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The Resilience of Ergative Structure in Language Created by Children and by Adults

Susan Goldin-Meadow & Elif Yalabik
The University of Chicago

Lisa Gershkoff-Stowe
Carnegie Mellon University

1. The Resilience of Language

One of the most convincing pieces of evidence that language is robust in humans is the fact that, when prevented from coming out of the mouth, it emerges in full form out of the hands. Sign languages developed by deaf communities are characterized by levels of structure just as spoken languages are, despite radical differences in how the two systems are perceived and produced (Bellugi & Studdert-Kennedy, 1980; Klima & Bellugi, 1979; Liddell, 1980; Lillo-Martin, 1991). Moreover, sign languages are acquired in the same way as spoken languages. Children are equally open to learning language in either the manual or oral modality (Newport & Meier, 1985; Petitto, 1988).

Even more striking, if a deaf child is not exposed to a conventional sign language, that child will use gesture to communicate (Fant, 1972; Lenneberg, 1964; Moores, 1974; Tervoort, 1961); those gestures are structured in language-like ways and are referred to as 'home signs' (Morford, 1996). The deaf children use points and iconic gestures which resemble those used by hearing children, but are distinct in several respects. Deaf children, but not hearing children, combine their gestures into strings structured according to patterns found in natural languages (Feldman, Goldin-Meadow & Gleitman, 1978; Goldin-Meadow & Feldman, 1977). Moreover, the deaf children use their gestures for all of the functions of language – requests, comments on the here-and-now, comments on the non-present, and even comments on the gestures themselves (Goldin-Meadow, 1997). We focus here on one of the language-like structures found in the deaf children's gesture systems – the ergative patterning underlying gesture sentences – and we explore a number of factors that might be influential in creating that structure. Is, for example, ergative patterning unique to deaf children in America or to children in general? Or does it arise whenever two individuals, old or young, find themselves in a situation where they must communicate ideas without a conventionally shared system to help them?

2. Ergative Structure in Home Sign

We have studied the home signs of ten deaf children of hearing parents in America (6 in Philadelphia, 4 in Chicago). All had hearing losses so severe that

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they were unable to make use of the spoken language input surrounding them, and hearing parents who had not yet exposed them to conventional sign language. All ten produced strings of gestures that were structured, albeit differently from English. We focus on two aspects of sentence-level structure beginning with one child, David, as an example.

Consider David's gesture sentences when he is in a 'two-gesture' period, a time when his 'sentences' for the most part contain no more than two gestures. If the child wants to communicate an idea with three elements, he will be forced to leave one of the elements out. For example, if he describes a mouse eating cheese, he will be unable to includes separate gestures for the eater, the eating action, and the eaten in a two-gesture sentence. Although in theory the child could randomly omit gestures for one of the three elements, in fact we find that the child is quite systematic in the way he constructs his transitive sentences. He tends to produce gestures for the cheese (the patient) and to omit gestures for the mouse (the transitive actor). David's tendency to omit gestures for the mouse is not, however, a prohibition against all actors. When the actor is part of an intransitive sentence (e.g., a sentences describing a mouse running to its hole), it is likely to be included in the surface form of the gesture sentence (see figure 1, left graph, which displays the probability that a transitive actor, intransitive actor, or patient will be gestured in David's two-gesture sentences). Note that, in terms of production probability, David treats the intransitive actor like the patient, and different from the transitive actor.

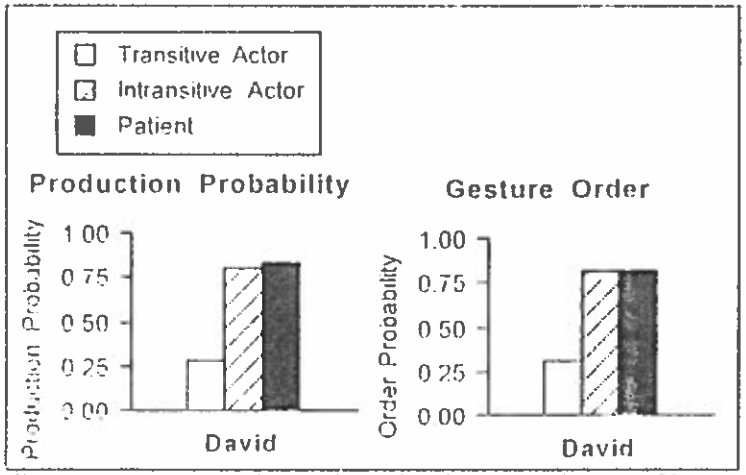

Figure 1. Probability that David produced a gesture for a transitive actor, intransitive actor, or patient in a 2-gesture sentence (left panel), and that he produced that gesture in 1st position of the sentence (right panel).

We turn next to where David places gestures for particular semantic elements in his two-gestures sentences. Even at the earliest stages of language-learning, children produce sentences characterized by consistent word order. For example, a two-word child learning English, might either say "mouse eat," "eat cheese," or even "mouse cheese" but would not say "cheese mouse." In other

words, the child follows the canonical pattern for English word order. What does David do? In fact, David also adheres to a consistent order, but the order is not the English pattern. David tends to place gestures for the patient in the first position of his two-gesture sentences, and gestures for the actor in the second position; that is, his preferred order would be "cheese mouse." Moreover, David also tends to place gestures for the intransitive actor in first position of his two-gesture sentences (see figure 1, right graph, which displays the probability that a transitive actor, intransitive actor, or patient will be gestured in 1st position of David's two-gesture sentences). Note again that, now in terms of gesture order, David treats the intransitive actor like the patient, and different from the transitive actor. This particular pattern is reminiscent of the ergative pattern found in some natural languages (e.g., Chinook, Djirbal).

The hallmark of an ergative pattern (Dixon, 1979; Silverstein, 1976) is that the actor in an intransitive sentence (mouse in the proposition 'mouse runs-to hole') is distinguished linguistically from the actor in a transitive sentence (mouse in 'mouse eats cheese') and instead is marked like the patient (cheese). In contrast, in English which is predominantly an accusative language, intransitive actors are treated like transitive actors and not like patients; e.g., both actors precede the verb ("the *mouse* runs to the hole" and "the *mouse* eats the cheese) while patients follow the verb ("the mouse eats the *cheese*). In a sense, ergative languages highlight the fact that the runner is affected by the running action (by treating it in the same way that patients are treated), while accusative languages highlight the fact that the runner initiates the running action (by treating it in the same way that transitive actors are treated). David produces gestures more often for patients (eaten-cheese) and for intransitive actors (running-mouse) than for transitive actors (eating-mouse). This pattern is ergative in that gesture production is high and equal for intransitive actors and patients, and low for transitive actors. Moreover, David produces gestures for patients (eaten-cheese) and for intransitive actors (running-mouse) in 1st position of two-gesture sentences, but produces gestures for transitive actors (eating-mouse) in 2nd position. This pattern, too, is ergative in that sentence position is the same for intransitive actors and patients, but different for transitive actors.

This ergative pattern is not unique to David. All ten of the American deaf children of hearing parents that we have observed thus far displayed an ergative pattern in their production of semantic elements (Goldin-Meadow & Mylander, 1984). In terms of gesture order, all of the children tended to produce patients and intransitive actors in 1st position of their two-gesture sentences; however, they produced too few transitive actors overall to discern any pattern with respect to this element.

3. Is Mother Responsible for the Ergative Pattern?

Where does this ergative pattern come from? We first look at some obvious ways that the deaf children's environment could have influenced their gestures. The deaf children's hearing parents gestured as they spoke to their children, as do all hearing parents (Shatz, 1982). It is possible that the parents fashioned a language-like system in their gestures which their deaf children then learned. In

previous work, we have found no evidence supporting this hypothesis for any of the constructions the deaf children created in their gesture systems (syntactic structure, Goldin-Meadow & Mylander, 1983; morphological structure, Goldin-Meadow, Mylander & Butcher, 1995; noun-verb categories, Goldin-Meadow, Butcher, Mylander & Dodge, 1994; communication about the non-present, Butcher, Mylander & Goldin-Meadow, 1991; Morford & Goldin-Meadow, 1997). Indeed, when we use the same tools to code and analyze the gestures produced by the deaf children's hearing mothers, we find that the mother's gesture production probability patterns bear no resemblance to her child's gesture patterns (see figure 2, left panels, which displays the production probability patterns for four deaf children and their hearing mothers in our American sample). Thus, the gestures that the hearing mothers produced did not provide a good model for the structure found in the deaf children's gestures. The mothers' data underscore two additional important points. First, the ergative structure found in the deaf children's gestures is not an inevitable product of our coding system. Second, the structure is not an inevitable product of the manual modality -- the children's hearing mothers are using their hands but their hands do not display ergativity.

Another possibility is that the structure found in the deaf children's gesture systems comes not from their mother's gestures, but from patterns within the culture that are so deep as to be beyond our awareness, for example, from they way parents structure interactions for their children. To explore this possibility, we observed deaf children of hearing parents in a Chinese culture. We know from previous observations (Chen & Uttal, 1988; Goldin-Meadow & Saltzman, 2000; Miller, Wiley, Fung & Liang, 1997; Stevenson, Lee, Chen, Stigler, Hsu & Kitamura, 1990; Wang, Mylander & Goldin-Meadow, 1996) that parents interact with their children, both deaf and hearing, differently in Taiwan and America. The question is whether these distinct interaction patterns have an impact on the deaf children's gestures. We observed four deaf children of hearing parents twice between the ages of 3;8 and 4;11 (yrs;mos.) As in our American sample, the children knew no sign language and had made very little progress in acquiring spoken language, even with intensive instruction. We examined structure in the gestures produced by the Chinese deaf children and by their hearing mothers, using the tools that we developed for the American deaf children and their hearing mothers (Goldin-Meadow & Mylander, 1998). We found that 3 of the 4 Chinese deaf children displayed an ergative pattern in their gestures (see figure 2, right graphs). The fourth child displayed an accusative pattern – she produced gestures for intransitive actors at the same rate as she produced gestures for transitive actors, and both rates were lower than for patients. Thus, 7 of the 8 deaf children displayed an ergative pattern in their gestures, suggesting that this way of organizing communication is relatively robust. Interestingly, the ergative pattern was far more robust in the children's gestures than in their hearing mothers' While the deaf children produced gestures more often for intransitive actors than for transitive actors and equally often for patients (an ergative pattern), the hearing mothers were not consistent in their treatment of intransitive actors. Indeed, the striking observation is that the American deaf children's gesture systems looked more like the Chinese children's gestures half-way around the globe than like their mothers' gestures in the very same room.

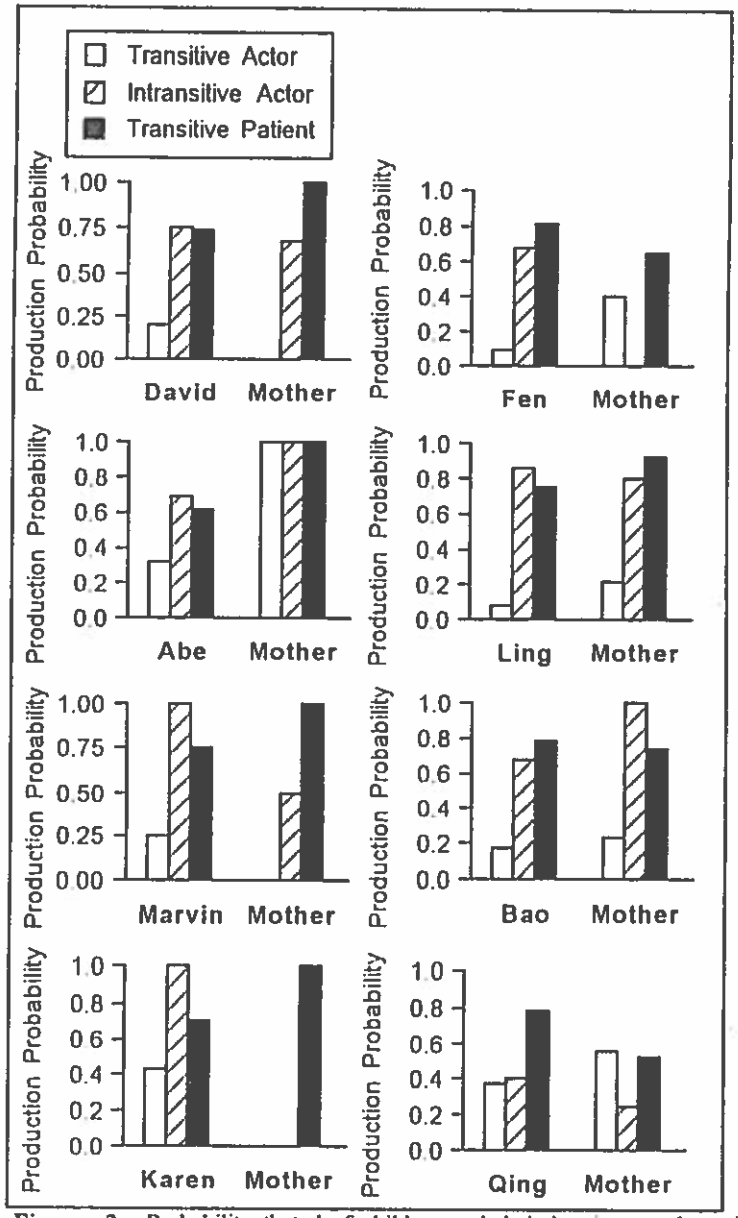

Figure 2. Probability that deaf children and their hearing mothers in America (left graphs) and Taiwan (right graphs) produced a gesture for transitive actors, intransitive actors, or patients in a 2-gesture sentence. Probabilities were calculated using sentences in which three semantic elements could be gestured but only two actually were gestured.

4. Could the Communicative Situation Itself be Responsible for the Ergative Structure?

The spontaneous gestures that the deaf children create to communicate with those around them are not dependent on the presence of a conventional language model – in this sense, they are resilient properties of language (Goldin-Meadow, 1982). However, if these properties are so resilient, why don't they appear in the gestures that the hearing mothers use? The mothers are using their hands to communicate. Why don't they form a gesture system that has the same resilient properties as their children's gestures?

We suggest that the hearing mothers are not at liberty to create a gesture system that has segmented and discrete structure. They already have such a system – speech. Moreover, McNeill (1992) has amassed considerable evidence showing that the gestures speakers produce along with their talk form an integrated system with that talk (see also Alibali & Goldin-Meadow, 1993; Goldin-Meadow, Alibali, & Church, 1993). Gesture forms a coherent system semantically as well as temporally with the talk it accompanies. Because the mothers talk continuously as they gesture (they are, after all, committed to teaching their deaf children oral language), their hands are not 'free' to take on the properties of their deaf children's gestures. Indeed, we have hypothesized that gesture takes on these language-like forms only when it assumes the functions of language (Goldin-Meadow, McNeill & Singleton, 1996), as seen in conventional sign languages created by deaf communities, or in the idiosyncratic gesture systems created by deaf children of hearing parents. If the deaf children's mothers were to stop talking, would they then begin to use gesture as their children do? Would they create a gesture system with ergative structure?

We attempted to simulate the deaf child's language-creating situation but with hearing adults as creators. There are two, very obvious differences between the adults and the deaf children. First, the adults already know a conventional language (English) and thus their created gestures could be heavily influenced by the particular language that they know. Second, the adults are not children and thus are well beyond whatever critical period there is for language-learning (but perhaps not for language-creating). To the extent that we find differences between the gestures that the adults and the deaf children create, age and language-knowledge become likely candidates for causing those differences. But to the extent that the gestures created by the adults and deaf children resemble one another, we have evidence that the created structures do not reflect a child-like way of organizing the world. Adults, even those who already have a language, may organize their communications in precisely the same ways as the deaf children, raising the possibility that the language-like properties found in the deaf children's systems result from trying to get information from one human mind to another in real time.

Two female college students, both native English-speakers who had no knowledge of sign language, participated in the study. We showed the adults videotaped vignettes from the battery designed by Supalla, Newport and their colleagues (in press) to assess knowledge of ASL. The adults were asked to describe each event depicted on the videotape without using speech and using only their hands. Neither the gesturer nor the 'listener' was permitted to talk. The two adults took turns gesturing and alternated playing the roles of gesturer and listener during the session (see Gershkoff-Stowe & Goldin-Meadow, 1998, for further details on the basic experimental procedure). Because we were interested in whether there would be changes in the gestures over time, we arranged for the two adults to meet twice a week for 10 weeks. Half-way through the sessions, we introduced a third adult – a novice – who had to learn the ongoing gesture system. The results presented in figure 3 come from the sessions prior to the entrance of the novice.

We used the same system of analysis for the adults as we did for the deaf children and their hearing parents. For this analysis, we looked at gesture strings that could have contained three semantic elements but, in fact, only contained two (e.g., transitive sentences with an underlying structure of actor-act-patient, and intransitive sentences with an underlying structure of actor-act-location). Figure 3 displays the probability that each of the adults produced a gesture for a transitive actor, an intransitive actor, or a patient in a 2-gesture sentence. Note that both gesturers produced gestures for intransitive actors as often as they produced gestures for patients, and far more often than they produced gestures for transitive actors. In other words, they displayed the same ergative pattern seen in the deaf children's gestures.

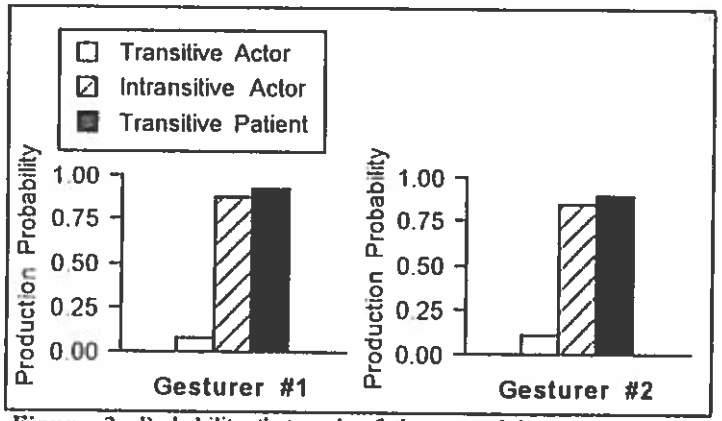

Figure 3. Probability that each of the two adult gesturers produced a gesture for a transitive actor, intransitive actor, or patient in a 2-gesture sentence.

In terms of gesture order, we found that both adults tended to produce gestures for intransitive actors in 1st position of their 2-gestures sentences (e.g., 'mouse runs'; 94% of 51 sentences for one gesturer, 91% of 47 for the other). This result is hardly surprising as the pattern parallels typical word order for intransitive actors in English. Neither adult produced many gestures for transitive actors (4 for one, 5 for the other), which made it impossible to determine an order preference for this semantic element. More interestingly, both gesturers tended to produce gestures for patients in 1st position of their 2-gesture sentences ('cheese eat'; 84% of 81 sentences for one gesturer, 73% of 73 for the other).

Not only is this pattern identical to the deaf children's gesture order for patients, but it is also different from the pattern typically found in English (i.e., "eat cheese"). The patient-first pattern is particularly interesting in the adults. The deaf children often (although not always, see Goldin-Meadow et al., 1994) used deictic pointing gestures to convey patients. The adults were unable to take advantage of this strategy simply because there were no objects in the room to which they could point. The adults were forced to invent an iconic gesture for their patients, for example, a smoking movement at the mouth to refer to an ashtray, which was then followed by a gesture representing the action that was done on that ashtray (e.g., a throwing action). Despite the fact that they used iconic rather than pointing gestures to refer to patients, the adults followed the same ordering patterns as the deaf children (see Yalabik, 1999, for additional details on the adults' gesture productions).

5. Conclusion

We have found the ergative pattern to be robust in communication situations. Deaf children of hearing parents who are inventing their own gesture systems organize their gesture sentences around an ergative pattern. Indeed, even hearing children who are learning English and thus acquiring a basically accusative structure display an ergative pattern when deciding which semantic elements to explicitly mention in words. Goldin-Meadow and Mylander (1984, pp. 62-64) reanalyzed the data from four hearing children in the two-word period and showed that each child tended to produce words for intransitive actors and for patients at the same rate, and both at a higher rate than for transitive actors. In fact, DuBois (1987) has suggested that ergativity underlies all languages (even accusative languages), albeit at a discourse level.

Equally striking, we found that when asked to describe a series of action vignettes using their hands rather than words, English-speaking adults invented an ergative structure identical to the one developed by the deaf children, rather than the accusative pattern found in their spoken language. These findings suggest that ergative structure is not unique to child language-creators. Rather than reflecting a child-like way of organizing information for communication, the ergative pattern may reflect a robust solution to the problem of communicating information from one mind to another, be it an adult or child mind.

We have shown that the ergative pattern is robust in a communicative situation in which the participants interact without a shared lexicon and in the manual modality. The next step in our research program is to determine whether the robust patterns we find in the deaf children's gestures arise even in non-communicative situations which do not involve the manual modality (e.g., arranging in a non-communicative task pictures that represent objects playing different semantic roles). If so, these patterns may reflect basic patterns in human thought, rather than basic patterns in human communication. Whatever the outcome of our future work, it is clear that the ergative pattern is resilient in communicative situations. Why then is it relatively infrequent in the syntax and morphology of the world's languages? The paradigm that we have developed to explore the forces that impact on language creation (see also Goldin-Meadow et al., 1996) will hopefully permit progress on this question in the future.

Endnotes

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