

# ENCODING MOTION EVENTS IN AN EMERGING SIGN LANGUAGE: FROM NICARAGUAN GESTURES TO NICARAGUAN SIGNS

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## **Abstract**

To what degree are the means of expressing motion events in sign language derived from co-speech gesture? The present study examines an emerging sign language with respect to manner and path expression, comparing it to gestures that accompany speech. Nicaraguan Sign Language is less than two decades old. We investigate the influence of gesture on its emergence by comparing the gestures that accompany Spanish, the sign language of the first arrivals (now adults), and the signing of newer arrivals (now adolescents). In elicited narratives, co-speech gestures and adults' signs often combined manner and path into a single holistic movement. Adolescent signers produced fewer combined movements, tending instead to separate events into multiple signs. These data suggest that the reanalysis of gesture into sign involves separating holistic representations into sequential components. Thus, signed constructions do not mirror gesture. Although sign, like gesture, offers the possibility of producing holistic expressions, young sign languages already may instead treat manner and path as basic, separable elements.

## **1. Introduction**

Linguists who have had contact with many different sign languages are often struck by the similarities they bear to each other. Elissa Newport, in her closing plenary address at the conference on Theoretical Issues in Sign Language Research in 1996, noted that this phenomenon begs an explanation. Is it due to the manual-visual modality in which sign languages are produced? Is it a consequence of the circumstances under which sign languages are typically acquired?

Perhaps some similarities are due to common origins in gesture, specifically, the gestures that accompany spoken language. There are two aspects of gesture that suggest such an account. First, gesture, like sign, operates in the manual-visual modality, and thus all of its elements are fully available to be co-opted by sign languages. Second, because sign languages emerge in communities that are populated predominantly by people using spoken language, co-speech gesture has surrounded every sign language at its origin.

Accordingly, there are two ways in which gestural origins could have similarly influenced sign languages around the world. By one account, gestures may have been similar

worldwide. Perhaps the manual-gestural modality is conducive to particular types of productions that were realized universally in co-speech gesture, and then adopted by the various sign languages. By another account, gestures may have differed, but been subject to similar analyses. Universal processing strategies shared by language-learners around the world may have been applied to the gestured part of the signal in a common way, converting different co-speech gestures into similar sign language grammars.

Alternatively, differences in gesture may have led to differences in sign languages. Some grammatical components of spoken language are reflected in the gestures that accompany them. These components would have been available to be adopted into a local emerging sign language. To the degree that this is the case, diversity in spoken languages should have engendered diversity in signed languages.

Consider an aspect of morphology that has been observed in numerous sign languages: multiple meaningful elements of a sign can be produced simultaneously (Fischer & Gough 1978; Klima & Bellugi 1979; Supalla 1982). For example, in a description of a bicycle going up a hill with an unsteady, weaving manner, the upward path and the unsteady manner are each represented with a separate element (the first, an upward trajectory of the hand; the second, a side-to-side wobble), and these elements are produced simultaneously (the hand moves simultaneously upward and side-to-side).

Like signing, co-speech gesturing allows simultaneity. To take the above example, as speakers describe the path and manner of the movement of a bicycle, they often produce hand movements that correspond to the upward trajectory and the unsteady manner, and the movements can be produced simultaneously. Furthermore, these gestures are produced simultaneously with spoken words.

Are the simultaneous aspects of signing derived from the simultaneous aspects of gestures that accompany speech? To address this question we compared the descriptions of motion events in co-speech gesture to those of an early, emerging sign language. Perhaps surprisingly, we did not find support for gestural origins of the simultaneity in sign language. At the moment at which gestures are co-opted by a sign language, the simultaneous aspect is not necessarily adopted. Instead, what appear simultaneously in gesture can appear as sequential components in a young sign language.

## 2. Manner and path in co-speech gesture

Let us first examine how manner and path are expressed in the gestures that accompany spoken language. This will provide a view of the gestural input available to sign languages at their time of origin.

In previous work, Özyürek & Kita (1999) found that the structure of co-speech gestures is partly determined by the structure of the spoken language they accompany. Where spoken languages differ from each other in the expression of manner and path in speech, they differ from each other in the expression of manner and path in gesture.

In some languages, such as English, manner and path are generally tightly combined into a single phrase that includes a verb expressing the manner of movement, followed by a word that describes the path of movement. For example, in the English expression "to roll down," the manner of movement is expressed in the verb *roll*, while the path is

expressed in the word *down*, immediately following the verb. This lexicalization pattern allows English-speakers to package manner and path tightly in discourse.

In other languages, such as Turkish and Japanese, manner and path information are separated in speech. The path of movement is expressed in one verb, such as *descend*, and the manner of movement is expressed in a second, separate verb, such as *rolling*. Thus, a Japanese speaker describing someone rolling down a hill might say “*korogat-te ochiru*,” (rolling descends). This kind of lexicalization pattern, combined with other syntactic properties of languages like Turkish and Japanese, allows speakers to express manner and path elements less tightly; in fact, there are often several intervening words between the word that expresses path and the word that expresses manner.

Özyürek & Kita (1999) found that this difference in speech is paralleled by a difference in gesture. For example, in English, the tightly packaged phrase of manner and path information is often accompanied by a single gesture that includes both manner and path simultaneously. Accordingly, a speaker uttering the expression “He rolled down the hill” would produce a single hand movement with both a circular pattern and a downward trajectory. In contrast, speakers of Japanese and Turkish separate their gestures, producing them in a segmented manner, such as a circular movement of the hand (accompanying speech about *rolling*), followed by a movement of the hand in a downward trajectory (accompanying speech about *descending*). Thus, for both types of languages, gestures match speech.

### 3. How do manner and path expression emerge in sign languages?

Historically, sign languages emerged in different countries all over the globe, each surrounded by its local spoken language. Consequently, early sign languages had different gesture patterns to draw from. As we discussed above, one salient variation in those gestures is in their expression of manner and path: gestures that represent manner and path separately occur with some spoken languages more than others. One might predict that sign languages emerging among these gesture systems would differ accordingly: those surrounded by combined gestures would include combined or holistic signs, those surrounded by separate gestures would include separate signs.

To test this prediction, we examined a young, emerging sign language with respect to how manner and path are packaged, and compared it to the gestures that accompany the local spoken language. The sign language we examined is a new language that has emerged over the last two decades within the Deaf community in Managua, Nicaragua. Throughout its emergence, Nicaraguan Sign Language has been surrounded by spoken Spanish. We will turn now to a history of this new sign language, followed by an examination of how manner and path are expressed in the sign language and in the gestures that accompany spoken Spanish.

### 4. A brief history of Nicaraguan Sign Language

Before the 1970s, deaf Nicaraguan children and adults had little contact with each other. In the late 1970s, 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.

These deaf children all had hearing parents, and none knew any signing deaf adults. They did not teach a sign language at the schools; instead, the teachers focused on teaching the children to lip-read and speak Spanish. However, when this first group of children spontaneously began gesturing with each other, they were not prohibited from doing so. They soon began to converge on a common system: an early, rudimentary sign language (Kegl & Iwata 1989).

Every year since the late 1970s, new students have entered school and learned to sign from the older students who were already there. In this way, Nicaraguan Sign Language has been transmitted from children to children, which is not unusual for sign languages. What is unusual is that the model that the first students provided for the new children entering school in the mid-1980s was not yet a fully developed language. Nevertheless, with the arrival of each new cohort of young deaf learners, the new language expanded (Senghas 1995; Senghas & Coppola 2001). Within a decade, these sequential cohorts of children developed the first sign language adopted community-wide in Nicaragua.

We can take advantage of the sequence of cohorts today to discover how a new language is created. In order to observe changes in the language, we will represent the population of Nicaraguan signers as two cohorts; the first cohort being the children who arrived in the late 1970s and early 1980s, and the second cohort those who arrived in the late 1980s and early 1990s. First-cohort signers are in their late twenties now, and second-cohort signers are in their mid-teens. Recall that the first cohort provided language input to the second. Differences between them indicate the reanalysis, or augmentation, that occurred when the second-cohort signers were still children.

In the present study, we examine the influence of gestures on the course of sign language emergence by comparing three types of expressions: 1) the gestures that hearing people use as they speak Spanish, that is, *co-speech gestures*, 2) first-cohort (adult) signing, and 3) second-cohort (adolescent) signing. We looked for evidence that the way manner and path elements are bundled together in sign is derived from their packaging in co-speech gesture.

## 5. Method

### 5.1 Participants

Four Deaf first-cohort signers, four Deaf second-cohort signers, and four hearing Nicaraguans participated in the study. The Deaf participants all entered the Nicaraguan 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 27 years at the time of testing. The four second-cohort signers entered in 1985 or later, and had a mean age of 15 years at the time of testing. The hearing participants were all native Spanish-speakers who had lived in Nicaragua since birth. They had a mean age of 21 at the time of testing.

## 5.2 Task

Each participant watched a brief animated cartoon (*Canary Row*, a “Tweety and Sylvester” cartoon)<sup>1</sup> and narrated its story to a peer. The narratives were videotaped for later analysis.

## 5.3 Coding

Three complex motion events that involve a salient manner and path of movement were selected from the cartoon. In the first event, a cat climbs the side of a building, up the outside of a gutter drainpipe; in the second, he crawls up the inside of the gutter drainpipe; and in the third, having swallowed a bowling ball, he descends rapidly downhill in a rolling, wobbling manner.

The twelve participants’ descriptions of these three events were located in their narratives, yielding 36 event descriptions. The signs or co-speech gestures that were included in these descriptions were then each coded as one of the following: 1) manner only (such as a circular movement of the hand), 2) path-only (such as a hand tracing a downward trajectory), or 3) manner and path combined (such as a hand moving in a circular manner, tracing a downward trajectory).

## 6. Results

### 6.1 Manner and path in event descriptions

For the first analysis, we examined how often both manner and path were expressed manually in the description of each event (that is, anywhere in the description, in any number of signs or gestures). Because we had selected events in which both manner of movement and path of movement were salient, we expected that signers would express both manner and path in their signing for most of the events. Recall, however, that the hearing participants are speaking Spanish as they gesture, and have the option of encoding manner and path information in their speech as well as in their gesture. We are interested in how often manner and path information were available in the gestured part of the signal, regardless of the nature of the speech.

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<sup>1</sup> This cartoon was selected because it has been used in much of the previous research on gesture. For a detailed story description, see the appendix in McNeill (1992).

Figure 1

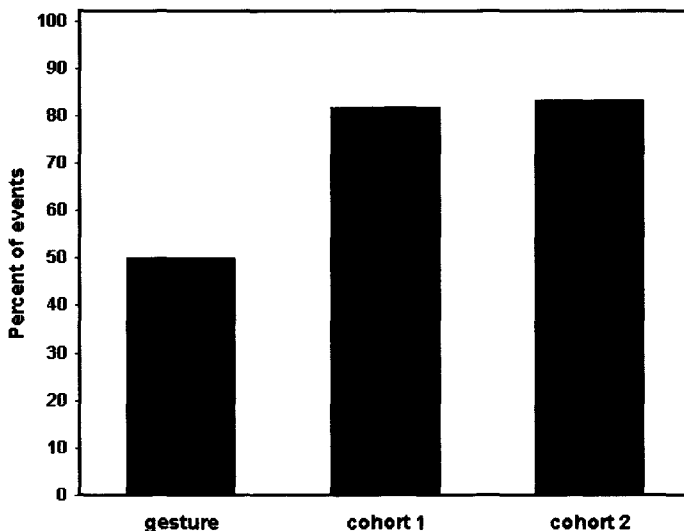


Figure 1: The percentage of event descriptions that included both manner and path expressed manually, in the narratives of Spanish-speakers, first-cohort signers, and second-cohort signers.

As can be seen in Figure 1, signers from the two cohorts were likely to mention both manner and path in their descriptions of the events we selected. First-cohort signers expressed both manner and path for 82% of the events, and second-cohort signers expressed them for 83% of the events. Even the hearing participants expressed both manner and path with their hands as often as half the time (50% of the events). We can consider this to be representative of the signal that was available to the first cohort of children when they created Nicaraguan Sign Language.

For the remaining analyses, we considered only these event descriptions -- that is, those that included both manner and path manually. We were interested in how the manner and path elements were combined.

## 6.2 Manner and path in individual gestures or signs

For the second analysis (as mentioned above), we considered the co-speech gestures and signs that occurred in those descriptions in which both manner and path were expressed. These totaled 52 movement descriptions: 7 co-speech gestures, 19 first-cohort signs, and 26 second-cohort signs. We examined each gesture and sign individually to determine how many expressed manner and path simultaneously. How many of the signs or gestures used in the complex descriptions were themselves complex or holistic?

Figure 2

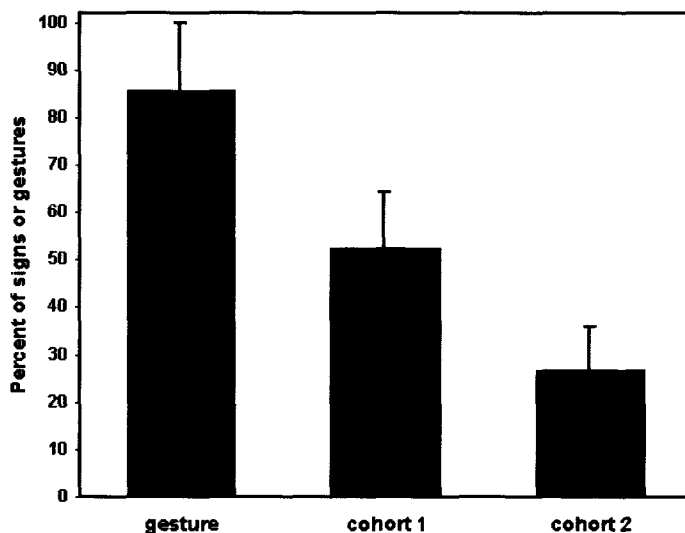


Figure 2: The percentage of signs or gestures that expressed manner and path simultaneously, in the narratives of Spanish-speakers, first-cohort signers, and second-cohort signers.

As can be seen in Figure 2, most of the co-speech gestures (86%) and half of the first-cohort signs (53%) combined manner and path into a single combined movement. In contrast, second-cohort signs included far fewer combined movements (27%). An analysis of variance (ANOVA) reveals that the gestures and signs indeed differ significantly in their simultaneity depending on whether they are produced by hearing gesturers, first-cohort signers, or second-cohort signers ( $F(2, 49) = 4.84, p = .012$ ). In particular, post-hoc comparisons reveal that second-cohort signs are significantly less likely to be a combined movement than co-speech gestures ( $p < .005$ ), and are marginally less likely to be a combined movement than first-cohort signs ( $p = .07$ , Fischer's Protected LSD).

Apparently, as the language develops, it uses fewer complex or holistic expressions for motion events. This result should be surprising to readers who expect increasing complexity in the language to result in increasingly complex individual signs.

### 6.3 Manner and path in sequential expressions

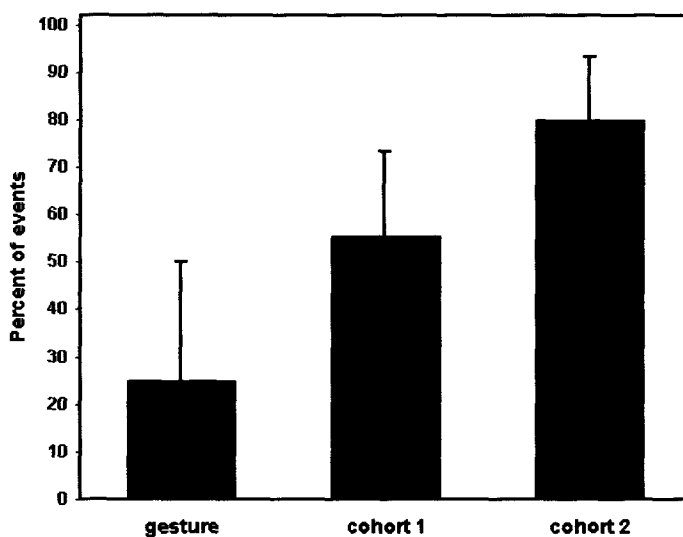
We next considered how often these signs and gestures were combined into longer, complex strings in order to express manner and path. That is, how many of the event descriptions were expressed with multiple, sequential signs or gestures?

We again examined all of the descriptions in which both manner and path were expressed on the hands. We coded as "sequential" those expressions that included multiple, nonidentical gestures or signs. For example, such a string could consist of a sign that

expresses manner, followed by a sign that expresses path, followed by a sign that expresses both.

One difficulty with this analysis is that for some of the participants, particularly the hearing gesturers, we were working with very little data. Two of the gesturers didn't produce any complex strings to express manner and path in the complex events we examined. We therefore lacked the power for statistical analyses to capture many patterns of variation. Nevertheless, the pattern of results we obtained is encouraging. We examined a total of 23 event descriptions: 4 in co-speech gestures, 9 in first-cohort signs, and 10 in second-cohort signs.

**Figure 3**



*Figure 3: The percentage of event descriptions that included multiple, sequential gestures or signs that together expressed manner and path, in the narratives of Spanish-speakers, first-cohort signers, and second-cohort signers.*

As is shown in figure 3, second-cohort signers frequently used multiple signs to express manner and path. They produced such sequential expressions 80% of the time. The first cohort produced them 56% of the time, and the gesturers only 25%. The expressions were not found to differ significantly by group in an overall analysis of variance ( $F(2, 20) = 1.98, p = .16$ ). The most prominent difference is between the second-cohort's expressions and the hearing gesturers'; this difference was marginally evident in post-hoc comparisons ( $p = .066$ , Fischer's Protected LSD).



#### 6.4 Manner-only, path-only sequences

As we were coding the data for the above analyses, we noted a particular construction that occurs frequently in the signed descriptions: a *manner-only* sign, followed immediately by a *path-only* sign. These constructions often occur within longer strings describing the manner and path of movement. We conducted an additional analysis to determine whether these signed expressions might be derived from gestural combinations. We asked how often the expressions from each group include a *manner-only, path-only* sequence.

Figure 4

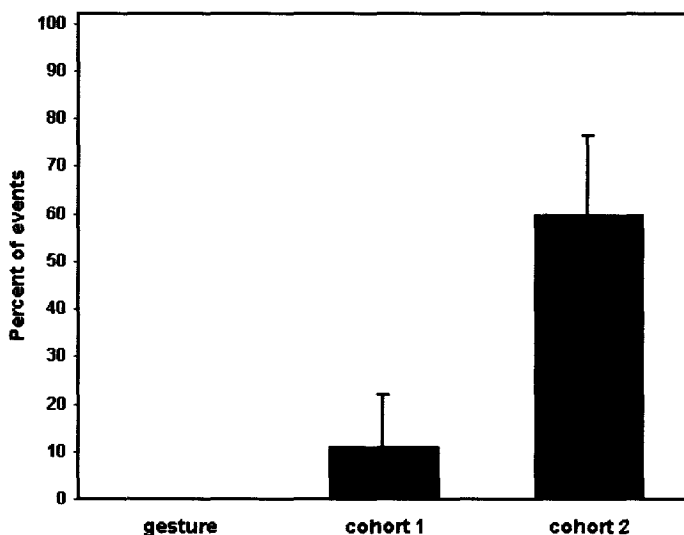


Figure 4: The percentage of event descriptions that included a *manner-only* element immediately followed by a *path-only* element, in the narratives of Spanish-speakers, first-cohort signers, and second-cohort signers.

Figure 4 presents the frequency of *manner-only, path-only* sequences in the descriptions produced by each of the three groups. Many of the second cohort's expressions (60%) included such a sequence. These sequences were less common in the expressions of the first cohort (11%) and entirely absent in the co-speech gesture (0%). An analysis of variance revealed that *manner-only, path-only* sequences do differ significantly by group ( $F(2, 20) = 4.81, p = .02$ ). In particular, post-hoc comparisons revealed that second-cohort signing is more likely to include *manner-only, path-only* sequences than both first-cohort signing ( $p = .02$ ) and co-speech gesture ( $p = .02$ , Fischer's Protected LSD).

The finding that *manner-only, path-only* sequences never occurred in co-speech gestures, and rarely occurred in first-cohort signing, suggests that these signed constructions are not derived directly from gesture.

## 7. Conclusion and discussion

Nicaraguan Sign Language currently packages manner and path information quite differently from the co-speech gestures that accompany Spanish. Where the co-speech gesture bundles manner and path information into a single, isolated movement, the sign language generates a sequential construction made up of basic elements. This finding suggests that sign languages do not inherit their means of packaging signs directly from the gestural patterns of the surrounding spoken language.

Recall the different types of spoken languages discussed earlier. English (including its gestures) bundles manner and path tightly together, while Turkish and Japanese (including their gestures) separate them. Spanish syntax, like English syntax, allows manner and path expressions to be packed tightly together, and Spanish-speakers typically use such tight expressions. That is, their manner and path verbs are typically uttered with one immediately following the other. Turkish and Japanese speakers, in contrast, typically insert a noun phrase, an adverb, or at least a clause-linkage morpheme between a manner verb and a path verb.

In the present study, Nicaraguan Spanish-speakers looked rather like English-speakers, producing tightly combined gestures. Nevertheless, Nicaraguan Sign Language resembles the gestures that accompany Turkish and Japanese more than the gestures that accompany Spanish, stringing signs together in sequence.

Although sign, like gesture, offers the possibility of producing holistic expressions, learners did not take advantage of that possibility. Apparently the reanalysis of gesture into sign involved separating holistic representations into sequential components. Why would Nicaraguan signers do such a reanalysis, when a combined model was available to them? It may be that other characteristics of Nicaraguan Sign Language made sequencing the preferred construction. On the other hand, perhaps sequential constructions were preferred because the reanalysis was being done by children. Being a young language, recently created by children, Nicaraguan Sign Language may still prominently include some consequences of the biases available during early language acquisition.

There is reason to believe that sign language acquisition is characterized by breaking combined constructions down into sequential strings. In his work on the acquisition of verb agreement in American Sign Language, Meier (1987) found that children will break down complex verbs into sequential strings, rather than combine verb agreement elements into the single, complex movement found in their adult models. Although the elements of verb agreement morphology are quite different from the elements of complex verbs of motion, it is intriguing to note the similarity of reanalysis at this first stage.

How likely is it that other sign languages were similarly sequential in their early stages? If children have a bias in language acquisition to break holistic representations down into more basic, sequential elements, this pattern of language emergence would have been universally available to sign languages at their origins. In this regard, consider the particular elements that are being extracted from a holistic signal. In the Nicaraguan case, young learners extracted manner and path, semantic units that are relevant to lexicalization patterns in many (possibly all) languages (Talmy 1985). In the case of verb agreement in ASL, children extracted elements indicating agent and patient (or perhaps subject and object) (Meier 1987). It may be that all sign languages, at first, expressed such primitives as individual, separable units.

What can we expect in the next stage? Whether Nicaraguan Sign Language will develop a preference for combinatorial, complex verbs of motion remains to be seen. An important difference between this case and the acquisition of verb agreement in ASL is that the model that today's Nicaraguan adolescents are providing for the next generation is a sequential one. Thus, if tomorrow's Nicaraguan signers prefer a complex, combined construction, it is likely to develop out of some other source than the holistic gestures from which the first cohort drew.

Such an account implies that sign languages historically go through an initial stage of segmentation, treating semantic primitives as independent elements. Then, over generations of learning, the languages could develop rules for combining these elements. However, having now propelled themselves beyond their gestural origins, the patterns of combination may now be unrelated to the gestures of the local spoken language. Thus, the diversity of spoken languages (and their combinatorial processes) does not automatically transfer to a diversity of signed languages. Instead, the way a sign language combines elements may be a function of the age of the language, or the age of its learners (Newport 1981), and unrelated to the characteristics of local co-speech gestures. It would be worthwhile to compare sign languages of different ages and histories to test this account.

Every sign language, at its birth, doubtlessly drew raw materials from the gestures that surrounded it. Gestures are a rich source, filled with movements and metaphors that are systematic, recurring (Webb 1996), and visually available. One may notice, on observing a foreign sign language, elements that are shared with local gesture. The present study has shown that even when elements are shared, the ways of combining them may not be. Gestures as raw materials, it appears, aren't raw enough, and children pull them apart into even more basic elements before reassembling them into a new language.

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