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The emergence of deixis in Nicaraguan signing

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1. INTRODUCTION

If you look closely at any sign language, you will soon discover familiar local gestures – nods, hand signals, even facial expressions – embedded within the language stream. At least, these signs appear familiar. However, their meanings, and the way they are combined with other signs, differ in many ways from their gesture lookalikes. Evidently, the first signers of these languages adopted everyday gestures as raw materials and used them to build the language. Once the gestures became part of a language, their functions changed.

These functions go beyond basic vocabulary. Many researchers of sign languages have suggested that gestures from the ambient culture were a source of grammatical elements too (Casey, 2003, Newport and Supalla, 2000, Wilcox, 2004). Studies comparing gestures with contemporary signs support such an account. For example, a Jordanian hand gesture meaning "wait a second" appears to have been co-opted as a negative

completive marker in Jordanian Sign Language (Hendriks, 2004), and a French gesture meaning "to go" is the likely source of a future marker in American Sign Language (ASL) (Janzen and Shaffer, 2002). There are non-manual examples too: the raising of eyebrows often seen on the faces of English speakers when they produce conditional sentences appears to be the origin of the eyebrow raise required with conditional expressions in ASL (Pyers and Emmorey, 2007), and common American head movements and body postures have apparently been reshaped into ASL markers of negation and role shift (McClave, 2000, 2001).

1.1 Grammaticalization

The emergence of new grammatical elements is not limited to sign languages, nor to language in its earliest stages. All languages undergo historical changes, referred to as grammaticalization, in which lexical forms, over time, can be reshaped into grammatical elements, which, over more time, can be again reshaped into other grammatical elements (Hopper and Traugott, 1993, Traugott and Heine, 1991). For example, the English verb *will*, meaning "to want," has grammaticalized into a future auxiliary. Thus the modern English expression "I will eat" says nothing about one's desire to eat; it indicates only that the eating will happen in the future. These changes appear not to be random, as common patterns of grammaticalization have been observed across languages and elements, and across various times in languages' histories.

Pfau and Steinbach (2006) argue convincingly, based on data from a wide variety of sign languages, that the typical paths taken by lexical items as they are transformed into

grammatical elements are the same in sign languages as in spoken languages. That is, these pathways are modality-independent, and not the result of the particular way that words are spoken or heard. Indeed, Aronoff, Meir, and Sandler (2005) have documented changes from lexical items to morphological affixes in American and Israeli Sign Languages, and observe that the age of a language predicts its degree of sequential morphology, in signed as in spoken languages. However, sign languages have the additional possibility of developing grammatical markers directly from the gestures produced in the surrounding community, even gestures such as facial expressions and body movements that are never adopted as lexical items (Janzen and Shaffer, 2002, Pfau and Steinbach, 2006, Rathmann and Mathur, 2004, Wilcox, 2004). This unusual source is evidently due to the particular way that signing is produced and received, through the visual-manual modality, a modality also exploited by the gestures that accompany speech.

These patterns of historical change in mature languages lead us to new questions. Are such changes the source of the first linguistic elements that arise when a new language emerges? How, exactly, do forms progress from nonlinguistic to linguistic elements? Most likely, such a process entails several steps, with every step representing a deviation from the surrounding language model. Why doesn't each new generation simply learn all the available forms faithfully, using them as they are used by the previous generation? Why change anything? We're not talking about lazy or inattentive learners here – note that the changes described above represent gains in the grammar rather than just the loss or degradation of elements. Evidently learners creatively change a language as they

inherit it. Do their learning mechanisms play a role in reassigning the function of elements as they acquire their language?

1.2 The present studies

In this chapter, we follow the changes in the use of a form as it progresses from its gestural origins through the early stages of an emerging sign language. We take as our case study the indexical point. A close look at this one form reveals the path taken as a basic deictic gesture, often produced along with speech to indicate real locations and objects, is being re-purposed and given new linguistic functions in a sign language. To foreshadow our findings, we observe a steady increase in the production of points to locations that refer not to locations but to entities. With this shift, points (and other common deictic gestures) are taking on certain grammatical functions, including indicating subjects, serving as pronouns and possibly determiners, and even participating in anaphoric constructions that track and switch reference.

We hypothesize that the pointing behavior of Spanish-speakers has been reanalyzed by deaf Nicaraguans into pronominal and agreement systems similar to those found in other sign languages around the world. That is, a process of reanalysis has led to the creation of grammar. In this case, the transformation of pointing gestures into grammatical elements involves the loss of their locative content, allowing points to take on grammatical functions. Because this series of changes occurs as new child learners are confronted with the task of learning language, we argue that children's natural language-learning abilities underlie the specific nature of the reanalyses that take place. To the

degree that the developments described here resemble historical changes observed in other, more mature languages, we speculate that the same learning mechanisms may underlie both kinds of change.

1.3 From Nicaraguan homesigns to Nicaraguan Sign Language

The recent emergence of a new sign language in Nicaragua allows us to observe the very earliest stages of a language in present-day individuals. The Nicaraguan Deaf community, and its language, have come into existence only since the late 1970s (Kegl and Iwata, 1989, Kegl et al., 1999, Polich, 2005, Senghas, 2003b). Before that time, deaf Nicaraguans had little contact with each other. Societal attitudes kept most deaf individuals at home, in contact only with neighbors and family members who were not deaf. The few day schools and clinics available for deaf children before the 1970s served very small numbers of children (Polich, 2005). Now adults, individuals who participated in such programs as children report that they did not continue to have contact with their classmates outside of school hours, or after leaving school. Furthermore, the programs actively discouraged gestural communication, training children instead in verbal articulation and reading lips, at which they were generally unsuccessful (Senghas, 2003b). As evidenced by the lack of sign language and the lack of a deaf community among individuals over the age of 45 today, these early conditions were apparently not favorable for the development of a sign language.

Research across a number of cultures indicates that in this situation, deaf children often develop *homesigns* to communicate with the hearing people around them (Goldin-

Meadow, 2003b, Morford, 1996). Homesigns are systems of gestural communication, typically limited to a single family household and the few other communication partners of a single deaf individual. Various homesign systems developed by young children in places as different as the United States and Taiwan have been found to include certain common fundamental characteristics of language, including a basic lexicon, consistent word order frames that allow recursion (Goldin-Meadow, 1982), and the ability to discuss referents displaced in space and time from the here-and-now (Morford, 1993).

Homesigners who remain separated from other deaf people will continue to use their homesigns as their primary language into adulthood, and the systems can develop language-like characteristics. An examination of the homesign systems used by three different Nicaraguan adults found that each had developed a way to indicate the grammatical subject of a sentence (Coppola and Newport, 2005). However, the fact that homesigners are not part of a larger signing community, and are therefore unable to pass their system along to new learners, seems to limit the complexity of homesign systems. Their lexicons, sentence patterns, and use of the signing space, while internally consistent, are idiosyncratic, and vary widely from one deaf homesigner to another (Coppola, 2002, Coppola and So, 2005).

The opportunities for deaf children in Managua expanded dramatically in 1977, when a new center for special education opened, including primary school classrooms for deaf students. The school's initial enrollment of 50 deaf students rose to 100 within the first few years, and continued to increase throughout the 1980s. Instruction followed an

oralist philosophy that emphasized speaking, writing, and lip-reading Spanish, again without much success. However, the children were free to communicate gesturally on the way to school (for many, an hour-long bus ride) and during free periods, and these interactions served as the starting point of a new sign language and a new social community. What started as a hodgepodge of different homesign systems must have begun to reshape itself at this time, eventually converging into a single, common system. In 1981, a vocational school was established for adolescents, and many of the alumni of the primary school program enrolled. By 1983 the two programs served more than 400 deaf students altogether.

Every year since, a new wave of children has entered school (typically at the preschool level) and learned to sign by socializing naturally with the older children there. Graduates of these programs have maintained social contact into adulthood, establishing social and athletic programs for deaf adults, celebrating major holidays together, even marrying other deaf people and starting new families together. Today, members of the community range in age from birth to 45, and number over 1000. The language of communication is Nicaraguan Sign Language (NSL), the language that emerged through their social contact, and most of them have used it as their primary (indeed, only) language throughout their lives.

Because children entered this group steadily throughout the 1980s and 1990s, the community today provides a snapshot of a continuum of language experience. Recall that those who arrived in its earliest years encountered a new, fledgling system of

signing, while those who arrived more recently encountered a richer, more developed language. This social situation has led to a somewhat topsy-turvy language community, in which the richest, most fluent signers are the youngest members. It provides us with the rare opportunity to track the historical development of a new language by comparing different age cohorts of signers, progressing "forward" in time from older to younger signers.

To capture different periods in the language's emergence, we have divided the community into three cohorts, based on the period in which individuals first arrived. Those children who arrived in the late 1970s and early 1980s (now adults) form the *first cohort*, those who arrived in the mid- to late-1980s (now adolescents) form the *second cohort*, and those who arrived in the 1990s (now children) form the *third cohort*. In the present study, we compared signed stories narrated in NSL by four deaf signers from each of these three cohorts. At the time these narratives were elicited (in 1998 and 2001), the first-cohort signers ranged from 23 to 30 years of age, the second-cohort signers ranged from 12 ½ to 17, and the third cohort signers ranged from 10 to 12 ½. All of the participants are fluent signers who have used NSL as their primary language from the age of 5 ½ or earlier (with a mean of 3 ½ years of age). Two of the participants, one from the first cohort and one from the second, had been exposed from birth to an older deaf family member who had acquired the sign language.

To complete the picture of language emergence, we also included four deaf homesigners who never entered the programs in Managua as children. As adults, they have had, at

most, sporadic contact with signers of NSL; none of them has a regular communication partner who signs NSL, none uses NSL vocabulary (aside from those signs that share forms with common Nicaraguan gestures), and none has even rudimentary knowledge of NSL grammar. The homesigners ranged from 20 to 30 years of age at the time their narratives were elicited. These participants should give us a view of the initial state of the communication systems of deaf Nicaraguans before NSL developed.

To collect comparable language samples from all of the participants, we showed them each an animated cartoon entitled Canary Row, involving the character Sylvester the cat chasing down Tweety the bird[1]. (These cartoon characters often appear on Nicaraguan television, so most of our participants were familiar with them.) Participants watched the cartoon a few times on a monitor and then told the story to someone else. NSL signers told the story to a peer from the same cohort, and homesigners told the story to a communication partner familiar with their homesign system. All of the narratives were videotaped for later analysis.

By laying these narratives out in order, across the continuum from homesigners through the three cohorts of NSL signers, we can create a record, like rings on a tree, of the progression of the emergence of a language. However, keep in mind that there is a factor that blurs this record. To the degree that adults are able to change the language, or acquire new developments, the groups will resemble each other. For example, if adults (as well as children) can easily acquire some form or use, it will spread to members of

[1] This cartoon was selected because it has been used extensively in cross-linguistic research on gesture. A full description of the cartoon can be found in McNeill (1992).

every cohort. (We have seen such a pattern in many lexical signs as they are coined and then spread throughout the community.) In contrast, a form or use that is initiated and learnable only by children will be observed only in that cohort that was still young when it first emerged, and subsequent cohorts. What this means, in terms of the living "fossil record" of NSL among present-day signers, is that the differences that we do observe between cohorts represent only those developments that were contributed by children. For this reason, differences between cohorts today highlight the specific effect of children's ability to both learn and to create language.

1.4 Indexical pointing

The form that we track here, pointing, has many characteristics that make it a likely candidate to be taken up and integrated into a new sign language. Pointing gestures are ubiquitous. Their use has been extensively documented in the gestures that accompany speech (Kendon, 2004, Kita and Özyürek, 2003, McNeill, 1992, and many others), in mature sign languages (Sandler and Lillo-Martin, 2006), and in homesign (Coppola, 2002, Fusellier-Souza, 2006, Goldin-Meadow and Mylander, 1984, Morford, 1996). They are typically produced with an extended finger or an open hand directed away from the body, though you can also point by using other handshapes or other parts of the body, such as jutting an elbow or pursing the lips in the direction of the intended referent (Kita, 2003). Hearing children (Bates et al., 1979) and deaf children (Bellugi and Klima, 1982, Hoffmeister, 1978) start producing points at a very young age, along with their very first utterances.

Points are so pervasive that it is easy to overlook their complexity, and the cognitive machinery required to interpret them. Even the most basic use of a point, to direct someone's attention to an object in the immediate environment, requires that both communication partners understand that the person who produces the point has the intention to refer to something. Try producing a point for your cat, and you will find she is more likely to sniff your finger than follow its trajectory across the room. Most of the points that hearing people produce are integrated with a spoken sentence (McNeill, 1992, 2005) and the listener must coordinate the nonlinguistic action with the spoken words and the greater context of the utterance in order to arrive at the full meaning of the sentence (Kendon, 2003). Among other uses, co-speech points often provide information about the location or identity of a referent, as in points that accompany expressions like "over there" or "that tablecloth." Even without being able to hear the speech, one can often infer the intent of these gestures to indicate places and objects in the world, a use referred to as *direct deixis*. For this reason, it is perhaps unsurprising that points can be used in sign languages for the same function. Researchers have proposed that the pointing gesture entered the grammar of sign languages as a marker of location (Pfau and Steinbach, 2006), though their use in mature sign languages has expanded to include many other functions, to which we now turn.

1.4.1 Pointing in sign languages

Pointing movements take on a range of grammatical applications in sign languages: they indicate the arguments of verbs (Engberg-Pedersen, 1993, McBurney, 2002, Meier, 1990, Padden, 1988, and others), and serve as determiners (Bahan et al., 1995, Zimmer and

Patschke, 1990), and locatives (Emmorey, 2002, Padden, 1988, Shepard-Kegl, 1985). Some recent accounts propose that points in ASL are not linguistic, and are better analyzed as a gestural component of the language (Liddell, 1995, Liddell and Metzger, 1998). Because the language in this case is produced using the same articulators as gesture, it can be difficult to determine whether certain uses are better categorized as part of the language or part of its accompanying gesture, so this distinction has been the focus of some debate. While we cannot resolve this question here for all uses of pointing, we will argue that many of the uses we document entail the incorporation of points into the grammar of NSL.

Different forms of pointing have been conventionalized within sign languages to correspond to different functions. For example, in ASL, a point with the index finger can serve as a nominative or accusative pronoun, such as *he* or *him*, while an open hand, palm forward, is used as the possessive form, such as *his* or *yours*. As Taub (2001) notes, "sign languages incorporate pointing into their grammar and vocabulary in conventionalized ways: There are many kinds of signs that consist basically of pointing in a specific way at a meaningful location or thing." What makes these locations "meaningful" is a wealth of context, usually in the signing that precedes a point. Of course, points can be used for direct deixis while signing, in much the same way as in co-speech gesture (Liddell, 1996). But when the referent is not in the immediate here-and-now, the use is a more abstract one. As Liddell (1995) describes it, "Pronouns can be directed at non-present but *projected* referents as well as at present ones, which can be

seen as being derived from direct deixis – once the image of the referent has been projected onto signing space, it is available to be pointed at."

Sign languages make extensive use of the three-dimensional space in front of the signer, and the use of pointing in a mature sign language must be fully integrated into these complex systems of spatial grammar. In one type of use found in many sign languages, certain locations in the signing space become associated with particular referents (Klima and Bellugi, 1979, Meier, 2002, Meir, 1998a, Padden, 1988, Supalla, 1982). The signer can then incorporate those locations into other signs in order to refer back to the referent, or to link other signs grammatically with the referent. For example, a signer might associate a man with a location on the right, and later produce the sign PAY toward the right, indicating that the man was paid. In this way, signers can link verbs with their arguments, and nouns with their modifiers. Locations in the signing space can also be associated with particular places, or points along a timeline (Frishberg and Gough, 2000, Taub, 2001).

All mature sign languages that have been documented take advantage of the signing space for these kinds of functions, though the specific devices that are available differ from language to language. Any use of pointing that is part of a grammar must be compatible with its other devices. Within the structure already established in the particular sign language, points can then be used to refer to locations in the signing space that are meaningful, thereby taking on meaning themselves.

Some of the uses of pointing that are common to sign languages have been documented in homesigns as well. Deaf homesigning children in many countries, including the United States, Taiwan, Nicaragua, and Spain, all use a point to refer to objects and locations (Goldin-Meadow, 2003b). Two elderly Japanese sisters who are homesigners were also found to use points for these functions, and to indicate non-present persons and objects. They also used points as prosodic markers for phrases and clauses (Torigoe, 2000). Previous work with four adult homesigners in Nicaragua found that each had developed a preferred means of indicating non-present participants and their roles in simple events; the devices they used included points to the chest to indicate the agent of an event, points to other people who are present and points to fingers to represent arguments of events, and points to empty spatial locations to indicate both locations and persons (Coppola and So, 2006).

1.5 Deixis

As we follow the use of points in the emergence of NSL, we pay particular attention to how their use fits into a system of *deictic expressions*. Deictic expressions are expressions that "point" beyond the utterance in order to have meaning. As Diessel (1999) defines them, deictics are "linguistic elements whose interpretation makes crucial reference to some aspect of the speech situation," such as when an utterance is spoken, where it is spoken, or by whom it is spoken. For example, the expression *yesterday* does not refer to any one particular day. In order to interpret it, the listener needs to know when the speaker said it. Similarly, to interpret deictic expressions like *here* and *there*, the listener needs to know the speaker's location. Personal pronouns are also deictic

expressions; the words *I* and *you* depend on the identity of the speaker and listener in order to determine their reference.

Deictic expressions can be used to refer to the immediate environment; this is referred to as *direct deixis*. By using *indirect deixis* a speaker can move beyond the here-and-now to indicate non-present people, places, and times. In such cases, the source, or *origo* (Bühler, 1990), used as a reference point for the deixis, is displaced from the place and time of the utterance. For example, in the expression, "The boy saw a plane *up above*," the origo is the location of the boy, and the deictic expression *up above* refers to the location above the boy, not above the speaker of the utterance. Similarly, in the expression, "The boy cut his arm *here*," accompanied by a touch on the elbow, the origo is not the speaker's arm, but some other arm, namely, that of the boy, and it is to his elbow that the deictic expression "here" refers. In sign languages, pointing can be used for both direct and indirect deixis. A point to a tablecloth to refer to that very tablecloth would be an example of direct deixis, as mentioned in the example above. A point to a tablecloth to refer to some other tablecloth would be an example of indirect deixis. In spoken and sign languages, many of the same words and gestures are used for both direct and indirect deixis, so a listener will often need to refer to the spoken and gestural context to interpret an expression.

Deictic expressions are *exophoric*; they link an expression to an aspect of the real world, outside of the utterance itself. These contrast with *anaphoric* expressions, which link an expression to another expression that appeared previously in the discourse (Diessel,

1999). For example, consider the discourse "My grandmother had a hand-embroidered tablecloth that she brought with her from Italy. I still have *that tablecloth* today on my dining room table." In this case, the *that* in the expression *that tablecloth* is anaphoric. Rather than directing the listener to some object in the world, it points to a noun phrase of the previous sentence. Again, the same forms within a language (such as *that* in English) are often used for both exophoric and anaphoric reference. Pointing is used for both functions in many mature sign languages, and it seems reasonable to hypothesize that the anaphoric use, which is more abstract and linguistically embedded, derived from the exophoric use, which is more concrete and free[2]. This is another trajectory that we will explore in our analysis of points in NSL.

2. ANALYSES AND RESULTS

2.1 Pointing observed in Nicaraguan signed narratives

The goal of the present study is to follow a specific case in which elements start out as para-linguistic forms, that is, co-speech gestures, to see if they become linguistic, and possibly grammatical[3] elements that are part of an emerging language. To this end, we systematically compared the deictic gestures, mostly points, produced by participants drawn from a single culture, but from groups situated at four different moments along a proposed continuum of language emergence: adult homesigners who have not acquired a

[2] Diessel (1999) proposes a similar grammaticalization cline of demonstratives in spoken languages, in which an exophoric demonstrative must always pass through a stage of anaphoric use before acquiring a grammatical function.

[3] We posit a contrast between *linguistic* and *grammatical* elements. Linguistic elements show language-like behavior, and are part of the language, but do not necessarily play a role in the grammar. The noun *dog* is a linguistic element but not a grammatical one; an agreement morpheme is both linguistic and grammatical; the gestured "thumbs-up" is neither linguistic nor grammatical.

conventional sign language, and NSL signers from each of three sequential age cohorts, that acquired the language at three successive periods during its emergence. How does the form and function of pointing change as we progress along this continuum?

We tabulated every instance of a manual deictic gesture in each narrative. These included points with a hand or finger[4], either toward some location, or with an outward arc movement (the common ANOTHER gesture, described in more detail below). We then determined whether the deictic gesture was directed toward some aspect of the immediate real-world environment, a part of the signer's body (typically the chest), or empty space. The deictics toward empty space were further categorized into those that referred to locations (such as *overhead* or *to the left*) and those that referred to persons or objects (such as *Tweety the bird* or *the cage*). We refer to these functions as *locative* and *nominal* uses[5]. They are described further in the section below entitled "Pointing to empty space."

Note that each category, in turn, reflects a greater displacement of the referent from the real world and real objects, resulting in a higher degree of abstractness and indirectness. Such displacement is a fundamental characteristic of language that allows reference to entities and locations that are not part of the here-and-now (Hockett, 1966). As the deictic signs took on more abstract functions, we examined how they combined into strings with

[4] Another form of deixis that has been observed in Nicaragua among hearing and deaf people is the lip point (Kegl 2002). However, this form was not attested in the present dataset.

[5] All data were coded by the first author; a subset of the data were coded by the second author to ensure reliability of the coding categories. Intercoder reliability for IX:chest was 1.00; ANOTHER, .97; and Locative vs. nominal reference, .95.

other words in the language. We were interested in whether these functions became syntactically differentiated as the elements became part of the emerging grammar of NSL.

2.2 Overall use of deictics

Figure shows the proportion of signs that were deictic produced by each participant. To compute the proportion, we first totaled all of the deictic signs produced by each participant in the eight stories that make up the Canary Row narrative. This is our numerator. We then calculated the signing rate of each participant for one of the stories. We extrapolated from this calculation to estimate the number of signs produced in the narrative. By using this second figure in the denominator, we effectively control for variation in the signing rate and length of narratives. (However, note that a similar pattern of results obtains if we plot raw frequencies of deictics instead.)

[Insert Figure 1 about here]

As can be seen in the figure, the proportion of deictics increases as we move along the continuum. On average, deictics represented 7% of the signs produced by homesigners (a mean of 26 out of 393 signs per narrative), 5% of the signs produced by first-cohort signers (26/501), 8% of the signs produced by second-cohort signers (38/501), and 12% of the signs by third-cohort signers (50/421). A linear regression analysis indicates that the proportion of deictics increases significantly across groups ($t = 2.23$, $p = .04$).

Evidently, over the past 30 years, deictic signs have been increasingly taken up as referring devices in NSL.

2.3 Points to the real-world environment

Points to real-world persons or objects can function to indicate those real persons or objects (such as pointing to a nearby tablecloth to mean exactly that tablecloth). Such *direct deixis* uses are very frequent in both spoken and sign languages, and we have certainly observed them in everyday NSL. Unsurprisingly, because the participants were asked to describe a situation that was not in the here-and-now, we did not observe any deictics of this type in the elicited narratives. We did, however, observe a few examples of *indirect deixis*. These included pointing to a real-world object to refer to a similar object; for example, pointing at a nearby tablecloth to refer to a tablecloth in the cartoon, as well as pointing to a real-world object to refer to some characteristic or property it possesses; for example, pointing to a nearby black tablecloth to indicate the property *black*.

Homesigners pointed to objects in the environment to refer to entities or attributes more frequently than did signers in the other groups, though even they did not do this very often. Three of the four homesigners produced this type of deictic expression (with a total of 6 instances), compared with one first-cohort signer (1 instance), one second-cohort signer (2 instances), and one third-cohort signer (1 instance).

2.4 Points to the signer's body

Parts of the signer's body can be used to represent other entities (such forms are often referred to as *classifiers*; for an overview, see Emmorey (2003)) and these forms, themselves, are then available to be pointed at. For example, the left forearm can be held up vertically to represent a telephone pole, and then pointed at with the right hand to refer to the pole. Additionally, a particular location on the forearm can be pointed at to refer to a location on the pole; for example, a point to the mid-forearm could refer to a location halfway up the pole. Twelve such uses were observed in the narratives altogether, distributed equally among the groups. So, while this is not a frequent type of deictic, it is one that is shared by homesigners and NSL signers.

[Insert Figure 2 about here]

However, a second type of pointing to the signer's body was much more frequent, and showed a different pattern. This was a point to the signer's own chest (glossed as *IX:chest*), generally used to refer to a character in the story[6]. As we span the continuum, we observe a dramatic increase in the use of the IX:chest deictic (see Figure 2). (Because the proportions are small, we have multiplied the values on the y-axis by 1,000 for ease of presentation.) The mean proportion of IX:chest signs produced by homesigners was .75/393 (0.2%); by Cohort 1 signers, 5.5/501 (1.1%); by Cohort 2 signers, 6.5/501 (1.5%); and by Cohort 3 signers, 14.3/421 (3.4%). A linear regression analysis indicated that the proportion of IX:chest deictics increased significantly across groups ($t = 2.52$, $p = .02$). IX:chest was produced by only two of the homesigners (a finding consistent with

[6] Pyers and Senghas (2007) provide more detail on these constructions, which they gloss as *IX:self*.

previous work with the same participants (Coppola and So, 2005)), three of the first-cohort signers, and all of the second- and third-cohort signers.

2.4.1 Ordering patterns of points to the chest in combination with other signs

IX:chest was nearly always combined with another sign to form a string, appearing alone in only 2 of 108 instances. It was combined with verbs, nouns, adjectives, other deictics, classifier-movement constructions, and reported action sequences. The combinations produced by NSL signers tended to be point-initial (in 93/96 instances, or 97%) rather than point-final, or in what we call "sandwich" constructions (prosodic units in which one sign appears before and after another (e.g, X Y X)).

[Insert Figure 3 about here]

By considering the patterns of use across NSL cohorts, we see that this deictic has changed dramatically over a short period. Grouping the verbal elements together (verbs, classifier-movement constructions, and constructed actions), we find that first-cohort signers predominantly combine IX:chest with a verbal element (18 instances) rather than a nominal element (3 instances). In their narratives, these were often expressions in which the agent had been identified and the signer was continuing to narrate from the perspective of that agent. For example, having already assumed the role of the cat, the signer might produce IX:chest, followed by a constructed action of climbing, to indicate that the cat climbed.

In contrast, second-cohort signers combine IX:chest with both nominal (15 instances) and verbal elements (10 instances). In the combinations with nominals, they almost always placed the IX:chest point immediately before the nominal element to identify the character that they were about to describe (14 of the 15 combinations with nominals). So, in a typical second-cohort use of this device, the expression *IX:chest CAT* would indicate that the signer was shifting into the role of the cat as the agent of subsequent actions (Pyers and Senghas, 2007).

Third cohort-signers used IX:chest combinations much more than any of the other groups (48 instances), but rarely in this nominal construction (2/48 instances). They were much more likely to combine IX:chest with a verbal element (44/48 instances, including classifier constructions, a combination not used in the other groups). (In the remaining two instances, the IX:chest was combined with another deictic.) This development may reflect that these signers have fully nominalized the IX:chest and are constraining it to a nominal position, such as immediately before, or simultaneous with, a verbal element. This is the typical subject position (Senghas et al., 1997); thus the expression *IX:chest CLIMB* would mean "he climbs." It is particularly striking that third-cohort signers appear to have abandoned the use of the IX:chest to establish a new agent, given that the device was used this way fairly frequently by the second cohort. As we will see, third-cohort signers have established other patterns of deictic use to introduce and switch referents, possibly freeing up IX:chest to take on the more specific use as a nominal, agentive element.

2.5 Points to empty space

The majority of points in the narratives are directed at empty space. Many of these points are used to refer to locations, what we refer to as locative uses. Of course, pointing can be used to refer to real-world locations, but, as mentioned above, such direct deixis uses were not attested in the narratives. However, there were many instances of indirect deixis, used to refer to analogous locations in the cartoon. An example is given in **Error! Reference source not found.**3, in which a homesigner points above his own head to refer to a location above the head of the cat in the story. Note that his eye gaze follows the point; this use of eye gaze is highly typical (possibly obligatory) with locative deictics for all four groups.

[Insert Figures 4 and 5 here (side-by-side is preferable)]

Points to empty space were also used to refer to entities, serving a nominal function. An example is shown in Figure 5, in which a first-cohort signer points to her left to refer to Tweety. These uses are quite different in appearance from the locative uses. They are articulated more quickly, and with a reduced movement, or no movement. Eye gaze, in these cases, does not follow the point; in Figure 5 you can see that the signer closes her eyes as she shifts her gaze away.

2.6 Ordering patterns of locative and nominal points in combination with other signs

We set aside for the moment striking differences in the frequency of locative and nominal points, which will be considered with another deictic form below, and turn to the word order patterns in constructions with points. Locative points are produced alone (14 instances) and in combination with other signs (138 instances). When combined with other signs, the ordering preferences are not strong, though they appear to depend partly on whether the other sign is a noun (Figure 6a) or a verb (Figure 6b)[7]. For the NSL signers, combinations with nouns are somewhat more likely to be point-initial (40 instances, or 67%) rather than point-final (20 instances, or 33%); homesigners show no ordering preference (8 instances of point-initial vs. 10 of point-final). Combinations of locative points with verbs are a bit more likely to be point-final, for all groups (36/47 instances, or 77%). Thus, a common combination of a point with a noun would be the point-initial expression *IX:up BIRD*, meaning "the bird (is) overhead"; while a common combination with a verb would be the point-final expression *CLIMB IX:up*, meaning "climb up."

[Insert Figure 6 about here]

Nominal points differ from locative points in their combination and ordering patterns as well as in their form. They almost never appear alone (2/53 instances). When combined with other signs, the nominal point is almost always placed initially, whether with nouns (Figure 6c) or verbs (Figure 6d). It appears initially in 42/51 combinations (82%), finally

[7] We present the ordering analyses based on raw numbers in order to preserve frequency information; the same analyses conducted on the proportion data (that is, taking into account the total number of signs produced by each participant) reveals a similar pattern of results.

in 7/51 combinations (14%), and twice embedded in a "sandwich" construction[8]. Thus, typical NSL combinations using nominal points would include the point-initial constructions *IX:left BIRD* meaning "the bird" (associated with a locus to the left) and *IX:left FALL* meaning "he falls." The use with a noun may constitute a determiner construction, and the use with a verb appears to be pronominal, in line with analyses of similar constructions in other sign languages (though a complete analysis of such constructions is beyond the scope of the present paper). All of the groups show this point-initial ordering preference with nominal points, though it is weaker in the homesigners (5/7 instances, or 71%) than in the NSL signers (34/36 instances, or 94%).

Note that there is a change in frequency across groups in the use of nominal points, depending on function. While no systematic pattern across groups is apparent in the combinations of nominal points with nouns (Fig. 6c.), the frequency of combinations with verbs appears to be increasing across the continuum (Fig. 6d.). Further, while both point-initial and point-final orders are attested for all groups in combinations containing locative points (Figs. 6a. and 6b.), combinations containing nominal points are almost exclusively point-initial (Figs. 6c. and 6d.). There are only four exceptions: two produced by a single homesigner, and two produced in the same sentence by a third-cohort signer. (This particular sentence includes three deictics, only one of which could logically appear in initial position. The other two are not the subject, appear in reported speech, and are part of a question. Clearly this sentence is too complex to be captured by our simple index-initial vs. index-final scheme.)

[8] Of these 51 combinations, 43 were with nouns or verbs and are shown in Figure 6; two appeared in sandwiches, and the remaining 6 were with adjectives or other elements.

2.7 The ANOTHER sign

We observed a second deictic form that differed in appearance from the simple indexical point. This form, which we gloss ANOTHER, is derived from a common Nicaraguan gesture used to mean "over there" or "another one" (Coppola, 2007). The gesture generally occurs with the spoken Spanish word *otro* ("other"). Both the gesture and the sign are produced with an arced outward movement, with an extended index finger or a loosely open hand, ending palm-up. Like the indexical point, the sign ANOTHER can be used for locative or nominal deixis. Figure 7 shows a locative use of ANOTHER, produced to the left, by a homesigner about to describe an event in a new location. As in the locative point, her eye gaze follows the direction of the gesture.

[Insert Figure 7 about here]

2.7.1 Locative ANOTHER

The ANOTHER sign is not as frequent as the point, but it is clearly established in the signing of all of the groups. The locative form was produced alone (16 instances), as well as in combination with nouns and verbs (13 instances), almost always appearing initially (10/13 instances). There were two instances of deictic-final constructions, both produced by a single homesigner, and one instance of a "sandwich" construction (*house ANOTHER:left house*) produced by a first-cohort signer. Thus, a typical NSL construction using the locative ANOTHER would be *ANOTHER:left BIRD*, meaning "in another location is the bird" or "over there is a bird." This new location would contrast

with the location of the immediately preceding event. There weren't enough instances to determine a change in use across the groups, though very few locative ANOTHERs were produced by the third cohort – two instances, by a single signer.

2.7.2 Nominal ANOTHER

As was found with the indexical point, the nominal form of ANOTHER appears to be a phonologically reduced version of its locative form. It is produced more quickly than the locative ANOTHER, and with a more closed handshape, often with only the index finger, and occasionally the thumb, extended. Rather than an arced path of movement, it consists of a rotation of the wrist and forearm. In this way, it is non-spatial, not making reference to any particular location in the signing space. Figure 8 shows a third-cohort signer producing ANOTHER as he switches the agent of action from the cat to the bird. As with the nominal point, and in contrast to the locative form of ANOTHER, his eye gaze does not follow the sign, but instead shifts away.

[Insert Figure 8 about here]

Nominal ANOTHER differs from the locative, and from the nominal point, in more than form. It appears alone about half the time (in 27/53 instances); recall that the nominal point rarely appears alone. In combinations with adjectives, nouns, and verbs, it is always in initial position (26/26 instances). Thus a typical use would be *ANOTHER*

BIRD, meaning "the bird" (as a change in subject); or *ANOTHER FALL*, meaning "he falls" (*he* being a different subject than in the previous clause)[9].

2.8 Locative versus nominal deictics

The most striking difference between the nominal and locative uses of ANOTHER parallels that of the indexical points: the nominal uses, and not the locative, increase dramatically across the continuum of language groups. This development can be seen in Figure 9, which combines the two deictic forms (indexical points and ANOTHER signs), separating the locative and nominal functions. The locative deictics (which are also common in co-speech gesture) are frequent in the signing of all four groups, and relatively constant. The mean proportion of locative deictics produced by homesigners was 16.8/393 (4.3%); by first-cohort signers, 14/501 (2.8%); by second-cohort signers, 18.8/501 (3.8%); and by third-cohort signers, 14/421 (3.3%). A linear regression analysis did not detect a change in the proportion of locative deictics across groups ($t = -0.62$, $p = .54$).

[Insert Figure 9 about here]

In contrast, while the nominal deictics are present in the signing of all of the homesigners, two of the first-cohort signers did not produce any of these forms, and as a

[9] This appears to be a *switch reference* device. Rather than indicating the previous referent (the way an anaphor does), it indicates a new referent, different from the previous referent. For example, in a language with a switch reference marker, a sentence like "The cat climbed the pole, and *he[anaphor]* fell" would mean that the cat fell, while "The cat climbed the pole, and *he[switch]* fell" would mean that someone other than the cat fell.

group the first cohort produces the fewest. From there, they increase significantly in the signing of the members of the second and third cohorts, all of whom produced them. Homesigners produced 3.5/393 (0.9%); first-cohort signers, 2/501 (0.4%); second-cohort signers, 9/501 (1.8%); and third-cohort signers, 14.3/421 (3.4%). A linear regression analysis indicated that the proportion of nominal deictics increased across groups ($t = 2.91$, $p = .01$).

2.9 The changing patterns of signing across groups

To summarize, we find an increase in the use of deictic signs as we progress from homesigners through the first three cohorts of NSL signers. This increase is due entirely to an increase in non-spatial, referential uses (what we call *nominal* uses) of deixis. Though locative uses are quite frequent – they are more frequent overall than nominal uses – their rate of use remains steady across the continuum.

A smaller, but probably also real change that we observed is that homesigners make more points to objects and locations in the immediate environment than NSL signers. This is not surprising. Presumably due to their sparser vocabulary, homesigners are more apt to take advantage of their physical surroundings to indirectly identify and describe referents.

The use of the point to the chest (*IX:chest*) is also increasing across the continuum. Note that this sign is spatially neutral from the outset, and has only a nominal use; thus, it follows the larger pattern of increased use of nominal deixis. Additionally, the function of IX:chest appears to be changing as it is taken up by the third cohort, from a role-shift

marker, followed by the identity of a new character, to a marker of semantic agency (possibly a subject pronoun) followed by a verb. This change could be due to a reanalysis of its typical position at the beginning of a sentence, a common position for subjects in NSL.

The change also represents an interaction with the changing use of the ANOTHER sign. By the time it was taken up by the third cohort, this sign appears to have almost entirely lost the spatial, locative function of its gestural counterpart. Rather, it is used almost exclusively as a device for switching to a new referent, replacing some of the previous uses of IX:chest.

It is interesting to note that both the IX:chest and the nominal ANOTHER sign, with their functions of indicating referents, are non-spatial forms, that is, they "point" to characters in the discourse without associating them with a particular locus in the signing space. The nominal indexical point (*IX:locus*), in contrast, does make such an association. That is, the sign itself has spatial content in its form, as it points to a particular location in the signing space. However, even in this case the meaning is a non-spatial one; the point refers to a person or entity and not its location.

Considered together, these three signs, the IX:chest, ANOTHER, and the nominal IX:locus, represent an emerging system of reference, possibly pronominal reference, in NSL. The picture that seems to be emerging is one in which ANOTHER is typically used to introduce a referent, the IX:chest is used to mark a referent as an agent (or at least

the topic or perspective of an event), and IX:locus is used to refer to more kinds of referents (including agents and patients), as well as to associate referents with abstract locations in the signing space. These locations can then interact with other uses of space in the language, for example, to link arguments with verbs.

Future analyses will confirm whether this picture is an accurate one. It would be particularly useful to conduct a reference-tracking analysis across the discourse to see how abstract locations in the signing space are initially established (whether with points, nouns, classifiers, or verbs) and whether these locations are then re-used with indexical points to indicate coreference. Such coreference would be an anaphoric use of space, derived from an exophoric deictic use.

As the system of spatial pointing and reference unfolds, one conclusion becomes quite clear. While there is vigorous debate regarding the appropriate characterization, gestural or grammatical, of the spatial modulations used in established sign languages, it is clearly the case that this use of space differs strikingly from that of gestures accompanying speech. Indeed, it is the relative *lack* of spatial meaning attributed to deictic forms that characterizes their increasingly grammatical uses by Nicaraguan signers. A crucial step in the transformation of pointing gestures into forms that can function as grammatical elements seems to be the loss of their locative content. Thus, as we move along the continuum from the earliest to the most developed form of NSL, we observe a steady increase in the production of points to loci that refer not to locations but to entities.

3. DISCUSSION

We have referred to homesigning as the starting point for NSL, and indeed it is in the historical sense. When the earliest members of the Nicaraguan Deaf community first began to gather and develop a common system of communication, many of them must have had years of experience using homesigns with their families. One might expect to find minimal evidence of deictic and other referential devices in homesign, followed by more in the language's initial stage, continuing to develop and becoming more frequent with each successive cohort. This is not the picture that emerges from these data. What we find instead is that the homesigners' productions include the seeds of all of the structures that eventually emerge, including points to the chest to indicate agents, points to empty space to reference non-present entities, and use of ANOTHER to switch reference. However, these devices are used sporadically and not integrated into the grammar of homesigns. They aren't used by all homesigners, and don't have regular patterns of combination with other elements; that is, they aren't syntactically differentiated. The same forms may also be applied to other functions, even by the same individual. The uneven profiles across homesigners reflect their lack of opportunity to conventionalize a system with others who also use it as a primary means of communication.

The effect of such individuals coming together, then, is somewhat unpredictable. The data suggest that this initial stage, when the first cohort of signers attempt to converge on a single system, is subject to two opposing forces. First, there is the loss of some relatively sophisticated functions (such as more abstract devices for nominal reference)

which are unlikely to map onto the same form across the group. Second, there is a rapid convergence on those form-function mappings that are most likely to be shared; that is, those that are closest to their gestural origins, such as pointing at locations to refer to those locations. After this initial stage, once convergence on a single system has occurred, new cohorts of learners can begin to build the more complex functions back in, this time with forms that are conventionalized across the group.

3.1 Parallels to grammaticalization processes

The changes that we observe in NSL resemble certain changes documented in the grammaticalization of spoken languages. Three interrelated processes that underlie such changes have been proposed (Heine et al., 1991a, Hopper, 1991): *desemanticization*, or *semantic bleaching*, in which a lexical item loses its meaning as it acquires a grammatical function; *decategorialization*, in which a lexical item loses properties characteristic of its category (for example, a verb losing the ability to constitute a predicate, and to take arguments); and *erosion*, or *phonetic reduction*, in which a lexical item loses its phonetic substance.

Reminiscent of grammaticalization, we observe in the Nicaraguan data changes in deictic points from a universal, concrete, locative meaning to a language-specific and abstract function. At the same time, they have become reduced phonetically, losing some or all of their movement across space. These forms may not yet be fully grammaticized, or may yet become other grammatical elements. Nevertheless, they already participate in constructions that have a more categorical, language-like, less context-bound flavor than

their original form. In the most developed form of NSL, represented by the signing of the third cohort, we observe differentiated forms of the point and the ANOTHER sign being used to link arguments with verbs, indicate subjects, serve as pronouns and possibly determiners, possibly differentiate subjects and objects, and to track and switch reference.

3.1.1 Input to grammaticalization processes

Grammaticalization processes need original forms on which to operate. It has been noted that the sources for grammar are drawn from the most universal, concrete and basic aspects of human experience, particularly the spatial environment and parts of the body (Bybee, 2003, Heine et al., 1991a). Over time and use, linguistic elements become emancipated from their concrete origins. For example, in an extensive cross-linguistic survey of spoken languages, Svorou (1994) found that words for human body parts were the most frequent sources of relational terms, such as the preposition *behind* in English deriving from the words *be* (indicating *at* or *on*) and *hind* (indicating *back*, (plus an adverbial suffix)). Svorou also notes that environmental landmarks can serve as sources for spatial grammatical elements. Given that even spoken languages tend to take the spatial environment as a grammatical source, and given that the visual-gestural modality affords the ability to point directly at one's own body and at the physical environment, it is unsurprising that sign languages are particularly (and perhaps universally) inclined to exploit this source of forms and meanings, and eventually develop a rich repertoire of abstract spatial grammatical devices.

To take the argument further, the particular privilege that the visual-gestural modality provides, namely this direct way to refer to the external, physical spatial environment, may enable sign languages to take a shortcut down the path of grammaticalization, occasionally bypassing the lexical stage altogether (Janzen and Shaffer, 2002, Pfau and Steinbach, 2006). Wilcox (2004) notes that certain aspects of gestures are bound, that is, they must appear as part of gesture or sign. For example, a movement can never appear alone; it must be attached to some base sign, co-occurring with some handshape, in order to be produced. Since they never appear by themselves, such bound components never lexicalize. Nevertheless, they are still available as sources for grammaticalization, which in this case proceeds directly from a gestural source to a functional element[10]. It is usually tricky to argue that a stage has been bypassed in the history of a language. There is always the possibility that the particular stage did occur but left no fossil record. The real-time nature of the Nicaraguan data allows us to observe the leap as it happens, directly from a gestural point to a functional sign.

3.1.2 Despatialization as emancipation

Certain words, repeated consistently in the appropriate context, can eventually become free of their contextual, instrumental associations through a process called *emancipation* (Haiman, 1994). Bybee (2003) argues that the change from a lexical to a grammatical function in grammaticalization involves a process that is quite parallel, that could also be considered emancipation. We argue for the same parallelism in the changes we have observed across groups in the emergence of NSL, namely from the use of a point as a

[10] It has been suggested that even spoken language demonstratives may not have developed from a lexical source (Diessel 1999).

deictic to indicate a location (its original instrumental function) to its use as a nominal (a more symbolic, abstract, and displaced function).

Coppola and So (2006) argue for a similar process of emancipation at an even earlier moment in the grammaticalization path, from gesture to homesign. They compared the productions of adult homesigners with those of hearing gesturers asked to describe stories without speech, that is, using gesture alone. Hearing gesturers tended to spatially modulate (i.e., produce in a non-neutral location) their gestures for both entities and actions at high rates; in contrast, adult homesigners were far less likely to spatially modulate their gestures referring to entities. Coppola and So suggest that hearing adults' use of space is consistent with a holistic, pictorial representation of the event. In contrast, the homesigners' lack of spatial modulations on entity gestures reflects a process of de-spatialization that allows the gestures to function as linguistic elements, with language-like constraints on form.

3.2 Grammaticalization paths for pointing in sign languages

We have established that spatial gestures, such as points, are particularly attractive grist for sign languages as they create grammatical elements, and, furthermore, that these gestures are likely to lose their spatial content in the process. So, what do they become? Figure 10 shows the grammaticalization cline proposed by Pfau and Steinbach (2006), in which points progress to locatives and demonstrative pronouns, to personal and relative pronouns, to the even more grammatical forms of agreement markers and auxiliaries. While this proposal is not uncontroversial, the changes observed in the Nicaraguan data

provide support for portions of it; namely, that pointing gestures first become locative, and that locatives become (pro)nominal. It remains to be seen whether pronominal forms become markers of verb agreement in NSL. Consistent with this possibility, younger cohorts of NSL signers are starting to spatially modulate their verbs consistently (Senghas, 2003a).

We did find that homesigners produce points that function as both locatives and pronouns, which might appear to violate this path. However, these uses were far less frequent than in third-cohort signers, and with less (apparent) systematic integration with the grammar. That is, there don't appear to be grammatical criteria in homesign for distinguishing these uses. Thus, the sporadic uses available in homesign foreshadow some of the ultimate functions that will appear, but do not show the formal progression observed across the three cohorts of NSL.

[Insert Figure 10 about here]

The path from the spatial to the grammatical is not particular to sign languages, and appears to be based on basic metaphors of physical movement and transfer. Anderson (1971) proposed a theory of grammatical cases based on such spatial relations, such as the dative marker *to* in English (as in "Alex gave a house *to* Adrian"), which derived from the locative term *toward.* It may be that the spatial nature of exophoric expressions sends them easily down a path to become particular types of non-spatial "pointing" expressions as they become semantically bleached. Specifically, they become anaphoric,

pointing to the content of the discourse itself rather than to the world. For example, the English word *that* can have spatial content, meaning relatively far from the speaker (in contrast to *this*, which is relatively near), but when we use the expression *that tablecloth* to refer to a tablecloth mentioned in the previous sentence, *that* has lost all spatial meaning.

The case in sign languages seems exactly parallel; the movements embedded into signs to indicate grammatical relations appear to be metaphorically linked to physical spatial relations (Taub, 2001). For example, the movement of a verb toward a locus in the signing space can indicate the recipient of a transfer of possession, even when the transferred object (such as a house) doesn't move anywhere.

Similar metaphorical extensions evidently guide the development of spatial modulations in NSL. Elsewhere, we have proposed that concrete uses of space served as a precursor for the more abstract use to indicate coreference relations between signs (Senghas, 2003a). Here, we argue for a process in which the development of a point into grammatical elements similarly requires a transformation of its spatial content: its locative component must be separated out from a holistic package that includes its immediate physical context, leaving its form, and a bit of associated semiotic content. Once segmented, the point can be combined with other linguistic elements to form more complex constituents. (See Senghas, et al. (2004) for a description of this segmentation process in the domain of path and manner of movement.)

It is children learning the language who do this reanalysis, which, in this extreme case, results not only in historical changes in a grammar, but the creation of a grammar. Over several iterations, as NSL has been passed from one cohort to the next, its grammatical elements have emerged. By comparing homesigners and signers of different ages today, we have been able to capture how the humble, "simple" point has progressed over the span of 30 years: from a concrete, deictic gesture intended to draw attention to a real world object, to an abstract point at empty air, intended to refer to some non-present referent at some non-present time, and serving a particular linguistic role in the sentence, such as its syntactic subject. This use is more abstract, more displaced from the here-and-now, and more grammatical in function, and its emergence reveals the transformative power of natural processes of human language acquisition. Gesture in, grammar out.

References cited

Anderson, John M. 1971. *The grammar of case: Towards a localist theory*. London: Cambridge University Press.

Aronoff, Mark, Meir, Irit, and Sandler, Wendy. 2005. The paradox of sign language morphology. *Language* 81:301-344.

Bahan, Benjamin, Kegl, Judy, MacLaughlin, Dawn, and Neidle, Carol. 1995. Convergent evidence for the structure of determiner phrases in American Sign Language. In *FLSM VI: Proceedings of the Sixth Annual Meeting of the Formal Linguistics Society of Mid-America. Volume Two: Syntax II & Semantics/Pragmatics*, eds. Leslie Gabriele, Debra Hardison and Robert Westmoreland, 1-12. Bloomington: Indiana University Linguistics Club.

Bates, Elizabeth, Benigni, Laura, Bretherton, Inge, Camaioni, Luigia, and Volterra, Virginia. 1979. *The emergence of symbols: Cognition and communication in infancy*. New York: Academic.

Bellugi, Ursula, and Klima, Edward. 1982. From gesture to sign: Deixis in a visuo-gestural language. In *Speech, place, and action: studies in deixis and related topics*, eds. R. J. Jarvella and Wolfgang Klein, 279-313. New York: Wiley.

Bühler, Karl. 1990. *Theory of language: The representational function of language*. Amsterdam: Benjamins.

Bybee, Joan. 2003. Cognitive processes in grammaticalization. In *The new psychology of language: cognitive and functional approaches to language structure*, ed. Michael Tomasello, 145-167. Mahwah, N.J.: L. Erlbaum.

Casey, Shannon. 2003. "Agreement" in gestures and signed languages: The use of directionality to indicate referents involved in actions, Psychology, University of California, San Diego: PhD.

Coppola, Marie. 2002. The emergence of the grammatical category of Subject in home sign: Evidence from family-based gesture systems in Nicaragua, Brain and Cognitive Sciences, University of Rochester: Ph.D.

Coppola, Marie, and Newport, Elissa L. 2005. Grammatical subjects in home sign: abstract linguistic structure in adult primary gesture systems without linguistic input [December 27, 2005]. *Proceedings of the National Academy of Science* 102:19249-19253.

Coppola, Marie, and So, Wing Chee. 2005. Abstract and Object-Anchored Deixis: Pointing and spatial layout in adult homesign systems in Nicaragua. In *BUCLD 29: Proceedings of the 30th Annual Boston University Conference on Language Development*, ed. M. R. Clark-Cotton A. Brugos, and S. Ha, 144-155. Somerville, MA: Cascadilla Press.

Coppola, Marie, and So, Wing Chee. 2006. The seeds of spatial grammar: Spatial modulation and coreference in homesigning and hearing adults. In *BUCLD 30: Proceedings of the 30th Annual Boston University Conference on Language Development*, eds. David Bamman, Tatiana Magnitskaia and Colleen Zaller, 119-130. Somerville, MA: Cascadilla Press.

Coppola, Marie. 2007. Gestures to signs: The origins of words in Nicaraguan Sign Language. In *Current Issues in Sign Language Research*. University of Köln, Köln, Germany.

Diessel, Holger. 1999. *Demonstratives: Form, Function & Grammaticalization*: Typological Studies in Language. Amsterdam: John Benjamins.

Emmorey, Karen. 2002. *Language, cognition, and the brain: Insights from sign language research*. Mahwah, NJ: Lawrence Erlbaum.

Emmorey, Karen ed. 2003. *Perspectives on classifier constructions in sign languages*. Mahwah, NJ: Lawrence Erlbaum Associates.

Engberg-Pedersen, Elisabeth. 1993. *Space in Danish Sign Language: The Semantics and Morphosyntax of the Use of Space in a Visual Language*. Hamburg: Signum Press.

Frishberg, Nancy, and Gough, Bonnie. 2000. Morphology in American Sign Language. *Sign Language and Linguistics* 3.

Fusellier-Souza, Ivani. 2006. Emergence and Development of Signed Languages: From a Semiogenetic Point of View. *Sign Language Studies* 7.

Goldin-Meadow, Susan. 1982. The resilience of recursion: A study of a communication system developed without a conventional language model. In *Language Acquisition: The State of the Art*, eds. Eric Wanner and Lila R. Gleitman, 51-77. New York: Cambridge University Press.

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

Goldin-Meadow, Susan. 2003b. *The Resilience of Language: What Gesture Creation in Deaf Children Can Tell Us About How All Children Learn Language*: Essays in Developmental Psychology. New York: Psychology Press.

Haiman, John ed. 1994. *Ritualization and the development of language. Perspectives on grammaticalization*. Amsterdam: John Benjamins.

Heine, Bernd, Claudi, Ulrike, and Hünnemeyer, Friederike eds. 1991a. *From cognition to grammar: Evidence from African languages*. vol. 1. *Approaches to grammaticalization* Amsterdam: John Benjamins.

Hendriks, Bernadet. 2004. *An introduction to the grammar of Jordanian Sign Language.* Salt, Jordan: Al-Balqa University.

Hockett, Charles Francis. 1966. The problem of universals in language. In *Universals of language*, ed. Joseph H. Greenberg, 1-29. Cambridge, MA: MIT Press.

Hoffmeister, Robert J. 1978. The development of demonstrative pronouns, locatives, and personal pronouns in the acquisition of ASL by deaf children of deaf parents, University of Minnesota: Ph.D.

Hopper, Paul J. 1991. On some principles of grammaticization. In *Approaches to grammaticalization*, eds. Elizabeth Closs Traugott and Bernd Heine, 17-35. Amsterdam ; Philadelphia: J. Benjamins.

Hopper, Paul J., and Traugott, Elizabeth Closs. 1993. *Grammaticalization*: Cambridge textbooks in linguistics. Cambridge: Cambridge University Press.

Janzen, Terry, and Shaffer, Barbara. 2002. Gesture as the substrate in the process of ASL grammaticalization. In *Modality and Structure in Signed and Spoken Languages*, eds. Richard P. Meier, Kearsy Cormier and David Quinto-Pozos, 199-223. Cambridge, UK: Cambridge University Press.

Kegl, Judy, and Iwata, Gail. 1989. Lenguaje de Signos Nicaragüense: A pidgin sheds light on the "creole?" ASL. In *Fourth Annual Meeting of the Pacific Linguistics Conference*, eds. R. Carlson, S. DeLancey, S. Gilden, D. Payne and A. Saxena, 266-294. Eugene, Oregon.

Kegl, Judy, Senghas, Ann, and Coppola, Marie. 1999. Creation through contact: Sign language emergence and sign language change in Nicaragua. In *Language Creation and Language Change: Creolization, Diachrony, and Development*, ed. Michel DeGraff, 179-237. Cambridge, MA: MIT Press.

Kegl, Judy. 2002. Language emergence in a language-ready brain. Acquisition. In *Directions in Sign Language Acquisition*, eds. Gary Morgan and Bencie Woll, 207-254. Amsterdam: Benjamins.

Kendon, Adam. 2003. Pointing by Hand in "Neapolitan" In *Pointing: where language, culture, and cognition meet*, ed. Sotaro Kita, vii, 339. Mahwah, N.J.: L. Erlbaum Associates.

Kendon, Adam. 2004. *Gesture: Visible Action as Utterance*. Cambridge: Cambridge University Press.

Kita, Sotaro. 2003. Pointing: A Foundational Building Block of Human Communication. In *Pointing: where language, culture, and cognition meet*, ed. Sotaro Kita, vii, 339. Mahwah, N.J.: L. Erlbaum Associates.

Kita, Sotaro, and Özyürek, Asli. 2003. What does cross-linguistic variation in semantic coordination of speech and gesture reveal?: Evidence for an interface

representation of spatial thinking and speaking [Jan]. *Journal of Memory and Language* 48:16-32.
Klima, Edward, and Bellugi, Ursula. 1979. *The signs of language*. Cambridge, MA: Harvard University Press.
Liddell, Scott K. 1995. Real, surrogate, and token space: Grammatical consequences in ASL. In *Language, Gesture, and Space*, eds. Karen Emmorey and Judy Snitzer Reilly, 19-41. Hillsdale, NJ: Lawrence Erlbaum.
Liddell, Scott K. 1996. Spatial representations in discourse: Comparing spoken and signed language. *Lingua* 98:145-167.
Liddell, Scott K., and Metzger, Melanie. 1998. Gesture in sign language discourse [December]. *Journal of Pragmatics* 30:657-697.
McBurney, Susan L. 2002. Pronominal reference in signed and spoken language. In *Modality and Structure in Signed and Spoken Languages*, eds. Richard P. Meier, Kearsy Cormier and David Quinto-Pozos. Cambridge, UK: Cambridge University Press.
McClave, Evelyn Z. 2000. Linguistic functions of head movements in the context of speech. *Journal of Pragmatics* 32:855.
McClave, Evelyn Z. 2001. The relationship between spontaneous gestures of the hearing and American Sign Language. *Gesture* 1:51-72.
McNeill, David. 1992. *Hand and Mind: What Gestures Reveal about Thought*: University of Chicago Press.
McNeill, David. 2005. *Gesture and thought*. Chicago, Ill.: University of Chicago Press.
Meier, Richard P. 1990. Person Deixis in American Sign Language. In *Theoretical Issues in Sign Language Research*, eds. Susan Fischer and Patricia Siple, 175-190. Chicago, IL: University of Chicago Press.
Meier, Richard P. 2002. The acquisition of verb agreement: pointing out arguments for the linguistic status of agreement in sign languages. In *Current developments in the study of signed language acquisition*, eds. Gary Morgan and Bencie Woll, 115-141. Amsterdam: John Benjamins.
Meir, Irit. 1998a. Syntactic-semantic interaction in Israeli sign language verbs: The case of backwards verbs. *Sign Language & Linguistics* 1:3-37.
Morford, Jill P. 1996. Insights to language from the study of gesture: A review of research on the gestural communication of non-signing deaf people. *Language and Communication* 16:165-178.
Morford, Jill Patterson. 1993. Creating the language of thought: The development of displaced reference in child-generated language, University of Chicago: Ph.D. dissertation.
Newport, Elissa L., and Supalla, Ted. 2000. Sign Language Research at the Millennium. In *The signs of language revisited: An anthology to honor Ursula Bellugi and Edward Klima*, eds. Karen Emmorey and Harlan L. Lane, xv, 580. Mahwah, N.J.: Lawrence Erlbaum Associates.
Padden, Carol. 1988. *Interaction of morphology and syntax in American Sign Language*. New York: Garland Press.
Pfau, Roland, and Steinbach, Markus eds. 2006. *Modality-independent and modality-specific aspects of grammaticalization in sign languages*. vol. 24. *Linguistics in Potsdam*. Potsdam, Germany.

Polich, Laura. 2005. *The Emergence of the Deaf Community in Nicaragua: "With Sign Language You Can Learn So Much"*. Washington, DC: Gallaudet University Press.

Pyers, Jennie E., and Emmorey, Karen. 2007. Two-faced: How knowledge of a sign language affects facial gesture. In *International Society for Gesture Studies*. Evanston, IL.

Pyers, Jennie E., and Senghas, Ann. 2007. Reported action in Nicaraguan and American Sign Languages: Emerging versus established systems. In *Visible Variation: Comparative Studies on Sign Language Structure*, eds. Pamela Perniss, Roland Pfau and Markus Steinbach. Berlin: Mouton de Gruyer.

Rathmann, Christian, and Mathur, Gaurav. 2004. Verb agreement as a linguistic innovation in signed languages. In *Theoretical Issues in Sign Language Research 8*, ed. Josep Quer. Barcelona.

Sandler, Wendy, and Lillo-Martin, Diane C. 2006. *Sign language and linguistic universals*. Cambridge, UK ; New York: Cambridge University Press.

Senghas, Ann, Coppola, Marie, Newport, Elissa L., and Supalla, Ted. 1997. Argument structure in Nicaraguan Sign Language: The emergence of grammatical devices. *Proceedings of the 21st Boston University Conference on Language Development*:550-561.

Senghas, Ann. 2003a. Intergenerational influence and ontogenetic development in the emergence of spatial grammar in Nicaraguan Sign Language [Oct-Dec]. *Cognitive Development* 18:511-531.

Senghas, Ann, Kita, Sotaro, and Özyürek, Asli. 2004. Children creating core properties of language: Evidence from an emerging Sign Language in Nicaragua [Sep]. *Science* 305:1779-1782.

Senghas, Richard J. 2003b. New ways to be deaf in Nicaragua: Changes in language, personhood, and community. In *Many ways to be deaf: International, linguistic, and sociocultural variation*, eds. L. Monaghan, K. Nakamura, C. Schmaling and G. H. Turner, 260-282. Washington, DC: Gallaudet University Press.

Shepard-Kegl, Judy. 1985. Locative relations in ASL word formation, syntax, and discourse, Linguistics, MIT: Ph.D.

Supalla, Ted. 1982. Structure and acquisition of verbs of motion and location in American Sign Language, University of California, San Diego: Ph.D. dissertation.

Svorou, Soteria. 1994. *The grammar of space*: Typological studies in language. v. 25. Amsterdam: J. Benjamins.

Taub, Sarah. 2001. *Language from the Body: Iconicity and Metaphor in American Sign Language*. Cambridge, UK: Cambridge University Press.

Torigoe, Takashi. 2000. Grammaticalization of pointings and oral movements in a home sign. Paper presented at *Theoretical Issues in Sign Language Research*, Amsterdam.

Traugott, Elizabeth Closs, and Heine, Bernd. 1991. *Approaches to grammaticalization*: Typological studies in language. v. 19: 1-2. Amsterdam ; Philadelphia: J. Benjamins.

Wilcox, Sherman. 2004. Gesture and language: Cross-linguistic and historical data from signed languages. *Gesture* 4:43-73.

Zimmer, June, and Patschke, Cynthia G. 1990. A class of determiners in ASL. In *Sign language research: Theoretical issues*, ed. Ceil Lucas, 201-210. Washington, D.C.: Gallaudet University Press.

Figure 1

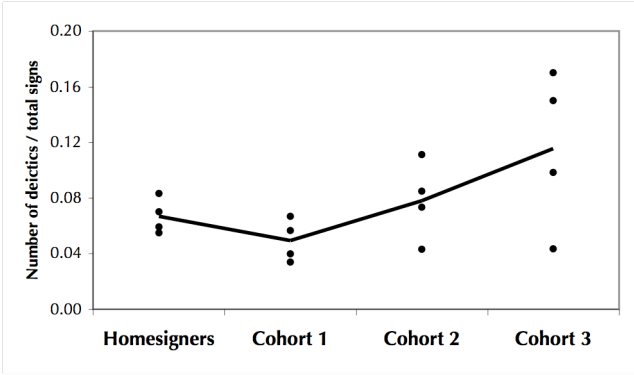

Figure 1. Proportion of signs produced that are deictics. Dots represent individual participants; the solid line indicates the mean for each group. Note that the use of deictics increases across groups.

Figure 2

Figure 2. Proportion of signs that are points to the chest. Dots represent individual participants; the line indicates the mean for each group. Note that the use of IX:chest increases across groups.

Figure 3

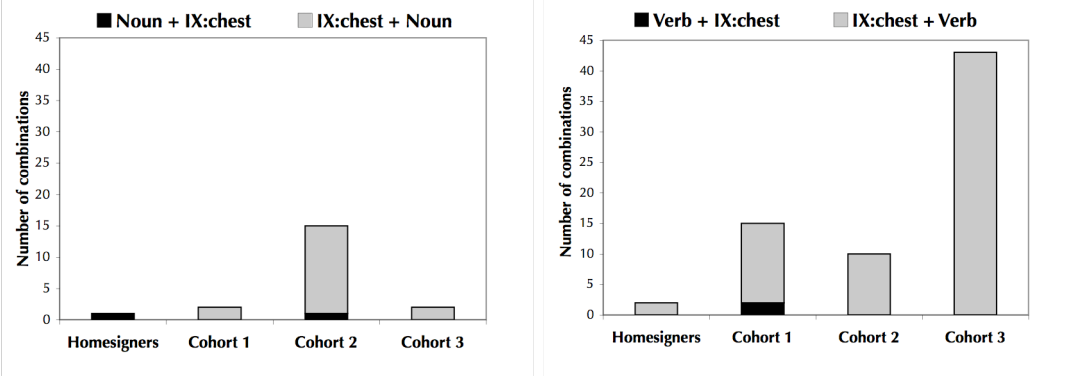

Figure 3. Orders of IX:chest in combinations with nouns (left) and verbs (right). Note that the combinations with IX:chest are predominantly point-initial. Indeed, Cohort 3 produced solely point-initial combinations. They also produced these combinations much more frequently than the other groups, and almost exclusively with verbs.

Figure 4

Figure 4. Example of a locative point. A homesigner points above his own head to refer to the location above the cat. Note that his eye gaze follows the point.

Figure 5

Figure 5. Example of a nominal point. A first-cohort signer points to her left to refer to the bird, who has been previously associated with that locus. Note that the movement is constrained within the signing space, and that her eye gaze does not follow the point.

Figure 6

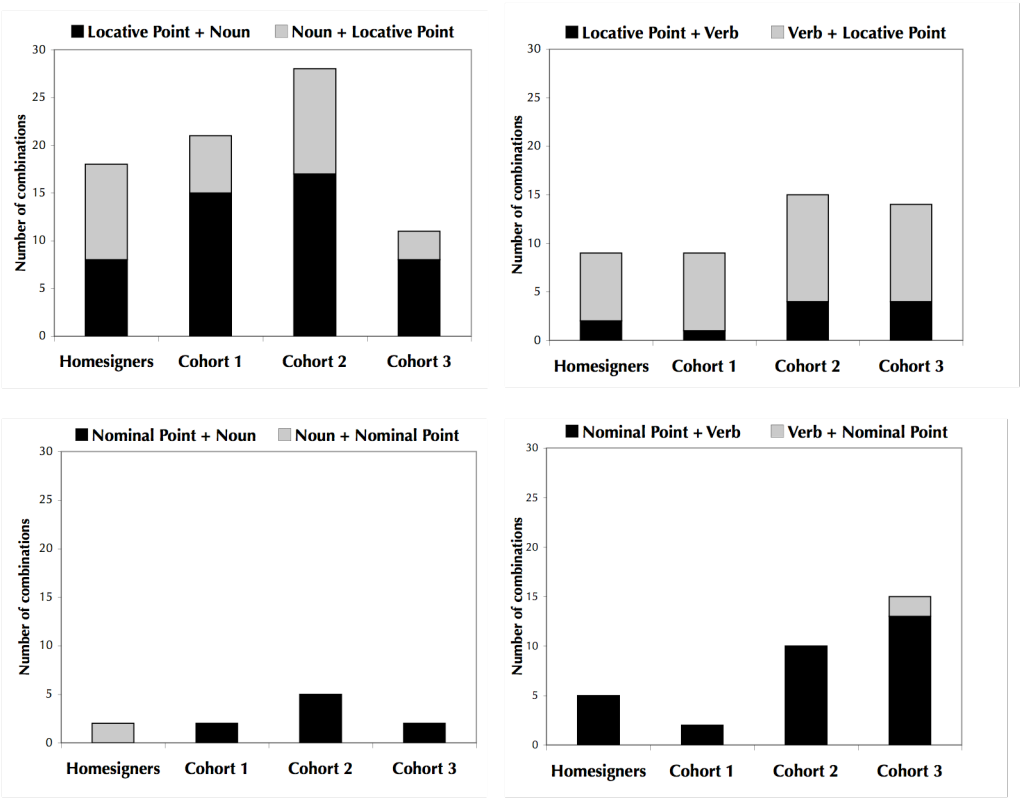

Figure 6. Orders of locative points in combinations with nouns (6a.) and verbs (6b.), and nominal points in combinations with nouns (6c.) and verbs (6d.). *Noun* refers to all nominal elements, including lexical nouns and nominal deictics. *Verb* refers to all verbal elements, including verbs, constructed actions, and classifier constructions. Note that combinations with nominal points, unlike locative points, are almost exclusively point-initial (6c. and 6d.) Note also that the use of the nominal point + verb constructions increases over cohorts (6d.), suggesting the emergence of a new semantic function for that form.

Figure 7.

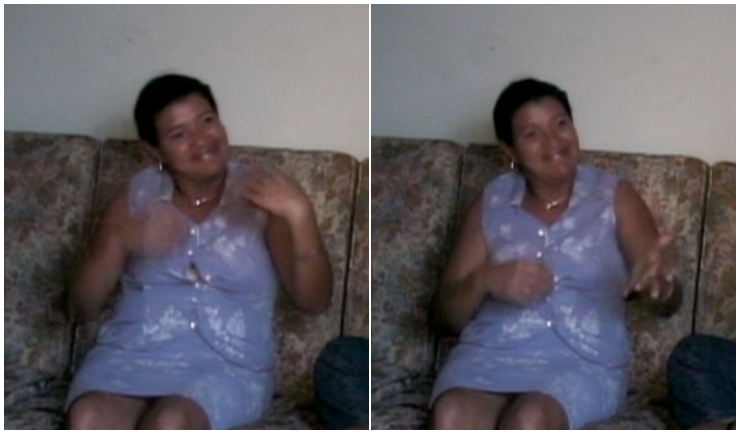

Figure 7. Example of a locative form of ANOTHER. A homesigner produces the sign to the left, to refer to a new location different from the one she has been discussing. Note that she bends both the elbow and wrist as she produces an arced movement with her forearm and hand. Her eye gaze follows the sign, to the left.

Figure 8.

Figure 8. Example of a nominal form of ANOTHER. A third-cohort signer uses the sign to switch reference from the cat to the bird. Note that the movement of the sign is constrained, involving a twist of the wrist as the index finger turns outward, and that his eye gaze does not follow the sign.

Figure 9.

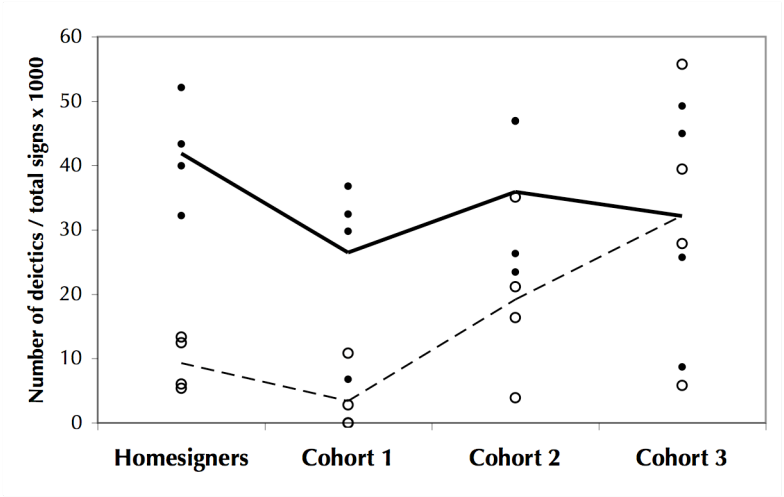

Figure 9. Deictics with locative uses (filled circles, solid line indicates mean) and nominal uses (open circles, dashed line indicates mean). In contrast to locative deictics, which do not differ systematically across groups, nominal deictics exhibit a linear increase across the language continuum, suggesting the emergence of a new semantic function for these forms.

Figure 10.

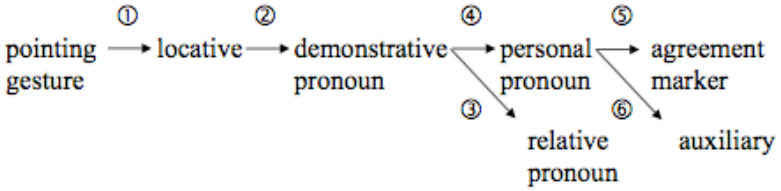

Figure 10. Hypothesized grammaticalization path of pointing gestures in sign languages (from Pfau and Steinbach 2006). The current data provide support for portions of this continuum, including the development of pointing gestures to locatives, and later to more nominal forms (such as pronouns).