprehension, the two brothers' mutual comprehension appears very limited, except in the cases where meaning can be determined by the pragmatics of the situation. Prior to our first encounter, Javier and his family had little to no awareness of conventional sign language, deaf community, or deaf culture.

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6 Javier's lack of contact with these deaf-blind aunts and uncles, who are now in their late sixties, is primarily due to the fact that they never leave their house and rarely receive visitors.

2.4.1.2. Home Signer 2, "Pedro"

Home Signer 2 (pseudonym Pedro) is a good-natured, responsible, hard-working young man who was 13 years old at the start of this study, and who was 19 years old at the time of the most recent analyses. Pedro lives with his mother and two younger siblings, all hearing, in a small rural village that is about a 6-hour drive from Managua. Pedro is profoundly and congenitally deaf. There is no known deafness in his family. His mother reports jaundice in early infancy, but does not know the cause of his deafness. Pedro's mother reports no cognitive deficits, nor were any observed by the experimenters. Pedro can copy his name with effort, but cannot read, write, speak, or comprehend Spanish.

When he was 12 (prior to our initial contact with him) Pedro attended a very small local school (about 10 children total) for a year. No special education services were available at the school. In the last three years, from the ages of 16 to 18, Pedro attended a recently established school for deaf children in a town about 4 hours away from his village. The school was in session for 2 months each year, and classes were taught by two or three Deaf teachers from Managua who used Nicaraguan Sign Language. The effects of this exposure to a conventional sign language, beginning at the age of 16, appear to be limited to very common lexical items. While the structure of Pedro's gestures has remained consistent over the six years of our work with him, the size of his gesture/sign vocabulary has increased dramatically.

Pedro is the oldest male in the household and works six days a week as a farm laborer to help support his family (as does his mother). Pedro interacts the most with his mother and younger brother. His mother often produces multiple gestures in an utterance, and rarely speaks Spanish to Pedro. Pedro's younger brother converses quite easily with him in gesture. While both Pedro's mother and brother prefer gesturing over speaking Spanish to communicate with him, I rarely observed extended gesture conversations among them. Spontaneous gesturing appeared to be

limited to conveying necessary information, and was often strongly constrained by context. Prior to our first encounter, Pedro and his family had no awareness of conventional sign language, deaf community, or deaf culture.

2.4.1.3. Home Signer 3, "Gerónimo"

Home Signer 3 (pseudonym Gerónimo) is a gregarious, energetic young man who was 18 years old at the beginning of this research project, and was 24 years old at the last testing session reported in this dissertation. Gerónimo is extremely alert and shows no cognitive deficits. He lives with his mother and extended family, all hearing, in a poor barrio in Managua, where they operate a small convenience store from their house and sell items on the street. Gerónimo is congenitally and profoundly deaf; he shows no evidence of any usable residual hearing. His mother reports no maternal or child illness prior to birth or during infancy, nor any history of deafness in the family. She began to gesture with him when he was very small, and notes that he does not speak. As a child, he communicated with his family via gesture. Of his family members, he gestures the most with his mother.

Gerónimo was born in 1977 in a town about 2 hours from Managua; his family moved to Managua in 1991. No school for special education existed in his hometown while he lived there. When he was 8 years old, he made three deaf friends, and they all gestured together. His mother reported that forming these friendships had little effect on Gerónimo's signing, and that he continued to use the same signs he had used with his family. Gerónimo was particularly close to one of these deaf friends; they went everywhere together, and signed together a great deal. Before his family moved to Managua, Gerónimo also had limited contact with the older deaf adults with Usher's syndrome described in the bio of Home Signer 1 (he encountered them a few times a year). Importantly, none of these deaf people had any contact with a conventional sign language.

While Gerónimo currently lives in Managua, and has visited the Deaf association there, he has not maintained significant contact with the Managuan Deaf community or Nicaraguan Sign Language (NSL). Gerónimo's formal education is limited to 6 months of training (at age 18) at a privately run vocational center in Managua for people with various disabilities (at that time, about 20 deaf students attended classes at the center). They did not teach signs at the center; his mother noted that he learned a few new signs, but that she could still understand him. Gerónimo exhibits very low levels of Spanish literacy; likewise, his production and comprehension of conversational spoken Spanish is poor. He often assists his mother in her work as a street vendor in Managua. Gerónimo effortlessly navigates the sprawl of Managua on foot and by bus, and appears to have little trouble interacting with hearing people through gesture. He spends time with a hearing friend in Managua who gestures fluently.

2.4.2. Stimuli and Procedure

We collected the majority of our data in an elicitation paradigm. Several factors placed constraints on the materials used in these elicitation studies. The lack of a language shared between the participants and the experimenters requires non-verbal materials that are simple, unambiguous, culturally appropriate, and devoid of arbitrary conventions typically used in pictures (e.g., using an arrow to indicate the direction of motion in an event like "give"). The materials were carefully constructed such that within a particular set of materials, we could examine structural consistency on a limited set of contrasts. We achieved this goal by designing studies in which the items differ on only one dimension of meaning or function, while other aspects of the items are controlled or varied in a balanced way. In one task, two characters, a man and a woman, participate in a series of videotaped events in which their roles are systematically varied. Example events and roles were: actor ("man run"); patient ("woman sneeze"); actor-patient ("man touch woman"); and experiencer-patient ("man fear woman").

In addition, each type of relation appeared in multiple tokens so that we could assess the consistency of a participant's performance. By coding how the signer signaled this meaning or function across items of the same type (in this case, the marking of grammatical roles), we can make generalizations about the use of certain gesture orders or other devices, at least within a particular task. Our goal has been to obtain converging results from a set of tasks examining the same construction in order to draw more general conclusions about how a given home signer expresses (or does not express) a particular set of contrasts.

In our procedure, we elicited gesture samples by presenting the participant with these non-verbal, visual materials and asking him (7) to describe the picture, scene, or vignette to his mother, who could not see what he is describing. This procedure has two advantages: 1) The mother potentially shares his system; at the very least, she is a familiar communication partner. In cases in which other familiar communication partners are available (e.g., siblings), we use them as interlocutors as well. We do not currently have enough data to say whether participants' gestures differ depending on his interlocutor. We can also get a measure of how well the interlocutors comprehend the gestures of the home signer by presenting them with a comprehension array from which they must select the object or vignette being described. 2) The second advantage afforded by this technique is that we can indirectly encourage the participant to provide fuller descriptions of events than they might otherwise do. From observations of spontaneous gesturing, we know that gestured utterances contain multiple gestures and are often quite elaborate. However, in an elicitation paradigm, participants often reduce their descriptions to just an action gesture,

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7 All of our participants thus far have been male, which is an unfortunate result of the lack of control we exert in selecting our participants. We are systematically less likely to encounter girls and women compared to men due to the fairly rigid sex roles in Nicaragua: girls and women are more likely to be in their homes caring for children and households, and we are less likely to be introduced to them or to have them brought to our attention.

omitting gestures for persons or objects (as these are often present in the context and do not need to be explicitly mentioned). Many of the questions we wish to ask depend on collecting complete utterances with nouns and noun phrases, but whose content is controlled (this is why we cannot simply analyze the spontaneous utterances). As described in the previous section, limiting the set of potential referents and repeating them across items while simultaneously varying their semantic roles maximizes the information we can extract about how home signers can and do express a range of meaning contrasts. In the next section, I will describe the coding procedure in detail, from beginning to end, for one task for one participant.

2.4.3. Coding and Analysis: a step-by-step example

In general, our transcription, coding, and analysis proceeded in accord with previously established conventions and procedures, such as the ones followed by Goldin-Meadow and her colleagues in their work on early home sign, as well as those established by researchers of sign languages. Researchers of typical child language development sometimes face similar issues of assigning structure to elements in a new/emerging system, though they have the benefit of being native speakers of the target language whose acquisition they are studying. Using the steps outlined by Feldman, Goldin-Meadow & Gleitman (1975) as a guide, I will describe the steps of our coding process, illustrating each step with a set of responses from a previously-analyzed study (Coppola et al., 1997).

2.4.3.1. Identifying communicative gestures

The first step in analyzing an unknown gesture system is to identify individual gestures, that is, to isolate the gesture from the stream of motor behavior. Researchers working in the manual modality must discriminate acts that communicate indirectly but are not intentionally communicative (e.g., pushing a plate away) from gestures intended to communicate (the object of study). In the current work, communicative gestures were distinct movements of the hands and arms that were

easily discriminable from functional motor behavior, and which were preceded by anticipatory eye contact or by other attention-getting behavior (e.g., the waving of hands). All gestures in these analyses were produced empty-handed; that is, the participant was not manipulating an object while gesturing. In accord with sign language research, we described the form of gestures in terms of handshape, location (on the body or in space), and movement parameters (Stokoe, 1965).

2.4.3.2. Segmenting utterances and gestures

The second step in the coding process is determining the gesture and utterance boundaries. Goldin-Meadow and her colleagues faced two issues in their analyses of young deaf children's gesture production: 1) providing justification for dividing up a long complicated gesture sequence into wordlike units; and 2) providing justification for grouping certain sequences of these gestures into larger units like sentences or utterances. Regarding the former, they defined a sign using distributional criteria whenever possible (Bloomfield, 1933; Harris, 1951). That is, a sign or individual gesture is an element that occurs separately in other contexts. However, it was not always possible to observe all the signs occurring separately due to the small size of their corpus. In addition, due to the fact that the corpus contained only spontaneous gestures, Goldin-Meadow et al. had little control over its content.

In our elicitation paradigm, however, the stimuli are very tightly constrained, containing the same concrete objects and actors (and therefore, possible referents) over and over across items, with only the event varying. Thus, picking out individual gestures that have appeared alone or in combination with other gestures is relatively straightforward, given the other items in the stimulus set. For example, in a task with depictions of a man and a woman engaged in various actions, the gestures corresponding to man and woman recur often and are easy to isolate; the remaining semantic element, the action, is therefore also easy to identify. When it was not possible to independently verify the occurrence of an element as a separate sign,

Goldin-Meadow and colleagues also used an intuitive perceptual criterion based on the apparent motor organization of the gesture: a sign was defined as "a continuous, uninterrupted gestural flow or a single motor unit." This intuitive criterion is difficult to describe but easy to observe, and it turns out to be highly reliable in both Goldin-Meadow's as well as in our own analyses. (Reliability is computed with a second coder to ensure consistency of these decisions.) In the current work we will also use both distributional (as described above) and perceptual criteria (e.g., hand orientation, path continuity, pauses between gestures, and accelerations/decelerations of manual articulators) to segment individual gestures.

A second, related, issue is providing justification for grouping certain sequences of these gestures into larger units (e.g., utterances). Goldin-Meadow's definition of an utterance relies most heavily on the timing of the gesture production: if two signs were uninterrupted by an "appreciable" time difference, then they were considered to be in the same utterance. Conversely, if they were interrupted by a pause, then they were considered to be in different utterances. In some cases they were able to use the "relaxed hand" criterion, in which the deaf child would relax his or her hands at the end of a sentence, but not in between elements of the same sentence. While we have also used the relaxation of the hands as an indication of the end of an utterance, this criterion may be too lax, as the home signers we work with (like adult signers of sign languages) often do not relax their hands until the end of a communicative turn, which can include multiple utterances.

2.4.3.3. Segmenting clauses and phrases

To segment clauses and phrases, we used the same prosodic and rhythmic characteristics of the signing that we used to determine utterance boundaries. We noted and transcribed the following prosodic and non-manual markers: pauses between gestures, gesture holds, stress/intonation (related to acceleration and deceleration of articulators), hand orientation, head nods, body shifts, eye gaze

changes, and eyebrow raises. In our notation, we used a period to indicate an utterance-final pause. We used a comma to indicate a brief, though non-terminal, pause or intonation. We used these features to tentatively group gestures into multiword phrases, which were then grouped into multiphrase clauses. One test of our coding scheme is whether these tentative assignments served to meaningfully organize the data. As with each of the other coding decisions but perhaps especially critical here, reliabilities on these decisions are computed with a second coder familiar with the home signers but blind to the initial coding decisions.

Figure 1 below shows a sample of our coding at this point in the procedure. The data are a 9-year-old home signer's gestured responses to a series of pictures, presented individually, depicting a boy and a girl engaged in simple events. (All data in Figures 1-5 are from Coppola et al., 1997.) The first three columns give the stimulus event and arguments. Arg1, or argument1, denotes the actor, and Arg2 gives the second major argument, whose semantic role is either patient or recipient/goal.

Figure 1. Home Signer 1 Responses—Coding of gesture and utterance segmentation

Stimulus Event			Item #	Response, after gesture and utterance segmentation					
Arg1	**Event**	**Arg2**							
boy	bite	girl	(1)	Gesture1	Gesture2	Gesture3.			
girl	comb	boy	(2)	Gesture1	Gesture2	Gesture3.			
boy	hit	girl	(3)	Gesture1	Gesture2	Gesture3.			
boy	hug	girl	(4)	Gesture1	Gesture2	Gesture3.			
boy	kiss	girl	(5)	Gesture1	Gesture2	Gesture3.			
boy	push	girl	(6)	Gesture1	Gesture2	Gesture3.			
girl	push	boy	(7)	Gesture1	Gesture2	Gesture3.			
boy	touch	girl	(8)	Gesture1	Gesture2	Gesture3.			
girl	throw	boy	(9)	Gesture1	Gesture2	Gesture3.			
girl	feed	boy	(10)	Gesture1	Gesture2	Gesture3	Gesture4.		
girl	give	boy	(11)	Gesture1	Gesture2	Gesture3	Gesture4.		
boy	feed	girl	(12)	Gesture1	Gesture2.				
boy	give	girl	(13)	Gesture1	Gesture2.				
girl	bite	boy	(14)	Gesture1	Gesture2	Gesture3.			
boy	comb	girl	(15)	Gesture1	Gesture2	Gesture3.			
girl	touch	boy	(16)	Gesture1	Gesture2	Gesture3	Gesture4.		
girl	hit	boy	(17)	Gesture1	Gesture2	Gesture3	Gesture4.		
boy	throw	girl	(18)	Gesture1	Gesture2	Gesture3.			
girl	kiss	boy	(19)	Gesture1	Gesture2	Gesture3	Gesture4	Gesture5	Gesture6.

Gesture-n refers to a motor movement classified as an intentional communicative gesture that was segmented from the motor stream and identified based on the distributional and perceptual criteria described above.

2.4.3.4. Assigning lexical meaning to gestures

The next step in the coding process is assigning lexical meanings to gestures. We assigned an initial lexical interpretation based on the form of the gesture and the stimulus event. Because many of the gesture forms were iconic, we often glossed gesture forms with lexical descriptions (glosses are given in English caps by convention). Thus, a gesture whose form was similar to its intended meaning (e.g., 'push' or 'hug') is glossed as PUSH or HUG. Even in cases in which the form of the gesture was not iconic, it was relatively easy to assign lexical meaning because we had controlled the content of the event. The nature of our data elicitation method makes this assignment much more straightforward than it is in the analysis of

spontaneous gestures. The fact that the elicitation events are simple and contain a small set of recurring characters, events, and objects facilitates the identification of gesture referents.

As part of our experimental procedure for the example task, we placed cardboard dolls corresponding to the boy and girl in the stimulus pictures in front of the participant. Participants produced three gesture types in relation to these real-world objects: 1) Points (abbreviated PT); 2) TRACE gestures; and 3) act gestures that incorporated movement through space. Points were produced with the index finger at the location of or towards the boy and girl dolls (abbreviated PT-boy and PT-girl respectively), or towards the testing book containing the stimulus pictures, usually on a table in front of the home signer or near his lap (abbreviated PT-book). TRACE gestures and spatial act gestures, both involving movement of a gesture through space, are described in the next section.

2.4.3.5. Coding of movement of gestures in space

We observed two types of gestures, TRACE and spatial act gestures, that each involve characteristic movements through space to and/or from meaningful locations in space. These locations in space are associated with the characters in the events by virtue of the dolls having been placed in front of the participant at the beginning of the task. The dolls themselves look like the characters (one is a boy, the other a girl), and they are each placed in the same relative location as the characters in the pictured events that the participants are describing (the girl is always on the left and the boy is always on the right). TRACE refers to a gesture articulated with the index finger that moves through space to indicate the causative direction of an action. TRACE gestures either moved from the boy doll to the girl doll ($_{\mathbf{B}}\text{TRACE}_{\mathbf{G}}$), or in the reverse direction, that is, from the girl doll to the boy doll ($_{\mathbf{G}}\text{TRACE}_{\mathbf{B}}$). For example, in an item in which the event depicted the girl pushing the boy, the TRACE gesture would

move from the left to the right through space, starting near the girl doll and ending near the boy doll.

The second type of movement gesture also involves moving the act gesture with respect to these meaningful locations in space associated with the characters. The TRACE gesture described above took the same form across participants; it consisted of a relatively neutral handshape, the pointed index finger, moving in a straight path from one location to another. In a similar fashion, Home Signers 2 and 3 (but not Home Signer 1) spatially modulated some of their act gestures. This was done in three ways: participants moved act gestures from the location of one doll to the other doll; they moved the act gesture from a neutral signing space in front of them towards one of the dolls; or, they produced the act gesture towards the right or the left of neutral space. In contrast to the unmarked index finger used in the TRACE gestures, spatially modulated act gestures included a wide range of handshapes, many of them complex. For both TRACE and spatially marked act gestures, reliability is computed with a second coder blind to the initial coding. Figure 2 shows the lexical assignments and movement coding for Home Signer 1's previously segmented gesture forms.

Figure 2. Home Signer 1 Responses—Coding of lexical interpretation and movement

Stimulus Event			**Item #**	**Response with lexical interpretation and movement coding**					
Arg1	**Event**	**Arg2**							
boy	bite	girl	(1)	BITE	PT-boy	PT-girl.			
girl	comb	boy	(2)	COMB	PT-girl	PT-boy.			
boy	hit	girl	(3)	HIT	PT-boy	PT-girl.			
boy	hug	girl	(4)	HUG	PT-boy	PT-girl.			
boy	kiss	girl	(5)	KISS	PT-boy	PT-girl.			
boy	push	girl	(6)	PUSH	PT-boy	PT-girl.			
girl	push	boy	(7)	PUSH	PT-girl	PT-boy.			
boy	touch	girl	(8)	TOUCH	PT-boy	PT-girl.			
girl	throw	boy	(9)	THROW	PT-girl	PT-boy.			
girl	feed	boy	(10)	FEED	PT-girl	PT-boy	$_{G}$TRACE$_{B}$.		
girl	give	boy	(11)	GIVE	PT-girl	PT-boy	$_{G}$TRACE$_{B}$.		
boy	feed	girl	(12)	FEED	$_{B}$TRACE$_{G}$.				
boy	give	girl	(13)	GIVE	$_{B}$TRACE$_{G}$.				
girl	bite	boy	(14)	BITE		$_{G}$TRACE$_{B}$	$_{G}$TRACE$_{B}$.		
boy	comb	girl	(15)	COMB		$_{B}$TRACE$_{G}$	$_{B}$TRACE$_{G}$.		
girl	touch	boy	(16)	TOUCH	PT-girl	PT-boy	PT-girl.		
girl	hit	boy	(17)	HIT	PT-boy	PT-girl	PT-boy.		
boy	throw	girl	(18)	PT-boy	PT-girl	THROW.			
girl	kiss	boy	(19)	$_{G}$TRACE$_{B}$	$_{G}$TRACE$_{B}$	PT-girl	PT-boy	KISS	$_{G}$TRACE$_{B}$.

PT-boy refers to a **POINT** at/towards the boy doll.
PT-girl refers to a **POINT** at/towards the girl doll.
$_{B}$**TRACE**$_{G}$ refers to a movement of the index finger tracing a path through the air from the boy doll to the girl doll; movement of the index finger from the girl doll to the boy doll is shown by $_{G}$**TRACE**$_{B}$.

2.4.3.6. Assigning thematic roles and predicate meanings

We next assigned thematic roles and predicate meanings to the gestures to characterize the relations among them. These assignments of relational meaning are based on those proposed by Fillmore (1968), Brown (1973), and Goldin-Meadow & Mylander (1984). The semantic elements used in Coppola et al., (1997) are:

1. Act
2. Actor (person who performs an action)
3. Patient (person that is acted on or manipulated)
4. Recipient (person towards which someone or something moves)
5. Location (location from which or towards which someone or something moves or is located)
6. Theme (inanimate object that is acted on or manipulated)

The determination of which participant was the actor, which the patient, etc., was made with regard to the stimulus event. For example, if the event depicted a boy pushing a girl, the gesture for "boy" was coded as the actor and the gesture for "girl" was coded as the patient. It is important to note that, particularly from this step forward, two procedures are used to evaluate the adequacy of our coding scheme. As in earlier steps, we used reliability measures to determine whether a second coder, blind to the initial coding, is in agreement with it. However, for abstract and non-objective decisions, a second "bootstrapping" procedure was also employed: As described by Feldman et al. (1975) and Goldin-Meadow & Mylander (1984), first a tentative set of coding decisions are made over the task; then, the regularity (or non-regularity) of the obtained results is used to determine whether this tentative coding decision was sound. If the tentative coding was not a reliable and/or valid interpretation of the gesture, then the final results should not be particularly well patterned in terms of these coding assignments. On the other hand, if the tentative coding reveals highly systematic analyses of the utterances, these coding decisions must be at least in part a valid reflection of the gesture system.

The important question in the present example, then, is whether a coherent and patterned description of the word order and morphological forms of this home signer will result from assigning thematic roles to his gestures (Figure 3). In the next step of the coding process, we ask whether the word order and directions of spatial movement are consistent in terms of these thematic roles (Figure 4).

Figure 3. Home Signer 1 Responses—Coding of thematic role assignment.

Stimulus Event			**Item #**	**Response with thematic role assignment**					
Arg1	**Event**	**Arg2**							
boy	bite	girl	(1)	act	PT-actor	PT-pat.			
girl	comb	boy	(2)	act	PT-actor	PT-pat.			
boy	hit	girl	(3)	act	PT-actor	PT-pat.			
boy	hug	girl	(4)	act	PT-actor	PT-pat.			
boy	kiss	girl	(5)	act	PT-actor	PT-pat.			
boy	push	girl	(6)	act	PT-actor	PT-pat.			
girl	push	boy	(7)	act	PT-actor	PT-pat.			
boy	touch	girl	(8)	act	PT-actor	PT-pat.			
girl	throw	boy	(9)	act	PT-actor	PT-rec.			
girl	feed	boy	(10)	act	PT-actor	PT-rec	$_{A}$TRACE$_{P}$**.**		
girl	give	boy	(11)	act	PT-actor	PT-rec	$_{A}$TRACE$_{P}$**.**		
boy	feed	girl	(12)	act	$_{A}$TRACE$_{P}$**.**				
boy	give	girl	(13)	act	$_{A}$TRACE$_{P}$**.**				
girl	bite	boy	(14)	act	$_{A}$TRACE$_{P}$	$_{A}$TRACE$_{P}$**.**			
boy	comb	girl	(15)	act	$_{A}$TRACE$_{P}$	$_{A}$TRACE$_{P}$**.**			
girl	touch	boy	(16)	act	PT-actor	PT-pat	PT-actor.		
girl	hit	boy	(17)	act	PT-pat	PT-actor	PT-pat.		
boy	throw	girl	(18)	PT-actor	PT-rec	act.			
girl	kiss	boy	(19)	$_{A}$TRACE$_{P}$	$_{A}$TRACE$_{P}$	PT-actor	PT-actor	act	$_{A}$TRACE$_{P}$**.**

act refers to a gesture corresponding to the action.
PT-actor refers to a **POINT** at/towards the doll representing the actor.
PT-pat refers to a **POINT** at/towards the doll representing the patient.
PT-rec refers to a **POINT** at/towards the doll representing the recipient.
$_{A}$**TRACE**$_{P/R}$ refers to a movement tracing a path through the air from the doll representing the actor to the doll representing the patient/recipient; movement in the reverse direction would be shown by $_{P/R}$**TRACE**$_{A}$ (these were not attested).

2.4.3.7. Assigning word order categories

Based on these coding steps and tentative gesture classes, we then looked across these gesture sentences for patterns in gesture order. We were able to discern gesture order regularities across the items in this task. Specifically, the ordering patterns produced by Home Signer 1 fell into three categories (see Figure 4), with the number of items out of the total noted for each category (8):

Figure 4. Word order categories in Home Signer 1's responses.

	Word order categories				Proportion of responses
1)	**act**	**actor**	**patient/recipient**	**($_A$TRACE$_{P/R}$)**	**11/19**
2)	**act**			**$_A$TRACE$_{P/R}$#**	**4/19**
3)	Other				4/19
	Total				19/19

Home Signer 1 did use the ordering of his gestures to indicate the case relations or thematic roles of the nominals in the sentence. That is, he regularly produced a gesture for the action, followed by a gesture referring to the actor, followed by a gesture referring to the patient or recipient (class 1). The ordering of his gestures reliably indicated the roles of those nominals in the sentence. The first nominal that appeared always referred to the actor of the event, and the second nominal always referred to the patient or recipient of the event. In the four items listed in class (2), he produced a gesture for the action followed by a TRACE gesture that moves from the actor to the patient/recipient. Note the relationship between classes (1) and (2); while the TRACE gesture is required in class (2), it is optional in class (1) because the case relations are already specified by the nominals. I will describe how the TRACE gesture reliably indicated these relations through the use of spatial morphology in the next section.

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8 The # symbol indicates that this element (i.e., the TRACE) may be repeated.

2.4.3.8. Identifying spatial morphology

We then asked whether home signers used the movements of their gestures through space to indicate the relative roles of the characters engaged in an event. For example, Home Signer 1 used a gesture that we have glossed as "TRACE;" does the direction in which the TRACE gesture moves indicate relationships among elements in his gestured utterances? TRACE, as described above, refers to a movement tracing a path through the air, for example, from the doll representing the girl to the doll representing the boy. Recall that these locations in space are associated with characters in the events by virtue of the dolls having been placed in front of the participant at the beginning of the task. Returning to our previous example (girl push boy), we would code a gesture that started near the girl doll and ended near the boy doll as a TRACE gesture from the actor to the patient. We used subscripts to indicate the beginning and end points of this movement: the above TRACE gesture, given the context of the depicted event, would be notated as ${}_{A}\text{TRACE}_{P}$ or ${}_{A}\text{TRACE}_{R}$ depending on whether the second argument in the event took the patient (P) or recipient (R) role. Then we can ask how many of the TRACE gestures move from A to P (or R), and how many move from P (or R) to A, to determine whether the spatial direction of the TRACE gesture is used systematically to mark thematic roles or grammatical relations.

All of Home Signer 1's TRACE gestures (as well as those produced by Home Signer 2) followed this pattern of indicating the direction or causation of the action from actor to patient or recipient. Movement of the TRACE gesture in the reverse direction would be shown by ${}_{P}\text{TRACE}_{A}$ or ${}_{R}\text{TRACE}_{A}$; however, no TRACE gestures of this form were attested in the data sets we collected from any of the home signers.

Note that, in Home Signer 1's gesture corpus shown above, either the ordering of the nominal gestures or the TRACE gesture alone is sufficient to identify the relative roles of the arguments. In the majority of items, both devices are used. However, in

a small subset (4/19), only the act and the TRACE are used; even in these utterances, the roles of the nominals and the nature of the event are clear from the three gestures that Home Signer 1 produced. This type of structural (syntactic) redundancy is common in languages. Thus, the movement patterns of the TRACE gestures appear analogous to a morphological agreement device that indicates the relative roles of characters in an event.

Another way in which spatial modulations of gestures might indicate the roles of the characters in the event is to move the act gesture with respect to meaningful locations in space associated with the characters. The TRACE gesture described above took the same form across participants; it consisted of a relatively neutral handshape, the pointed index finger, moving in a straight path from one location to another, always from the location associated with the actor to the location associated with the patient/recipient. In a similar fashion, Home Signers 2 and 3 (but not Home Signer 1) spatially modulated their act gestures, moving them from the location of the doll associated with the actor to the location of the doll associated with the patient/recipient. Given the distributional analysis described above, act gestures were easily distinguished from TRACE gestures based on both their form and their relative placement in the gesture sentence. In contrast to the unmarked index finger used in the TRACE gestures, Act gestures produced by all three participants included a wide range of handshapes, many of them complex. Home Signer 1's act gestures were also easily distinguished from TRACE gestures because he never spatially modulated his act gestures, and because they almost always occurred in sentence-final position. In sum, it appears that the TRACE gestures and the act gestures are spatially modulated in a way that consistently marks the thematic roles: both TRACE gestures and act gestures move from actor to patient/recipient. This is equivalent to saying that the spatial movements serve as morphological agreement markers indicating the roles of arguments in an utterance. Such spatial morphological devices are common in sign languages.

2.4.3.9. Identifying meaningful multi-gesture groupings (phrases) indicating syntactic structure

In a previous section we asked whether gestured responses fell into categories with respect to word or gesture order. In this step of the coding, we asked whether there is also consistency in the order of the gestures in phrases within longer utterances. Thus, we performed an analysis similar to the word order analysis, but on just the prosodically marked groups of gestures. Home Signer 1's word order patterns can be coded without respect to phrases referring to actor and patient; he usually only produces one gesture for each of these semantic elements. The majority of his sentences contain only three gestures, one each for the actor, patient, and act. In contrast, the other two participants often produced longer gesture utterances containing prosodically marked gesture groupings. For example, in some of Home Signer 3's utterances, the actor is described using a group of gestures, such as **Point-BOY BOY Point-BOY**. (These groupings are not evident in the coding example I have illustrated because Home Signer 1 does not produce them.) These groupings were set off prosodically by the stress pattern across the items, as well as by pauses and other non-manual markers. In fact, many of the same prosodic and non-manual markers that we used to segment utterances also figured into grouping these recurring sequences of gestures. The prosodic markers indicating the boundaries of these groupings included pauses, eye gaze shifts, eyebrow raises, head tilts, and holds.

We then asked how to best characterize the structure found in these groupings. Specifically, we wondered whether these groupings constituted phrases, that is, whether we could make generalizations across the groups about the types and ordering of the gestures within each group. To address this issue, we further examined the large number of multi-gesture groupings produced by Home Signer 3. Before turning to this analysis, I will first describe a new gesture type that we have not yet encountered called Poses, which incorporate attributes of a character. For example, the boy in the stimulus drawings was wearing a tie; this attribute formed the

basis for a Pose gesture that took a form we glossed as "ADJUST-TIE", which was used to refer to the boy. Figure 5 shows the sequences that Home Signer 3 produced to refer to the patient or recipient of an event (regardless of whether it was the boy or the girl). Each line indicates a response to a different item. For each item I have extracted the group of gestures that referred to the patient or recipient in the event. Not all responses contained such multi-gesture sequences.

Figure 5. Examples of multigesture groupings produced by Home Signer 3 to refer to the Patient or Recipient in an event.

Response 1		Patient	Patient-pose
Response 2		Patient	Patient-pose
Response 3		Patient	Patient-pose
Response 4		Patient	Patient-pose
Response 5	Patient-pose	Patient	Patient-pose
Response 6	Patient-pose	Patient	Patient-pose
Response 7	Patient-pose	Patient	Patient-pose
Response 8	Patient-pose	Patient	Patient-pose
Response 9	Patient-pose	Patient	Patient-pose
Response 10	Patient-pose	Patient	Patient-pose

The regularity of the ordering of gesture types in the above sequences referring to the patient or recipient suggests that these groupings have a consistent structure. They do appear to be "true" phrases. Home Signer 3 also produces consistent phrasal patterns like these to refer to arguments bearing the role of actor.

2.4.3.10. Reliability of coding steps

We obtained high reliability for coding gesture, clause, and utterance boundaries, as well as the gesture categories observed in Coppola et al. (1997). To compute reliability, we first selected a sample of responses from each participant for training on the coding system. Two coders discussed and agreed upon the criteria for each gesture classification. At the end of that process, a new set of responses was selected over which to compute reliability. The two coders each coded these responses

independently, and their coding decisions were compared. The degree to which the two independent coders agreed on coding classifications on this novel set of test items was as follows (percent agreement is indicated for each, with the number of occurrences coded the same way out of the total coded given in parentheses):

1. Sentence boundaries: 100% (20/20)
2. Number of gestures per sentence: 92.2%
3. Identification of gesture forms overall: 91.1% (41/45)
4. Identification of gesture forms by class: Nominals (excluding Points), 100% (7/7); Acts, 100% (20/20); Poses, 50% (2/4); Points (PT-boy or PT-girl): 77.8% (7/9); TRACE gestures: 100% (2/2); Within-sentence Points at testing book (PT-book): 100% (3/3)
5. Clause boundaries: 100% (10/10)
6. Spatial morphology: 100% (10/10).

Reliability data for the current studies was conducted in the same way, and summaries are reported along with the results for each experiment. The full list of reliabilities for subsequent studies appears in Appendix B.

Chapter 3: Seeking structure in home sign systems

3.1. Properties of young languages

Because very little is known about home sign used as primary communication systems beyond childhood, we started our research by examining very basic elements of structure. Even very young languages, (e.g., pidgin languages, and the early stages in the genesis of a new language, such as Nicaraguan Sign Language) have devices to mark the contrasting roles of basic arguments in an utterance. Thus, we started by examining whether home sign systems contained devices for marking basic argument structure, and specifically investigated the use of syntax and/or morphology to express these grammatical contrasts.

3.1.1. Notes on typology

Language typology refers to classifying languages based on the types of devices that they use, such as the devices used to mark grammatical relations (e.g., word order, or syntax, vs. case marking, or morphology). An important typological question is how the semantic and pragmatic properties of noun phrases are mapped onto morphosyntactic features and properties across languages. Grammatical roles are defined language-specifically in terms of morphosyntactic properties such as case marking or linear position (word order). Many languages use word order to mark grammatical roles, some languages use morphological marking to encode such functions, and many languages use a combination of the two.

Thus, languages choose different means to express grammatical contrasts. Russian is an example of a case-marking language that appends specific morphemes to noun phrases in order to indicate their role in the sentence. The word order in such languages is often more flexible than one would find in a word order language, because the grammatical contrasts are carried by the morphemes and not by the order of the words. However, even languages with relatively “free” word order usually

exhibit a basic or default word order. In contrast, English predominantly uses the order of words in a sentence to convey contrasts in grammatical roles. In simple sentences in English, the leftmost noun phrase in a sentence is the Subject, and the noun phrase following the verb is the Object. These basic sentences exhibit the canonical word order of English, which is Subject-Verb-Object, or SVO.

Previous research has shown that young languages tend to use word order preferentially for expressing these contrasts. In fact, across a wide range of not fully established or reduced language circumstances, word order is the method of choice for encoding information about semantic roles. For this reason, word order has been argued to be a "resilient" or "environment-insensitive" property of language (Goldin-Meadow & Mylander, 1984; Newport et al., 1977). Compared to word order, the use of complex morphology for indicating contrasts is quite rare in these languages. In fact, complex morphology serving any function is rare in a young language. In this framework, then, morphology is considered a "fragile" property of language.

What might we expect from sign languages with respect to this typology? In an apparent paradox, spatial grammatical devices, which are often analyzed as complex morphological systems, are robust in the sign languages that have been studied to date (Supalla, 1995). In fact, spatial devices are found even in young or reduced sign systems, such as Nicaraguan Sign Language (Senghas et al., 1997) and International Sign. International Sign, a signed interlanguage spontaneously developed within an international community of sign language users, contains much more morphological complexity than would be expected from or found in a spoken pidgin (Supalla & Webb, 2000). Therefore, it is unclear which type of device we might expect to see in an elaborated home sign system. Our tasks were designed to detect the consistent use of either kind of device.

3.2. The experiments

In the present studies we chose to investigate in depth home signers' expression of one basic set of contrasts, the marking of argument structure or grammatical role, using a variety of converging materials and methodologies. This approach stands in contrast to studying a wide range of structures on many levels of linguistic representation. We chose this approach to gain a solid understanding of basic structures in these relatively little known systems before moving on to more complex and potentially more variable structures. An overview of the current studies follows, with a brief summary of how they are interrelated and build on each other.

3.2.1. Experiment 1: The consistent use of gestures over time to mark semantic contrasts in home sign systems

The objective of Experiment 1 was to assess the stability of home signers' gesture systems by examining the consistency of these patterns over time (the two data sets were collected 2 1/2 years apart). We reported the word order and morphology patterns for each participant based on the data collected in 1998, and compared these patterns with those produced by each participant in 1996.

3.2.2. Experiment 2: Mothers' gestural marking of semantic contrasts

We then conducted an analysis to determine whether the word orders and devices used consistently over time by the home signers could be attributed to their gestural input, i.e., the gestures produced by their hearing mothers. To determine if the mothers' gesture patterns could be a source of the structure we have observed in the home signers' gesture systems, we compared their performance on the elicitation task described above. The results indicated that two of the three mothers (of Home Signers 2 and 3) showed internal consistency in the order of their gestures; however, in neither case did the mother's preferred gesture order match her son's. In the third case, the mother's gestures did not exhibit a consistent order, while her son's did (Home Signer 1). Thus, we conclude that the patterns observed in the home signers' gestures cannot be attributed to their input, at least insofar as the mothers' current

gesturing reflects the input these signers received as they developed their home sign systems.

3.2.3. Experiment 3: Grammatical categories in home sign systems

Coppola et al. (1997) showed that home signers use consistent word orders and grammatical devices to mark contrasts in the roles taken by arguments in an event. Based on those data, however, it is difficult to determine whether these devices were based on grammatical relations (like *subject* and *object*), or semantic relations (like *actor* and *patient*). Because the events did not vary much in type (they were all physical actions), or in the semantic roles of the participants (they almost all exhibited actor-patient or actor-recipient relations), Coppola et al. could not make this distinction. Grammatical categories in established languages cross semantic role categories; for example, the category of subject in English encompasses noun phrases that take on a range of thematic roles, including Actor, Patient, and Experiencer. In Experiment 3 we asked whether such an abstract grammatical category exists in home sign systems. We elicited home sign descriptions of 1- and 2-argument events containing a range of semantic roles, and looked for patterns within and across semantic roles. Our results showed that each home signer placed noun phrases bearing different semantic roles in the same structural position. This pattern of results is consistent with the notion that home signers have a grammatical category like Subject.

3.2.4. Experiment 4: Distinguishing Subject and Topic in home sign systems

The notions of Subject and Topic are tightly coupled. We asked to what extent the "Subject-like" arguments we observed in Experiment 3 are like grammatical Subjects, or whether this evidence suggests a more pragmatically based category like "Topic," which typically expresses old information, that is, what is being talked about. We asked home signers to describe short, simple narratives conveyed via videotaped vignettes in which Subject and Topic were contrasted within the same entity over the

course of the narrative. The results showed that home signers were consistent in their treatment of subject-like noun phrases over the course of narratives, and that the structure we observed in both Experiments 1 and 3 was not pragmatically determined.

I begin the more detailed report of each experiment below, with Experiment 1.

3.3. Experiment 1: The consistent use of gestures over time to mark semantic contrasts in home sign systems

In Experiment 1 we compared the gesture patterns produced by home signers to the same stimuli over time (the two data sets were collected 2 1/2 years apart). We reported the word order and morphology patterns for each participant based on the data collected in 1998, and compared these patterns with those produced by each participant in 1996.

3.3.1. Participants

The participants were the three deaf Nicaraguan home signers described in Chapter 2 (Home Signers 1, 2, and 3). Their ages at the time of testing in 1996 were 9, 13, and 18, and in 1998 they were 11, 15, and 20, respectively.

3.3.2. Stimuli

The stimuli were a set of 24 line drawings depicting a boy and a girl engaged in simple events. All events were physical actions involving two people (e. g., kiss, push, and give). Four events also contained an inanimate object, either a theme (e. g., a ball) or an instrument (e. g., a comb). To facilitate the use of spatial devices, the drawings always showed the girl on the left and the boy on the right (see Procedure for details). Their roles in the events were counterbalanced such that half the items showed the girl as the actor (the person who performed the action, e.g., kissing) and the boy as either the patient of the action (the person who was acted upon, or kissed) or the recipient of the action (the person towards which someone or something moves). Appendix A contains the list of items and an example pair of counterbalanced items.

3.3.3. Procedure

As in Coppola et al. (1997), in order to elicit well-controlled samples of home signers' gesture systems, we presented each participant with a series of line drawings and asked him to describe the event to a familiar person. We collected data in two conditions: the Object-Support condition, and the No-Object-Support condition. Studies of deaf children natively acquiring a sign language indicate that they possess devices for marking grammatical roles using spatial morphology (Newport & Meier, 1985). However, they initially have difficulty in setting up and maintaining the abstract spatial locations that are required to correctly demonstrate having such devices. Thinking that home signers might face a similar barrier, in the Object-Support condition, we placed small cardboard dolls representing the boy and the girl in front of the participant corresponding to their positions in the drawings (girl on the left, boy on the right). Our goal was to facilitate the expression of such spatial devices, if they existed.

After eliciting gestures for "boy" and "girl" (which were consistently used gestures for each participant, though different across participants), we presented the drawings one at a time, in a random order, and asked each participant to describe the event to their partner, who could not see the stimuli. Home Signer 1 gestured to his brother, and Home Signers 2 and 3 gestured to their mothers. All responses were videotaped and transcribed.

3.3.4. Analysis

One coder who is a native signer transcribed and coded all responses in accord with the procedure outlined in Chapter 2. A second independent coder who is also a native signer then coded a subset of responses, and the agreement between the two coders was assessed. For all coding categories, reliabilities ranged between .89 and 1.00. The full list of reliabilities appears in Appendix B.

3.3.5. Results: Home Signer 1 gesture order patterns

Table 1 summarizes Home Signer 1's responses for both 1996 and 1998; the 1996 data for all home signers are taken from Coppola et al., 1997. Home Signer 1's 1996 responses on this task overwhelmingly showed a single word order pattern: an act gesture denoting the action, followed by one or two gestures indicating the actor and then the patient or recipient, in short, **act actor patient** (9) (10). In 15/19 responses in 1996, Home Signer 1 marked the roles of the actor versus the patient in one of two ways: either with a point to the actor followed by a point to the patient (that is, syntactically), or with a TRACE gesture that moved from actor to patient (that is, morphologically). Eleven of these 15 responses contained both devices. The remaining 4 utterances also shared most aspects of this overall pattern, but did not follow either pattern exactly. Home Signer 1 also very consistently used the TRACE morphological device (in 7/19 responses) to mark actor and patient in the same way: the TRACE always moved from the actor to the patient (11/11), and never the reverse. The notation used for this type of TRACE movement, from actor location to patient location, is $_{A}$TRACE$_{P}$.

In 1998, Home Signer 1's most frequent pattern (indicated in bold type in Table 1) was **patient act**, followed by an optional **actor act** sequence. Home Signer 1's remaining responses on this task showed multiple word orders. The common feature of 11/12 of the remaining responses is that the actor gesture always preceded the act gesture, and only 2 cases contained a gesture intervening between the actor and the act (11).

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9 I will refer to these two roles together as "patient" because the number of recipients is small, and because the patterns are the same for both semantic roles.

10 Note that these patterns are not merely pointing at the girl and then at the boy, but that the order of the points is determined by their respective semantic roles.

11 In one response, the patient was fronted and set off prosodically.

There is not extensive overlap between Home Signer 1's performance in the two data sets. His 1998 responses showed no uses of spatial devices, in contrast to the earlier results (12). Also, his 1998 responses are not as consistent in their ordering as the 1996 responses. One possibility is that this lack of consistency characterizes home sign usage in general. However, we shall see that the other home signers we studied were much more consistent over time, and in the second visit, than was this home signer. We return later to the possible reasons for his lack of consistency in 1998.

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12 The dolls were present during the running of this task in both 1996 and 1998, as described in the Procedure, but in 1998 Home Signer 1 did not gesture at, towards, or near them.

Table 1. Home Signer 1: Comparison of 1996 and 1998 gesture patterns, Object-Support condition.

1996	Proportion of responses following pattern	**1998**	Proportion of responses following pattern
Pattern 1: act [actor] [patient]	**15/19**		
act PT-actor PT-patient ($_A$TRACE$_P$)	**11/15**		
act $_A$TRACE$_P$#	**4/15**		
		Pattern 1: patient act, (actor act) +	**9/21**
		actor act	4/21
		actor act patient	3/21
		actor patient act	2/21
		patient, actor act	1/21
		actor act, patient act	1/21
Other	4/19	Other	1/21
Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response	5	Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response	4
Total	**19/19**	**Total**	**21/21**

act refers to a gesture referring to the action**, actor** names the actor**,** and **patient** names the patient.
PT-actor refers to a **POINT** at/towards the actor (in this case, to the doll representing the actor).
PT-patient refers to a **POINT** at/towards the patient doll.
$_A$**TRACE$_P$** refers to a movement tracing a path through the air from the spatial location of the actor referent to the spatial location of the patient referent; movement from patient to actor would be noted by $_P$**TRACE$_A$**.
Elements enclosed in parentheses are optional; "#" indicates that an element may be repeated.
"+" at the end of a pattern indicates additional elements in the pattern that were not systematic.

3.3.6. Results: Home Signer 2 gesture order patterns

Home Signer 2's responses across both data sets exhibited a combination of word order (syntax) and word-internal structure (morphology) to indicate grammatical relations. The most frequent word order in both sets of responses (Pattern 1) is the same, and is shown in bold type in Table 2. In fact, Home Signer 2's second most frequent pattern (Pattern 2) is also the same in the 1996 and 1998 data sets, and is produced in approximately the same proportions in both years.

In Pattern 1, Home Signer 2 marked the actor and/or the patient using either nouns (points), spatial modulation on the act gesture (indicated by "actor" and "patient" subscripts), or a combination of both devices. While Pattern 1 indicates many optional elements (in parentheses), in fact only the form of the marking is optional (that is, actors and patients are always marked either syntactically or morphologically).

Home Signer 2 produced more complex morphological forms than did Home Signer 1. Like Home Signer 1, Home Signer 2 produced TRACE forms which were always articulated as a movement of the index finger through space from the actor to the patient. Note that $_{A}\text{TRACE}_{P}$ conveys no information about the event except the grammatical roles of the participants. In contrast to Home Signer 1, Home Signer 2's lexical act gestures (articulated with more complex handshapes that conveyed information about the event) sometimes incorporated actor and patient markers by moving the handshape from the actor to the patient (denoted by $_{A}\text{act}_{P}$, like the $_{A}\text{TRACE}_{P}$).

Because Home Signer 2 uses morphological devices so pervasively to mark grammatical roles, maintaining an invariant word order to identify relations becomes less crucial. This pattern is also observed in morphologically complex languages, in which syntax conveys grammatical relations redundantly with morphology. That is,

languages that predominantly use morphological affixes to indicate grammatical roles often follow a canonical word order.

Pattern 2 differs from the predominant **actor act patient** order in an interesting way. While the act can appear initially or finally, the Actor always appears immediately before the Patient, preserving the marking of semantic role contrasts. This Actor-Patient contiguity may be the precursor to the $_{A}$TRACE$_{P}$ device. As sequential points to the Actor and Patient become frequently articulated over time, the movement between them may become more rapid and fluid, forming the $_{A}$TRACE$_{P}$ device (13). Overall, Home Signer 2's responses across the two data sets separated in time are remarkably similar.

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13 In fact, Mother 2 frequently produces a Point to the Actor quickly followed by a Point to the Patient; however, she has not developed a $_{A}$TRACE$_{P}$ device. His younger brother also rapidly produced the sequence PT-Actor PT-Patient, but these gestures have also not been conventionalized into a $_{A}$TRACE$_{P}$ device.

Table 2. Home Signer 2: Comparison of 1996 and 1998 gesture patterns, Object-Support condition.

1996	Proportion of responses following pattern	1998	Proportion of responses following pattern
Pattern 1: Basic actor act patient	**12/19**	**Pattern 1: Basic actor act patient**	**14/24**
(PT-actor) $_{(actor)}$ act $_{(patient)}$ (PT- patient)	**(10/12)**	**PT- actor $_{(actor)}$ act $_{(patient)}$ PT- patient**	**(9/14)**
$_{(actor)}$ act $_{(patient)}$ $_{actor}$ TRACE $_{patient}$	**(2/12)**	**(PT- actor) $_{(actor)}$ act $_{(patient)}$ (PT- patient)** With Object Focus (Object Phrase or Object Pose)	**(5/14)**
Pattern 2: actor before patient	7/19	Pattern 2: actor before patient	10/24
PT-actor PT- patient act	(2/19)	[actor] [patient] act $_{actor}$ TRACE $_{patient}$ or act [actor] [patient] $_{actor}$ TRACE $_{patient}$	(10/24)
Pattern 3: Other spatial modulations on act gestures	(5/19)	Pattern 3: Other spatial modulations on act gestures	(0/24)
Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response	5	Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response	2
Total	**24/24**	**Total**	**26/26**

act refers to a gesture referring to the action**; actor** refers to an actor gesture; **patient** refers to a patient gesture.
PT-actor refers to a **POINT** at/towards the actor (in this case, to the doll representing the actor).
PT-patient refers to a **POINT** at/towards the patient doll.
$_{actor}$**TRACE**$_{patient}$ refers to a movement tracing a path through the air from the spatial location of the actor referent to the spatial location of the patient referent; movement from patient to actor would be noted by $_{patient}$**TRACE**$_{actor}$.
Gesture elements in parentheses are optional; gestures enclosed in [brackets] were either Point gestures or lexical gestures.

3.3.7. Results: Home Signer 3 gesture order patterns

Home Signer 3's gesture system exhibits the most complex grammar, with patterned rules at both the phrase and sentence levels across both data sets. That is, the elements in each of his utterances are ordered in predictable, generalizable ways; the same holds true for the subunits of those elements, the phrases. His predominant word order in both 1996 and 1998 was **Patient, actor act** (Table 3). The majority of utterances in this category consist of a Patient noun, Point, or Noun Phrase (abbreviated $NP_{patient}$), set off prosodically, followed by the Actor and Act gestures.

Home Signer 3's second basic word order pattern is $\mathbf{NP_{actor}}$ **act,** $\mathbf{NP_{patient}}$ **act**. A subset of responses in this category is **actor** $\mathbf{act_1}$ **patient** $\mathbf{act_2}$. This pattern was restricted to events with salient physical consequences: hit (get-hit); push (fall-back); and touch (get-touched). In these sentences the event is expressed by naming the actor and the main action (for example, push), followed by the patient and its reaction (for example, fall-back). This is notated using subscripts on the act gestures to indicate act_1 (PUSH) and act_2 (FALL-BACK). The core of these responses is thus **actor** $\mathbf{act_1}$ **patient** $\mathbf{act_2}$. Like Home Signer 2, Home Signer 3 shows very consistent word orders; sentences vary only in whether all the permitted repeated phrases are expressed. Only a small number of sentences overall are not strictly captured by these two patterns.

Table 3. Home Signer 3: Comparison of 1996 and 1998 gesture patterns, Object-Support condition.

1996	Proportion of responses following pattern	**1998**	Proportion of responses following pattern
Pattern 1: Basic patient, actor act	**25/40**	**Pattern 1: Basic patient, actor act**	**6/18**
$NP_{patient}$, NP_{actor} act	**(21/40)**	[patient], actor act with variation	**(6/18)**
NP_{actor}, $NP_{patient}$, NP_{actor} act	**(4/40)**		
Pattern 2: actor act patient act	13/40	Pattern 2: actor act patient act	6/18
actor act_1 patient act_2	(8/40)	actor act_1 patient act_2	(5/18)
(actor act); (patient act), (actor act)	(5/40)	actor act patient	(1/18)
Pattern 3: actor patient act		Pattern 3: actor patient act	
actor patient act_1 patient act_2	1/40	actor patient act	2/18
		Pattern 4: Classifier constructions	3/18
Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response.	8	Events that typically did not elicit act gestures (e.g., "like"), or that did not elicit an analyzable response.	6
Other	1/40	Other	1/18
Total	**40/40**	**Total**	**18/18**

act refers to an act gesture**.**

act_1 refers to the first action in an event; **act_2** is a second act gesture with a different form; the act forms are related in that **act_2** refers to an event that is the consequence of **act_1**.

NP_{actor} refers to a **Noun Phrase** naming the actor.

$NP_{patient}$ refers to a **Noun Phrase** naming the patient

Gesture elements in parentheses are optional.

Gesture elements enclosed in [brackets] were either Point gestures or lexical gestures referring to the specified role.

3.3.8. Results: Home Signer 3 multigesture patterns

The subunits of the above rules, the phrases, also show a high degree of systematicity. Participants in the event (the Actor and the Patient) are referred to using multigesture sequences within the sentence that are themselves patterned. That is, the sentences contain noun phrases with their own word order patterns, and which are consistent for both Actor NPs and Patient NPs. The two rules below (Figure 6) capture the ordering of elements in the vast majority of Actor and Patient noun phrases produced by Home Signer 3 (14). Note that each noun phrase is not simply a rote repetition of the same elements in the same order; rather, like natural languages, phrases have both obligatory and optional elements. Thus, across two testing sessions separated by a period of two years, Home Signer 3 exhibits patterns consistent with hierarchical constituent structure: his sentences exhibit consistency in the internal structure of phrases, as well as in the sequencing of those phrases in a sentence.

In Figure 6, "Pose" refers to a gesture that indicates a posture or physical attribute of the participant being referenced (for example, their stance or item of clothing). "Point" refers to a point at the testing book or at the doll representing one of the participants. "Noun" is a stable lexical gesture (15) produced regularly to refer to a person or object (for example, BOY). Parentheses indicate optional elements; curly brackets indicate selection of one of the enclosed elements (i.e., in Rule 1 below, a Noun or a Point must be selected, but both may not appear in that position). All Actor and Patient NPs were included in the analysis. Patient NPs were more frequent (26 vs. 11), but both types occur in each category below.

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14 One exception is a type of phrase that includes act gestures (for example, **act N act**). These might be topicalized verbs, not noun phrases, but too few of them occurred for full analysis.

15 Home Signer 3's gesture for BOY was a one-handed gesture tracing the outline of a mustache above the mouth with the thumb and index finger. His lexicalized gesture for GIRL was either one- or two-handed, and indicated the location of breasts. (Both gestures were often reduced, as is typical for common words in both signed and spoken languages).

Figure 6. Home Signer 3 Noun Phrase (NP) Structure.

Rule 1:	Noun Phrase →	(Pose)	{Noun} {Point}	Pose	28/37
Rule 2:	Noun Phrase →		Point	Noun	4/37
Other:					5/37
Total					37/37

3.3.9. Results: Summary

The current analyses indicated that the patterns produced by Home Signers 2 and 3 remained remarkably stable over time, while the patterns of Home Signer 1, the youngest participant, were somewhat different. The gestures produced by Home Signers 2 and 3 appear to reflect a stable home sign system that generates well formed sentences from an underlying set of principles. It does not appear that Home Signers 2 and 3 created gesture strings *de novo* to express meanings in a particular situation. The same distribution of response patterns occurs within the results for each home signer, in similar proportions, to the same stimuli, over a period of 2 1/2 years. It is extremely unlikely that *ad hoc* gesturing, that is, gesturing devised on the spur of the moment, could have led to such stability of structure over time.

In contrast, it is difficult to interpret the stability of Home Signer 1's gesture patterns from these data. He approached the task in a very different manner in the two testing sessions, referring spatially to the dolls using Point and TRACE gestures in 1996, but using no spatial devices at all in 1998. Thus, the mismatch in his results over time is confounded by a change in the strategy by which he performed our task. However, this change could also be related to the fact that he is the youngest of the three participants, and so his home sign system may not yet have had sufficient time to crystallize. A final possibility is that not all home sign systems show stability through time. Further testing with this participant will help to clarify these results.

Chapter 4: The source of the structure found in home sign systems

What is the source of the structure previously found in home sign systems? It is unlikely that it is influenced by the structure of Spanish, because the home signers have virtually no access to spoken or written Spanish (they cannot hear the spoken Spanish around them, and they know very few people who are literate). Furthermore, if spoken Spanish were a significant influence on home signers' gestures, we might expect to observe effects on gross characteristics like word order. For example, we might expect that the presence of a common spoken language in the environments of all three home signers would be reflected in a common gesture order preference among them. However, we have already seen that each of the three home signers in the current series of studies has his own preferred word order, and that each expresses this word order using spatial devices not found in Spanish (or indeed, in any other spoken language).

One obvious potential source of the structure we have observed in home signers' gesturing is their mothers' gestures. A common feature in the home signers' environments is that each mother uses gestures to communicate with her child, though to varying degrees. Goldin-Meadow and Mylander's (1990b) comparisons of American mothers' gestural input to their deaf homesigning children indicated that the patterns produced by the children could not be attributed to the mothers' gesturing. One of their primary arguments is that the mothers rarely produced gesture strings, probably because their gestures usually occurred while they were speaking.

In contrast to the American mothers, mothers of Nicaraguan home signers gesture prolifically, perhaps because they tend not to speak while they gesture. These observations led us to ask what kinds of gestures and gesture patterns Nicaraguan mothers make available to home signers to build their systems, and whether home

signers make use of these gestures and patterns. Note that we are being somewhat generous in attributing structure found in the mothers' gestures to the mothers themselves. It is certainly possible that mothers have learned structured gesture patterns from their children, the home signers. While home sign systems are developed collaboratively between a home signer and his family, it is possible that the influence of family members is limited to providing raw material for lexical items and handshape and movement repertoires. However, the direction of learning would only become an issue if indeed the mothers are producing consistent patterns that are similar to those produced by their children.

We know from previous work with hearing adults that gesturing without speech differs in important ways from gesturing with speech. I will elaborate on these differences below. In the next study, we asked whether the gesturing of the home signers' mothers is consistent with the type of gestures produced by hearing, English-speaking adults, as reported in the literature. The first question is whether mothers of Nicaraguan home signers produce gesture sequences when they are not simultaneously speaking, whereas such gesture sequences are rarely produced during the running speech of mothers of American home signers, and indeed, among American adults in general. We then compared the gesture patterns produced by the Nicaraguan home signers and their mothers to determine whether the mothers could have been the source of their children's patterns.

4.1. Gestures produced by hearing people with speech

Hearing people tend to gesture only once per clause while speaking, precluding either word order patterns or phrase structure in most of their gesturing. Evidence for these kinds of structures would require at least three concatenated gestures; however, such multi-gesture strings are rarely, if ever, produced by individuals while speaking

(McNeill, 1995) (16). Consistent with these results, the parents of very young American home signers studied by Goldin-Meadow and her colleagues (1984) did not even produce many two-gesture combinations in their interactions with their deaf children, making the parents an unlikely source of complex linguistic structure. Recall that, in accord with the oral methodology and training, these parents were speaking while they were gesturing, and they were consciously trying not to use gesture to communicate with their children. Thus, for many reasons it is not surprising that they did not produce many multi-gesture strings. If we could induce hearing people to remain silent while gesturing, what would their gestures look like? If the parents of home signers did not speak while they gestured, and thereby produced a large number of gesture strings, what would the structure of those strings be? To address the first question, I will review the evidence on the gestures of hearing people when they are not speaking; the next experiment (Experiment 2) addresses the second.

4.2. Gestures produced by hearing people in the absence of speech

Goldin-Meadow, Singleton, & McNeill (1996) compared the properties of gestures produced with and without speech. They used a series of brief videotaped vignettes (17) to elicit short gesture narratives from hearing people who had had no exposure to a sign language. For both the speech and no-speech conditions, they analyzed which semantic elements were conveyed by participants, in what order(s) they appeared, and how often objects were explicitly conveyed. The vignettes were structured as follows: 20 vignettes contained one moving object (M) engaged in an action (A) (e.g., broom moves across screen), and 20 vignettes showed two objects, a moving object

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16 Also see Duncan (1996), who found that Chinese adults gesture more than American adults in an experimental narrative situation.

17 These vignettes comprised the Verbs of Motion Production, developed by Supalla, Newport and colleagues to study this verb class in ASL.

(M) and a stationary object (S), engaged in an action (e.g., a motorcycle drives up to a tree). They found that, in contrast to the gestures that accompany speech, gesture sequences produced *without* speech exhibited segmentation and hierarchical structure, both of which are properties of human language as well as of human communication in general.

In both conditions participants produced gestures for the Action (A) most often, followed by the Stationary Object (S), followed by the Moving Object (M). The overall relative placement of the gestures was S M A, which does not follow the traditional order of semantic elements in English, which would be M A S. Participants produced MA most often, followed by SMA, followed by SA. Objects were more likely to be explicitly conveyed in the gesture-only condition. Participants could do this either lexically, by producing a separate gesture for the object, or by incorporating a handshape for the object into the action gesture. The level of redundancy (objects expressed both via a separate gesture and by incorporation into the action gesture) was higher in the gesture-only condition (39%) vs. the gesture and speech condition (7%). Goldin-Meadow et al. showed that the gestures produced by hearing adults in the gesture-only condition are characterized by the properties of segmentation and hierarchical combination, like those of the home signers she and her colleagues have studied. However, the gestures produced in the gesture + speech condition are not characterized by these properties (like the mothers of the home signers studied by Goldin-Meadow, who always spoke when they gestured). The authors conclude that segmentation and hierarchical combination are *resilient* properties of symbolic human communication when they are forced to assume the full burden of communication.

Hammond & Goldin-Meadow (2001) extended these findings, showing that English-speaking hearing adults use a consistent gesture order to describe two types of events. The two event types are those in which actors move in space (e.g., a mouse running to

a hole) and those in which actors act on objects (e.g., a mouse eating cheese). Participants used similar non-English orders when describing both types of scenes. For example, to describe a scene in which a mouse runs to a hole, speakers produced HOLE MOUSE RUN. While speakers produced this order consistently, it is not typical of English. Hammond and Goldin-Meadow speculate that while the idea to order gestures may come from participants' knowledge of English, the actual order may come from a natural way of ordering elements in scenes of these types. In their data, gestures for stationary and moving objects tended to come before those representing actions. This tendency is consistent with the fact that in natural languages, goals appear to be salient: cross-linguistically, they are systematically marked and they are never dropped.

Singleton, Morford, & Goldin-Meadow (1993) complemented the above studies by focusing on a different dimension of structure: they asked whether gestures are organized into a system of internal contrasts. That is, do participants use the same handshape to refer to the same object throughout the task? Using the same vignettes, they compared the gestures of participants in three different groups: 1) David, one of the home signers studied by Goldin-Meadow; 2) Hearing adults; and 3) Hearing children matched for age to David. They found that while David's gestures formed a contrastive system with respect to form-meaning relationships, the hearing controls rarely used the same handshape to refer to the same object throughout the task. Hearing participants tried to faithfully represent the objects, which hindered their ability to generalize objects to semantic classes. That is, they used a form-referent mapping. Home signers, on the other hand, organized their gestures with respect to one another (a form-form mapping, which they refer to as a "problem space"). The authors suggest that the time available to develop the system might play a role in this difference. That is, perhaps home signers originally represented referents, like the hearing participants, but then developed internal contrasts over time as they were able to isolate the components of forms and generalize them to classes.

Further exploring the gesture-sign language continuum, Dufour (1993) studied the development of grammatical structure in the gestured narratives produced by hearing people. He asked participants to tell stories in gesture, without speaking, over a period of five or seven sessions. Dufour sought to determine if and when participants' gestures ceased being holistic and became sequential. He found that even in the first session, participants produced sequences of gestures in which each gesture represented part of a proposition. This rapid development of language-like properties is consistent with the results of Bloom (1988), who conducted a similar gesture narrative task. Bloom also observed sequential gesture production, as well as extremely rapid development of structure at the lexical level, which manifested itself in the production of nouns. One participant exhibited strong tendencies to lexicalize multi-gesture sequences referring to nouns, reducing the form of these sequences (two separate gestures becoming one complex gesture) and producing them far more quickly at the end of the narrative than at the beginning.

The gesture order patterns produced by the participants in Dufour's studies were remarkably consistent over time. However, unlike the results described above, the gesture orders were not always the same across participants. This difference is likely due to differences in the materials used across studies: while the Goldin-Meadow et al. gesture studies have all involved events of motion, Dufour's study involved a wider range of event and verb types. The most frequent gesture order pattern was **Agent-Action-Theme** (corresponding to SVO, the predominant word order in English), but participants also used gesture order patterns that were not English-like. One participant preferred an **Agent-Theme-Action** (SOV) order, and this was the second most frequent order for the remaining participants. All participants in one study (6/6) showed verb-agreement-like structures for both concrete (e.g., walk) and abstract (e.g., tell) events, and these referential uses of space increased over the course of the study. While these uses of space resembled verb agreement in ASL,

they did not display all of the components of verb agreement. For example, participants would set up abstract referents in space, but then fail to move the verb gesture from the correct location in space, or they would move the verb from one location to another without having previously set up abstract spatial referents. Dufour concluded that the syntactic complexity of these gestured narratives was greater than that found in contrived gesture systems, but less complex than that of young home signers' gesture systems. That is, while participants produced referential uses of space not found in some kinds of conventionalized gestural communication systems (e.g., in the gesture systems of sawmill workers and monks (Bakarat, 1975; Meissner & Philpott, 1975)), they did not produce complex features like recursion found in early home sign systems (Goldin-Meadow, 1982).

Casey (2000) conducted another study of hearing adults' gestural uses of space, looking specifically at the directional markings that could be added to a gesture. She presented adults with video segments of two characters engaged in simple events and asked them to describe the event using only gesture. Two conditions were tested: The Photograph-present condition and the Photograph-absent condition. (The use of photographs in the Photograph-present condition is reminiscent of the use of dolls in Coppola et al., 1997.) As in Dufour's study, the participants had had no exposure to a sign language; yet, they produced directional action gestures to indicate referents in both conditions (with more directionality produced in the Photograph-present condition). These results accord well with those of Dufour, and suggest that gestural uses of space can develop rapidly in both a single-event elicited context as well as in a narrative context.

Gershkoff-Stowe and Goldin-Meadow (1997) examined the effect of a communication partner on the development of consistency in a gestural communication system. They asked whether participants in this situation would establish a systematic way of combining gestures to form an elementary syntax. They

also asked whether participants would develop a consistent and stable lexicon of gestures that reveals internal standards of form. They presented pairs of hearing, same-sex adults who had had no exposure to a sign language with short videotaped vignettes, and asked one member of the pair to communicate the event gesturally to his or her partner. Two conditions were tested. In the Feedback condition, each member of the pair took turns acting as the listener; in the No Feedback condition, there was only one participant, and the experimenter, acting as the listener, provided no feedback. How did this work? One member of the pair would gesture each event to the listener, and then the listener was free to ask questions (in gesture) regarding the event, and the gesturer could respond in gesture. When the listener was satisfied, she would write down what she thought the event was. Every 10 items they would switch roles.

Gershkoff-Stowe and Goldin-Meadow found that participants gestured more (in terms of both types and tokens, as well as time spent gesturing) in the Feedback condition than in the No Feedback condition. Participants represented all semantic elements (Action, Moving Object, and Stationary Object) 100% in the Feedback condition, but not in the No Feedback condition. Gesturers were quite successful at conveying their message, and successful communication increased over the course of the task for Objects (60% to 84%), but remained unchanged for Actions (68%). As in Goldin-Meadow's previous study using these stimuli, SMA order was most frequent for gesturers in both conditions, but participants in the Feedback condition produced this more often (resulting from the fact that they were more likely to produce all three semantic elements than were the No Feedback subjects). Gershkoff-Stowe and Goldin-Meadow also analyzed the consistency of the handshapes used in the gestures. However, this was only calculated within-category, and thus they could not determine whether participants' handshapes were organized into a system of internal contrasts. Participants in the No Feedback condition were more consistent in their use of handshapes, but they tended to produce the same handshape with *and* across

categories, thus providing little information about the class of object they were trying to describe.

At the lexical level, the authors conclude that having a communication partner increases the number and types of gestures in a gesture lexicon. The increased size of the lexicon may push participants to reorganize their lexicons, and thus to develop an internally consistent and contrastive system. In accord with Dufour's findings, at the syntactic level they found an immediate tendency to produce a stable gesture order regardless of whether a partner was present. As in the previous studies of gesturing without speech, this ordering pattern did not reflect the order in participants' spoken language (English), but emerged with the act of gesturing itself. Gershkoff-Stowe and Goldin-Meadow speculate that the modality (i.e., the use of space or movement) introduces structure to gestures.

4.3. Gestures produced by the parents of home signers

Goldin-Meadow and Mylander (1998) presented the first cross-cultural and cross-linguistic comparison of gestures produced by young home signers and their mothers. They compared the gesture patterns produced by the mothers of young Chinese and American home signers, and found that the home signers, across cultures, shared the same overall production probability patterns for certain semantic classes, while their mothers did not. Specifically, the children all showed a pattern in which gestures for intransitive actors ("mouse" in MOUSE RUN) and patients ("cheese" in CHEESE EAT) were more likely to be produced than were gestures for transitive actors ("mouse" in MOUSE EAT CHEESE). These production probabilities are a structural analogue to the ergative pattern found in a subset of the world's languages, in which intransitive actors and patients pattern together in the syntax. (See Chapter 5 for a discussion of ergativity.) Gesture order was analyzable for two of the eight children studied (the others did not produce enough multigesture sentences to allow analysis of gesture order). Both of these children (one American, one Chinese)

produced gesture orders that were consistent with an ergative pattern. Though their specific patterns differed, both children consistently placed patients and intransitive actors in the first position in 2-element sentences.

More recent cross-cultural comparisons of maternal gesturing conducted by Goldin-Meadow and Saltzman (2000) showed that Taiwanese mothers gesture more to their deaf *and hearing* children than American mothers gesture to their deaf children. Thus, it may be possible that Nicaraguan mothers provide richer gestural input to their deaf children than American mothers do. While we cannot travel back in time to collect samples of the mothers' gestural input during the development of these home sign systems, the mothers' current gesturing is a reasonable estimate of the maximum consistency and complexity that they could have provided to their deaf children.

What might we expect from Nicaraguan mothers based on these previous studies? Recall that Goldin-Meadow and her colleagues found that the structure in young deaf children's home sign systems was not derived from the gestures produced by their mothers. The American mothers in those studies were pursuing an oral education approach with their young deaf children, which likely influenced their gesturing. Nicaraguan mothers, unencumbered by the constraints placed on their gesturing by an oral education approach, appear to be more fluent gesturers than American mothers. Unlike the American mothers, Nicaraguan mothers did not accompany their gestures with speech, did not avoid gesturing with their children in favor of speaking, and always produced sequences of gestures in their elicited responses.

To determine if the mothers' gesture patterns could be a source of the structure we have observed in the home signers' gesture systems, we compared their performance on the elicitation task described in Chapters 2 and 3. One possible outcome is that the mothers will not show consistent patterns in their gestures over the items in the task. That is, when one looks across the responses, one might find no reliable indicators, either in gesture order or movement, to identify which character performed which

role in an event (was it the boy or the girl who did the pushing?). If a mother's responses show this kind of inconsistency, then it is clear that she could not have been the source of the consistent structure found in her son's gesturing. If, on the other hand, her responses are consistent over the course of the task, and one can reliably identify the semantic roles from her gesture patterns, then we must take a closer look at those patterns to see if they match those produced by her son. If a mother's patterns are internally consistent but differ from those produced by her son, it is unlikely that her gesturing is the source of the structure found in his gestures. Only in the case where a mother's gesture patterns are the same as those produced by her son need we be concerned about which of them might have created the patterns and which of them might have learned the patterns from the other.

4.4. Experiment 2: Mothers' gestural marking of semantic contrasts

4.4.1. Participants

The participants were the mothers of Home Signers 1, 2, and 3; at the time of testing they were aged 50, 33, and 47, respectively.

4.4.2. Stimuli

The home signers' mothers were tested using the identical stimuli from Experiment 1 (see Chapter 2 and Appendix A for details and descriptions of stimulus items).

4.4.3. Procedure

Testing with Mothers followed exactly the same procedure as did testing with Home Signers (each mother gestured her responses to her son). All responses were videotaped and transcribed.

4.4.4. Coding and Analysis

The coding and analysis proceeded in an identical fashion to Experiment 1. Mothers' responses were transcribed and coded for gesture segmentation, order, and

movement. We then asked whether each mother's responses showed patterns in the ordering or movement of gestured elements referring to characters who have different semantic roles in the events. Finally, we compared each Mother's gesture patterns to those produced by her son (18).

4.4.5. Results: Comparison of Mother 1 and Home Signer 1 gesture patterns

Mother 1's predominant word order is **actor patient act (patient),** produced in 8 of 19 utterances, compared with **act actor patient** for Home Signer 1 (Table 4; most frequent patterns are in bold type). The rest of her utterances were roughly equally distributed among three other word order categories. However, these other categories exhibited much unsystematic variation within them (indicated by "+" at the end of the category description). Thus, it is unlikely that these utterances were rule-governed variations of the gesture order shown in the first category. Most important, the mother's most frequent gesture order pattern, **actor patient act (patient),** differs markedly from that produced by Home Signer 1, **act actor patient**. Therefore, it is unlikely that his predominant word order, which he uses quite consistently, is modeled on his mother's gesturing.

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18 Comparisons were made to Home Signers' 1996 patterns.

Table 4. Comparison of Home Signer 1 and Mother 1 response patterns.

Home Signer 1: act actor patient	**#**	**Mother 1: actor patient act**	**#**
act PT-actor PT-patient ($_A$TRACE$_P$)	**11/19**		
act $_A$TRACE$_P$#	4/19		
		actor patient act (patient)	**8/19**
		patient actor act +	3/19
		actor act +	4/19
		actor act patient +	4/19
Other	4/19	Other	0/19
Total	19/19	Total	19/19

4.4.6. Results: Comparison of Mother 2 and Home Signer 2 gesture patterns

Mother 2, in contrast to Mother 1, is extremely consistent in ordering her gestures to indicate contrasting semantic roles. She produces essentially the same gesture pattern in 19/20 utterances: **PT-actor PT-patient act** (Table 5). However, Home Signer 2 produces an **actor act patient** pattern most often. The response types are presented in the same order from top to bottom across the Home Signer and Mother portions of the table to facilitate comparison of particular orders.

In ten of her nineteen consistent responses, Mother 2 produces only **PT-actor PT-patient act,** in that order. In 9/19 responses, she produces additional gestures with very structured variations. These groupings appear to function to emphasize or clarify the direction of the event. For example, she produced the following sequence three times (3/9): **PT-patient, PT-actor PT-patient**. In one response she produced this sequence at the beginning of the sentence, followed by the verb. The resulting sentence is her most frequent order, **PT-actor PT-patient act**, with an extra point at the Patient at the beginning of the sentence. She produced this grouping at the end of another response, after her most frequent gesture pattern. The resulting utterance is:

PT-actor PT-patient act <u>PT-patient,</u> PT-actor PT-patient. The third occurrence follows a false start (she produced the first two gestures of her canonical pattern, followed by a pause, then the full canonical pattern, then the **PT-patient, PT-actor PT-patient** grouping. Again, this additional group of gestures appears to emphasize the Patient and highlight the direction of the action. Unlike Home Signer 2, Mother 2 produced no TRACE gestures, though the phrases described above appear to serve the same function.

Table 5. Comparison of Home Signer 2 and Mother 2 response patterns.

Home Signer 2: actor act patient	**#**	**Mother 2: actor patient act**	**#**
(act) (PT-actor) $_{(A)}$act$_{(P)}$ (PT-patient) (act)	**13/19**		
PT-actor PT-patient act	1/19	**PT-actor PT-patient act**	**19/20**
Other spatial modulations	5/19		
Other	0/19	Other	1/20
Total	19/19	Total	20/20

The other structured variations produced by Mother 2 at the end of her canonical pattern include a reaction act gesture (act_2) associated with the Patient (as we observed in Home Signer 3—for example, act_1 would represent 'push' and act_2 would represent 'fall-back') followed by a point at the Patient (PT-patient). The resulting order, **PT-actor PT-patient act_1 act_2 <u>PT-patient</u>** occurred 3 times (3/9), with one occurrence repeating the final **act_2 PT-patient**] sequence. Other additional gestures produced at the ends of utterances included one point at Home Signer 2 (her interlocutor); three responses contained gestures describing an inanimate object (e.g., box, ball) present in the pictures of events; one repetition of the verb followed by a **PT-actor**; and one sentence that contained gestures describing the box and then act **PT-actor**. In one response, Mother 2 repeated her entire canonical sequence exactly, except that the repetition contained only the handshape for the act gesture, and not the associated movement.

As can be seen from these responses, Mother 2 is very consistent in indicating grammatical roles via her gesture order. Only one of nineteen responses deviates from her canonical pattern. Variations beyond her canonical pattern are quite structured. Mother 2 also produces some multigesture sequences that appear to serve the function of the TRACE gesture, though she did not produce any TRACE forms. However, her canonical pattern **PT-actor PT-patient act** differs from that of Home Signer 2 **actor act patient**. Furthermore, unlike Home Signer 2, she did not produce any spatial modulations on her gestures. These differences strongly suggest that Mother 2's gestures are not the model for Home Signer 2's gesture system.

4.4.7. Results: Comparison of Mother 3 and Home Signer 3 gesture patterns

Mother 3, like Mother 2, shows a canonical gesture order in her responses; she produced **actor patient act,** with some structured variation, in 9/20 utterances. In contrast, Home Signer 3 produces a canonical **patient, actor act** order (Table 6) (19). Four of the nine responses produced by Mother 3 are simply **actor patient act** or exact repetitions of **actor patient act**. Four of the remaining utterances vary slightly, but systematically, from this pattern. In two utterances, [act] or **actor act** is repeated at the end. One utterance contains a [locL] gesture, in which Mother 3 uses a neutral handshape to indicate a spatial location. In another response, the act gesture moves toward the Patient location; this response may also contain reduced articulations of **PT-actor PT-patient**, a sequence found in the canonical order.

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19 Though they were not included in these analyses, 12/27 of Mother 3's second responses were also of the form **actor patient act**. This pattern seems to be her modal response.

Table 6. Comparison of Home Signer 3 and Mother 3 response patterns.

Home Signer 3: patient, actor act	#	**Mother 3: actor patient act**	#
$NP_{patient}$, NP_{actor} act	**21/40**	patient, actor act	3/20
NP_{actor}, $NP_{patient}$, NP_{actor} act	4/40		
NP_{actor} act_1 $NP_{patient}$ act_2	8/40		
(NP_{actor} act) ($NP_{patient}$ act), (NP_{actor} act)	5/40	actor act (patient) (act)	8/20
		actor patient act	**9/20**
Other	2/40	Other	0/20
Total	40/40	Total	20/20

4.4.8. Results: Summary of Mother/Home Signer comparisons

Mothers' and Home Signers' most frequent gesture order differs in every case (see Table 7).

Table 7. Most frequent gesture order for each Home Signer/Mother pair.

	Home Signers	**Mothers**
1	**act PT-actor PT-patient**	**actor patient act (patient)**
2	**actor $_{(A)}act_{(P)}$ patient**	**PT-actor PT-patient act**
3	**patient, actor act**	**actor patient act**

Mothers 2 and 3 each show a predominant gesture order that reflects their own internally consistent way of marking grammatical roles in this task. Mother 3 shows more variation across and within response types than does Mother 2, but these variations are all quite structured. While Mother 1 uses one gesture order more often than the others, this pattern does not appear to reliably indicate grammatical roles, and the variation present within that category and across the other categories is not systematic. While Mothers 2 and 3 are internally consistent, crucially, their most frequent gesture order differs markedly from the predominant order produced by their

sons. Mother 1's most frequent gesture order, though not systematically used, does not correspond to her son's.

An important point to notice is that Mothers 1, 2, and 3 all show the same most frequent gesture order **actor patient act**. While the mothers are not speaking Spanish while gesturing, this ordering may reflect influence from spoken Spanish. This order is the same as the order in spoken Spanish for sentences using pronouns: Subject-pronoun Object-pronoun Verb. In contrast, the Home Signers use neither the same orders as their mothers nor as spoken Spanish. Each Home Signer uses a distinctive order not characteristic of their gestural input.

Chapter 5: The nature of the structure found in home sign

5.1. The nature of grammatical categories

Coppola, et al. (1997) and results from the previously described studies, as well as previous work by Goldin-Meadow and colleagues, showed that structure exists in home sign systems. However, in those studies the events described by home signers were predominantly concrete actions on physical objects, and the coding of word order and other structural devices was confined to semantic categories such as 'Actor' and 'Patient.' One of the hallmarks of established languages is the existence of abstract grammatical categories that transcend the semantic level of analysis. For example, while nouns tend to refer to people, places, and objects, this tendency is not absolute. Some parts of speech, like gerunds, pattern as nouns in the grammar even though they refer to actions. Moreover, while the notion of grammatical subject often corresponds to the agent role in a sentence, not all subjects of sentences are agents. For example, while none of the underlined noun phrases in the following examples takes the same semantic or thematic role, they are all subjects in English:

- John opened the door. "John" is an *agent*.
- The door opened. "The door" is a *theme* or *patient*.
- The key opened the door. "The key" is an *instrument*.
- The wind opened the door. "The wind" is an *instigator*.

The data from these previous studies did not address the question of whether home sign systems show such abstract grammatical categories. Therefore, we designed Experiments 3 and 4 to address the question of whether one needs to appeal to an abstract grammatical category such as "subject" in order to adequately characterize the patterns in the home sign data. Experiment 3 addresses this question by asking whether a description of a home sign system using only semantic categories is sufficient. If home signers use the same syntactic and morphological devices to mark contrasts in grammatical roles across items in which the arguments bear a range of

semantic roles (e.g., Actor, Experiencer, Patient, and Theme), then we can only explain the patterns in the data by appealing to a more abstract grammatical notion such as "subject."

5.2. Criteria for subjecthood

Keenan (1976) suggested that there is no fixed set of criteria that will categorically identify a given noun phrase as a subject, but that there are common criteria across languages. He therefore proposed multi-dimensional criteria for subjecthood: For a particular noun phrase, the greater the number of subject properties it has, the more prototypical a subject it is. Keenan's analysis is based on the typical properties of subjects in "basic" sentences of a language (i. e., those that are the simplest syntactically), and it is intended to apply cross-linguistically. He notes a large number of properties associated with subjects, only some of which are relevant for young languages like home sign systems. Of the following list, adapted from Keenan (1976), only the first four appear feasible to systematically elicit in the context of a simple, emerging grammar like a home sign system.

Subjects:

1. Occupy a characteristic position in the sentence (word order) or show characteristic distribution (e.g., predictable absence).
2. Control verb agreement
3. Carry overt subject case marking in languages that mark case.
4. Express the agent of the action, if there is one (though see the section on Ergativity below)

5. Can control reflexive pronouns
6. Can control coreferential deletions (e.g., coordinate conjunctions, serial verb constructions, and deletions in sentence complements when coreferential with matrix NPs) and pronominalizations

7. Are the most likely targets/endpoints of "advancement" transformations (e.g., Passive in English advances direct object to subject). That is, they hold the leftmost position in an implicational hierarchy of advancement (any language in which obliques can advance to object position also allows objects to advance to subjects, but the converse is not true).
8. Can be relativized, questioned, and clefted.
9. Can undergo raising (e.g., (a) *John believed Fred to have struck the gatekeeper* vs. (b)**John believed the gatekeeper Fred to have struck.*
10. Can always be expressed by morphologically independent, possibly emphatic, pronouns.
11. Show the maximum number of pronominal distinctions in number, etc.

5.3. Ergativity and other issues regarding the notion of Subject

In some languages the notion of a subject is controversial. More precisely, the source of the controversy is the notion that only one noun phrase in a sentence carries all the subject properties. This situation occurs frequently in a subset of the world's languages that are classified as ergative languages (Manning, 1996). Ergative languages have a different pattern of case marking than that found in traditionally studied Indo-European languages. In the "accusative" pattern found in Indo-European languages, the agent of a transitive verb (A) and the actor of an intransitive verb (S) share the same case marking (nominative case); this contrasts with the accusative case marking found on the patient of a transitive verb (O) (Dixon, 1972; 1979). In ergative languages, however, it is the actor of an intransitive verb (S) and the patient of a transitive verb (O) that share case marking, receiving absolutive case, with the agent of a transitive verb (A) marked with the ergative case. From this foundation in case marking, the term "ergative" has been generalized to other subsystems of language in which S and O pattern together, and A is treated differently. This difference in patterning has led linguists to question whether ergative languages have a fundamentally different syntactic characterization from

accusative languages. For example, by complicating the mapping from semantics to syntax, the ergative pattern challenges the assumption that (in a basic active sentence) the agent should take the role of subject. This notion has often been considered a language universal, but it may need to be re-evaluated in the context of ergative languages.

Manning (1996), citing Chomsky (1957), argues for the inclusion and assimilation of ergative languages into our concept of basic grammatical primitives. Indeed, he argues that the difficulty of incorporating ergative languages into our concept of grammatical subject suggests that our traditional characterizations of it may need refinement. Because the syntactic processes found in ergative languages are generally familiar, there is no reason to think that linguists need not characterize their syntactic primitives in a general way, along with those of accusative languages. This process becomes more difficult when, as noted above, more than one noun phrase in a sentence carries subject properties. In these cases, a choice must be made in order to bring the analysis of ergative languages into alignment with the analysis of accusative languages. The ergativity question arises here in part due to the data patterns discovered by Goldin-Meadow and her colleagues in the gestures produced by very young home signers. We will address these issues further in Experiment 4.

5.4. Origins of grammatical categories: Evidence from language acquisition

As is the case in studies of other grammatical systems, the relevance of the subject properties set forth by Keenan is determined by answering the following question: Does one *need* to mention a particular grammatical relation in describing grammatical structure? This question has been addressed in other areas of emerging language. For example, in the very early stages of language production, children initially rely on semantic roles to structure their utterances. However, Hyams (1984) found that even very young children properly extend the notion of "subject" to noun phrases with a

range of semantic roles. A question naturally raised by these results, especially in the context of seeking evidence for such syntactic categories in an emerging linguistic system, is the origin of children's apparent syntactic knowledge. McNeill (1966a; 1970a; 1970b; 1971) proposed that the basic deep structure of children's utterances (and of all languages) is syntactic and that knowledge of basic grammatical relations is innate (e. g., Subject of a sentence, Predicate of a sentence, Verb of the verb phrase, Direct Object of the verb phrase). In contrast, Schlesinger (1971) asserts that the components of the structural relationships of children's utterances are semantic (e. g., agent, action, object, and location), and they are determined by general innate cognitive capacity of the child. However, neither of these explanations seems satisfactory.

Bowerman (1973) provides analyses of the productions of three children (two Finnish and one American) that address the nature of the deep structures and structural relationships in children's utterances. In attempting to ascertain the nature of these structural relationships in child language, Bowerman faced many challenges. Child language is an emerging system; consequently, children tend to produce short, simple sentences. Children's productions may therefore not be complex enough to be evaluated with respect to the subject criteria set out by Keenan. Bowerman notes one problem stemming from transformational theory's definition of the grammatical relation "Subject of": "the deep structure Subject of a sentence defined as the noun phrase immediately dominated by S." She concludes that there is no basis for making the case for the abstraction of subject in children's language because it lacks transformations that require the notion of Subject (i.e., its surface structure is equivalent to its deep structure). She then outlines a series of more specific additional issues which preclude the evaluation of child language with respect to the subject properties noted by Keenan.

The analysis of home sign systems faces similar challenges. Thus, we are compelled to begin exploring these issues by asking about the criteria for abstract grammatical

categories in a way that does not require large quantities of complex data. In the present studies we examined whether structural properties of utterances observe domains that are consistent in grammatical structure but cross semantic categories.

The work of Maratsos and Chalkley (1980) addresses the origin and representation of syntactic categories, noting that they are not equivalent to semantic categories, and positing reasons why this may be the case. They observe that the symbols we use to characterize syntactic categories refer to the correlated uses of forms (e.g., Noun and Verb) in a set of semantic-distributional-phonological contexts, and not to innate givens or inherent semantic characteristics. Yet one cannot fail to observe the striking tendencies towards the clustering of form class categories around various semantic poles. For example, if agency is *not* a central organizing principle for the grammatical properties of noun phrases, why does it so accurately predict the following grammatical privileges in Indo-European languages: case marking, NP argument position, pronominal usage, and number agreement? Another example comes from a different level of linguistic organization: Why do the major form classes adjective, verb, and noun cluster so strongly around the poles of action, state, and object reference, if these are not due to a basic conceptual division among these entities?

Maratsos and Chalkley acknowledge these semantic-syntactic clustering tendencies, but argue that they are not reliable. They cite evidence from language typology, namely, that ergative languages mark patients uniformly in transitive and intransitive sentences, in contrast to Indo-European languages, which mark agents similarly across transitivity. They also consider Bloom's (1975) acquisition data, which find no evidence that children use agents to organize their concept of grammatical subject. This would certainly be a predicted result if agency were an organizing principle of the notion of subject. Finally, they note that the semantic boundaries of form classes overlap. Because there are systematic ways for terms in one form class to mark the

semantic characteristics of another form class, they encroach upon each other and are therefore unreliable.

Maratsos and Chalkley speculate that the mismatch of semantic and syntactic levels of analysis may have arisen from the difficulty of semantically classifying all terms and concepts in a clear fashion. However, this may not be a major issue faced by home signers in the construction of a simple and limited communication system. Maratsos and Chalkley also speculate that this mismatch is related to the availability of correlated semantic-distributional uses of terms. However, this explanation is not relevant to the formation of home signs, which are created by their users and are not acquired from uses in the input.

5.5. Experiment 3: Grammatical categories in home sign systems

We designed Experiment 3 to elicit evidence to evaluate the structures of home sign systems with respect to Keenan's and other linguistic criteria for subjecthood. One of the hallmarks of subject noun phrases cross-linguistically is the range of semantic roles they display. While the subject of a sentence will most likely be the Agent if there is one in the sentence, many other semantic roles can be assigned the Subject (including Experiencer, Patient, and Theme (Jackendoff, 1988; Fillmore, 1968)). Consequently, the current design investigated the breadth of semantic roles of arguments that are treated syntactically as Subjects.

5.5.1. Participants

The participants were the three home signers described in Chapter 2. The home signers' ages at testing were 14, 18, and 23. We also tested a control group of hearing native English speakers to ensure that the videotaped narratives elicited the descriptions we intended.

5.5.2. Stimuli

The stimuli consisted of 23 1-argument events and 54 2-argument events, for a total of 77 test items. Within each of these groups, we varied the semantic roles and

animacy of the arguments. The primary semantic roles were Actor (person performing an action); Experiencer (person experiencing a psychological or emotional state); Patient (person being acted on or manipulated); and Theme (inanimate object). The secondary semantic roles were Reference Object, Identificational Reference Object, and Location. (Table 8 provides example items displaying all factors in the design: the full set of combinations of semantic role categories and animacy of arguments; and examples of video representations.) Primary semantic roles are potential subjects cross-linguistically; secondary semantic roles include noun phrases that are not treated as subjects cross-linguistically, but which may combine with Non-Actor roles (Experiencer, Patient, and Theme) in which the Non-Actor role, as the primary semantic role, is treated as the subject (Jackendoff, 1988). Secondary role arguments were included to increase the number of item types in which the primary role is a Non-Actor. In each role type, arguments were Human, Inanimate, or Abstract (Abstract arguments appeared only in items including an Identificational Reference Object or Location).

We videotaped two actors, a man and a woman, engaged in the events (with inanimate objects where appropriate) and edited these videos into short clips that averaged about 4 seconds in duration. These video clips were then randomly ordered and were presented, one at a time, to the participants (see Procedure below). For ease of presentation (we did not want the task to be too long for participants) we divided the items into two approximately equal sets. (Appendix C contains the full set of stimulus items categorized by subtype.) The subsets were counterbalanced with respect to the semantic roles of the arguments and their animacy status, as well as (for human arguments) with respect to which actor (the man or the woman) occupied the primary semantic role.

Table 8. Example events and semantic role categories in Experiment 3.

1-Argument Events				**2-Argument Events**			
Semantic Role Categories	Animacy	Events	*Example item*	Semantic Role Categories	Animacy	Events	*Example item*
Actor	H	Run	***Woman*** *runs*	**Actor**-Experiencer	H-H	Frighten	***Man*** *frightens woman*
				Actor-Patient	H-H	Kiss	***Man*** *kisses woman*
				Actor-Theme	H-I	Break	***Woman*** *breaks pencil*
Experiencer	H	Be happy	***Man*** *is happy*	**Experiencer**-Patient	H-H	See	***Woman*** *sees man*
				Experiencer-Theme	H-I	Fear	***Man*** *fears mask*
Patient	H	Sneeze	***Woman*** *sneezes*	**Patient**-Identificational Reference Object	H-abstract	Is a doctor	***Man*** *is a doctor*
				Patient-Location	H-abstract	Sit in shadows	***Woman*** *sits in the shadows*
				Patient-Theme	H-I	Lose bracelet	***Woman*** *loses a bracelet*
Theme	I	Fall	*Paper falls*	**Theme**-Experiencer	I-H	Frighten	*Mask frightens woman*
				Theme-Location	I-abstract	Be in the spotlight	*Cup is in the spotlight*
				Theme-Reference Object	I-I	Obstruct	*Block of wood obstructs toy truck*

H = Human; I = Inanimate

5.5.3. Procedure

We presented each participant with a short videotaped vignette depicting a simple event, and asked him to describe the event to his interlocutor (the participant's mother, sibling, or a friend who gestures frequently with the participant). In this analysis, Home Signer 1 gestured to his best friend of the same age; Home Signer 2 gestured to his younger brother; and Home Signer 3 gestured to his mother. For each vignette, we placed an array of four pictures in front of the interlocutor. The interlocutor's task was to choose the picture corresponding to the home signer's gestured description. The purpose of this task was to ensure that the participant described the event in full and did not merely name an object or an action, and not, in fact, to test the interlocutors' comprehension. All responses were videotaped and transcribed.

The arrays were structured as follows (See Table 9 for schematic comprehension arrays for 1- and 2-argument events): The first picture corresponded to the event being described (the target). For the 1-argument events, the second picture (Foil 1) showed the other actor engaged in the event (e.g., if the target event was "woman sneeze," Foil 1 depicted "man sneeze"). For 2-argument events Foil 1 showed the same actors engaged in the event but with their roles reversed. The third picture (Foil 2) showed the primary argument of the target engaged in an unrelated event (e.g., if the target was "woman sneeze" then Foil 2 was "woman run"). The fourth picture (Foil 3) also varied depending on the number of arguments in the target. For 1-argument targets, Foil 3 showed the other actor engaged in a different event with an inanimate argument (e.g., if the target was "woman sneeze," this picture might be "man drop ball"). For 2-argument events, Foil 3 showed the patient (or secondary argument) of the target involved in a different, 1-argument event (e.g., for a target of "man kiss woman" Foil3 might be "woman fall"). Target and foil placement in the comprehension array was randomized for each item.

Table 9. Experiment 3: Structure of comprehension arrays for 1- and 2-argument stimulus items.

1-argument events	Target: Woman sneeze	Foil 1: Man sneeze
	Foil 2: Woman run	Foil 3: Man drop ball
2-argument events	Target: Man kiss woman	Foil 1: Woman kiss man
	Foil 2: Man push chair	Foil 3: Woman fall

5.5.4. Analysis

While many patterns of results are possible, we might expect from previous results that Home Signers will mark the grammatical roles of arguments in events using devices found in sign languages of the world, such as word order or spatial modulations on gestures. In the present analyses, we seek a principled patterning across semantic roles in the way that a given home signer marks grammatical roles. For example, we might observe that in one-argument events, all arguments, regardless of semantic role, would be treated the same way (e.g., will take the same word order position in a sentence). Such a pattern would be consistent with the notion of Subject described by Keenan and others. Alternatively, we might observe that, while all actor arguments take a certain word order position, non-actor arguments might not be restricted to that position. Such a pattern would suggest that the language might not yet have developed the notion *Subject,* but rather is organized in terms of the simpler and more concrete category *Actor*. Yet another factor that might influence the expression of arguments in both 1- and 2-argument events is the animacy of a particular noun (Comrie, 1988; Croft, 1990, 1991): Animate nouns might pattern differently than inanimate nouns. In addition to these possibilities, we might expect differences across the participants in their organization and grammatical expression of semantic roles. We analyzed the results for each participant individually to determine whether the semantic role and the animacy of an argument affects the devices that are used to express it in the participant's gesture system.

We conducted three analyses of the data from Experiment 3, and observed that participants typically marked the primary argument in an event using word order, rather than using spatial devices. Analyses 1 and 2 focused on the word order position of the gesture expressing the primary argument in an item within a target clause (see below for criteria). We coded patterns for sub-categories of items bearing the same role or combination of roles, and compared the positions of the primary arguments across these subcategories. The main question here concerned comparing the word order position for Actors to those of Non-Actors (Experiencers, Patients, and Themes). We also compared these results with the gesture order patterns produced by the same home signer participants in previous studies. Taken together, we were able to use the results from the current study to determine whether assignment of an abstract grammatical category like "subject" is appropriate for each participant.

In Analysis 3, we assigned each full response to a word order category, and generalized the typical word order produced by each home signer to describe each sub-type of event. Full responses differ from target clauses in that they may include gestures referring to the secondary argument, while the target clauses do not always include such gestures. For example, in cases where two predicates were used to describe an event, each would often take its own argument (e.g., Man come in, woman be frightened).

5.5.5. Selecting responses for analysis

Before reporting the results, I will describe the procedures followed in the analyses regarding target and item selection. For each item, we analyzed the first response produced by the participant that contained a complete *target clause*:

1) Within a response, clauses were defined using the prosodic criteria described in Chapter 2. These criteria included pauses, eye gaze, holds, head position, head nods, and the rhythm of gesture production[MEVC15]. Intercoder reliability for clause boundaries was .90 overall.

2) The *target clause* was defined as the clause containing gestures referring to both the primary argument and the action or event depicted in an item. For example, for the Actor-Patient item "Man kiss woman," the target clause must contain a gesture referring to the man (Actor), and a gesture referring to the action "kiss." For the vast majority of items, no selection was required-- the target clause simply consisted of the entire response, which formed a single clause (20). Responses that did not include any clauses containing both of these elements could not be coded for the grammatical devices under examination, and were therefore excluded from the analyses.

5.5.6. Coding primary argument position

Within the target clause, noun phrases (expressions referring to the people and objects of the target event) were coded for word order position, both within the target clause and within the whole response. In the coding, the order of the argument noun phrases and the action gestures were the primary gestures considered. Thus, for example, the noun phrase was coded as occurring in *clause-initial position* if the gesture was the first noun or noun phrase, regardless of whether it was preceded by other non-argument gestures (for example, gestures pointing to the location of the object (like adverbs) or referring to an attribute (like adjectives or potential relative clauses).

5.5.7. Verifying the categorization of items

To determine whether the videotaped segments we created elicited the types of descriptions we intended in the experimental design, we videotaped 8 hearing, native English-speaking participants describing each event in English. We used the identical materials, and followed exactly the same procedure outlined above for the home signers: Each English-speaking participant described each item to a communication partner who had to choose the picture of the corresponding event from the

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20 For Home Signer 1, 34/34 target clauses consisted of the entire response; for Home Signer 2, 20/35; and for Home Signer 3, 30/37. Denominators from Analysis 2 (Matching items) are reported.

comprehension array. We transcribed these responses, and for each response determined which argument (which semantic role) was expressed in the Subject position. We pooled the data across participants, and noted for each item whether the semantic role treated as the subject by the English speaker matched our assignment of primary role in the experimental design.

Based on this analysis, we divided the items into three categories: Matching, Mixed, and Non-Matching. Items in which 7 or 8 English speakers out of 8 used the primary semantic role as the subject were placed in the Matching category. That is, these items did succeed in eliciting subject marking in a language (English) in which we know there is a grammatical category "Subject." The Mixed category contained items in which 4 to 6 participants used the primary semantic role as the subject in their response, but 2 to 4 did not. The Non-Matching category contained items to which 0 to 3 participants produced matching responses. Items in this category apparently may not succeed in eliciting the target subject marking even in a language (English) where the category "Subject" is available, and therefore may not be viewed by most observers as depicting the precise event we aimed to depict. (For example, an event targeted as "The mask frightened the woman" might have been described by English speakers as "The woman jumped.") Table 10 shows the number of items originally in each item subtype, and the numbers of items that were placed into each of the above categories based on the English speakers' responses. Results on home sign will be presented below not only with reference to the target classification of items, but also with respect to how the items were treated by English speakers.

Table 10. Categories of items based on English speakers' treatment of primary role.

Argument roles (PRIMARY/secondary)	**Number of items in original design**	**Matching**	**Mixed**	**Non-Matching**
TOTAL ACTOR as primary argument (combined 1- & 2-argument)	**24**	**19**	**3**	**2**
actor	4	4	0	0
ACTOR/experiencer	5	1	2	2
ACTOR/patient	7	6	1	0
ACTOR/theme	8	8	0	0
2-argument ACTOR total	20	15	3	2
TOTAL NON-ACTOR: Experiencer, Patient, and Theme as primary argument (combined 1- & 2-argument)	**42**	**18**	**12**	**12**
experiencer	5	3	1	1
EXPERIENCER/patient	7	0	2	5
EXPERIENCER/theme	5	2	1	2
2-argument EXPERIENCER total	12	2	3	7
EXPERIENCER total	17	5	4	8
patient	8	4	4	0
PATIENT/identificational reference object	4	0	0	4
PATIENT/location	4	3	1	0
PATIENT/theme	6	4	2	0
2-argument PATIENT total	14	7	3	4
PATIENT total	22	11	7	4
theme	7	6	1	0
theme/EXPERIENCER	4	0	0	4
theme/LOCATION	3	2	1	0
theme/REFERENCE OBJECT	6	3	0	3
2-argument THEME total	14	7	3	4
THEME total	20	11	2	7

Overall, the English speakers' responses matched the target responses better for primary roles that were Actors rather than Non-Actors. Most items did match their targets, but some did not. The following item subtypes never elicited the primary argument as the subject: Experiencer-Patient (e.g., Man fear woman), Patient-Identificational Reference Object (Woman is a teacher), and Theme-Experiencer (Mask frighten woman). These items were therefore excluded from the analyses.

Other combinations of roles often did not elicit the desired arguments in the roles we had intended: 2-argument events with Experiencer or Patient as the primary argument and Theme-Reference Object combinations. English participants only produced an Experiencer as the subject of their response about half the time in 2-argument events. For example, the Experiencer-Theme item "Woman see mask," instead led to sentences such as "There is a mask on the table and the woman walks in."

Two-argument items which have Theme as their primary argument were also excluded from the analyses based on the distribution of responses from English speakers. Though some responses did treat the Theme as the subject, the responses to the Theme-Location and Theme-Reference Object categories were split equally regarding which (the Theme or Location/Reference Object) was the subject. This distribution suggests a symmetry of expression for these role combinations in spoken languages (which was also reflected in the home signers' responses). Sign languages typically express the arguments in Theme-Theme or Theme-Location combinations simultaneously; home signers often did this, precluding analyses of word order. When arguments were produced sequentially, as might be expected, we obtained mixed responses from both language groups regarding which role was considered primary.

English provides many more lexicalized, complex, 2-argument-taking verbs to describe events; home signers are operating with fewer lexical items, and tend toward

serial verb-type constructions for events like "frighten" in which one can break down the action into two separate events (The man comes in, and the woman is frightened). English speakers often use this type of two-predicate construction to describe such events, so it is not solely a consequence of using a language system that is not fully developed.

5.5.8. Analysis

We analyzed the home signers' responses in two ways: Analysis 1 includes all items for which there was a complete target clause, while Analysis 2 excludes those items for which the English speakers' responses were Mixed or Non-Matching. Both sets of analyses yielded very similar results, albeit with fewer items available for Analysis 2. The results section for each participant will begin with a brief review of the gesture order patterns produced by that home signer in previous studies (which focused on the expression of Actor-Patient relations in physical events and actions) and a comparison to those produced for these types of events in the current study. The main presentation of the present results then begins by describing the position of the noun phrase referring to the primary role for items having Actor as the primary role, and comparing that pattern to the position of the noun phrases produced for items having Non-Actors as the primary role. Similarity between Actor and Non-Actor patterns would suggest that an abstract grammatical category like "subject" is appropriate to characterize the patterns observed in the data. I will conclude by comparing the treatment of noun phrases referring to animate (in this study, human) and inanimate arguments. Examples of possible animacy effects are differences in the order used to express Actor-Patient relations compared with Actor-Theme relations, or Experiencer-Patient vs. Experiencer-Theme relations.

5.5.9. Results: Home Signer 1

In previous studies conducted in different years, Home Signer 1 used two different patterns to express Actor-Patient events involving concrete physical actions. In 1996, he strictly followed an **act actor patient** ordering, combined with a spatial device

called a TRACE that moved from a location associated with the actor to a location associated with the patient. In 1998, he predominantly placed the actor before the act gesture, and the actor almost always appeared first. The relative placement of the patient gesture was not regular. Further, he did not use the spatial device at all. In the present study, as detailed below, he primarily used an **actor patient act** gesture order, and again did not use the TRACE spatial device, though he occasionally did spatially modify his act gestures.

5.5.9.1. Home Signer 1: Analyses 1 and 2

The first question of interest is how sentences describing actors as the primary role express this actor role. These data are presented in the top section of Table 8. Recall that Analysis 1 includes all items for which there was a complete target clause, while Analysis 2 includes only the Matching items (those on which the English speakers produced the target response). Because the patterns were very similar for both analyses across all home signer participants, I will cite the results for Analysis 2 in the text; however, the results for Analysis 1 are presented alongside those for Analysis 2 in the tables. Home Signer 1 was quite consistent in his treatment of these events, placing the gesture for the Actor first in 12/14 items (see Table 8, Analysis 2).

Table 11. Analyses 1 and 2: Primary argument position, Home Signer 1.

Proportion of items with primary argument appearing in first position		
Analysis 1: All items	**Analysis 2:** Matching items only	**Argument roles (PRIMARY/secondary)**
14/15	**12/13**	**TOTAL ACTOR** as primary argument (combined 1- & 2-argument)
3/3	3/3	**ACTOR**
1/1	0/0	**ACTOR**/experiencer
5/6	4/5	**ACTOR**/patient
5/5	5/5	**ACTOR**/theme
11/12	9/10	**2-argument ACTOR total**
32/35	**17/20**	**TOTAL NON-ACTOR**: Experiencer, Patient, and Theme as primary argument (combined 1- & 2-argument)
5/5	3/3	**EXPERIENCER**
6/6	0/0	**EXPERIENCER**/patient
4/4	2/2	**EXPERIENCER**/theme
15/15	5/5	**EXPERIENCER total**
8/8	4/4	**PATIENT**
2/4	1/3	**PATIENT**/location
2/2	2/2	**PATIENT**/theme
12/14	7/9	**PATIENT total**
5/6	5/6	**THEME**
5/6	5/6	**THEME total**

The question of particular interest in this study is whether the same marking pattern (in this case, as the initial noun in the sentence) will also be used for potential subjects that are not actors. Home Signer 1 did in fact show the same word order pattern overall for events with Non-Actor (Experiencer, Patient, or Theme) primary roles, placing the gesture for the primary role first in the target clause in 17/20 items. Only one sub-category did not follow this pattern: Patient-Location, in which the Patient came first in the target clause in only one out of three responses. The Patient-Location category appears to be treated in a symmetric fashion, similar to the Theme-

Theme category described earlier. The expression of arguments seems to depend more on the framing of the event for Patient-Location items than it does in other categories.

Overall, then, Home Signer 1 expresses Actor and Non-Actor primary arguments in the same way, by placing them first in clauses. Further, there are no distinct patterns based on specific semantic roles. Because these responses encompass a range of semantic roles, it appears that we must appeal to the abstract grammatical category "subject" to characterize the patterns observed in the data.

5.5.9.2. Home Signer 1: Analysis 3

Recall that Analyses 1 and 2 focused only on the target clause (the clause containing a gesture referring to the primary argument). Analysis 3 goes beyond Analyses 1 and 2 by examining larger segments of participants' responses, including phrases, that referred to secondary arguments. These phrases and clauses were set off from the target clause prosodically, and could appear before or after the target clause. Occasionally participants expressed events without explicitly referring to the primary argument, and instead, produced gestures referring only to the secondary argument and predicates related to one or both arguments. Analysis 3 (Table 12) shows the most frequent overall word order pattern produced for each item sub-type, along with the number of responses showing that pattern.

Home Signer 1 showed a consistent word order pattern in each subtype, as can be seen from the high proportions of responses following the most frequent word order pattern. However, there is not a perfectly uniform word order across all subtypes. Examining the ways that Animate and Inanimate arguments are treated reveals mixed influences of animacy, mostly occurring in relation to the secondary argument. Animate primary arguments (Actors, Experiencers, and Patients) are placed first in both 1- and 2-argument events, as are one-argument Inanimate primary arguments

(Theme). (Two-argument events with Theme as the primary argument and animate secondary arguments did not elicit the intended semantic roles and/or events and were therefore excluded from analyses. In addition, 2-argument Theme events with inanimate secondary arguments were expressed in a symmetric fashion, making it difficult to distinguish a hierarchy.) However, we do observe some ordering differences in two-argument combinations in which the secondary arguments contrast in animacy, such as Actor-Patient and Actor-Theme. While animate Patient arguments tend to precede the act gesture, inanimate Theme arguments tend to follow the act gesture. That is, the overall word order was Subject-Object-Verb when the Object was a Patient (that is, a person acted upon or manipulated), but it was Subject-Verb-Object when the Object was a Theme (that is, an inanimate object).

Table 12. Analysis 3: Word order patterns by item subtype, Home Signer 1.

Argument roles (PRIMARY/secondary)	**Most frequent word order pattern**	**Proportion of responses following most frequent pattern**
ACTOR	**Actor** act.	3/3
ACTOR /experiencer	**Actor** act. [Experiencer experiencer-pose.]	1/1 [5/5]
ACTOR /patient	**Actor** (patient) act.	4/5
ACTOR /theme	**Actor** act theme.	3/5
EXPERIENCER	**Experiencer** experiencer -pose.	3/3
EXPERIENCER /patient		0/0
EXPERIENCER /theme	**Experiencer** theme experiencer -pose. **Experiencer** experiencer-event-theme.	[1/1] [1/1]
PATIENT	**Patient** event/patient-pose.	4/4
PATIENT/location	**Patient** patient-pose location. Location **patient**-pose. Event adverb **Patient**.	1/1 1/1 1/1
PATIENT/theme	**Patient** event (theme).	2/2
THEME	**Theme** event.	5/6

5.5.10. Results: Home Signer 2

In previous studies, Home Signer 2 used an **actor act patient** order to express Actor-Patient events involving concrete physical actions. He also used two types of spatial devices in conjunction with this basic gesture order. The first is a TRACE gesture, similar to that used by Home Signer 1, that moved from a location associated with the actor to a location associated with the patient. In the second device, Home Signer 2 spatially modified his act gestures, moving them away from a location associated with the actor, or towards a location associated with the patient. Either of these movements could occur alone, or they could occur in combination. In the small number of items that did not strictly follow these patterns, the actor gesture always preceded the patient gesture.

5.5.10.1. Home Signer 2: Analyses 1 and 2

In the current study, Home Signer 2 was quite consistent in his treatment of events in which Actor was the primary semantic role, placing the gesture for the Actor first in 13/15 items (see Table 13, Analysis 2). Home Signer 2 was also very consistent in his treatment of arguments bearing Non-Actor (Experiencer, Patient, or Theme) primary roles, placing them first in the target clause in 19/20 items. In Analysis 1 (where all items are included, especially many Experiencer items excluded in Analysis 2), the same consistency appears over an even greater number of Non-Actor items (32/36).

These data show that Home Signer 2 expresses Actor and Non-Actor primary arguments in the same way, by placing them first in clauses. Further, there are no patterns based on specific semantic roles. Because these responses encompass a range of semantic roles, we must appeal to the abstract grammatical category "Subject" to characterize the patterns observed in Home Signer 2's data.

Table 13. Analyses 1 and 2: Primary argument position, Home Signer 2.

Proportion of items with primary argument appearing in first position		
Analysis 1: All items	**Analysis 2:** Matching items only	**Argument roles** **(PRIMARY**/secondary)
16/18	**13/15**	**TOTAL ACTOR** as primary argument (combined 1- & 2-argument)
3/3	3/3	**ACTOR**
3/3	1/1	**ACTOR**/experiencer
5/7	4/6	**ACTOR**/patient
5/5	5/5	**ACTOR**/theme
13/15	10/12	**2-argument ACTOR total**
32/36	**19/20**	**TOTAL NON-ACTOR**: Experiencer, Patient, and Theme as primary argument (combined 1- & 2-argument)
4/5	3/3	**EXPERIENCER**
6/7	0/0	**EXPERIENCER**/patient
3/3	2/2	**EXPERIENCER**/theme
13/15	5/5	**EXPERIENCER total**
8/8	4/4	**PATIENT**
4/4	3/3	**PATIENT**/location
2/3	1/2	**PATIENT**/theme
13/15	8/9	**PATIENT total**
6/6	6/6	**THEME**
6/6	6/6	**THEME total**

5.5.10.2. Home Signer 2: Analysis 3

Table 14 shows the high degree of consistency of Home Signer 2's word order patterns in each item subtype. As for Home Signer 1, comparing the treatment of Animate and Inanimate arguments revealed an influence of animacy on the word order position of the secondary argument only. Animate primary arguments (Actors, Experiencers, and Patients) were placed first in both 1- and 2-argument events, as are one-argument Inanimate primary arguments (Themes). With respect to secondary arguments, like Home Signer 1, Home Signer 2 showed an ordering difference for the Actor-Patient vs. Actor-Theme categories. However, his pattern is opposite that of

Home Signer 1's: When a gesture for the patient or theme is produced, animate Patient arguments follow the act gesture (Subject-Verb-Object), while inanimate Theme arguments precede the act gesture (Subject-Object-Verb).

Table 14. Analysis 3: Word order patterns by item subtype, Home Signer 2.

Argument roles (PRIMARY/secondary)	**Most frequent word order pattern**	**Proportion of responses following most frequent pattern**
ACTOR	**Actor** act.	**3/3**
ACTOR /experiencer	**Actor** act.	**1/1**
ACTOR /patient	**Actor** act (patient).	**5/6**
ACTOR /theme	**Actor** (theme) act.	**5/5**
EXPERIENCER	**Experiencer** state.	**3/3**
EXPERIENCER /patient	 Target clause: [**Experiencer** state/pose/action.] Full response: [Patient-phrase, **Experiencer**-phrase.] [**Experiencer**-phrase, patient-phrase.]	**0/0** [6/7] [5/7] [2/7]
EXPERIENCER /theme	**Experiencer** event-theme.	**2/2**
PATIENT	**Patient** event.	**4/4**
PATIENT/location	**Patient**-pose location.	**2/3**
PATIENT/theme	**Patient** event-theme.	**1/2**
THEME	**Theme** event/location/act.	**6/6**

5.5.11. Results: Home Signer 3

In previous studies, Home Signer 3 primarily used a **patient, actor act** order (the comma indicates a strong prosodic break after the patient gesture) to express Actor-Patient events involving concrete physical actions. He also used a second pattern for events in which the patient was particularly affected, such as "push": **actor act$_1$, patient act$_2$**, in which the act$_2$ or "react" gesture could be glossed as "get-pushed" or some other consequence of the pushing event, like "fall."

5.5.11.1. Home Signer 3: Analyses 1 and 2

In the current study, for events in which Actor was the primary semantic role, Home Signer 3 consistently placed the Actor gesture in the initial position in the target clause (in 16/19 items) (See Table 15, Analysis 2). Home Signer 3 treated Non-Actor (Experiencer, Patient, or Theme) primary roles the same way, placing them first in 14/18 items. Including all items in this analysis greatly increases the number of items in the Non-Actor categories, showing that Home Signer 3 still places these primary arguments in first position (32/37).

These data show that Home Signer 3 expresses Actor and Non-Actor primary arguments in the same way, by placing them in clause-initial position. The data show no patterns based on distinct semantic roles. Because the Actor and Non-Actor categories encompass a range of semantic roles, we must appeal to the abstract grammatical category "subject" to characterize the patterns observed in Home Signer 3's data.

Table 15. Analyses 1 and 2: Primary argument position, Home Signer 3.

Proportion of items with primary argument appearing in first position		
Analysis 1: All items	**Analysis 2:** Matching items only	**Argument roles (PRIMARY**/secondary)
21/24	**16/19**	**TOTAL ACTOR** as primary argument (combined 1- & 2-argument)
4/4	4/4	**ACTOR**
5/5	1/1	**ACTOR**/experiencer
5/7	4/6	**ACTOR**/patient
7/8	7/8	**ACTOR**/theme
17/20	12/15	**2-argument ACTOR total**
32/37	**14/18**	**TOTAL NON-ACTOR**: Experiencer, Patient, and Theme as primary argument (combined 1- & 2-argument)
5/5	3/3	**EXPERIENCER**
7/7	0/0	**EXPERIENCER**/patient
4/5	1/2	**EXPERIENCER**/theme
16/17	4/5	**EXPERIENCER total**
7/8	3/4	**PATIENT**
2/4	1/3	**PATIENT**/location
2/3	2/2	**PATIENT**/theme
11/15	6/9	**PATIENT total**
5/5	4/4	**THEME**
5/5	4/4	**THEME total**

5.5.11.2. Home Signer 3: Analysis 3

Table 16 shows the high degree of consistency of Home Signer 3's word order patterns in each item subtype (with the possible exception of Experiencer-Theme). As for Home Signers 1 and 2, comparing the treatment of Animate and Inanimate arguments revealed an influence of animacy in the secondary argument only. Animate primary arguments (Actors, Experiencers, and Patients) were placed first in both 1- and 2-argument events, as were one-argument Inanimate primary arguments (Themes). With respect to secondary arguments, yet again we observed ordering differences in the Actor-Patient and Actor-Theme categories. Home Signer 3's pattern is slightly different from those of Home Signers 1 and 2. Phrases referring to the patient are fronted and set off prosodically in 6/6 Actor-Patient responses, while fronting of the Theme argument occurs in only 2/8 Actor-Theme items. In addition, the theme can appear between the Actor and act gestures in Actor-Theme responses, a pattern which never occurs in Actor-Patient items. Yet again we see the simultaneous articulation of acts and themes, but not of acts and patients.

Table 16. Analysis 3: Word order patterns by item subtype, Home Signer 3.

Argument roles (PRIMARY/secondary)	**Most frequent word order pattern in target clause**	**Proportion of responses following most frequent pattern**
ACTOR	**Actor** (actor-phrase) act.	**4/4**
ACTOR/experiencer	**Actor** act.	**1/1** [5/5]
ACTOR/patient	**Actor** act (get-act).	**6/6**
ACTOR/theme	**Actor** (theme) act-(theme).	**6/8**
EXPERIENCER	**Experiencer**-phrase state.	**3/3**
EXPERIENCER/patient	[patient-phrase, **Experiencer** state.]	**0/0** [7/7]
EXPERIENCER/theme	**Experiencer-pose** event-theme. Event-theme, **Experiencer**-phrase.	**1/2** **1/2**
PATIENT	**Patient**-phrase event.	**3/4**
PATIENT/location	**[Patient** patient-pose +.]	**0/0** [4/4]
PATIENT/theme	**Patient** theme event-(theme).	**2/2**
THEME	**(Theme-**phrase) event-(theme).	**7/7**

5.5.12. Results: Summary of Analysis 2, All Home Signer participants

The notion of grammatical subject to some degree varies cross-linguistically, and does not have a perfectly defined set of characteristics. Nonetheless, researchers do agree on a central set of characteristics that occur for subjects in most or all languages. One central characteristic of grammatical subjects is that they are marked by a single syntactic device (such as a particular word order position) across a range of semantic roles. The results from Home Signers 1, 2, and 3 are concordant with each other, in this regard, as summarized in Table 17. Each participant treats a wide range of semantic role arguments similarly using a single syntactic device, by placing them in clause-initial position. We must appeal to an abstract grammatical category like Subject to adequately characterize this pattern. While there are many other criteria for subjecthood, and we have not examined all of them, the results concerning

this core feature of subjects in invented home sign communication systems are clear. Note that while the results across participants are in agreement, this pattern of results is not logically required. None of these participants has had contact with each other, and the analyses proceeded independently for each participant.

Table 17. Analysis 2: Proportion of items with primary argument appearing in first position, All participants.

Home Signer 1	Home Signer 2	Home Signer 3	**Argument roles** (**PRIMARY**/secondary)
12/13	**13/15**	**16/19**	**TOTAL ACTOR** as primary argument (combined 1- & 2-argument)
3/3	3/3	4/4	**ACTOR**
0/0	1/1	1/1	**ACTOR**/experiencer
4/5	4/6	4/6	**ACTOR**/patient
5/5	5/5	7/8	**ACTOR**/theme
9/10	10/12	12/15	**2-argument ACTOR total**
17/20	**19/20**	**14/18**	**TOTAL NON-ACTOR**: Experiencer, Patient, and Theme as primary argument (combined 1- & 2-argument)
3/3	3/3	3/3	**EXPERIENCER**
0/0	0/0	0/0	**EXPERIENCER**/patient
2/2	2/2	1/2	**EXPERIENCER**/theme
5/5	5/5	4/5	**EXPERIENCER total**
4/4	4/4	3/4	**PATIENT**
1/3	3/3	1/3	**PATIENT**/location
2/2	1/2	2/2	**PATIENT**/theme
7/9	8/9	6/9	**PATIENT total**
5/6	6/6	4/4	**THEME**
5/6	6/6	4/4	**THEME total**

Chapter 6: Discourse and syntactic factors in home sign

Experiment 3 showed that Home Signers 1, 2, and 3 consistently place the primary noun phrase in an utterance in clause-initial position across a range of semantic roles and event types. These results strongly suggest that each Home Signer has a grammatical category featuring the central characteristics of the notion of Subject. Experiment 4 addressed the necessity of invoking a syntactic notion of "subject" to characterize these patterns as compared with discourse notions like "topic." It could be the case that we have assigned the grammatical notion of "subject" to a system in which the arguments could be described as "topics" (Li, 1977; Schacter, 1976, 1977; Clark & Haviland, 1977). Linguists have long debated the necessity of syntactic properties as defining criteria for subjecthood. Schacter argues for the syntactic nature of role-based subject properties in Philippine languages (though many of these languages have subsequently been re-analyzed as having ergative structures (see Manning, 1996)). We designed Experiment 4 to distinguish these possibilities. Our goal was to find out whether noun phrases that show the properties of Subjects in home sign systems might be better characterized as Topics. Our strategy was to design narratives that pitted arguments with Subject properties against those with Topic properties to see if these noun phrases are treated differently.

6.1. Experiment 4: Distinguishing the notions of "topic" and "subject" in home sign systems

6.1.1. Participants

The participants were the three home signers described in Chapter 2 and, as a control group, the hearing native English speakers described in the Participants section of Experiment 3 in Chapter 5. We collected data from English speakers to ensure that the videotaped narratives elicited the descriptions we intended. Specifically, we examined whether English speakers treated the primary arguments in the initial and final sub-events as the Subject. We used the identical stimuli and procedure as we

did with the Home Sign participants, and we conducted the same analyses of their responses.

6.1.2. Stimuli

The stimuli were 14 videotaped vignettes, each consisting of 2- or 3-event narratives. There were 8 test narratives, 4 filler narratives, and 2 practice narratives. Narratives were about 60-90 seconds long; each sub-event within an item was set off by a very brief fade-in and fade-out. All narratives are presented in Appendix D. See Table 18 for the structure of two example test narratives.

In the test items, the primary argument changed over the course of the narrative; this allowed us to contrast the roles of Subject and Topic across the two characters and within the narrative. The filler and practice items maintained the same character throughout the narrative. In each test narrative, Character 1 was introduced as the primary argument (that is, intended to be treated as a Subject), in the first sub-event, designated the *Setup* event. Character 1 appears as an Actor in 5 items, and as a Non-Actor in 3 items. In the 3-event narratives, that same character (Character 1) appeared again as the intended Subject in the second sub-event (half the time as an Actor, and half the time as a Non-Actor). By the third sub-event, we expected Character 1 to be treated as old information (and thus to be considered the Topic). (The responses of English speakers provided a measure of support for this assumption.) The final sub-event in each narrative (either the second or the third sub-event) is the crucial *Test* event. In the *Test* event we introduced a new character (Character 2), who was always presented in the Actor role to facilitate its being treated as a Subject.

Table 18. Examples of Experiment 4 test items.

Narrative	Event type	Character 1	Character 2	Sub-event
1	Setup	Woman (Subject/Topic)		Woman is hot
		Woman		Woman takes off her sweater
	Test	Woman (Topic)	**Man (Subject)**	**Man** gives the woman a fan
2	Setup	Woman (Subject/Topic)	Woman	Woman arranges flowers
	Test	Woman (Topic)	**Man (Subject)**	**Man** kisses the woman

In our analyses, we examined the test items to see whether the device used for the initial central character (Character 1) in the first event (the Setup event) was also used to express the new actor (Character 2) in the final Test event. Because Character 1 in the Setup event is both a Subject and a Topic, similar treatment of Character 2 (the new actor and intended Subject) in the Test event would indicate that that device is marking Subject. On the other hand, use of the Setup device to mark Character 1 in the Test event (that is, to mark old information) would suggest that the device marks Topic. We compared the types of devices used to refer to Characters 1 and 2 (e.g., lexical nouns or spatial devices). We also compared the order that these gestures appeared in the sentence or clause, or the nature of the spatial marking on them, focusing particularly on when these characters were the topic vs. the potential subject of their clauses.

6.1.3. Procedure

We presented the narratives one at a time. The practice items were presented first and served to train participants to view all of the sub-events before responding. The majority of filler items were presented next, followed by the test items mixed with filler items. After viewing each narrative, we asked the participant to describe the series of events to his or her interlocutor. In these analyses, Home Signer 1 gestured

to his older brother; Home Signer 2 gestured to his younger brother; and Home Signer 3 gestured to his mother. (For English-speaking participants, the interlocutor was another English speaker.) Participants could re-watch the narrative as often as they liked. All gestured and spoken responses were videotaped and transcribed.

6.1.4. Analyses

The analysis proceeded as follows for both groups of participants. For test items that elicited multiple responses, I chose the first response to analyze. However, in some items the first response did not include gestures for all referent characters in the event. In those cases in which subsequent responses contained more of the target noun phrases to analyze (thereby permitting the intended analysis), I analyzed the subsequent response instead. Recall that the test items are those in which the primary argument (that we expected to be treated as the Subject) changed from the initial Setup event to the final Test event. For each sub-event, I noted whether the participant had expressed a gesture or spatial modulation referring to each character. For the analysis, I extracted those items that would allow comparisons of the treatment of noun phrases referring to Characters 1 and 2. That is, I selected the items in which Character 1 was expressed in the first or second sub-events *and* Character 2 was expressed in the final Test sub-event. (Items in which no gesture was produced for Character 1 in the first two sub-events and/or no gesture was produced for Character 2 in the final subevent could not be used for the present analysis (21).) For the retained items, I noted the type of device used to mark each Character: lexical noun, pronoun (for English speakers), phrase, pose, point, or spatial modulation. I then noted the word order position of the device, found in the "Position" column in the tables that follow.

The results will be presented first for the English speakers. These data will be used as a check on the effectiveness of the test items and, as described above, will be used to

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21 Home Signers 1, 2, and 3 each did not produce the required noun phrases for analysis in 2/8 items.

determine whether a test item should be kept or removed from the analysis. The home signers' data on the successful test items (those for which they produced analyzable responses) will then be presented, one participant at a time.

6.1.5. Results: English speakers

In terms of the factors described above in the Analysis section, all eight English-speaking participants responded in accord with the structure we assigned to test items. They marked Character 1 in the initial Setup event and Character 2 in the final Test event as primary arguments (Subjects) in all but one sub-event (63/64) (22). Based on these results, we concluded that each videotaped narrative effectively conveyed the event structures that we intended to the home signer participants. In addition, English participants' use of pronouns to refer to Character 1 in events subsequent to the initial Setup event indicated that they regarded Character 1 as "old" information (Topic). Thus, we included all test items in the following analysis.

6.1.6. Results: Home Signer 1

Home Signer 1 explicitly marked Character 1 in the first or second sub-events *and* Character 2 in the Test event in only two of the eight test items (see Table 19). (The cells containing information about the target arguments (that is, Character 1 in the initial Setup event and Character 2 in the final Test event) are shaded.) Within each of these two items, Home Signer 1 used the same device to refer to each target argument, placing them in initial position in the clause or phrase in which they appeared. In one item he expressed both characters using lexical nouns, and in the other he expressed both characters embedded in phrases.

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22 In that item, the participant used a passive construction to describe the event (e.g., "The woman is given a fan by the man"). She placed the primary argument (Character 2) of the final Test event in a by-phrase, and placed the old information (Character 1) in the Subject position.

Table 19. Home Signer 1: Comparison of the expression of Character 1 in the Setup event and Character 2 in the Test event.

Item	Character	Events	Position of Character 1 NP	Position of Character 2 NP	Same word order position used for Setup and Test target NPs?
3	Man Man Woman	Builds a structure Is pleased by the structure Takes a picture of the structure	1st NP	1st NP	Yes
8	Woman Man	Builds a house Knocks over the house	1st Noun	1st Noun	Yes
				Total	**Yes 2/2**

In three other items excluded from this analysis, Character 2 was expressed implicitly by movement of the act gesture. These items were not included in the above analysis because I did not consider spatial modulation of the act gesture as marking the character unless the character had explicitly been set up in that location prior to the spatial modulation. Thus, for these items, no comparison of the expressions of Characters 1 and 2 could be made. However, the relative roles in these three items, as shown below (Table 20), are expressed clearly by spatial modulations on the act gesture with respect to Character 1, with no explicit mention of Character 2. In all three cases Character 1 is marked, using spatial modification, as the "object" noun phrase (leaving Character 2 as the unexpressed subject).

Test Item 1, also included in Table 20, is like these three items in that the referent of the expression in the third sub-event (a point gesture toward the interlocutor) is not explicit. However, it differs from the items above in that its referent is ambiguous, and could refer either to the man or to the woman. In this item, Home Signer 1 referred to the woman in the second sub-event with a noun in first position. Then in

the third sub-event (Man gives woman a fan), he spatially modifies the act gesture (give) towards the right (in the direction of his brother, who served as his interlocutor for this task). He then points to his brother. Because no spatial locations have been previously associated with this direction, and no character has been associated with either the home signer or his brother, it is unclear with which role the point is associated. Two possibilities exist: He could be emphasizing that his brother is the man, and the one who performed the giving, or he could be indicating that his brother, representing the woman, is the recipient of the "give" gesture. If the latter is the case, and the point is associated with the woman, then the change in the position of the point is easily explained: instead of referring to the actor or subject of the event, it refers to the patient or object of the event. Act gestures (as well as verbs in signed languages) typically move towards patients and objects, and away from actors and subjects. Without further information regarding the intended role of the referent of the point gesture, we cannot classify this item. One piece of evidence suggesting that the point referred to the man is that the woman has already been identified explicitly with a noun.

Table 20. Home Signer 1: Comparison of the expression of target noun phrases for items with implicit or ambiguous expressions of Character 1 and Character 2.

Item	Character	Events	Device used for Character1	Device used for Character2	Word order position or spatially-defined referent of Device1	Word order position or spatially-defined referent of Device2
2	Woman	Cries	Lexical		1st Noun	
	Man	Gives the woman a handkerchief		Spatial		Act gesture moves toward implicit woman-role-character.
6	Man	Sleeps	Lexical		1st Noun	
	Woman	Taps the man	Spatial		Recipient of act (get tapped).	
7	Woman	Brushes her hair	Lexical & Setup	Lexical & Setup	In phrase, sandwiched between points at brother.	1st
	Man	Points at the woman		Spatial		Act gesture moves toward explicit woman-role-character, but man is not expressed.
1	Woman	Is hot				
	Woman	Takes off her sweater	Lexical		1st Noun	
	Man	Gives the woman a fan	(Point-brother?)	(Point-brother?)	2nd?	2nd?

Only two items were available for the original analysis of explicitly marked target arguments for Home Signer 1; in these cases he used the same devices to mark Character 1 in the Setup event and Character 2 in the Test event. In spite of the small number of items in the original analysis, Home Signer 1 clearly expressed the relative roles of target arguments using spatial modulations on act gestures with respect to Character 1, with no explicit mention of Character 2. Thus, the overall results for Home Signer 1, combining explicitly and implicitly marked target arguments,

indicate that he used devices appropriate for marking target arguments as Subjects rather than topics. While Subjects were not always explicitly expressed in these items, his movement of act gestures towards spatial locations associated with patients is suggestive of the grammatical category of Object.

6.1.7. Results: Home Signer 2

Home Signer 2's expression of noun phrases in the test narratives was very consistent. He explicitly marked Character 1 in the first or second sub-events *and* Character 2 in the final sub-event in six of the eight test items (see Table 21). In all six items, he used a noun to refer to each character. In five of six items he placed the noun referring to Character 1 in the initial Setup event in clause-initial position, and then in the final Test event put the noun referring to Character 2 in the same position. In the one remaining item, the noun was preceded by a grouping of elements containing gestures for the theme and the act ("structure" and "build"). This grouping of elements was prosodically set off from the "man" gesture; the main clause was then ordered exactly as in the other five items, with the noun phrase for Character 1 in the Setup events and the noun phrase for Character 2 in the final Test event both in first position in the clause.

Table 21. Home Signer 2: Comparison of the expression of Character 1 in the Setup event and Character 2 in the Test event.

Item	Character	Events	Position of Character 1 NP	Position of Character 2 NP	Same word order position used for Setup and Test target NPs?
2	Woman Man	Cries Gives the woman a handkerchief	1st Noun	1st Noun	Yes
3	Man Man Woman	Builds a structure Is pleased by the structure Takes a picture of the structure	1st NP	1st Noun	Yes
4	Woman Man	Arranges flowers Kisses the woman	1st Noun	1st Noun	Yes
6	Man Woman	Sleeps Taps the man	1st Noun	1st Noun	Yes
7	Woman Man	Brushes her hair Points at the woman	1st Noun	1st Noun	Yes
8	Woman Man	Builds a house Knocks over the house	1st Noun	1st Noun	Yes
				Total	**Yes 6/6**

6.1.8. Results: Home Signer 3

Like Home Signer 2, Home Signer 3's expression of noun phrases in the test narratives was very consistent. Home Signer 3 explicitly marked Character 1 in the first or second sub-events *and* Character 2 in the final sub-event in six of the eight test items (see Table 22). In all six items, he used the same device and ordering to express Character 1 in the Setup event as was used for Character 2 in the final Test event. In the remaining item, the marking of Character 1 (a pose gesture referring to

the woman) was articulated simultaneously with the act gesture (arranging flowers) instead of before it. (Because the gesture encompassing the simultaneous articulation of these two referents was in clause-initial position, as was the marking of Character 2 in the final event, I considered them the same.)

In all six items, he used a noun, a pose, or a phrase to refer to each character. In three items he placed this noun in clause-initial position. In Item 4, as described above, the pose was articulated simultaneously with the act gesture. In the remaining two items, the lexical noun referring to Character 1 in the Setup events was sandwiched inside an act gesture, whereas the expression of Character 2 was in first position in its clause.

Table 22. Home Signer 3: Comparison of the expression of Character 1 in the Setup event and Character 2 in the Test event.

Item	Character	Events	Position of Character 1 NP	Position of Character 2 NP	Same word order position used for Setup and Test target NPs?
1	Woman	Is hot	1st NP		
	Woman	Takes off her sweater	1st Noun		
	Man	Gives the woman a fan		1st Noun	Yes
3	Man	Builds a structure	1st Noun		
	Man	Is pleased by the structure			
	Woman	Takes a picture of the structure		1st Noun	Yes
4	Woman	Arranges flowers	1st NP		
	Man	Kisses the woman		1st Noun	Yes
6	Man	Sleeps	1st Noun		
	Woman	Taps the man		1st Noun	Yes
7	Woman	Brushes her hair	1st Noun		
	Man	Points at the woman		1st Noun	Yes
8	Woman	Builds a house	1st Noun		
	Man	Knocks over the house		1st Noun	Yes
				Total	**Yes 6/6**

6.1.9. Summary of results: Home Signers 1, 2, and 3

Across the task, each of Home Signers 1, 2, and 3 most often used structures in ways appropriate to marking arguments as Subjects (rather than Topics). That is, the device used to mark the primary argument in the Setup events – whether word order or another device – was also used to mark the new character (Character 2) acting as the initiator of the final Test event, as opposed to being used to mark the old Character 1 (see Table 23). Their responses are therefore more consistent with a syntactic notion of Subjecthood than they are with a pragmatic or discourse notion like Topic. These results suggest that the pattern we observed in Experiment 3 (clause-initial position for nouns bearing a range of semantic roles) is a reflection of the grammatical category Subject, and not a result of their being the topic, or old information, in these sentences.

Home Signer 1 had only a small number of responses available for analysis. However, his responses in items with implicit expressions of characters are quite consistent, and in each case he used a spatial device to identify the subject of the sub-event. The fact that he did not explicitly set up these abstract locations in space for each item is unsurprising, since this is a relatively late development in the acquisition of signed languages (Newport & Meier, 1985). He may also have relied on a setting up of characters early in the task that he continued to use, thereby obviating the need to explicitly identify spatial referents for succeeding items.

Table 23. Home Signers 1, 2, and 3: Similarity of the devices used for Character 1 in the Setup event and Character 2 in the Test event.

Item	Character	Events	Same word order position used for Setup and Test target NPs?		
			Home Signer 1	Home Signer 2	Home Signer 3
1	Woman Woman Man	Sweats/is hot Takes off her sweater Gives the woman a fan	(see Table 20)		Yes
2	Woman Man	Cries Gives the woman a handkerchief	(see Table 20)	Yes	
3	Man Man Woman	Builds a structure Is pleased by the structure Takes a picture of the structure	Yes	Yes	Yes
4	Woman Man	arranges flowers kisses the woman		Yes	Yes
5	Woman Woman Man	Breaks an egg in a bowl Scrambles the egg Brings the woman tortillas			
6	Man Woman	Sleeps Taps the man	(see Table 20)	Yes	Yes
7	Woman Man	Brushes her hair Points at the woman	(see Table 20)	Yes	Yes
8	Woman Man	Builds a house Knocks over the house	Yes	Yes	Yes
			Yes 2/2	**Yes 6/6**	**Yes 6/6**

Chapter 7: Conclusions

7.1. Summary of Experimental Results

Experiments 1, 3, and 4 provide novel evidence that the gestures of deaf adolescents and young adults not exposed to a conventional sign language display remarkable consistency and complexity. The degree of consistency and the nature of the structure described in these studies have not previously been observed in the very simple, semantically based home signing of very young deaf children. Coppola et al. (1997) showed that older home signers use stable, consistent word orders and grammatical devices to mark contrasts in the semantic roles (Actor and Patient) taken by arguments in a concrete action event. In this dissertation we have explored the nature of this structure to determine whether more mature home sign systems transcend these semantic categories. We have asked whether these gesture patterns reveal abstract grammatical categories, and specifically the category Subject. The results of Experiment 3 showed that this was indeed the case: Each participant systematically applied the same syntactic treatment (initial position in a clause) to nouns and noun phrases appearing as the primary argument of an event, regardless of its semantic role (Actor, Experiencer, Patient, or Theme). Experiment 4 provided evidence that these patterns could not be attributed to pragmatic factors (whether the noun was old information, or the topic). Taken together, the results suggest that a structural (syntactic) explanation is warranted to account for the data.

The notion of grammatical subject is difficult to define and varies cross-linguistically (see Chapter 4 for discussion). However, a central characteristic of grammatical subjects is that while they bear a variety of semantic roles, they are treated similarly at the structural (syntactic) level. The results from Home Signers 1, 2, and 3 are in accord with this criterion. While there are other criteria for subjecthood, not all of which have been examined here, the present results concerning this core feature of subjects in invented home sign communication systems are quite clear.

Some limitations must of course be noted on the interpretation and scope of the current results. First, we have analyzed a relatively small data set, especially for certain types of contrasts. Some types of sentences that are critical to these kinds of analyses are very difficult to elicit, especially using concrete pictorial and video stimuli. Thus, for example, few of our vignettes succeeded in consistently eliciting Theme-Experiencer sentences in native speakers of English (for example, Mask frighten woman). In natural settings such sentences are relatively rare and are elicited primarily by discourse or conceptual contexts, not by the structure of the event alone. For a particular event, speakers might say 'The girl jumped' or 'The girl was afraid of the mask' or 'The mask was ugly' just as readily as the target 'The mask frightened the girl.' We utilized English speakers to determine whether the stimuli uniformly elicited their targets. Since they sometimes did not, the number of items we could analyze for home signers was reduced. One way to enhance the richness and quantity of data in future studies examining this topic would be to develop more creative ways to elicit difficult contrasts based on approaches that were successful (as well as unsuccessful) in the current work.

We have examined one type of linguistic structure (abstract grammatical categories), and we discovered evidence for this aspect of language in mature home sign systems. We are not claiming that all aspects of developed languages are present in these systems, nor are we claiming that the language-like structure we have found places home sign systems on the same level of complexity or sophistication as established languages. We do think that these results can illuminate several long-standing issues in linguistics, psychology, and cognitive science.

7.2. Comparisons with previous home sign research

Before turning to the larger-scale implications of these results, I would like to compare the results obtained with older home signers to the results obtained by Goldin-Meadow and her colleagues working with young home signers. The most

striking difference in the two groups of participants is the greater complexity in the gesture systems used by the older home signers. The evidence presented here shows that older home signers exhibit consistent word orders, spatial devices, and a category that resembles grammatical Subject. These findings go well beyond the production probabilities of gestures exhibited in the home sign systems of very young deaf children.

One interesting question evoked by the current results is why older home signers produce more complex structures. At least two possibilities exist regarding the differences between the two groups: 1) Older home signers have a longer time to develop their systems than do younger home signers; or 2) Adulthood is a better period for home signers to develop more complex devices due to adults' more advanced general cognitive functioning. Other types of explanations are external to the learner: It could be that different levels of gestural input and/or the presence of a willing communication partner produce differences in the complexity of the end-state home sign system.

Another point of comparison between the current home sign findings and those of Goldin-Meadow and her colleagues is with respect to word order and ergativity. In the ergative pattern, found in a subset of the world's languages, intransitive actors and patients of transitive events pattern together in the syntax. Recall that young American home signers showed such a pattern, in which gestures for intransitive actors ("mouse" in MOUSE RUN) and patients ("cheese" in CHEESE EAT) were more likely to be produced than were gestures for transitive actors ("mouse" in MOUSE EAT CHEESE) (Goldin-Meadow et al., 1990). Young home signers across very different cultures (in the United States and Taiwan) produce this same ergative pattern (Goldin-Meadow & Mylander, 1998). The ergative pattern does not appear to hold in the current studies, though the small number of items involving intransitive actors does not allow this finding to be definitive. It is clear from the present results that older home signers differ in the basic word order they use, displaying several

different word order patterns common in the world's languages. In contrast, Goldin-Meadow and Mylander's (1998) young home signers all exhibited the same word order tendencies, even across cultures. These differences suggest that the uniform organization principles of early home sign may be in part a feature of young children's communication. Older and more developed home sign systems do not appear to be as uniform in their organization. Though each is well structured, the particular word orders and structural devices vary from one home sign system to another.

7.3. Contributions to related areas

Experiment 2 showed that the mothers of the home signers studied here are not the sources of the structure observed in their gestural systems. This result has potential implications for theories of language acquisition, especially regarding the relative contributions of a learner's internal tendencies and environmental input. The relatively high level of structure present in these home sign systems, and its manifestation in all three of the participants, suggest robust internal tendencies to organize language-like input on the part of the learner. In spite of the scarcity of raw materials available in their environment for creating language, these deaf individuals produce very systematic and well-developed language-like output. However, the variations we have observed in these gesture systems argue against specification of particular ways to express linguistic contrasts.

An interesting issue highlighted by the current findings is whether the organization of language-like input into a coherent, abstract system is driven by a language-specific mechanism. It is difficult to answer this question given the current paradigm, but it does seem clear from the current body of work that specifically linguistic input is not required to trigger the mechanism that foments such language-like structure.

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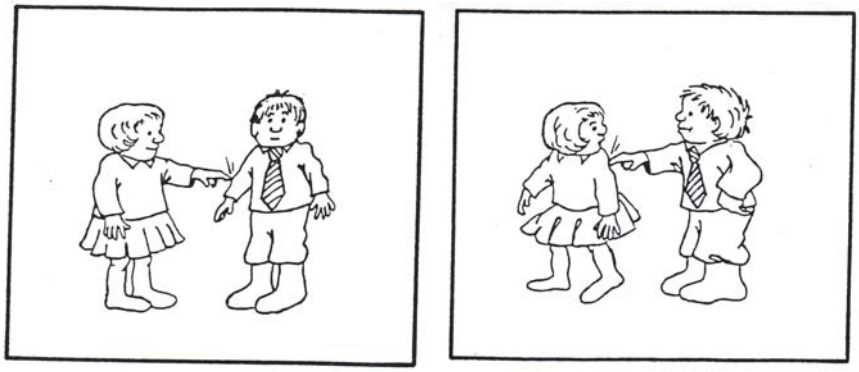
Appendix A

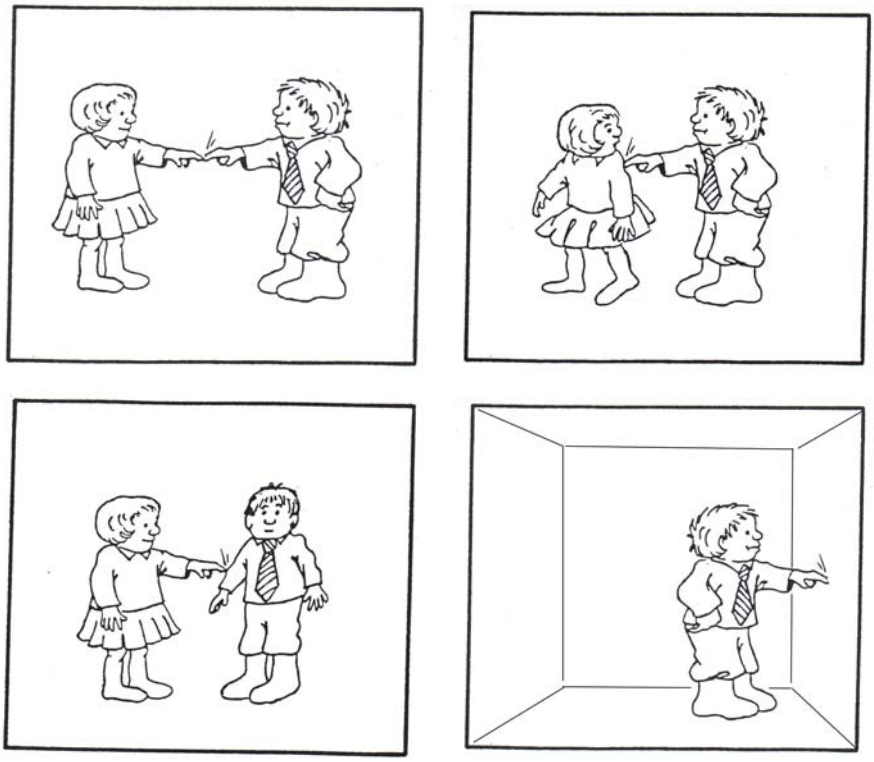
List of stimulus items, Coppola et al. (1997)

Item	Actor	Event+theme	Patient or Recipient
A	Boy	Throw+ball	Girl
B	Girl	Bite	Boy
C	Boy	Push	Girl
D	Girl	Throw+ball	Boy
E	Girl	Push	Boy
F	Boy	Bite	Girl
1	Girl	Give+box	Boy
2	Girl	Comb	Boy
3	Boy	Hit	Girl
4	Boy	Kiss	Girl
5	Boy	Hug	Girl
6	Girl	Hit	Boy
7	Girl	Shout	Boy
8	Girl	Kiss	Boy
9	Boy	Give+box	Girl
10	Boy	Shout	Girl
11	Girl	Touch	Boy
12	Boy	Like	Girl
13	Boy	Comb	Girl
14	Girl	Feed+ice-cream	Boy
15	Boy	Touch	Girl
16	Boy	Feed+ice-cream	Girl
17	Girl	Hug	Boy
18	Girl	Like	Boy
19	Boy	Yell	Girl
20	Girl	Yell	Boy

Sample counterbalanced item pair: “Boy touch girl” and “Girl touch boy”.



Sample comprehension array for the item “Boy touch girl”.



Appendix B

Reliabilities, Experiment 1, Home Signers, 1998:

Structure	Home Signer 1	Home Signer 2	Home Signer 3	Overall	
	Ratio	Ratio	Ratio	Ratio	Percentage
1) Sentence boundaries	12/12	8/8	12/12	20/20	1.00
2) Total number of gestures per sentence	36/37	46/47	102/103	185/186	.99
3) Overall identification of gesture class	36/37	46/47	102/103	185/186	.99
By class:					
Nominals (excluding Points)	18/19	32/33	45/46	96/97	.99
Acts	18/18	14/14	33/35	65/67	.97
Poses	0/0	0/0	8/9	8/9	.88
Points	0/0	0/0	15/15	15/15	1.00
4) Spatial modulations	0/0	0/0	0/0	0/0	1.00
5) Clause boundaries	3/4	7/7	26/29	36/40	.90

Reliabilities, Experiment 2, Mothers, 1998:

Structure	Home Signer 1	Home Signer 2	Home Signer 3	Overall	
	Ratio	Ratio	Ratio	Ratio	Percentage
1) Sentence boundaries	11/11	10/10	13/13	34/34	1.00
2) Total number of gestures per sentence	31/32	38/38	69/69	139/139	.99
3) Overall identification of gesture class	31/32	38/38	69/69	139/139	.99
By class:					
Nominals (excluding Points)	19/20	30/30	27/30	77/79	.98
Acts	11/11	7/7	25/27	43/45	.96
Poses	0/0	0/0	0/0	0/0	1.00
Points	1/1	1/1	14/15	16/17	.94
4) Spatial modulations	0/0	0/0	0/0	0/0	1.00
5) Clause boundaries	0/0	3/3	7/7	11/11	1.00

Reliabilities, Experiment 3, Home Signers:

Structure	Home Signer 1	Home Signer 2	Home Signer 3	Overall	
	Ratio	Ratio	Ratio	Ratio	Percentage
• Sentence boundaries	5/5	7/7	5/5	17/17	1.00
• Total number of gestures per sentence	15/15	24/27	29/30	68/72	.94
3) Overall identification of gesture class	15/15	23/23	28/29	66/67	.99
By class:					
Nominals (excluding Points)	9/9	10/10	14/14	33/33	1.00
Acts	4/4	10/10	5/6	19/20	.95
Poses	2/2	0/0	6/6	8/8	1.00
Points (including taps (e.g., on chair) and locatives (e.g., "in-pocket")	0/0	3/3	3/3	6/6	1.00
• Spatial modulations	0/0	0/0	0/0	0/0	1.00
• Clause boundaries	1/1	2/3	6/6	9/10	.90
• Identification of target clauses	13/14	12/14	12/14	37/42	.88

Appendix C

List of stimulus items, Experiment 3 (Grammatical categories in home sign systems). Primary arguments in bold.

1-Argument Events (23 items)			**2-Argument Events** (54 items)		
Semantic Role Categories	**Animacy**	**Events**	**Semantic Role Categories**	**Animacy**	**Events**
Actor (4)	H	Woman cries Woman runs Man stands up Man yells	**Actor**-Patient (16 total)	H-H	Man kisses woman Woman pushes man Woman hits man Man chases woman Woman touches man
			Actor-Theme	H-I	Man eats banana Man pushes chair Woman hits pillow Man throws ball Woman breaks pencil Woman sits in chair
			Actor-Experiencer	H-H	Woman frightens man Man surprises woman Man makes woman angry Man wakes up woman Woman wakes up man
Experiencer (5)	H	Woman is happy Woman is sad Woman is angry Man is afraid Man is hurt	**Experiencer**-Patient (12 total)	H-H	Man sees woman Woman sees man Man fears woman with mask Woman fears man with mask Woman smells man Man smells woman
			Experiencer-Theme	H-I	Woman sees mask Woman fears spider Man smells flowers Man dislikes banana Woman likes flowers Man smells shoes

1-Argument Events (24 items)			**2-Argument Events** (53 items)		
Semantic Role Categories	**Animacy**	**Events**	**Semantic Role Categories**	**Animacy**	**Events**
Patient (6)	H	Woman sneezes Man faints Man sleeps Woman falls Woman limps Man appears	**Patient-** Location (14 total)	H-abstract	Woman stands in the corner Man lies on the floor Man sits in the spotlight Woman crouches in the shade
			Patient- Theme	H-I	Man loses keys Man loses handkerchief Woman loses bracelet Woman loses sunglasses Woman drops ball Man misses ball
			Patient- Identificational Reference Object	H-abstract	Man is a doctor Woman is a teacher Man is a farmer Man is a cowboy
Theme (8)	I	Paper falls Ice melts Paper burns Cup is blue Stones disappear Flower floats Rug flaps Ball appears	**Theme-** Experiencer (12 total)	I-H	Mask frightens woman Gift surprises man Phone call makes woman happy Suitcase makes man tired
			Theme- Location	I-abstract	Cup is in the spotlight Ball is in the corner Rug is on the floor
			Theme- Reference Object	I-I	Block of wood obstructs a toy car Blocks of wood surrounds a banana Toy car sits on top of a block of wood Toy car hangs from a block of wood Candle is in the bowl of water

Appendix D

List of stimulus items, Experiment 4 (Distinguishing the notions of "topic" and "subject" in home sign).

#	Item Type	Sub-Event	Character	Event
A	Practice	1	Man	Wipes his forehead with a bandanna
		2	Man	Folds the bandanna
		3	Man	Puts the bandanna in his pocket
B	Practice	1	Woman	Washes a vase
		2	Woman	Puts flowers in the vase
		3	Woman	Knocks over the vase
1	Filler	1	Man	Dislikes a banana
		2	Man	Likes a banana
2	Filler	1	Man	Watches T.V.
		2	Man	Gets up and leaves his watch
		3	Man	Finds the watch
3	Test	1 (Setup)	Man	Sits in a chair
		2 (Test)	Man	Eats a banana
4	Test	1 (Setup)	Woman	Is hot
		2	Woman	Takes off her sweater
		3 (Test)	Man	Gives the woman a fan
5	Filler	1	Woman	Loses a pair of sunglasses
		2	Woman	Looks for the sunglasses
		3	Woman	Picks up the sunglasses
6	Test	1 (Setup)	Woman	Cries
		2 (Test)	Man	Gives the woman a handkerchief
7	Test	1 (Setup)	Man	Builds a structure
		2	Man	Is pleased by the structure
		3 (Test)	Woman	Takes a picture of the structure
8	Test	1 (Setup)	Woman	Arranges flowers
		2 (Test)	Man	Kisses the woman
9	Test	1 (Setup)	Woman	Breaks an egg in a bowl
		2	Woman	Scrambles the egg
		3 (Test)	Man	Brings the woman tortillas
10	Test	1 (Setup)	Man	Sleeps
		2 (Test)	Woman	Taps the man
11	Test	1 (Setup)	Woman	Brushes her hair
		2 (Test)	Man	Points at the woman
12	Test	1 (Setup)	Woman	Builds a house
		2 (Test)	Man	Knocks over the house
		3	Woman	Gets angry