

The Development of Early Spatial Morphology in Nicaraguan Sign Language

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1. Introduction

Over the past two decades, a new sign language has emerged within a young Deaf community in Nicaragua. This new language provides an opportunity to examine the processes that drive language development and change over time. In particular, we can discover children's biases in organizing linguistic information as they leave their imprint on the language's structure.

The present study examines the emergence of morphological devices for linking arguments with their respective verbs. We examine Nicaraguan signers' attention to spatial contrasts, that is, movements to the left or right, as they interpret the semantic roles (such as agent and patient) in the signing they observe. We find that Nicaraguan Sign Language is changing in this area; the newest form of the language, used by the younger children, is different from that used by the older signers who served as their original language models.

2. Background

Before the 1970s, deaf Nicaraguan children and adults had little contact with each other. This situation changed in the late 1970s when a primary school for special education was established in Managua, followed in 1980 by a vocational school for adolescents. By 1983, the schools served over 400 deaf students (Polich, 1998). For the first time, a Deaf community existed with continuity from childhood through early adulthood.

The children who arrived at these schools all had hearing parents, and none knew any signing deaf adults. Susan Goldin-Meadow and her colleagues (Goldin-Meadow & Mylander, 1984) have shown that such children can develop family gestural communication, or *homesign*, systems. Some of the first students in 1980 presumably had such homesign systems, which most likely varied widely in complexity and form (Coppola, Senghas, Newport, & Supalla, in prep.).

The teachers at the schools did not know any sign language, and lessons were conducted in spoken Spanish. Nevertheless, the first cohort of children spontaneously began gesturing with each other on the school grounds and buses. They soon began to converge on a common system: an early, rudimentary sign language.

Over the course of the decade that followed, a second cohort entered school and learned to sign by observing and conversing with their older

schoolmates. This was an unusual language-learning situation, in that the model that the first cohort of children provided for this new second cohort was not yet a fully developed language. The second cohort responded to the situation by expanding and systematizing the language, as they learned it, into the richer form we see them using today (Kegl & Iwata, 1989; Senghas, 1995a; 1995b).

The first cohort of children to enter the community are now adults in their mid-twenties and early thirties, and the younger second cohort that followed are adolescents. Differences between them reveal the reanalysis and grammaticization that took place as the second cohort expanded the language in the 1980s.

The data presented in this paper compare the two cohorts with respect to their use of spatial devices for indicating semantic roles. In order to be able to detect most clearly the historical progression of the language, we included only early-exposed signers from each cohort; in this way we eliminated the variability in signing competence and grammatical structure evident among those who learned the language only later in life.

3. Previous work on argument structure in Nicaraguan Sign Language

The present study is part of a series examining the expression of argument structure in Nicaraguan Sign Language (NSL), and the course by which it emerges and changes (see Senghas, Coppola, Newport, & Supalla, 1997). One of the most central components of a language's grammar is its means of expressing argument structure; that is, how subjects and objects are linked to their respective verbs.

There are conflicting predictions of how such structures might appear in an early sign language. Research on spoken pidgins suggests that early languages produce a consistent word order to express basic grammatical relations, and have minimal morphological structure (Kay & Sankoff, 1974; Hymes, 1971). Morphological structure then develops over subsequent generations of the language. On the other hand, cross-linguistic work on sign languages (Supalla, 1995) has shown that sign languages tend to develop rich morphological systems that incorporate spatial elements into verbs to express their grammatical relations.

Previous work on the production of argument structure in NSL (Senghas et al., 1997) examined the sentences produced by 4 first-cohort and 4 second-cohort signers to express simple events they had seen on a video monitor, such as a woman tapping a man, or a man giving a cup to a woman. In that study, we found that the first cohort expresses the relations among elements of the sentence with a small set of basic word orders. Interestingly, this syntax does not permit two animate arguments to be expressed with a single verb, and thus involves two verbs per sentence for many single-action events, as in (1) and (2) below. The resulting systematic NVNV-based word orders effectively make an agent/patient distinction.

- (1) WOMAN TAP MAN TAPPED
'A woman taps a man'

- (2) MAN PUSH WOMAN FALL
'A man pushes a woman over'

The second cohort, in contrast, uses these basic word orders less frequently. Instead, they often produce new word orders not observed in the signing of the first-cohort signers who served as their language models. The appearance of these alternative orders suggests that other syntactic structures are beginning to appear. Examples of second-cohort sentences are given in (3) through (5) below.

- (3) WOMAN MAN TAP TAPPED.
'A woman taps a man.' or 'A man taps a woman.'
- (4) MAN WOMAN TAP TAPPED.
'A woman taps a man.' or 'A man taps a woman.'
- (5) MAN PUSH FALL WOMAN.
'A man pushes a woman over.'

Note that sentences (3) and (4) could be produced to refer to the same event, despite the contrast in the order of their elements. While second-cohort signers still produce two verbs for events that involve two animate arguments, each verb is not unambiguously linked with its noun based on word order alone.

4. The direction of movement in verb production

Senghas et al. (1997) then asked whether semantic roles were being expressed in the location or direction in which signs are produced. We examined the movements in the verbs produced by each cohort to determine if such spatial elements were being used as a morphological device.

For researchers familiar with only spoken languages, the concept of spatial morphological elements may be unfamiliar. As in spoken languages, developed sign languages append grammatical elements to words. Many signs are produced neutrally in a central location in front of the signer. By altering the direction of a sign's movement to or from a non-neutral location, the signer adds a spatial morpheme. For example, in American Sign Language, nouns are marked as definite and specific by being indexed to a particular location in front of the signer; verbs then agree with their noun arguments by taking on these same locations. An agreeing verb will begin at the location assigned to its subject, and move to the location assigned to its object.

To explore whether Nicaraguan Signers might be indicating semantic roles spatially, we examined whether the direction in which signs were produced was systematic and consistent. The signers did not typically produce nouns in a marked location, and also did not indicate any marked location (for example, in a determiner) as part of the noun phrase; we therefore could not ask whether verbs agreed with their associated nouns. However, in the signing of both cohorts many verbs were produced with (sometimes subtle) movements toward

the right or left of the signer. We therefore asked whether these movements toward non-neutral locations were predicted by the semantic roles associated with the nouns in the sentence. For example, for a given signer, if we consider all of the events involving the man in some role, that were expressed using a verb movement to the right, how often was it the case that the man was the agent of the event? When the man was the patient, was the verb more likely to be produced with a leftward movement?

Our primary interest was not so much if these movements were to the right or to the left, but whether there was a consistent pattern across the set of sentences produced by each signer. The videotaped stimuli that the signers watched all involved the same people, in the same positions, engaging in different activities. A signer representing the relative positions of these characters in the signing space could do so in either of two ways. One way matches the view of the characters in the video (in our stimuli, with the man to the right); the other way takes the view the signer has while watching the event on the monitor (that is, with the man to the left). We refer to these as *character view* and *signer view*, respectively.

For each signer, we examined all of the sentences that described events involving two characters. We determined whether individual signers, and each cohort as a group, used a consistent representation of the characters' relative positions across their responses. As can be seen in Figure 1, the signers from the first cohort did not consistently map the direction of their verbs' movements to one set of relative positions. Subjects 1 and 2 have each adopted an internally consistent system, but have selected different systems from each other. Subjects 3 and 4 did not use verb movement in any consistent way. It is therefore unlikely that this cohort is using a verb's direction of movement as a shared morphological device.

The second-cohort signers, in contrast, were systematic. They each consistently chose one system for incorporating a movement into their verbs. Furthermore, all of the signers shared that system, what we have called the *character view*, with each other. Direction of verb movement, relative to semantic role, is used consistently across sentences and across signers. This suggests that a morphological system underlies the production of verb direction for these younger signers.

5. A problem of interpretation

This new pattern of verb direction observed in production, though compelling, is not enough evidence to conclude that the younger second cohort has introduced a system of spatial morphology. What the second cohort produces is more constrained in its choice of direction; nevertheless, every directional verb produced by signers from the second cohort could have been produced by signers from the first. Thus, the complex verbs produced by the second-cohort signers are a logical subset of those produced by the first cohort. For this reason, we cannot yet argue that there has been a change in the underlying rules that produce these constructions.

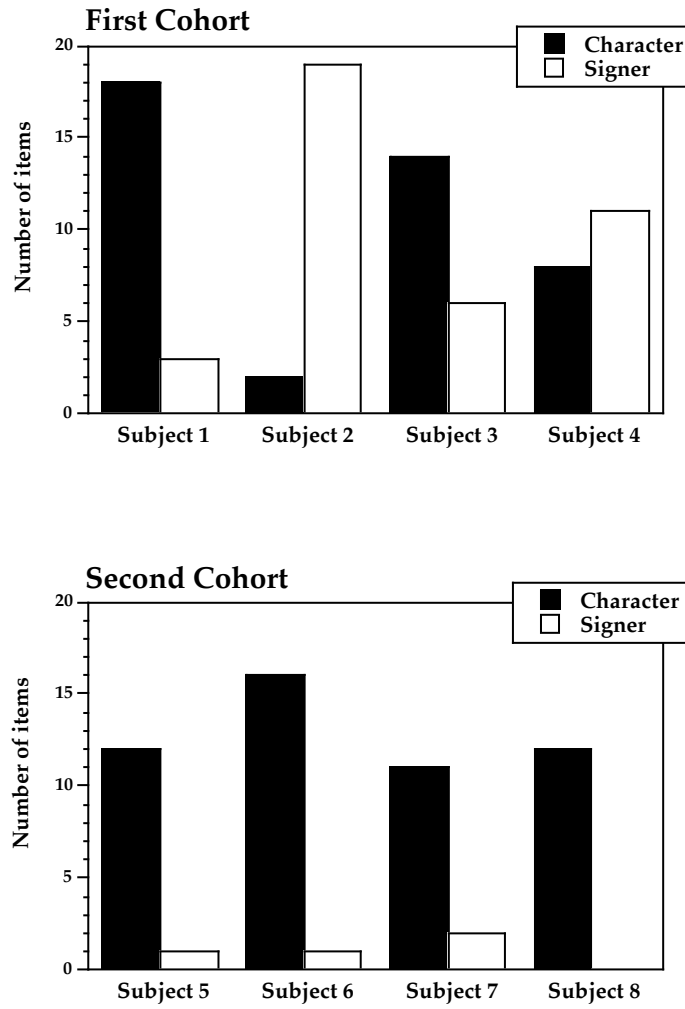


Figure 1. Consistency of directional movements incorporated into verbs, relative to the spatial layout in stimuli presented, in the sentences produced by first- and second-cohort signers. While first-cohort signers (particularly subjects 3 and 4) produced verbs in both directions, second-cohort signers all consistently employed a character-view representation.

In order to determine whether spatial devices are emerging in Nicaraguan Sign Language, we need evidence that changing the direction in which a sign is produced changes the meaning of the sign, or the sentence in which it is situated. The contrast in form must correspond to a contrast in meaning. Determining this requires not only production data, in which the first cohort produces verbs in either direction, and the second cohort in only one; it requires comprehension data showing a difference in the interpretation of the two types of verbs by the two cohorts.

The present study compares how first- and second-cohort Nicaraguan signers interpret directional verbs. We expect second-cohort signers to have a more specific interpretation of the possible grammatical relations in a given sentence than first-cohort signers. For example, given the relative positions of the actors in the video that signers viewed, if sentence (3) above were presented with the verb TAP produced in a rightward direction, we would expect it to mean either 'the woman taps the man' or 'the man taps the woman' to members of the first cohort, but only 'the woman taps the man' to members of the second. Such a difference in interpretation would point to a shift in the grammar of the language.

To ascertain whether signers considered the direction of a verb's movement relevant to the interpretation of semantic roles, we presented them with sentences that had been collected in the production study above, and asked them to indicate the range of interpretations available for each sentence by selecting among pictures that depicted possible versions of the event. Unfortunately, most naturally produced sentences (particularly those produced by first-cohort signers) present verbs in a word-order context that makes the assignment of semantic roles unambiguous, such as WOMAN TAP MAN TAPPED. When a subject attributes a meaning to such a sentence that matches the meaning intended by the original signer, we cannot know whether the subject is relying on word order or verb direction cues to assign semantic roles. For this reason, in order to contrast the relative locations of the characters being described, we presented subjects with target pictures of each event along with their left-right reversed images, as well as with unrelated distractor pictures. In this way, we could determine if a contrast in the spatial relations to which a signer referred must correspond to a contrast in the direction of movement of the verb describing the event. If the direction of movement in a verb is meaningful and specific for second-cohort signers, they should attribute spatial verbs to only one of the versions of the event. In contrast, we expect first-cohort signers to accept both the original and the reversed image of the event as possible representations for a sentence.

6. Method

The subjects in the present study were eight Nicaraguan signers, four from the first cohort, and four from the second cohort. All had entered the signing community before the age of six. The four first-cohort signers entered the community in 1980 or earlier, and had a mean age of 26 years at the time of testing. The four second-cohort signers entered in 1985 or later, and had a mean

age of 14 years at the time of testing. All eight subjects had participated in the production study reported in Senghas et al. (1997) described above.

The subjects each watched a set of 22 signed sentences produced by the same set of subjects (that is, themselves and each other) two years earlier. These sentences had been collected in the course of the production study, and were originally responses to simple events, such as a woman tapping a man, displayed on a video monitor. Thus, each item consisted of a single sentence produced by a native first- or second-cohort Nicaraguan signer, seated at center screen.

The first four sentences served as training items, and described events that involved only one person, with no directional movement on the verb, such as MAN CRY, or WOMAN JUMP. Eight of the test sentences described events that involved two people, such as WOMAN TAP MAN TAPPED, with directional movement incorporated into the verbs. The remaining items were fillers, again with no directional movement, or with inconsistent directional movements over the multiple verbs in the sentence. The sentences were divided into two equal sets, set A and set B, with four of the directional test sentences included in each set. The sentences were counterbalanced with respect to left-right spatial contrasts, and with respect to character view vs. signer view representations. The order of items was randomized within each set, with the constraint that the same signer not be presented twice in a row. Half of the subjects from each cohort viewed set A before set B; the other half of the subjects viewed set B before set A.

After watching each sentence being signed on a small monitor, subjects were asked to indicate their interpretation of the sentence's meaning(s) by writing on an answer sheet. The answer sheet consisted of four pictures extracted from the original event video clips (presented as stimuli in the production study), such as a picture with a woman on the right tapping a man on the left. Each picture had a white checkbox in the upper left corner, and subjects were instructed to write a checkmark in the box above all pictures that could correspond to the signed sentence they had just viewed, and to draw an X in the box above pictures that did not correspond to the signed sentence.

For directional items, at least one of the pictures (the target) presented the event that had been viewed by the signer producing the sentence. Another picture presented the left-right reversed image of that event (thus, the man was shown on the right). The remaining two pictures presented either another moment in the target event or its reversed image, or a distractor picture that presented a different event. The answer sheets presented for non-directional and inconsistent filler sentence items sometimes presented no picture (2 items) or only one picture (2 items) of the target event, with the remainder unrelated distractors. In this way, subjects had reasonable opportunities to "correctly" select 0, 1, 2, or 3 pictures on the page, whether they used a less-constrained or more-constrained interpretation of directional movements.

Thus, in a typical trial, a subject might watch a signer produce the sentence WOMAN TAP MAN TAPPED in which the first verb included a movement to the right, and the second verb included a movement from the left. The subject would then select from among four pictures on an answer sheet, including two

images of a woman tapping a man (one to her left, and the other to her right) one of a man showing a woman a paper, and one of a man pushing a woman.

After completing the first set of sentences, subjects were asked directly if it made any difference in which direction a verb was produced, in reference to the most recently completed item. The subject then proceeded to the second set of sentences.

7. Results

Our question concerned whether the second cohort is changing Nicaraguan Sign Language with respect to how the arguments of verbs are identified. We examined the comprehension of verbs with a directional movement to determine if second-cohort signers assign them a narrower interpretation than first-cohort signers do. If this were the case, we would then seek to confirm that the increased specificity matched the contrast we had observed previously in their production. That is, in their comprehension of sentences with directional verbs, we expected second-cohort signers to assign a character view, and not a signer view, to the representation.

The interpretation of each sentence was coded as reflecting either a character-view interpretation, a signer-view interpretation, or an interpretation in which both were accepted. As can be seen in Figure 2, members of the first cohort consistently indicated that sentences with directional verbs could correspond equally to both versions of the event. Three subjects selected both interpretations for all of the sentences; the remaining subject selected both interpretations for six of the eight. Evidently first-cohort signers do not interpret the direction in which a verb is produced as a meaningful feature assigning the person on one side (and not the other) to the patient role.

Signers from the second cohort, in contrast, indicated a narrower interpretation for the sentences. Furthermore, in doing so, they consistently selected the character view as the best representation of the event. Two of the subjects selected the character-view interpretation for all of the sentences; the other two selected the character-view interpretation for seven of the eight. No second-cohort subject equally accepted both versions of the event. (It should be noted that second-cohort subjects did accept both the original and reversed images on items that involved only one person in a nondirectional event, such as a woman tearing a tortilla, and a man crying. Thus, their more constrained selections do not reflect a resistance to selecting two pictures for a single item.)

When asked halfway through the task whether the direction of movement in a verb made a difference in their responses, all four first-cohort subjects responded that a verb could be signed to the left or the right without changing the meaning of the sentence, and without affecting their responses. In contrast, all four of the second-cohort subjects responded that the direction in which the verb was produced did make a difference. Interestingly, the degree to which it made a difference decreased as the subjects' ages increased. The youngest subject (12 years old) said that the character-view image was the only acceptable option, and the signer-view image could never correspond to the sentences. ("If you wanted to say that, you would sign it the other way," he explained, as if it

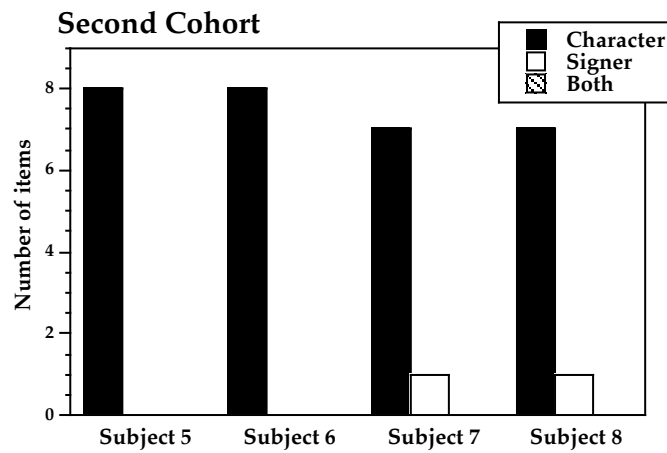
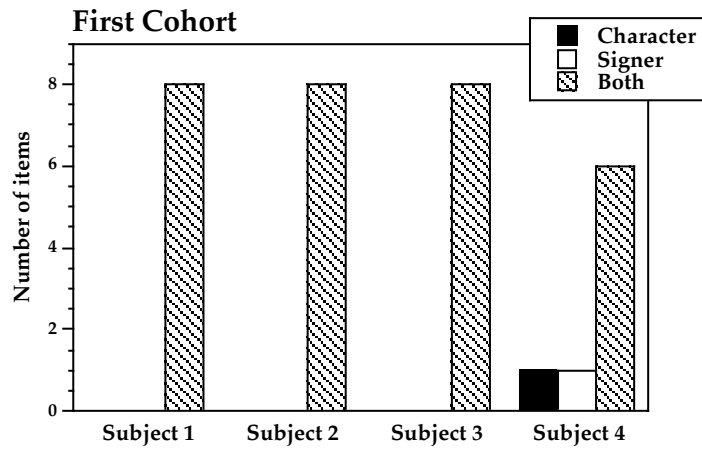


Figure 2. Interpretations assigned to sentences that included a verb with a directional movement by signers of the first and second cohorts in a comprehension task. First-cohort signers accepted both character-view and signer-view spatial representations as possible interpretations. Second-cohort signers assigned a narrower interpretation, accepting only a character-view representation.

were unreasonable to expect otherwise.) The second-youngest subject (13 years old) responded that older signers will often sign the other way, since they “can’t always remember” which way the relative positions were originally assigned. The two oldest subjects (16 and 17 years old) said that the other (signer-view) representation was possible, but that they strongly preferred the character-view representation evident in their production. Apparently a change in the use of verb direction has been taking place over the course of this cohort’s acquisition of the language.

These results are particularly striking when we consider that half of the sentences used as test items had been produced (by first-cohort signers) in a direction that would appear to represent a signer-view representation. We now know that for these sentences the direction in which the verb was produced was not necessarily intended to reflect a specific link with the arguments of the verb. Nevertheless, second-cohort signers observing these sentences interpreted them as if the direction of movement in the verb were a meaningful device. When they selected only the image that was the character-view interpretation, for these items it was the left-right reversal of the event to which the original signer referred. Thus, on half of the items, second-cohort subjects misinterpreted the sentences produced by first-cohort signers.

8. Discussion

The younger, second cohort of Nicaraguan signers has certainly left their imprint on the structure of Nicaraguan Sign Language as they have acquired it. Signs are now being systematically and meaningfully linked to specific locations, in both production and comprehension, by second cohort signers only. This device appears to perform much of the work that we would expect of morphological agreement systems. It links words in the sentence together, including words that are at a distance, and enables the addressee to connect verbs with their arguments.

This constrained use of spatial elements is new with the second cohort. They have acquired a more specific system than their input language to such a degree, that with other cues removed, the differences between cohorts ultimately lead to misinterpretations of each other’s signing.

Nevertheless, one must still ask what precisely it is in the language that has become more specific. The data presented here show that directional movements, when incorporated into verbs, enable addressees to decipher the semantic roles of elements in the sentence. However, the representation examined here is still, to a large degree, grounded in a physical model of the event. It remains unclear whether the directional movements encode semantic role directly, or whether they encode locative information from which semantic roles, such as agent and patient, can be derived.

Two lines of further research address this question: in one, we are examining how the physical locations of objects are communicated, to see if true locative expressions resemble the directional movements found in the verbs we have examined here. It is interesting to note that the character-view representation of events is only one of many representational mappings available

in Nicaraguan Sign Language for discussing the spatial relationships among objects and persons. Another line of research will include an exploration of constructions that represent non-localizable, but still transitive events, to determine if directional movements can be used to link elements in a sentence without grounding them to physical models of location. For example, we will explore whether Nicaraguan signers use directional verbs to describe events such as influencing, owing, and remembering.

Based on our observations so far, it is clear that Nicaraguan Sign Language is expanding and growing as it is acquired by a new generation of learners. One way in which it has become more expansive, perhaps surprisingly, is in its increased specificity: the use of space and movement is more constrained for the second cohort than for the first. This is the type of imprint we seek; it is evidence of the very reanalysis that drives language learning and language change. These changes will be passed down to future generations of Deaf Nicaraguans, who will each take a turn at developing the language's grammar. Every tweak provides us with a glimpse of human capacities to learn and to create new languages.

Endnotes

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