14

Beyond Herodotus:
The Creation of Language by Linguistically Deprived Deaf Children

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CONTEXTS FOR LANGUAGE LEARNING

It is sometimes said that language is created by the young child, rather than merely learned. But if so, the creative act is massively contaminated by effects of the environment, with the outcome that some children come to speak English and others come to speak Tagalog. To understand what the child contributes to language learning from his own internal resources and dispositions, we ordinarily have to abstract away from the influences of a received, fully elaborated, natural language. In fact, there is a sizeable and growing literature that minimizes the child's contribution and seeks to account for language learning as a tight function of specifiable features of maternal and other caretaker speech (e.g. Snow, 1972; Levelt, 1975), on the plausible supposition that teachers or at least fluent users are required if language is to emerge in the novice. It does seem unlikely that a child deprived of this linguistic environment would come up with a communication system resembling a natural language (though, to be sure, *someone* must have, once upon a time). But so far there are not many conclusive answers from this literature about the requirement for a tutor or exemplar in the acquisition process. Could it be that a child would think to communicate

even in the absence of this environment of communicators—is this a species characteristic of humans? Could this untutored novice design a system *de novo* for communicative purposes? And, most centrally, would that system look anything like the received language systems, rather than arbitrarily different from them—are there pre-given ways of organizing communicative intents, apart from the (perhaps fortuitous) likenesses that exist among the received natural languages?

We have been able to observe a number of children deprived of a catalyzing linguistic environment who allow us to address some of these questions, however tentatively. They are deaf children of hearing parents who, for reasons we shall discuss, have decided not to allow the children access to a manual language. If these children are to communicate, they must make a partly independent decision to do so, and they must largely create their own means. In this chapter, we report what we have surmised about the modes of communication these children have devised. We believe these findings bear on predispositions the child, any child, brings into the search for communication, and therefore bear derivatively on the allocation of internal and external resources for the normal language-acquisition process.

Evidence From Natural Language Acquisition for a Creative Component in the Learning Process

That language is responsive to external input requires no argument. But a number of inferential lines suggest a crucial role, as well, for species-specific endowments supporting language learning. That is, there is evidence of innate dispositions in humans to organize the linguistic environment in set ways. For example, a number of investigators have shown that the character of what is learned remains essentially the same, at least in early stages of acquisition, despite extreme differences in general intellectual capacity: Lenneberg (1967), Lackner (1976), and Morehead and Ingram (1976) have found that the order of acquisition of certain syntactic structures is the same, though slower, for feeble-minded children as it is for normal children. Lenneberg also showed that the language learning capacity early in life survives rather radical pathologies such as anarthria and organic damage to the speech centers in the brain, as well as other abnormalities (e.g. certain tracheotomies) which interfere with the ability to practice speech during the early learning period. These facets of the acquisition process (relative indifference to co-existing individual differences, relative immunity to pathology, and relative ineffectiveness of the opportunity to practice on the rate of skill development) are reminiscent of simpler behaviors in simpler creatures for which the evidence for a significant innate component is good (as a suitably distant example: swimming in tadpoles after lengthy immobilization; Carmichael, 1926).

Further evidence for this "inside out" rather than "outside in" component in acquisition comes from a look at the child's accomplishments under varying within-language input content and presentation conditions. While no one can doubt that facts about heard speech contribute to the course and outcome of the child's learning, still there are certain *non*-effects of adults on young language learners that would be puzzling on a strictly environmentalist interpretation. For instance, Newport *et al.* (1977) have shown that the rate of growth of selected syntactic structures is in many ways insensitive to a variety of individual differences in caretaker speech-style (e.g. the length and complexity of maternal speech does not predict the rate of growth in the child's MLU (mean length of utterance) nor in his tendency to express obligatory thematic relations). Similarly, enrichment of the input data does not appear to influence growth rates very dramatically, even when the procedures used are quite plausible as serving teaching functions. For example, Cazden (1965) systematically presented "expansions" (immediately presented adult versions of the child's utterances after he makes them) to learners over an extended training period. Such exemplars could reveal to the learner the appropriate linguistic renderings for concepts he has just tried to express. Yet these subjects showed no learning advantage over a group of control subjects. Thus, under diffuse and variable environmental conditions, there seems to be a maturational scheduling of language emergence that is hard to modify—a good argument in favor of species-specific endowments for language acquisition.

Finally, there is evidence that, in the presence of varying environmental influences, the child has narrowly defined pre-set ways of organizing these environments. This evidence comes from cross-cultural studies of language acquisition: despite significant differences in cultural ambiance and differences in the languages that are being learned, children seem to pass through very similar sequences of developmental accomplishments (Brown, 1973) within the same narrow development time frame (Lenneberg, 1967). Perhaps the most stunning fragment of evidence for a task-specific component in the acquisition process comes from Slobin (1973). He asserts, on the basis of cross-language studies, that among the earliest syntactic devices deployed systematically by young children is word-order—not only for acquirers of a word-order language such as English, but often for learners of highly inflected languages (e.g. Russian) with weak word-order constraints also. Slobin suggests that children may be biased to notice sequential properties of the speech-stream. The thrust of this finding is that language

learning responds to internal specifications about the nature of human communication as well as to external specifications (i.e. characteristics of the input data).

Summarizing, there is emerging evidence that acquisition of the structure of language is unresponsive to large variations in non-linguistic endowment and linguistic environmental circumstances. Rather, language learning in its earliest stages seems to have a pre-set semantic and syntactic character, some of whose details are beginning to be discernible from descriptive, and particularly cross-cultural, studies of child development.

Communication in the Linguistic Isolate

In all of the settings just described, there has been an explicit, though varying, environment for the learner to organize mentally, and all these environments share critical properties. Natural languages are fundamentally alike, for whatever reasons. This fact restricts interpretation of most of these findings as arguments for innate structures: samenesses in acquisition can be viewed as effects of overriding environmental identities. What would happen if the child were given no language to learn? Is there a human "urge" to communicate which can manifest itself in the absence of a systematically communicating environment? Notice that the arguments in favor of a species-specific language endowment make no prediction on this further matter. (They assert only that a learner is disposed to organize language data in certain specific ways, if these data are in fact provided to him.) But if suitably circumstanced humans will "invent" a language when there is no presented language to be learned, this would allow us to ask more cleanly about possible task-specific properties of language functions: what if any, are the essential pre-given properties of any "allowable" human communication system (due, possibly, to conditions on acquisition)? These questions cannot even be raised in any humane situation we can devise, but surely in principle the kinds of inference that arise from the investigations we have cited would be materially enriched by use of an explicit deprivation paradigm—if only we could maroon some spare infants on a desert island to see if and how language develops on its own.

Classical cognoscenti will recall that this ultimate language learning experiment once was done. Herodotus (B.C. 460) reports that two infants were set apart from adults, but fed, and raised in an isolated cabin. No one was to speak to them on pain of death. The experimenters were an Egyptian and a Phrygian king. Their investigation was designed to resolve the question of which (Phrygian or Egyptian!) was the first of all languages on earth. Appropriately enough for kings, the two appear to have been radical innatists, for they never considered the possibility that an uninstructed pair of children might not develop language at all. In the event, Herodotus tells us that these subjects began to speak Phrygian, and there the matter has rested for some millenia.

To be sure, tragedies of nature and circumstance have created more recent opportunities to observe language-deprived children. But in general the social and even nutritional deprivations of these individuals have been so extreme that nothing of value for the nature-nurture question can be gleaned from them. Examples are the feral children (summarized in an excellent discussion by Brown, 1958) who never could be taught language and who, to our knowledge, never created anything of the sort while in the wild. Similarly, socially isolated children (e.g. Davis, 1947; Fromkin, 1975; Rigler and Rigler, 1975) show variable capability for rehabilitation, but give no evidence of having developed any communicative skills while isolated. Of course not: if for no other reason, it would be pointless to externalize the language of the mind if there were no "other" to whom it could be addressed. For this and many other reasons, an interpretable deprivation experiment would require that the infant be raised in approximately normal social circumstances, with language being the sole, or at least the major, system of which the learner is deprived. In such circumstances, would human children —perhaps like the Egyptian children or perhaps like Marler and Tamura's white-crown sparrows (1964)—devise a skeletal species-specific variant of a human language? While the study we now report, of language-deprived deaf youngsters, is a very imperfect analogue of this situation, we believe it reproduces enough of its properties to suggest task-specific language endowments in the human learner.

A Study of Linguistically Isolated Deaf Children

Our observations of six deaf children not exposed to manual language, over a lengthy period during their early development, show that they do begin to use manual gestures of their own to reveal their thoughts and wishes to others. There is preliminary evidence that they—not we or their mothers—devise these gestures. They eventually begin to join pairs and even longer sequences (up to 13 "words") of these gestures into what we believe are manual equivalents of phrases and sentences. In both form and intent, in so far as we can make such inferences, these early communications look much like those of normally circumstanced language learners. Their communications are about the same topics discussed by hearing children of similar ages.

Moreover, these children follow a gesture-order rule for coding thematic roles within sentences, and they omit expression of certain roles as a function of the length and underlying structure of their sentences. All of this evidence points to systematicity in the deaf child's spontaneous communication. Despite many caveats owing to methodological limitations and thinness of comparable control data (studies of the acquisition of formal sign language are few), we believe we have suggestive evidence that these uninstructed novices, while severely limited in means, do have the internal wherewithal to develop a passable communication system. To the extent that it closely resembles early child speech, the self-generated deaf sign system may give us some insights about the properties of early normal utterances: in some degree, at least, it seems that the hearing child's "telegraphic speech" is what it is not solely because of what the learner takes from the linguistic surround, but also because of predetermined properties of "novice communication" in humans.

In what follows, we provide a description of early stages in the self-generated communication situation. The method of investigation, and particularly the bases for coding gestures and gesture sequences, are described in painful detail, for questions arise all along the line whether properties of communication by the subject or comprehension by the experimenter account for the structure of our findings.

SUBJECTS

Six congenitally deaf children, two girls and four boys, with no other apparent physical or cognitive problems, served as subjects. They ranged in age from 17 to 49 months at the first interview, and from 30 to 54 months at the last interview from which data are reported here (see Table I; continued interviewing of some subjects will be the basis for a forthcoming follow-up report). The children differed in family structure and in socio-economic background. The characteristic which they shared was their inability to rely on oral communication. The similarity in their circumstance was that none was exposed to formal sign language.

The children are moderately to profoundly deaf by their scores on standard audiometric tests, when measured with or without hearing aids. They were unable to acquire any verbal language naturally in the home. Under a program of oral education (see discussions below) they have shown only minimal progress in speech production and lip-reading. At the initial interview, Kathy, Dennis and Chris produced fewer than five words each.

David and Donald in their later sessions, and Tracy at both visits, could produce and lip-read a few single words, but primarily within structured situations, such as when they had to choose between flash-cards on which pictures were displayed. None of the children was able to use or understand the spoken words in the unstructured situations we introduced or in the daily activities we observed.

Why were these children not learning formal sign language? There is a controversy among educators of the deaf as to whether it is appropriate to teach a manual language. Some, including those at the schools through which we contacted these subjects, believe that profoundly deaf children can learn to lip-read and articulate English, if practice is frequent, formal, and begun early in life—but not so well if the child has an alternative means (sign language) of communication. Whether this is so, and whether it makes sense to withhold from the young deaf child a readily available communication system until "oralist" training can begin is a matter on which we will take no stand here. But this is the viewpoint of the school authorities in the metropolitan Philadelphia area who instructed parents of these subjects *not* to gesture to them formally or informally, lest this interfere with the motivation for acquiring spoken English. We have evidence (see pp. 376-378) that the families of these subjects followed the instructions rather well; they were observed to sign only in rather primitive and largely unconscious or unintentional ways. Sibling gesturing to the deaf children was similarly primitive. Overall, the manual effort by the family seemed to be unstructured, and responsive to the deaf child's gestures rather than the impetus for them.

PROCEDURE

We began this investigation without predetermined procedures, armed only with videotape machines and a collection of toys we thought might be enticing for children to communicate about. But we also had some serious hints that these subjects would make discernible contact with us. It is well known that deaf children educated in oralist schools often develop a set of idiosyncratic gestures which they use literally behind the teacher's back—of course it was the genesis of such gesturing that we were looking for. Fant (1972) has discussed these informal gestures, calling the mode "home sign". Tervoort (1961) has provided a most helpful description of their use by both Dutch and American children in oralist schools. On the basis of this prior evidence, and on the assumption that these "natural gestures" were at least partly self-generated by children (after all, the teachers clearly disapproved

of them), we were primed to look for primitive iconic representations by our young subjects. Many long sessions of videotape peering were spent before we had any confidence that we could reliably extract the subjects' gestures from their wiggles and ear-scratchings. But as the subjects grew older, there was no longer room to doubt that they had begun to communicate by the use of manual signs. At this juncture, we settled into a regular schedule of visits with the subjects and tried to standardize these sessions and our analytic tools in useful ways.

Two investigators (S.G-M. and H.F.) visited each child in the home several times (Table I). The number of visits we were able to arrange varied across subjects. The interval between visits was from six to ten weeks, a span which allowed us to observe some developmental changes from visit to visit. The only major departure from this schedule was between the seventh and eighth visit to the subject we call Donald (all names used are fictitious). All sessions were videotaped.

Despite initial attempts to formalize the interactions, these sessions turned out to be simply relaxed play sessions, for the subjects were not amenable to more structured elicitation procedures. The toys we brought, the same for all subjects, served the purpose of narrowing the topic of conversation and keeping the children involved with us. Each toy had at least one of the following properties: it was multifaceted and detailed, such as a toy schoolhouse; it required skill and co-ordination to operate, such as a zoo from which the animals rolled out only when the proper key was fitted into a shape-matched keyhole; or it involved some dramatic event such as a bursting bubble. (The reader may now think he knows why most of the subjects' communications involved action and motion, as we will demonstrate, and perhaps he does. But, as with hearing children of the same ages, it is also probably significant that we could not engage the deaf children's interest with the Encyclopedia Brittanica or chess boards instead.)

Midway through the study, we stabilized the interview protocol to the extent possible. Each subject except Dennis was interviewed at least twice in the standardized way.*

*For details of this procedure, see Feldman (1975) and Goldin-Meadow (1975). These details are not reported here because, in the event, they had no relevant effect on the way the subjects behaved. For the same reason, data reported here come both from the informal and standardized interviews. Note particularly that none of the developmental changes we will report coincided with the changes in stimuli or procedures.

Table I
Subjects: ages at each session in years and months

Subject	Sessions										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Kathy	1;5	1;6	1;9	1;10	2;0	2;2	2;3	2;5	2;8		
Dennis	2;2	2;3	2;4	2;6							
Chris	3;2	3;3	3;6								
David	2;10	2;11	3;0	3;3	3;5	3;6	3;8	3;10			
Donald	2;5	2;5½	2;6½	2;7	2;8	2;10	3;0	3;11	4;0	4;2	4;6½
Tracy	4;1	4;3									

THEORETICAL BASIS OF THE ANALYSIS AND THE DERIVATION OF CODING CATEGORIES

How can we get to the forms and meanings of the subjects' communications? Consider a typical event, at a session with the subject David. Mother is cooking lunch in the kitchen. David points toward a plate of food, puts his fist to his mouth and makes biting motions, and then points at one of us (Susan). Informally—and if David is behaving as *we* might behave in gesturing to a non-English speaker—we might claim that he was inviting us to lunch. Moreover, that in particular he was performing the signs FOOD-EAT-SUSAN. Further, that these signs had the syntactic properties of noun, verb, and noun respectively; and finally that a true rendering of the propositional intent was: *You-Susan will eat food.* But these decisions cannot really be made informally. Every one of them involves a strong claim about how the child's communicative acts relate to the relevant contents of his mind. For this reason, the description of findings (p. 375) hangs crucially on—is largely a consequence of—the coding decisions that preceded. Therefore the ideas behind the coding system are presented in detail; unless these are persuasive, there are no results to report.

Taxonomic decisions about the subjects' gestures and their meanings were arrived at on a kind of bootstrap basis. Neither the significant units nor their combinatorial and semantic properties were derivable on a prior theoretical basis. The criteria for segmentation of the gestures seem fairly straightforward, while the assignment of meanings to these gestures is distinctly more problematical.

On looking to the literature on the normal child's language acquisition for guidance, it is mildly dismaying to realize that almost all the very formidable problems we face in analyzing the deaf child's language arise for the hearing child's also, though they are not always explicitly discussed. The hearing child's use of our (adult) words sometimes gulls us into the assumption that he is using our language as well. For comparison, consider a hypothetical field observation of a hearing child in the setting just discussed. Mother is still in the kitchen, cooking lunch. The child points toward the plate of food and says "FOODEATSUSAN". It might be claimed the child was inviting us to lunch, that his utterance was segmentable into the words FOOD-EAT-SUSAN, categorizable as noun, verb, and noun, and semantically analyzable as *You-Susan will eat food.* For each decision about form, segmentation, and intent there is some question about whether the source is the utterance of the child or the language organization of the observer. Thus for the hearing child, approximately to the same extent as for the deaf subjects in this study, a number of features of the findings may be built into the coding procedures, and thus many of the outcomes are predetermined.

How to begin? Our mode of procedure is in part justified in terms o limited goals of this research, as described in introductory comments: luc these do not require us to get precisely at the contents of the deaf chi mind through his gestures. Our main aim is to ask whether communica develops similarly for the *deaf* child *without* linguistic input as for *hearing* child *with* linguistic input. This commits us only to developing for these subjects that are as directly as possible comparable to the data u to describe normal language learning. So wherever possible, we have lea on the methodology of language-acquisition field studies in in assignment of appropriate coding categories. In the next main sec p. 375, which we have somewhat capriciously segregated from this one, entitled "Results") we argue for the validity of the coding on quite differ retrospective, grounds: the subjects' behavior, over developmental ti coheres and is internally consistent when analyzed in terms of these co categories.

Finally, we have taken care to establish the reproduceability and reliabi of the coding, and the reliability scores are reported with the descriptio the coding categories below. The basis for deriving reliability scores independent coding of a sample videotape (the eighth session with David; Table I) by one of the authors and a trained coder who was not present at videotaping session with the child. This tape lasted about 45 minutes yielded about 400 codable gestures.

The discussion of coding categories proceeds in two steps: first, describe methods for isolating the gestures from other motor acts and f each other, to determine the systematically functioning units of the man system. Then we describe methods for assigning semantic/synta functions to these units.

The Isolation and Segmentation of Gestures

A good many of the child's actions can be interpreted meaningfully. example, one can punch one's sister or grab her candy and the thou behind such acts are subject to easy inference—but that these acts expressive and communicative is not evidence that they are symbolic or they function within a language-like system. Analogously, the gurgles coughs of English speakers are susceptible to meaningful interpretatio one is choking, one has a cold—but they are not "in English" (see classic discussion of this issue by Sapir, 1968). The first task in investigation, then, was to segment systematically functioning man gestures from each other and from the stream of motor behaviors in wh they are embedded.

(1) Extracting Communicative Gestures from the Stream of Motor Behavior

Two bases for recognizing a language-like *gesture* by our subjects seemed reasonable on the face of it: the motion should be an attempt at communication with another individual (henceforth: "the listener") and it should be an abstract representation of a communicative attempt, rather than a direct act; i.e. as remarked earlier, eating of candy may communicate that one is greedy, but it is not a "*greedy*-gesture". The criteria were considered to be satisfied if (1) the subject made an attempt to engage the listener by establishing eye contact with him; and (2) the gesture was not a direct motor act *on* the listener (e.g. pushing him, to convey "go") or on some object (e.g. throwing it away, to signify "no"). As a positive example, if the subject made a twisting motion of his fingers in the air, with his eye first on the listener's eye and then on a jar with a twist-top, we assumed a communicative gesture had been made. Ordinarily, auxiliary context supported these decision criteria. For example, there was often nodding and smiling if the listener then opened the jar, and there was often repetition of the gesture if he did not.

Once isolated, the gestures were described physically in terms of Stokoe's (1960) three dimensions, developed for description of American Sign Language: the shape of the hands, the location of the hands with respect to places on the body or in space, and the movement of the hand or body. Gestures were classified as different if they differed on any of these dimensions. Reliability scores were derived both for the isolation and description of the gestures. In the 45-minute sample videotape, 84% of gestures identified and described by either of the coders were identically identified and described by both coders, yielding 350 reliably coded gestures from this sample session.

(2) Segmenting Gestures: the Category *Sign*

The next job was to describe the gestures in terms of systematically functioning formatives of some kind. The task is similar to segmenting utterances of English, which have systematically functioning substructures (morphemes, phrases, etc.). Moreover, an utterance as a whole may be a systematically functioning unit (i.e. a sentence) or not (i.e. it may be half a sentence or two sentences long). Described here is derivation of the unit *sign*, analogous to morpheme or word, from the gestures.

When can we say that two gestures occurred in succession? For spoken

language, this matter is partly approached on a distributional criterion (Bloomfield, 1933; Harris, 1951). Thus if a speaking child is heard to utter "booktable", an initial basis for claiming two units is not hard to find, if he also says "book" and "table" in other contexts, on other occasions. *Signs* were recognized within the gestured communications if they met this distributional criterion—if they had been observed to occur in isolation or within other combinations. While this criterion was considered sufficient, it could not be considered necessary (it is too much to expect every word to be used twice during the brief times we were with the subjects). There is another criterion, perhaps a better one, though it resists formalization: it is easy for an observer to perceive quite directly (presumably in terms of his own organization of motor acts) when there have been two signs as opposed to one within a gesture. There is a change or break in the flow of movement preceding and following the sign.

High inter-rater reliability scores were achieved by joint use of these two criteria: there were 335 cases (among the 350 gestures reliably isolated on the sample videotape) where sign boundary decisions could be made, and there was 93% agreement between the two coders on these decisions.

(3) On Defining a Sentence

Once it is determined that a string of signs has occurred, how can we decide whether they are *in construction* with one another, as in a spoken sentence? For English, there are intonational and junctural clues to sentence boundaries with which to begin (e.g. pre-pausal lengthening: Lehiste, 1970); then aspects of the emerging structural descriptions of the child's speech fill many gaps for questionable cases. Similar physical criteria exist for defining the manual sentence boundaries: (1) if two gestures appear to be uninterrupted by any appreciable time interval, they are candidates for being "within a sentence"; and (2) the hands must not return to the "neutral position" (hands relaxed in front of the body) between two gestures, if they are within a sentence.

The neutral position just described segments sentences in established manual languages (Stokoe, 1960). This same motor behavior is used consistently by our subjects, without teaching. The segmentations derived on the basis of our two criteria correspond to conceptual segmentations of propositions in natural languages; that is, pauses and the neutral position occur between sequences that we readily interpret as "complete thoughts". For 337 decisions about sign concatenation into sentences, inter-rater agreement was 93%.

Interpreting the Deaf Child's Communicative Intents

Moving now into the area of semantic imputations, coding matters become much more thorny, sufficiently so that decisions here are more conclusions than coding categories. It is hard—in fact it is the heart of the problem under study here—to know exactly what some sign or string of signs means to its user, even though our *subjects'* responses to *our* responses to *their* gestures often indicate that they are satisfied with our interpretations.

Glossing Signs by their Referents

Consider a subject making a small twisting motion of his fingers in the context of some interaction among him, us, and a jar of bubble soap. Is he referring to the "jarness" of the jar? To its "openness"? To the means, "twisting", by which it may be opened? The "act of opening"? All of the above? The problem of interpretation here is sobering, but it is in principle no different from problems of interpreting the single-word utterances of young speaking children.

Consider for comparison a hearing child saying "jar" under the same circumstances. If we knew the conditions under which he acquired use of this vocabulary item, we might be more secure about claiming it means *jar*. But vocabulary items are presumably acquired under rather diffuse extralinguistic circumstances, i.e. within some complicated situation involving jars and other objects, and also involving motions and other events, so it is not easy to know what the child has picked out as the meaning of *jar*. (For instance, a child of one of us was often shown the picture of a baby on the baby-food jar, and also shown herself in the mirror. In both cases, the mother would say "See the baby . . ." The child also came to say "baby" in both circumstances. But later the child was observed to say "baby" also in response to roundish coffee stains on the kitchen floor, at which time it was realized that while the mother was looking at the baby, the child had been looking at the round picture and mirror frames.) Even if a gloss is specifically called for in a standardized situation, it remains something of a mystery how a unique concept is picked out. For instance, the child can point somewhere in the visible world and wait for an adult to provide a verbal label. But precisely what was pointed at when the adult responded, say, "jar"? Both interlocutor and speaker were seeing opening-of-jar in the visible world. The tendency of mothers and other English-speaking humans is to respond as though the child were querying the name of an object. This represents a strong implicit claim by the adult about the nature of the child's concepts, and about language acquisition (probably, but only probably, it is right). But

if this is the condition under which lexical items are often acquired (pointings are responded to with noun labels) it is hardly surprising that an English speaker's first *words* are mainly nouns of English. But we do not know from this if English-speakers' first expressed *concepts* are noun-like concepts.

The problem with lexical interpretation for the deaf subjects is approximately the same—only we are poignantly aware of it because we do not know the child's language and it is awesome even to impute knowledge of it to him. We suggest, however, that in so far as observations of the hearing child's usage are taken to provide evidence about his expressed concepts, the same evidence is available in the present study, and it requires only the same degree of scepticism.

Following the lead of most investigators of spoken language learning, we do provide isolated signs with tentative glosses, but we are wary. The first step is to guess at a probable referent on the basis of the extralinguistic context of use (cf. Bloom, 1970). The second step is one where we have rather an advantage over the investigator of spoken language: we gloss the item according to the form of the sign, for it is often iconic. Finally, the glosses are justified retrospectively in terms of the system as it becomes combinatorial.

The deaf subjects make reference in two ways: they point to objects, persons, and locations; and they "pantomime" properties of things and events in stylized ways.*

Glossing Points

The subjects very often point to things and people and places. We had a preliminary notion to exclude these pointings from analysis, because we were unsure whether they participated systematically in a language-like communication—after all, hearing people point also, but these pointings do not participate in the logical forms of their sentences. Two facts changed our minds. First, when the subjects' communications became combinatorial (more than one sign per sentence), it was clear that the points functioned systematically within these combinations: they had restricted privileges of occurrence relative to other signs within sentences (see pp. 383-401) and they showed constructionally sensitive physical deformations (i.e. points "flowed" into other gestures within, but not across, sentences, as described on p. 363). Second, the character of the deaf children's vocabularies is conceptually ludicrous, if points are excluded. This last needs some explanation.

Clearly it is easier to pantomime an action than an object (a potentially fatal flaw in a manual language, if it requires a non-arbitrary relation

*The children produced a third kind of sign which served modulation functions. These *sign markers* were head-nods and side-to-side head shakes. Notionally, they are similar to the words *yes* and *no* in English. Clearly, these gestures were learned from the children's hearing caretakers.

between a thing and its name). An available instance of the nominal concept in mind (the real thing) is a reasonable *pro tem* way of rendering it, so the point serves a quite general function. If only motor-iconic signs, excluding pointing, are considered, these subjects' vocabularies, at various stages, are remarkable in excluding just the things that should be most obvious and salient to the subjects—most objects, particularly objects that are around whenever the child is around (his eyes, for example, or his nose) lack vocabulary items. Surely this is not because the gesturing child never refers to such matters, but rather because he has a kind of "universal morpheme" with which it is easy to make concrete reference to objects in the here and now.

For syntactic purposes, it is sufficient to treat the points to objects and people as pronominals or demonstratives, such as *this*. However, we have as a further ambition the analysis of these gestures in terms of the semantic intents of their users. These vary, though the pointing sign does not. For this reason, we provided a derivative gloss of points in terms of their presumed referents, based on the context in which they occurred. Each point was glossed as the object, person, place, etc., toward which the pointing was directed. One might think this methodological decision would yield enormously inflated nominal vocabularies for these subjects, compared to their hearing peers, for the latter are not usually granted a separate lexical item for each thing they refer to as "this". However, as will be demonstrated (pp. 379-381), the nominal vocabularies that result from this analysis are quite small, and highly restricted in semantic scope: the subjects do not point to everything they can see.

The context of use makes clear that points are also used to indicate some concepts that are not substantives. For instance, a subject responds to seeing a picture of his brother, by pointing first to the picture and then pointing toward the door—his brother is away at school. We classify the sign as *out* or *there*. Similarly, the subject makes successive downward points toward the floor to indicate that a shovel he has just been shown a picture of is stored downstairs, in the basement. We classify the sign as *down*. By similar means, the subjects can even gesture quite intelligibly about some perceptual attributes that are not directly representable in space or motion. For instance, they render *red* by pointing successively at various red objects in view.

In sum, the points can refer to objects and people (e.g. *duck* or *Mother*) to locative notions (*out* or *down*), and adjectival notions (*red*). Transparent aspects of the contexts of use lead us to these attributions of meaning.

Glossing Characterizing Signs

The subjects use a wide variety of signs more specific than pointing. These are essentially stylized pantomimes. Usually, there is no great difficulty or

ambiguity in interpreting or classifying them. Thus we are confident that the subjects are able to gesture about actions. For example, hands jiggling on an imaginary steering wheel approximate a concept like *drive;* flapping arms approximate *fly*. In addition to the iconic properties of the signs, the contexts of their use strongly suggest verbal classifications of them. For instance, upon seeing a mechanical mouse beating a drum, the subject points to this object, and himself makes the *drumming* motion. This is action in response to action; it seems perspicuously verb-like in intent and we have no hesitation in making this classification. Similar contextual supports exist for interpreting certain gestures as adjectival in intent. For instance, as a toy tower is built higher and higher, the subject raises his arms (and eyebrows) and then points to it; he has indicated that the tower is *big*. In short, join clues from the form of the sign and the context of its use are the basis for classifying characterizing signs as either verbal (*action*) or adjectival (*attribute*).

However, there are certain contexts in which action-based characterizing signs are used where an argument could be made that they are simple nominals, and not verbal at all, despite the fact that their derivational source in physical motions is verb-like. As an analogy from English, a word such as *walk* is basically a verb, but obviously this word functions as a noun in such sentences as *I swept the front walk yesterday*. The same issue sometimes arises for the deaf subjects: might they not have simple nominal intentions for characterizing signs, when the situation in which these are used is not expressly action-like? The clearest example of such a possibility is when the child uses characterizing signs in response to seeing pictures of objects. For instance, the *twist* motion of the fingers (relevant to jars and their openings) is made by a subject in response to seeing a picture of a jar in a book. The mouth is opened in a snarling expression in response to a picture of a lion. Open hands, palms forward, are held behind the ears and then flopped in response to seeing a floppy-eared Mickey-Mouse. Perhaps though these signs iconically recreate some typical shape or action of the object, they may be functioning as simple nouns. That is, maybe the *twist* in response to the jar picture is intended to convey the nominal notion *jar* and not the verb/adjective notion *twist* or *twistable*. We digress here to pursue this problem because the classificatory decision has systematic consequences for the semantic analysis of sentences in which such signs figure (p. 369).

The case we are considering is one in which the child first points at the noun referent, followed by the iconic sign, in non-action contexts. The interpretation we have made assumes that the point refers deictically to the noun referent and the characterizing sign refers to an action-based feature of that noun; hence roughly "jar (is that which is) twistable", "Mickey-Mouse (is the one with the) floppy ears", "Lion (is one who) snarls". But it is

possible to assume, on the contrary, that the characterizing sign refers directly to the noun that it mimics, in which case the same sequence would be intepreted "This is a jar", "This is Mickey-Mouse", and "This is a lion". Notice that both interpretations fit the extralinguistic context, so this gives no guidance on this issue. Yet the fact that the subject has himself invented and used an action to describe this event seems to us to argue that action is involved in the mental intent. This argument is strengthened by a look at analogous innovative uses of language by speakers.

For the case of English, just as in the examples above, complex noun formation is often based on predicative sources. For example, etymologically speaking, a *cartwheel* is that *whose motion resembles the motion of the wheel of a cart*; hence, an *acrobatic trick*. But what is the psychological status of this item, etymology aside, for an English speaker as he says "We learned to do cartwheels in gym today?" Is there an implicit organization in terms of the etymological source, or only an unanalyzed two-syllable noun? This is essentially the same question being asked about the use of *twist* by the deaf subjects in non-action contexts. For English, the answer will be partly different depending both on the item and the speaker in question (for discussion, see Gleitman and Gleitman, 1970). Only a few philologists will be aware that a muscular cramp is called a *charley horse* because lame old family horses in England were typically named Charley. Only a minority of outdoorsmen, probably, will analyze *backlog* as a complex item and know just why it means a *reserve*. However, many compound words such as *birdhouse* are much more transparent, and these may be represented mentally as morphologically more complex than some of their synonyms (e.g. *cage*) by most fluent speakers.

There is one situation in which we can be sure that a lexical item has psychological substructure. Consider a child who has just received the unusual present of a pet aardvark and who names its cage the *aardvark-house* instead of, say, the *glip*. Both *aardvark-house* and *glip* are new forms, inventions. In the instance *aardvark-house*, the invention has the non-arbitrary, rule-governed, source *house for an aardvark*, so we must grant the inventor this complex mental representation.

The same arguments apply to the deaf subject's characterizing signs, for he is their inventor. That in conversation about Mickey-Mouse he creates a sign that looks like flopping mouse-ears is understandable only by acknowledging that he mentally conceives the mouse as the *one with floppy ears*. Then it is fair to grant him expressible knowledge of predicates of this sort. (For both hearing and deaf inventors, the psychological status of these words may change with time. After months of cleaning it, the aardvark house may be just a smelly box, and the action-iconic source of Mickey Mouse may be similarly submerged. These are often the historical facts both about

spoken language (where *charley horse* is now a dead metaphor) and American Sign Language. For an excellent account of the loss of iconicity in formal sign languages, over historical time, see Frishberg, 1975.)

Summarizing, the etymological argument supports classification of items like *ear-flop* and *twist* in non-action contexts as having action-like substructure. We therefore classify them as describing the actions of things and people. We do not classify them, along with points, as nominals that refer directly to the things and people themselves.

Reliability of the Categorial Assignment of Signs

Whatever the merits of the taxonomic decisions we have made about points and characterizing signs, it is possible to provide reliable glosses of the subjects' gestures in terms of them. Reliability scores for assigning referents both to points and to characterizing signs were calculated. In the set of gestures identified, segmented, and similarly described by both coders from the videotape sample, there were 312 instances where decisions about a referent and a taxonomic categorization could be made. There was 93% agreement between the two coders on these decisions.

The Meanings of Signed Sentences

The problem here is to discover the semantic logic that holds signs together when they appear in construction with each other. This is hard to do even for an adult English speaker. A semantically perspicuous description of the English sentence is hard to come by. It is harder still to analyze the semantics of naturally occurring utterances, because of such problems as constructional ambiguity, production errors, and the like. The problems are measurably worse in analyzing the exotic productions of very young speakers who (presumably) express meaningful ideas, but do so in the absence of shared conventions about how these meanings are to be rendered linguistically. The same problems of course recur for the subjects in the present study. Because of their limited resources, both in lexical types and syntactic forms, all of their conversational intents are mapped onto only a few superficial structures: strings of two or a very few ordered signs. These only grossly limit inferences about what the child had in mind to express. As an aid, we have leaned on the situational context in which the signs occur. Let us illustrate with an example: Dennis is watching a toy mouse eat spaghetti. He looks at one of us, points to the mouse, produces the characterizing sign *eat*, and then returns his hands to the neutral position. The criteria for sentencehood have been met (see p. 363) but what does the child mean to express? Without context, the sign pair is as easily interpreted, say, as "Eat the mouse!" or as

"The mouse eats". But arguably, the context of use favors the latter interpretation. We conclude that Dennis has commented about an ongoing action, "*Mouse eats*".*

Lois Bloom (1970), in a landmark study, was the first among recent students of language acquisition to make systematic use of situational contexts to enrich the possibilities of semantic interpretation. Although there is room for dispute about just how the extralinguistic situation can constrain inferences about what has been intended—since language encodes what the speaker happens to be thinking about a situation, rather than the situation itself—some plausible guesses appear possible. Bloom's method ultimately was justified retrospectively by aspects of her findings, particularly through the fact that the semantic-syntactic categories so derived elegantly described the subjects' emerging speech and made many acute longitudinal predictions about the acquisition of grammar. We have extended this method to the deaf subjects' sign sequences in order to develop data comparable to those currently appearing in the language acquisition literature. Details of this analysis and notation follow (but see Goldin-Meadow (1977) for a complete description).

Sentence Types: Action and Attribute

We separated the subjects' sentences into a group that seem to comment on or to request the actions of people and objects, and a group that seem to comment on the perceptual attributes of these people and objects. This division of the signed sentences follows from the prior division of the characterizing signs into a verb-like group (e.g. *eat, sleep*) and an adjectival group (e.g. *big*). Thus there are *action* sentences such as "*Mouse* (point) *eat* (biting motions)" and attribute sentences such as "*Drum* (point) *big* (raised arms)". The sentences whose elements were points only were assigned to these categories on the basis of the contextually derived meanings of the sentences. For example, the pair "hat-red", signed about a visible red hat (the subject points to the red hat, then points to other red objects in view), was assigned to the attribute category of sentences. But the pair "Susan-David", signed as a point first to Susan and then to David, after Susan gave a cookie to David, was reconstructed as an action sentence ("Susan gives a cookie to David").

*Simply for expositional clarity, we are adding appropriate inflectional suffixes and the like to the interpretation of sentences. But we are not claiming that the concordance *s* in our interpretation *Mouse eats* or the *the* in the interpretation *The mouse eats* is a property of the language of the subject. Use of these markers, we trust, simply disambiguates certain claims we do mean to make. That is, we interpret this sentence as noun-verb, not as, e.g. the compound nominal *mouse-eat*. For all instances cited henceforth, we never mean to imply that the subject has inflectional or derivational affixes in any of his sentences, nor determiners or quantifiers. None of these ever occur, or are inferrable, from anything the subjects do.

Reliability scores were established for classifying action and attribute sentences. Sixty-six such classification decisions were made in the videotape sample. There was 96% agreement between the two coders on these decisions.

The Semantic Analysis of Action Sentences

A detailed semantic coding of elements of the action sentences was now performed.* The coding categories roughly follow Fillmore's (1968) *case* and *predicate* analysis of the semantic logic of sentences. On this view, each sentence is viewed as a miniature drama whose scenario is given by the *predicate* (the verbal element, the characterizing sign) and whose *dramatis personnae*, in their various roles, are given by the *cases* (the nominal elements, the points). For example, the English sentence:

(1) Herod gives the head to Salome in the ballroom

expresses a semantic relation through its predicate (*give*) and the sensible connections of all its nominal phrases (*cases*) to each other and to this predicate. The example sentence (1) instantiates each of the cases we require for describing the deaf subject's relational meanings:

Actor: The object or person which performs an action to change its own state or location or to change the state or location of an external patient; *Herod*, in sentence (1).

Patient: The object or person which is acted upon or manipulated; *head*, in sentence (1)

Recipient: The locus or person toward which someone or something moves, either by transporting himself, or by being transferred by an actor; *Salome* in sentence (1).

Place: The locale where an action is carried out, but which is not the endpoint of a patient's or actor's change of location of an external patient; *ballroom* in sentence (1).†

*Excluded from this analysis are one-sign utterances and multi-sign utterances that consist solely of repetitions of a single sign, because the analysis of child "holophrases" in these relational terms may well be inappropriate (i.e. the one-word speaker or signer may have no relational meaning in mind; see Bloom, 1973, for discussion) and in any case, reconstruction of relational meaning on the basis of a single word would require too much guesswork. Multi-predicate utterances and attribute sentences are excluded on grounds of insufficiencies in the data base for the early stages of the deaf sign-language that we are reporting on in this chapter. The effect of these exclusions is that each sentence analyzed here contains at most one characterizing sign (which is always the predicate) and a maximum of three points (the cases).

†Obviously a variety of further cases have to be recognized to get at the semantic logic of English sentences as used by fluent adults. For some sentences there is an *instrumental* case (e.g. in "Herod tapped Salome with the *scepter*") and a *benefactive* case (e.g. in "Salome danced *for Herod*"), etc. Our subjects give little evidence of trying to express these additional relational meanings, so we discuss them no further in this section.

The usefulness of this analysis is that the same nouns can be identified as playing the same roles in quite different sentences, if these have about the same meaning. For example, in at least one version of a "case grammar", the nouns of:

(2) Salome receives the head from Herod in the ballroom

are assigned the same semantic roles that they had in (1); that is, *Salome* is still the recipient case, *Herod* is still the actor, and *head* is still the patient. In this way, the relational analysis explicates the semantic relatedness of sentences (1) and (2). For other sentences, the same nominals will play quite different roles. For example, in one version of a case grammar, the sentence:

(3) Salome takes the head from Herod in the ballroom

Yields *Salome*, not *Herod*, as the actor.* Thus on this (case) analysis, sentences (1) and (2) are alike, while (3) is different. In contrast, on any reasonable syntactic analysis (2) and (3) are alike while (1) is different: *Salome* is *subject* in (2) and (3) and *indirect object* in (1); *Herod* is *subject* in (1) and *indirect object* in (2) and (3).

It should be emphasized that nothing is implied in this discussion about the priority of either the syntactic or case descriptions. Both these analyses describe psychologically real representations of language, to the best of our belief. A serious goal in language description is to explicate how the presumed relational meanings are mapped onto the syntactic forms. Clearly, from our examples, the mappings are not one-to-one. But while the relation between these levels is to that extent complex, it is quite regular. There are fairly reliable clues in the syntax of English (both from word order and from such "case markers" as the prepositions) to the semantic roles. Consequently, the main argument that our subjects have a "language-like" communication system will come from the demonstration that the relational analysis of their gestures maps in regular ways onto a syntactic analysis of their gestures. Thus neither description can replace or supercede the other, if language description is to link sounds (or signs) to meanings.

We now describe how the subjects' sentences were coded in relational terms. There are two descriptive problems. First, we show how the context of

*It may appear to be an embarrassment to this kind of model that the semantic roles in sentences (2) and (3) are not treated identically, for on some accounts these sentences mean the same thing (i.e. if one is true, the other must be true; if the two are connected with *but*, a semantic anomaly results; a movie depicting the event would be the same for both sentences to be used appropriately, etc.). But it should be said in defense of this model that the subtle differences in vantagepoint between sentences with *take* (a quite active thing to do) vs. *receive* (a quite passive thing to do) is precisely captured by this difference in case labeling. Perhaps it is worth noting as well that we are not subscribing to the view that case grammars are the final solution to the problem of describing the semantics of natural language sentences. However, Bloom (1973), Brown (1973) and Bowerman (1975) have convincingly argued the value of this kind of analysis for representing the primitive semantics of child speech.

use of occurring sentences determines their analysis. Second, we show how certain labels are inferred on some occasions when they are not explicitly gestured.

(a) Rich interpretation and semantic coding. Consider the subject David, apparently wanting Susan to stay for lunch, and gesturing:

(4) *food* (point to food)—*eat* (bite motions)—*Susan* (point to Susan)

and then returning his hands to neutral position. By observing this sentence in context, we can assign predicate and case labels to the sequence. The deictic point to food is the *patient*; the deictic point to Susan is the *actor*; and the characterizing sign *eat* is the *predicate*. Moreover, the sequence in its entirety approximates the propositional meaning, or *semantic relation*, conveyed also by the English sentence:

(5) You, Susan, will eat food.

Had the context of use been different, the assignment of case labels might have been different also. Sentence (4) yields only a far-fetched example here: in the unlikely event that some food-substance was observed eroding the skin on Susan's hand, sentence (4) signed in response would have been coded as food (*actor*), Susan (*patient*), eat (*predicate*), and the semantic relation would have been coded as:

(6) Food will eat (at) you, Susan.

(b) Reconstruction of relational meaning when gestures are not explicit. What happens if the subject does not explicitly provide a sign for every one of the semantic elements we think he might have had in mind? After all, young speaking children are known to produce incomplete overt sentences due, arguably, to linguistic inadequacies, but they may have more complete thoughts in mind nevertheless. It is the essence of Bloom's method of "rich interpretation" that she tries to reconstruct the more complex meaning behind the incomplete utterance. (Later of course she attempts to relate this inferred thought to the actual linguistic formatives that are produced.) We have adopted the same strategy. As an illustration, suppose that in the same context presented for (4), the subject signed only:

(7) *Eat* (biting motions)—*Susan* (point at Susan)

We assume that (5) is still the semantic relation, rather than:

(8) You, Susan, *will* eat.

There are three grounds for this inference:

1. *Food* was part of the extralinguistic context in which both (4) and (7) were said, so *food* is the plausible candidate for fulfilling the *patient* role that is part of the logic of the predicate *eat*.

2. Enough overtly signed elements appeared in the sentence to lend plausibility to the analysis; that is, we excluded all one-word "sentences" from such analysis on grounds that they provide insufficient basis for inferences about relational meanings (see footnote, p. 371).
3. The case label that was inferred (did not occur overtly in the sentence under analysis) was one that had been overtly expressed by the same subject in some of his other sentences. That is, (7) is reconstructable as (5) rather than (8) only if the subject once said something like (4).

In further detail, we would not reconstruct, say, a *benefactive* case for sentence (4) or (7) even though one is logically possible and fits the context (e.g. "You, Susan, will eat food to please my mother") because the subject who signed (4) and (7) never was seen to sign a benefactive case. Yet we do reconstruct the *patient* case for (7) because we know from (4) that the subject conceives and sometimes expresses this relational meaning. The analysis rests on the supposition that there is a relational logic associated with specific predicates that we can reconstruct for the subjects, but only in so far as they express part of this logic in the utterance being analyzed and only in so far as they give prior evidence of deploying this logic in overt gesturing. (An exception here is the *place* case. Since the overt marking of this case is optional, we do not reconstruct it, but only score it when it is overtly signed.)

The descriptive outcome of this analysis is that the subjects' utterances are analyzed as containing predicates of different kinds, whose logic requires different case labeling and different numbers of case labels. For example, the predicate *sleep* requires only one case (*actor*) while *eat* requires two (*actor* and *patient*) and *give* requires three (*actor*, *patient* and *recipient*). Then in analyzing the gesture sequence:

(9) *sleep* (eyes shut, head down)—*dog* (point to dog)

we would argue that all cases logically required have been signed; but in

(10) *give* (palm up, hand extended)—*dog* (point to dog)

we would argue that two cases have been *omitted*. This supposition is implicated in the analysis of the subjects' syntax (p. 383).

Reliability scores were calculated for the assignment of semantic relations to sentences. There was 96% agreement between the two coders on the 66 relation assignment decisions that could be made in the videotape sample. Reliability scores for the assignment of semantic cases and predicates to the individual signs in sentences were comparable: there was 97% agreement between the two coders in the 115 case/predicate assignment decisions that could be made in the sample tape. All of the gestured sentences that were used for the syntactic analysis reported on pp. 384-398 were coded by two independent coders; disagreements were resolved by discussion, and sentences for which disagreements remained were discarded.

RESULTS AND DISCUSSION

All of the subjects we studied developed the ability to communicate with manual gestures. All began, like hearing children, simply by pointing to the people and things around them, engaging their listeners by eye contact (that is, they did not point if no one else was looking). These points continued to bear a heavy burden in the subjects' communications throughout our observation. In comparison, gesturing tends to decline for hearing children as speech emerges. As our subjects grew older, two striking changes in their communicative attempts took place. They began to use the points in combination, in ways that seemed clearly intended to convey semantic relations between the referents of the points. And they began to invent motor-iconic gestures that seemed to specify predicates of various kinds. These gestures, which we have called characterizing signs, soon came to be used in combination with the points in structured ways. Such extensive elaboration of the gestural mode is not typical for hearing children. As observers, we came inescapably to understand these signs and sign combinations as communicative acts—as comments about the world, queries, requests, and demands addressed to the listener. All in all, it is impossible to observe these subjects and deny seriously that they achieved considerable communicative skill in a gestural mode: each subject must be credited with an idiosyncratic "home sign" system that puts him into mental contact with those around him.

It is very difficult to convey in words the simultaneous pantomimic clarity and yet abstractness of the characterizing signs and their manifest constructional relations, when used within "sentences". They were iconic, certainly, but also highly stylized—just enough to render an intent, rather than an attempt to imitate veridically some scene or object in the visual world. We can do no more than give some examples that show the iconic content of the characterizing signs: a downward facing open palm moving back and forth signifies *cut;* flat palms bouncing on the floor designate *dance*; a point gliding diagonally upwards derives from tracing the *take-off* of an airplane; a point curling downwards from the nose derives from the *trunk* of an elephant: hands held in praying position denote the subject's (Catholic) *school*. Of course this last gesture is directly given in the environment. But the context for inferring its intent may help to concretize the nature of our own inferences about these subjects' meanings. In this instance, the subject was shown a picture of his older brother, who was at that moment at school, a Catholic school which the subject also attended. The subject pointed first to the photograph, then pointed to the door ("away"), then made the praying motion, then nodded most earnestly at us.

These are the kinds of interactions that lead us to claim that the subjects *undeniably* communicate, and they know they are doing so. This subject managed to convey to us that his brother was away at school.

A more detailed description and interpretation of our findings follows. It is organized in terms of the three questions raised in introductory comments: (1) does the deaf child manifest (successfully) an "urge to communicate" despite the poverty of his linguistic input? (2) is the communicative system of these subjects similar in character to natural languages? and (3) are the growth patterns in the deaf children's usages similar to the patterns observed in normal acquisition? We will give a qualified "yes" answer to all three questions in this section, and then comment more discursively in a final note (p. 408).*

Is There An Urge to Communicate in the Untutored Child?

The Egyptian isolated children on whom Herodotus reports were considered successfully tested when they ran to their caretakers shouting "bekos" (the Phrygian for *bread*), thus approximately demonstrating that (a) they, not their (Egyptian) caretakers had invented the language; and (b) their lexical items encoded about the same semantic notions as those of received languages. For our subjects, we take up these two topics separately.

The Child is Mother to the Sign

Certainly our subjects performed elaborate and structured gesturing, as will be demonstrated. But is it possible that the source was an *ad hoc* communication system unconsciously fashioned by their caretakers (unconsciously, because the subjects' parents were committed to oral education)? Some of the mothers clearly did gesture to their children. To determine which member of the dyad bore the major responsibility for creating the system, we transcribed the gestures produced by Dennis' and David's mothers during the first four interviews. The same coding procedures were used for maternal and child gestures. Comparisons were made with respect both to lexicon and sentence form. There were no clear differences between mother and child in their tendency to point to objects. Since pointing is common in mother-child interactions, we might as well acknowledge that our subjects may have "learned to point" from speakers around them. But pointing does not exhaust the system. More interesting comparisons concern the use of the characterizing signs, and the embedding of signs in gesture combinations (sentences). Inspection of Table II reveals that the mothers did use approximately as many characterizing signs as the children, calculated either in types or tokens (columns 1 and 2 of Table II). However, there is a striking difference between mothers and children in the tendency to use characterizing signs within a sentence, as column 3 of Table II shows. There is no evidence here that the subjects were learning to integrate the characterizing signs into sentences from the mothers; if anything, the suggestion is the other way around. Moreover, the mothers produced few gesture combinations that were analyzable in propositional terms; that is, sentences that conveyed *semantic relations*, as we have defined these (pp. 371-375). Instead, most of their sentences consisted merely of, e.g. a head-nod followed by a point, or a repetition of a single point. Over the course of the four interviews, David and Dennis produced 127 and 42 sentences, respectively, that conveyed semantic relations, while their mothers produced 41 and 13. The mothers began production of these phrases later than their children. Both children produced a number of these sentences in session I. David's mother produced only three in session I compared to David's 27. Dennis' mother produced none until session II. Since the mothers *did* produce many one-sign gestures (see Table II), it is not possible to assume that the rarity of their combinations had to do with aspects of their conversational roles in these interviews. Rather, their gesturing is primitive and inept, compared to that of the children.

A number of further findings bolster the interpretation that the child's gesturing was independent, rather than learned by example from the mother. Only 25% of the children's characterizing signs were the same as the mothers'; each member of the dyad seems to create with some independence. Also, the children often created characterizing signs to refer to the toys we brought to the sessions, which neither they nor their mothers had ever seen. This is straightforward evidence that the children could create manual representations independent of a tutor.

Finally, there is a striking qualitative distinction in form between the signs

*Not all of the data and findings from this project are reported in the present chapter, but only sufficient to provide existential evidence on these three limited questions. The treatment will be more or less formal depending on the demands of each question for exhaustive statistical treatment; the effect is that the bulk of formal presentation concerns syntactic properties of these children's home sign. Much more detailed analysis of the early lexicons of these subjects appears in Feldman (1975). More complete syntactic/semantic description appears in Goldin-Meadow (1977). Summary accounts of some of these findings appeared in Goldin-Meadow and Feldman (1975, 1977). Data reported here are selections from that material. Finally, these subjects have progressed in their manual communication system well beyond the early data reported in this chapter. Very long (up to 13 morpheme) sentences can be identified in the productions of two subjects who we have continued to study (David and Donald). Analysis of this material is underway. Preliminary inspection of the advanced productions suggests the emergence of elaborate structures which—owing to their interaction with left-to-right production constraints—show an increasing disparity between deep and surface representations. These data will be described in a forthcoming report.

Table II
Mother-child comparison of number of characterizing signs produced during sessions I-IV

	Types[a]		Tokens[b]			
			Alone		In sentences	
	Child	Mother	Child	Mother	Child	Mother
David	56	54	107	90	47	9
Dennis	25	23	50	58	18	3

[a]Types = Number of different characterizing signs.
[b]Tokens = Number of occurrences across types.

of mothers and children: the mothers depend heavily on objects in the world around them as props for their gestured communication—rather like people who cheat at Charades. For example, David's mother picked up a toy apple and poised it near her lips while performing an *eat* sign (biting motions). It is true that the child subjects also occasionally perform signs near appropriate objects in the world. However, in the bulk of the children's signing there is no such reliance on objects as props. Signing is their only means of communication and they use it analogously to the way we use spoken words. On the contrary, the mothers typically move, display, and wave real objects to hint at their meanings—the kind of desperate device we all employ in foreign places where we have no language to use.

Semantic Properties of the Lexicon

We find that the lexicons of the uninstructed deaf subjects are strikingly similar to the lexicons of young hearing children reared in normal language environments. This finding again suggests a powerful role for internal organizing principles in accounting for the acquisition of language in humans. We have acknowledged in earlier discussion the considerable hazards involved in inferring meaningful content from manifest forms, even with contextual support. Perhaps, then, it is worth reiterating here that field studies of the hearing child face the same problem: that the hearing child produces real words of English when he talks is no guarantee about the concepts behind them. We can do no more than develop data under similar assumptions, for comparative purposes. (Studies of the comprehension of speaker-hearers make clear that these difficulties are real. A number of investigations such as Clark, (1973c), Carson and Abrahamson (1976), Huttenlocher (1975), Thomson and Chapman (1975) suggest that a productive lexical item gives only the roughest clue to the child's concept in using it. We have not been successful at all in getting these subjects to participate in manipulative situations which would allow us to probe more directly for the meanings behind their signs.)

The Meaning of the Points

If clues from the context of use are accepted, it is apparent that the subjects' points express nominal concepts by making reference to actual instances of these concepts. The child points to a dog to refer to a dog and points to a cat to refer to a cat. That is, the point serves as a pronominal by means of which the deaf child can make reference to almost anything visible in the environment. The question here is whether these individuals chose to refer to the same things that hearing children choose to refer to, despite the fact that they were not provided with verbal labels for concepts.

One might well expect the outcomes to be quite different from those that have been reported for hearing children, owing to our coding decisions. We have glossed each point as its apparent referent (see p. 365). This means that a point is called *dog* if a dog is the salient object at the end of the line of regard of the point; but it is called *cat* if a cat sits there. In contrast, no one credits a speaking-hearing child with multiple lexical items just because he uses the word *this* deictically. Then it might be expected that the method of analysis would yield hugely inflated nominal vocabularies for the deaf subjects. Given this inflating factor, the *poverty* of the observed nominal vocabularies of our subjects is striking. They do not point to everything they can see. Rather, the semantic scope of their points is quite narrow, as can be seen from inspection of Table III. Table III is a content analysis of all the points that occurred within the subjects' two-sign sentences. (Isolated points were excluded, because their interpretation is subject to a good deal more ambiguity. The two-sign sentences were chosen because they are the most characteristic of these subjects' combinations, and because we could derive similar analyses from data for hearing children.) As the table shows, almost all of the points can be subsumed, in word meaning, under a few common superordinate categories: inanimate objects, people, animals, body-parts, food, clothing, vehicles, furniture and places. For comparison, we submitted data from Bloom's (1970: Appendices C, D, E, F, G; Katherine I, Gia I and II, Eric II and III) hearing subjects, all aged about 2 years, to the same analysis. Bloom's data are particularly useful for such a comparison, because the conditions for data collection were about the same as ours. Bloom too went to the children's houses armed with toys, which became topics of the conversation during those interviews. Thus, if the interview situation biases the sample vocabulary that is derived (and surely it does), very similar biases

Table III
Types of object lexical items used in sentences[a]

	Inanimate objects	People	Body parts	Animals	Food	Clothing	Vehicles	Furniture	Places	Total
Younger deaf subjects:										
Kathy I-IX	0·41	0·13	0·14	0·10	0·09	0·03	0·00	0·10	0·00	29
Dennis I-IV	0·53	0·12	0·00	0·00	0·12	0·00	0·06	0·00	0·18	17
Chris I-III	0·38	0·21	0·04	0·17	0·00	0·04	0·08	0·04	0·04	24
Older deaf subjects:										
David I-VIII	0·44	0·11	0·10	0·08	0·07	0·07	0·05	0·01	0·08	114
Donald I-XI	0·51	0·14	0·10	0·10	0·02	0·04	0·04	0·02	0·04	51
Tracy I-II	0·19	0·28	0·10	0·14	0·00	0·14	0·00	0·05	0·10	21
Bloom's hearing subjects:										
Kathryn I[b]	0·23	0·14	0·14	0·08	0·14	0·13	0·01	0·02	0·05	100
Gia I-II[b]	0·26	0·21	0·05	0·14	0·07	0·07	0·06	0·04	0·02	106
Eric II-III[b]	0·28	0·15	0·04	0·15	0·09	0·04	0·11	0·04	0·05	54

[a] Names for toys representing inanimate objects, people, animals, food, clothing and vehicles are included in their respective categories.
[b] Data are from Bloom (1970), Appendices C, D, E, F, G, lexical items in syntactic contexts. A small number of items did not fit in any of the categories: Kathryn, 0·06; Gia, 0·09; Eric, 0·05.

should have appeared in both her situation and ours. The content analysis Bloom's lexical data shown in Table III was performed on items that occurred in the two-word sentences of her subjects, again for comparability with our own analysis, and is of course limited to the nouns, for comparison with the points. Approximately the same superordinate categories describe the hearing children's nominals as those that describe the deaf children's points, and the proportions of items appearing under each superordinate category are not strikingly different for the two populations, if we acknowledge that some biases arise because of the particulars of specific conversations.

A plausible interpretation of the similarities in expressed nominal meanings between the deaf and hearing subjects is simply that children converse about what interests them, a not so deep idea. But it is a sufficient one for what we set out to show here: the deaf child uses his communicative skills to express the same kinds of things as do hearing children just because he is about the same in interests and cognitive level, only he is deaf.

The Meaning of Characterizing Signs

Table IV shows similar effects for the characterizing signs, which we take to represent predicate notions. These usually pertain to simple actions—the motions of objects and persons and the transfer of objects among persons and across locations. For example, there are signs for *strum* (fingers strumming on the chest, an imaginary guitar); *hit* (hammering motions); *bike-ride* (rotating fists); *drive* (hands jiggling on an imaginary wheel); and the like. Rarer, and usually later in developmental appearance, are terms that describe perceptual attributes such as *big* (arms spread, open palm down) and *floppy eared* (open hands flapping, palms forward behind ears).

We can ask, as we did for the points, about the extent to which the medium of communication and the method of analysis predetermine the bias toward action verbs in the deaf communications. Surely it is easier to pantomime *eat* than, say, *ruminate*. But it is at least possible to conceive of pantomimes for bodily and mental states, e.g. *pain* by stomach-clutching or *sorrow* by tear-trickling. Yet the subjects do not attempt this. It is suggestive that the verb vocabularies of very young English speakers show the same bias toward action and motion verbs and a paucity of items expressing mental and bodily states. For comparison, we again analyzed Bloom's data (1970), this time her verb and adjective lists, in terms of the same categories used for the deaf children; the outcomes are shown in the bottom three rows of Table IV. Again the results for the two populations are roughly similar. The hearing children also speak much more often of actions than of mental states, attributes and the like. We conclude, as we did when considering the

Table IV
Types of action and attribute lexical items used in sentences

		Action[a]	Attribute	Total
Younger deaf subjects:				
Kathy	I-IX	0·92	0·08	12
Dennis	I-IV	1·00	0·00	9
Chris	I-III	0·92	0·08	13
Older deaf subjects:				
David	I-VIII	0·68	0·32	104
Donald	I-XI	0·68	0·32	38
Tracy	I-II	0·58	0·42	24
Hearing subjects:				
Kathryn	I[b]	0·68	0·32	66
Gia	I-II[b]	1·00	0·00	41
Eric	II-III[b]	1·00	0·00	45

[a]Action = items marked + VB in Bloom's terminology.
Attribute = items marked + ADJ in Bloom's terminology.
[b]Data from Bloom (1970), lexical items in syntactic contexts in Appendices C, D, E, F, G.

nominal pointing, that the deaf children have a means of communication that enables them to traffic in the same matters, important to them, as do hearing children in contact with a received language.

Summarizing, the deaf lexicon is roughly comparable to the lexicon of young hearing children, despite the fact that the latter are exposed to proficient and mature models. Thus there is no evidence—for either group—that the nature of young children's vocabularies is in any direct sense a function of linguistic exposure and training.

Summary: Expressive Content Without Explicit Models

It has been suggested that the deaf subjects are the main creative forces in developing the "home sign" system for communicating their thoughts and wishes to others. They gestured sooner and in more complex ways than did the adults around them. Thus we have answered positively the first question raised by the Egyptian king for *his* isolated subjects: children raised apart from a fluent caretaker system *will* try to communicate and *can* do so; and they choose to express roughly the same lexical-semantic content as do children more fortunately circumstanced. Specifically, though they could have, the deaf subjects did not choose to discuss, say, their bodily states. Instead, like normal children everywhere, they communicated about ducks and food and hitting and running, and the semantic relations among these notions.

We tentatively conclude that much of the creative force for communication in humans, and the character of the concepts in which it traffics—at early stages, at least—comes from inside the novice himself. Though the same has been shown previously by Marler and Tamura for birds, those were merely birds. (And though the same has been shown by the Egyptians for humans, we had three times as many subjects as they did.) We claim these findings ought to bear seriously on the interpretation of correlational studies of the normal mother-child dyad in language acquisition. It seems that if the apparent "teacher" in this dyad is seriously deficient in the relevant language skills (as were the mothers of our deaf subjects) this does not seriously handcuff the apparent "pupil". Even if one considers the evidence that our mothers knew *less* than our child subjects to be weak, certainly there is no evidence that they knew *more*. Thus there is no evidence that the mothers could present the kinds of "graded lessons" or "miniaturized samples" often spoken of in this literature (cf. Levelt, 1975) as explanatory concepts in understanding the child's acquisition of language.

Is the Communication of the Deaf Children "Language-like?"

The ancient kings made a more radical supposition about language in isolation than any we have discussed so far: they presupposed that, in formal structural detail, their subjects' language would be just like that of naturally occurring languages. Specifically, it would be either Eguptian or Phrygian. Our findings allow us to approach this question more objectively than they did. We can ask whether the self-generated communication system shares structural features with natural language, as used by non-isolated hearing children of comparable ages. Throwing caution to the winds, we pursue an analogy made in our introductory remarks: white crown sparrow chicks that are isolated from birth will sing skeletal species-specific songs of their fore-birds nevertheless, approximating birds raised in the bosom of the family. At the same time, however, the songs of these isolated individuals lack the rich elaboration and detail characteristic of their socially reared peers (Marler and Tamura, 1965). To the extent that human language is similarly a species-specific characteristic, we might expect to find a skeletal resemblance between our subjects' communication and the hearing child's speech. But we would not expect this communication to be elaborate. That is, we are unlikely to replicate the finding that a language so sophisticated as Phrygian can be invented in one generation.

The question here is whether the categories and combinatorial devices of the home sign-system are like those of natural languages, when used by

appropriately circumstanced novices. It has been demonstrated elsewhere that the forms and functions of sign languages such as ASL are so close to natural language that they should be accorded the same status (e.g. Bellugi and Fischer, 1972; Newport and Bellugi, 1977). Thus the fact that our subjects' communications are manual should not bar us from raising these structural questions. We will show now that the semantic intents of the subjects are encoded syntactically, in ways that resemble the speech of young speakers. These findings, in turn, will enable us to conclude that the subjects' gesturing takes place in terms of the same hierarchy of category levels (phonological element, morpheme and sentence) that universally characterize natural languages. The major quantitative treatment is expended on this issue for, in our view, the essence of a language-like communication system is its mapping of meaningful relations onto organized output structures. It is this *syntactic* property of natural languages that enables their users to make infinite use of finite (phonological and lexical) means, and distinguishes them most clearly from the expressive and semantically non-trivial communications of other beasts, even including college-educated primates.

Structure in the Representation of Semantic Relations: Reduction Rules

We find that the gestured sentences of these subjects are very short, just like the sentences of young speakers. However, we will present evidence that the underlying semantic representations associated with these gestured sentences are neither so simple nor so short as the overt sentences themselves. That is, the subjects map relatively complicated thoughts onto relatively simple output structures. We will demonstrate that there are regularities in the ways the long semantic representations are mapped onto the short overt sentences. This orderly, but not one-to-one, mapping of meanings onto surface structures is tantamount to a rule of syntax, a *reduction* rule.

The Gestured Sentences of the Deaf Subjects are Short

Our subjects, like young children everywhere, tend to produce very short sentences. Throughout the period of observation, the majority of gestures by each subject consisted of a single sign (76%, pooled over all subjects and all sessions; see Table V). Moreover, 69% of the remainder of utterances (pooled over all subjects and all sessions) consisted of two signs only. Thus the "MLG" (mean length of gestured sentence, in signs) is in the range from 1·0 to 1·5 throughout the course of observation. This is rather surprising. After all, it is not as if our subjects, like hearing children, have to acquire a new and arbitrary representation for each word they want to say. Recall we have been content to give them credit for a lexical item if only they will point at something; and we call two successive points, even in the absence of a characterizing sign, "a sentence". On this evidently generous criterion, would it not seem an easy matter to produce long sentences in developmental advance of hearing children at the two-word stage of production? For instance, the subjects could just point successively to five different people in the room or to ten peas in a pod. But the fact is they do not do this. The deaf children are limited in the number of points and other signs in a sentence, just as hearing children are limited in the number of words in a sentence. (As the subjects grow older, they do produce some longer sentences, as we will demonstrate when we look at their developmental progress; see Table XI). We suspect this close synchrony in superficial structures of the deaf and hearing subjects, despite specifiable differences in the demands of the expressive medium and the context of learning, suggests that the same organizing principles are at work in both populations.

Table V
Number of strings produced by each subject classified according to length

	Number of signs per sentence								
	1	2	3	4	5	6	7	8	9+
Younger subjects:									
Kathy I-IX	672	62	13	5	0	1			
Dennis I-IV	290	40	5						
Chris I-III	378	50	9	4					
Older subjects:									
David I-VIII	1,550	530	164	87	26	14	6	6	6
Donald I-XI	1,006	151	25	5					
Tracy I-II	348	67	14	3	1	1			

The Semantic Representations of the Signed Sentences are Long

We have just shown that the signed sentences are short. Here we show that their underlying representations, in terms of semantic elements, are longer; i.e. the semantic elements are not mapped one-to-one onto signs in the output sentences.

Recall from the methodological discussion (p. 370) that each sign within a sentence was coded for its relational meaning (*act* or *attribute*) on the basis of its form and the context in which the sentence was uttered; and that high inter-rater reliability was achieved for this coding. Each child exhibited the ability to sign both *act* and *attribute* semantic relations, but the *acts* far outnumbered the *attributes* for each subject. (This outcome is taken up later,

p. 402, see Table XII, when we discuss the results in developmental terms.) The action sentences, for which we had substantial amounts of data, were submitted to a case analysis, whose results are shown in Table VI. This table shows the percentages of each semantic element type in the subjects' action sentences (for the two-sign sentences that were most characteristic of these subjects). Inspection of this table reveals that each child exhibited the ability

Table VI
Semantic elements in action sentences[a]

	Act predicate	Cases				Total one-relation action sentences
		Patient	Recipient	Actor	Place	
Younger subjects:						
Kathy	0·81[a]	0·57[a]	0·33	0·33	0·00	33
Dennis	0·62	0·88	0·40	0·19	0·00	27
Chris	0·85	0·62	0·41	0·20	0·00	29
Older subjects:						
David	0·74	0·62	0·32	0·34	0·05	248
Donald	0·85	0·64	0·28	0·21	0·02	84
Tracy	0·87	0·53	0·00	0·54	0·08	24

[a]Each cell represents the proportion of times each semantic element occurs in one-relation action sentences, for each subject. Thus, for example, an *act* predicate appeared in 0·81 of Kathy's sentences and a *patient* appeared in 0·57 of her sentences.

to sign the *patient*, *recipient* and *actor* cases, just those that are most salient to action semantic relations, a finding that has also been reported for young hearing children (Brown, 1973). The *place* case, which serves to modulate certain action relations, was much rarer. Further modulating cases (such as *instrumental*, *benefactive* and *source*) are rarely explicitly signed by these subjects, a result that again reproduces the findings in the literature on early stages in first language acquisition (Brown, 1973).

If the coding procedures are taken to be valid, then, we have demonstrated that the subjects' overt gestures refer primarily to *action* semantic relations which are conveyed by expressing an *act* predicate and the *patient*, *recipient* and *actor* cases. Despite the fact that certain semantic elements appear much more often than others (e.g. the percentage of signs that are *patients* is far greater than the percentage of signs that are *actors*), each subject does exhibit the ability to gesture each of these relational meanings, within two and three-sign sentences.

How shall we represent the semantic structure of the signed sentences? would seem most straightforward to claim for each overt sentence only th relational meanings that were expressly gestured. That is, if the subjec gestures "cookie—give" when his sister is giving him a cookie, we might cod the semantic intent as *patient-act*. It will be recalled, however, from th methodological discussion (p. 371) that we inferred the existence of furthe semantic elements that were not at all represented in the gesture, but whic seemed to be implied by the extralinguistic context of use. That is, for th present example, we would reconstruct the semantics as "sister (*actor*)—giv (*act*)—cookie (*patient*)—David (*recipient*)". (In this notation, nothing i claimed about the order of occurrence of the elements either in underlying o surface representations.)

The results presented in Table VI already lend some plausibility to thi kind of reconstruction: each subject did, though on separate occasions exhibit the ability to gesture each of these cases, and thus we can be sure tha he could conceive of all of them. Table VII presents a further sample result that considerably bolsters the argument in favor of such reconstruc- tions: though few of the subjects ever explicitly gestured all of the semantic elements required for three-case predicates such as *give* within a single sentence, they did often sign all of these required elements if we pool the case labels over all of the sentences containing *give*. Table VII shows such productions from David. He exhibits knowledge that *actor*, *patient* and *recipient* are associated with this predicate, and he exhibits the ability overtly to express each of them in this predicate context. On this basis, we suggest that the full logic of *give* is mentally involved whenever this predicate is involved; i.e. the semantic intent is reconstructed as shown in the final column of Table VII. The effect of this decision is that the five syntactically and lexically distinct sentences of column 1 of Table VII are claimed to be identical in underlying semantic structural typology. (Obviously, we were not able to elicit the whole range of case labels for each predicate for each subject, since the children would not submit to formal elicitation procedures in the manner of linguistic informants. They would not produce gestured sentences just because we needed them for complete analysis. The data of Table VII provide only existential evidence supporting reconstruction of "omitted" case labels. However, by extrapolating from this kind of evidence, we reconstructed the case labels for all predicates for all subjects in the same way.)

Short Sentences from Long Thoughts: Reduction at the Surface

We presented evidence on p. 384 that the subjects' signed sentences were short, generally only two signs long. A first guess in explaining this brevity is

Table VII
Sample of David's signed sentences with the predicate *give*[a]

Actual signed utterances	Coding of overt signs according to semantic element type
(1) cookie—give	patient—act
(2) sister—David	actor—recipient
(3) give—David	act—recipient
(4) Duck—Susan	patient—recipient
(5) book—give—David—book	patient—act—recipient—patient
(6) crackers—give—David—give—crackers—give	patient—act—recipient—act—patient—act
(7) give—gum—mouth	act—patient—recipient
(8) give—hole	act—recipient
Situational context of use	**Inferred propositional intent[b]**
(1) Sister just gave cookie to David	You—sister give cookie to David
(2) David wants sister to give him a toy motorcycle	You—sister give motorcycle to David
(3) David wants Heidi to give him a mask	You—Heidi give mask to David
(4) David wants sister to give the duck to Susan	You—sister give duck to Susan
(5) David wants mother to give him the book	You—mother give book to David
(6) David wants mother to give him crackers	You—mother give crackers to David
(7) David wants Heidi to put gum in his mouth	You—Heidi give gum to mouth
(8) David wants Heidi to put key in keyhole	You—Heidi give key to keyhole

[a]The predicate *give* is an open palm, facing upward, with an arm extending toward listener. The nominals are always points.
[b]Since David is appropriately greedy, almost all uses of *give* have himself as the recipient. Example (7) is not an exception, because here he wants the gum in his own mouth. Examples (4) and (8) are the only ones in the sample where David is not the recipient. Notice that our own interpretation of the predicate in (7) and (8) is *put*. But David makes the *give* sign (see [a] above) so there is no indication that he distinguishes between these two concepts. Thus while we use the word *put* to describe our interpretation of the situation (column 3), we use the word *give* to describe the propositional intent (column 4).

that the subjects' semantic intents were so simple that it took only two words to express them. But in the last section we presented evidence that this is not so: the children were able to conceive of and express semantic relations in terms of a substantial number of case and predicate notions. Only they did this, generally, two signs at a time. These outcomes raise two questions: why are the signed sentences so short; and what is the basis on which the short sentences are related to the long thoughts?

We suggest that the same hypotheses generally put forward to describe the brevity of hearing children's sentences fit the deaf children's as well. Presumably the young child has memorial and information handling inadequacies that limit the character of his outputs, whatever the complexity of his intents. If there are such output constraints, there is a "cost" to every word and so the child must "telegraph" his intents with as few of them as possible, omitting others (Bloom, 1970). Put another way, the semantic elements are in competition with each other for space in the output sentence. Our question now is which (among the semantic elements) will be the winner and which the loser in this struggle for overt expression.

We have seen from Table VI that some semantic elements are signed more frequently than others. The *act* and *patient* are signed very often, compared to the *actor* and *recipient*. Table VIII shows the pairwise co-occurrence of these semantic elements (disregarding order) for the two-sign sentences that are most characteristic of these subjects. Again the frequencies of the various pairs are quite different. For instance the pairing of *act-patient* is quite common (39% of all pairs of semantic elements, over subjects) while the pairing of *actor-patient* is rarer (5% of all pairs of semantic elements, over subjects). We might examine these frequency distributions to determine which semantic elements the children are biased to express overtly. But these data displays may well be misleading. We already know that there are in the subjects' repertories one-case predicates such as *sleep* (which requires only the *actor* case), two-case predicates such as *hit* (which requires *actor* and *patient*) and three-case predicates such as *put* (which requires *actor*, *patient* and *recipient*).* For this reason alone, the frequency of appearance of the semantic elements should differ since, e.g. *actor* and *act* are logically required in all the action sentences, but *patient* is logically disallowed for some of them (for instance, *sleep*). On these grounds, one would expect more *actors* and *acts* to be signed than *patients*. A more realistic measure of the frequency of explicit signing of the various semantic elements, then, takes into account whether they are allowable, given the logic

*Analysis here is again for the action sentences (those with *act* rather than *attribute* predicates). Excluded from further analysis are two-case predicates such as *go*, in "You go there" which require the *actor* and *recipient* cases. Though these do occur in our corpora, they are rare, making quantitative treatment of them problematical. A more fine-grained syntactic analysis, distinguishing between transitive and intransitive *actors*, does allow further interpretation of this rarer kind of two-case predicate. In fact a good deal more structure than will be reported here falls out of this further atomization of sign types. These results are reported in Goldin-Meadow (1977). The scope of discussion here is narrower. We simply demonstrate that the subjects' overt sentences are orderly, but significantly reduced, mappings of the semantic elements defined on pp. 371-374. For a complete syntactic description of the signed utterances, see Goldin-Meadow (1977).

Table VIII
Pairwise occurrence of semantic elements in action sentences with two signed elements (in proportions)[a]

	PA[b]	PR	AR	A Actor	P Actor	R Actor	Total action sentences
Kathy	0·36	0·06	0·18	0·21	0·09	0·03	33
Dennis	0·44	0·22	0·07	0·00	0·11	0·04	27
Chris	0·41	0·14	0·17	0·17	0·00	0·00	29
David	0·34	0·18	0·08	0·22	0·05	0·02	248[c]
Donald	0·50	0·08	0·17	0·14	0·04	0·02	84[c]
Tracy	0·45	0·00	0·00	0·38	0·08	0·00	24[c]

[a]This table includes all two-element action sentences regardless of the order of the elements in the sentence. For example, the column marked "PA" includes sentences in which patients precede acts, acts precede patients, patients and acts are signed simultaneously, and also sentences in which one or both elements are repeated. The proportions do not sum to one because from 5 to 10% of the sentences combined three elementrs, and so are excluded here (see also footnote[c]).
[b]P = Patient, A = Act, R = Recipient.
[c]David and Donald produced a few Act-Place sentences (3% and 2% of their action sentences, respectively) and Tracy produced one Actor-Place sentence (4% of her action sentences).

of the predicate. Table IX shows these conditional probabilities of the appearance of semantic elements in the two-sign sentences: the entry for each semantic element is given as a proportion of the times it *could* have appeared, treating separately the one-case, two-case, and three-case predicate types.

It is clear from Table IX that the frequency of explicit occurrence of each semantic element, as a proportion of the time it could logically have occurred, diminishes as we move from predicates requiring fewer cases to predicates requiring more cases (moving from left to right across the rows of the table). This outcome is anticipated on the hypothesis stated earlier: there is a constraint toward brevity in the output sentences. Since the more complex predicates logically involve more semantic elements, this brevity constraint will lead to more frequent omission of explicit signs in the longer predicates. Notice, for example, that the *actor* is always expressed in a one-case predicate (conditional probability of 1·00) but more rarely (conditional probability of 0·24) in a two-case predicate, and almost never (conditional probability of 0·06) in a three-case predicate.*

It remains now to ask how the subject chooses semantic elements for expression, when the bias toward short sequences disallows him to choose all that are logically required. It is possible to suppose that the subject will omit semantic elements haphazardly. On this hypothesis, we can estimate the

conditional probability that each semantic element will occur in each sentence type. These chance expectations are shown in the bottom row of Table IX: if the sentence length is two, both semantic elements (*actor* and *act*) have a conditional probability of 1·00 in a one-case predicate; but one of the required semantic elements (*actor*, *act* or *patient*) must be omitted from a two-case predicate, yielding a conditional probability of occurrence of 0·67 for each of them; and two of the semantic elements (*actor*, *act*, *patient*, *recipient*) must be dropped from the three-case predicate, yielding a conditional probability of occurrence of 0·50 for each of them. We have already looked at support for this hypothesis: the conditional probability of appearance of each semantic element does diminish moving from left to right in Table IX.

But notice that the fit of the findings with this "haphazard omission" hypothesis is rather poor. For example, the expected values for the *actor* case (leaving aside the one-case predicates, for reasons described in the footnote) are 0·67 and 0·50 but the obtained values (row 8 of Table IX) are 0·24 and 0·06. That is, the *actor* is omitted much more often than would be expected by chance. In contrast, the *act* predicate resists omission much more strenuously: while the expected values are again 0·67 and 0·50, the obtained values are 0·87 and 0·59. Similarly, the *patient* case has expected occurrence values of 0·67 and 0·50, but obtained values of 0·86 and 0·73. It appears, then, that the *actor* case is being singled out for omission as the semantic logic of the sentence becomes more complex, for its appearance is dramatically less frequent than would be expected by chance. Consequently, the *act* and the other cases are explicitly signed somewhat more often than would be expected by chance, the selective omission of the *actor* having left space for them in the surface sentence.

The facts for three-sign sentences produced by these subjects at the same developmental period (often within the same interview session) support the notion that the *actor* is part of the underlying semantic structure of the children's sentences, but has a low priority for overt expression. Table X displays the expected and obtained conditional probabilities for the semantic

*It is almost, but not quite, a tautological outcome of the coding procedure that both *act* and *actor* are always explicitly signed in one-case sentences. Recall that one-sign utterances were excluded from sentence status (p. 371). Then we report no instances of a one-case predicate (e.g. *sleep*) from which one of the two elements (*act* or *actor*) is presumed to be omitted. It is just possible, under our coding scheme, that this situation could have occurred, just when the optional *place* case was explicitly signed with a one-case predicate, e.g. the subject could have gestured "sleep in bed" or "baby in bed" as ways of indicating "baby sleeps in bed". But this never happened, so the appearance of both *actor* and *act* in one-case predicates is 100% (see Table IX). Given the dependence of this fact on the coding procedure, we cannot dignify the outcome for one-case predicates by calling them "findings". The interest of Table IX lies in the effects for two-case and three-case predicates, as well as in the relations between the entries in this table compared to Table X.

Table IX

Conditional probability of case and predicate production in sentences with two signed elements

	One-case			Two-case				Three-case				
	Actor	A[a]	Total	Actor	A	P	Total	Actor	A	P	R	Total
Kathy	1·00	1·00	3	0·44	0·77	0·77	9	0·13	0·81	0·63	0·44	16
Dennis			0	0·20	0·80	1·00	10	0·08	0·46	0·85	0·62	13
Chris	1·00	1·00	4	0·00	1·00	1·00	7	0·00	0·71	0·64	0·64	14
David	1·00	1·00	17	0·28	0·85	0·83	88	0·02	0·47	0·78	0·73	88
Donald	1·00	1·00	5	0·10	0·93	0·90	29	0·08	0·75	0·53	0·53	40
Tracy	1·00	1·00	6	0·30	0·85	0·85	13	0·00	1·00	1·00	0·00	2
Summed over subjects	1·00	1·00		0·21	0·88	0·89		0·05	0·70	0·74	0·49	
Summed over instances	1·00	1·00	35	0·24	0·87	0·86	156	0·06	0·59	0·73	0·63	173
Chance expected values	1·00	1·00		0·67	0·67	0·67		0·50	0·50	0·50	0·50	

[a] A = Act, P = Patient, R = Recipient.

Table X

Conditional probability of case and predicate production in sentences with three signed elements

	One-case[b]			Two-case				Three-case				
	Actor	A[a]	Total	Actor	A	P	Total	Actor	A	P	R	Total
obtained	1·00	1·00	1	1·00	1·00	0·75[b]	8	0·07	1·00	1·00	0·93	15
expected	1·00	1·00		1·00	1·00	1·00		0·75	0·75	0·75	0·75	

[a] A = Act, P = Patient, R = Recipient.

[b] A three-sign sentence can occur for a one-case predicate if the *place* case, in addition to *act* and *actor*, is explicitly signed. There is only a single instance of this in our data. Similarly, a three-sign sentence for a two-case predicate can have an "omitted" case label just when the optional *place* case occupies the third "slot" in the surface. For two of the eight instances in the data, *place* was signed, and *patient* was omitted.

elements in three-sign sentences (here the data are pooled, for the number of instances is small). We assume these longer sentences occur as relaxations of the constraint toward brevity. Thus there are now three surface "slots", each of which can be filled with a semantic element. We should now expect no omissions of semantic elements in sentences with either one-case or two-case predicates, for there are three slots in the surface and only two or three semantic elements to fill them. This is essentially the finding (but in two instances, a subject signs the *place* case, accounting for the two deleted *patients*). But for three-case predicates, which involve four semantic elements, there is again one slot too few, so we should expect each of the required elements to appear with a conditional probability of 0·75. But instead, *act* and *patient* were always signed (conditional probability of 1·00), and the *recipient* in 0·93 of all instances. The *actor* is again singled out for omission from such three-word sentences, appearing for only 0·07 of the three-case predicates where it was logically involved.

This finding certainly tells us something about the priority of expression of the various semantic elements. But more than this, the variable appearance of the *actor* (conditional on the number of other semantic elements) bolsters reconstruction of the *actor* case in the many instances where it was omitted. The structure of this argument is analogous to that of Bloom (1970) who reconstructed missing *subjects* in negative sentences on grounds that (1) the *subjects* were there in corresponding positive sentences and (2) the length (in morphemes) added by the negative element was sufficient reason for *subject* omission in these, if there really was a length constraint on sentences used by novices. Similarly, we have shown that the *actor* case is part of the underlying representation of these subjects' intents, for its non-appearance is a regular function of the length (in signs, and also in semantic elements) of sentences in which it could occur. Summarizing, the results cohere on the view that the children have an output constraint on their signed productions that interacts with the underlying semantic structure of the sentences and with the priority assignment of elements within the underlying structure. The outcome is short sentences with the *actor* omitted.

Let us now describe how the deletion of *actors* takes place. So far we have concluded that the utterances can be coded as semantic relations consisting in a set of semantic elements (the *act* predicates and the cases). They can also be coded syntactically, as a set of output structures, and these are primarily two-sign utterances. The linguistic descriptive question is whether there are regularities in the ways the internal (semantic) representations are mapped onto the external signed sequences, i.e. whether there are syntactic rules in this system. The finding for *actor*-omission suggests that there are. Roughly, there appears to be a rule that maps internal representations of any length onto superficial structures of preferred length two. The rule operates by

omitting *actors* as a function of the number of underlying semantic elements. Once the actor is omitted, if the output string still exceeds length two, then one of the remaining semantic elements is omitted at random. In so far as the length constraint is relaxed (i.e. there are sequences of length three) the same rule holds: the *actor* is omitted if the internal representation exceeds length three, and there should never be occasion to omit anything else.

It should be acknowledged that these principles do not operate categorically, but rather are only statistically discernible. To this extent it may be over-exuberant to grant them the status of "rules", but regularities they certainly are. (Similar caveats apply, at any rate, to regularities in the output structures of speaking-hearing children at early stages.)*

Why should the *actor* be selected for omission when there is competition for space in the signed sentences? Quite possibly, there are semantic grounds. The child seems to be more interested in what got done to whom or what, and less interested in who the culprit was who did it. One obvious hypothesis about why is that the *actor* might have been, most often, the subject himself and if so, any appropriately egocentric youngster might assume this is self-evident and thus unworthy of mention. But the findings are otherwise: 7% of *actors* and 17% of *recipients* that are overtly signed represent the subject himself; 11% of *actors* and 34% of *recipients* that are omitted (and that we reconstruct) represent the subject himself. (The *patient* is almost invariably an inanimate object, so this category has no relevance here). These findings do not fit with the explanation either (1) that the *actor* is omitted most often because it is primarily the case-label for oneself, or (2) that the *actor* is omitted the more often *when* it is oneself than when it is someone else.

The number of alternative semantic hypotheses one could develop (about "cognitive salience" and similar vague notions) to describe *actor* omission are practically infinite, so we will not go on developing them. Anyhow, the explanation may turn out to be internal to the subjects' syntax (i.e. it could turn out to be related to sentence-functional notions such as "subject of" rather than to semantic notions such as "self" or pragmatic notions such as "addressee", "topic" or "new information"). Whatever the explanation, the descriptive facts turn out to be about the same as those for the hearing child. Bloom (1970) has shown the same selective omission of transitive actors in

*The regularities are discernible in terms of a sign classification based on case notions. There may be better classifications (for all we know) of the signs and sentence forms that would account for yet more of the variance in omission. A good candidate is a topic-comment analysis, one that has been useful in the description of ASL (Fischer, 1974; Friedman, 1976). That is, there may be a deeper generalization underlying *actor* omission which artifactually yields significant results under a case analysis (i.e. because *actors* are often *topics*). But whatever the "best" units and the best analysis, it clearly involves a non one-to-one mapping of semantic entities onto surface structures: a syntactic mapping of meanings onto external forms. This was what we set out to demonstrate.

the two-word sentences of hearing children (for a comparative discussion of these data, see Goldin-Meadow, 1977). So again we have suggestive evidence that the same organizational principles are guiding the deaf children without linguistic input as guide the hearing children with linguistic input.

Structure in the Representation of Semantic Relations: Gesture-Order

In the previous analyses, we disregarded the order in which the signs appeared within sentences. Figure 1 presents the two-sign sentences once again, now classified according to the temporal order of appearance of each semantic element in the sentence. As the figure shows, the subjects seem to have preferred orders among some of the semantic elements, though not all orderings reach statistical significance for all subjects.* All of the children always produced *patients* before *recipients*. Certain of the children tended to produce *patients* before *acts* (David $X^2 = 5{\cdot}48$, $p<0{\cdot}02$; Dennis $X^2 = 7{\cdot}36$, $p<0{\cdot}01$). In addition, David always produced *acts* before *recipients* and Donald showed a strong tendency in the same direction ($X^2 = 10{\cdot}28$, $p<0{\cdot}001$). Note that not all the children showed ordering tendencies for all pairs of these three elements, but those who did show ordering tendencies all showed them in the same direction. Kathy's productions provided too few examples for statistical evaluation of ordering tendencies, though her data show trends in the expected direction both for *patient-recipient* and for *act-recipient* sentences. Chris does not show any ordering tendencies in terms of the semantic elements.

Overall, a tendency to deploy temporal order as an organizing device seems to emerge in some deaf subjects without instruction, as it does in hearing subjects with instruction (i.e. in speakers learning English), and as it sometimes does also in hearing subjects without instruction (i.e. in certain speakers learning languages such as Russian, which does not have strong word-order constraints; Slobin, 1973). To summarize the constraints on gesture order that characterize the corpora of (at least) David, Dennis and Donald, we can write:†

*All sentences containing points at pictures are excluded from this analysis, because the subjects tended to point at pictures they were shown before producing other signs. The pictures pointed at were most often facsimiles of objects playing the *patient* role. Thus the *patient*-first orderings would have been inflated, perhaps wrongly, had we included these sentences. As a result, data from Tracy are excluded from this analysis because she produced very few sentences conveying action semantic relations which did not contain points at pictures. It is worth noting that the data reported in the text were also analyzed to discover whether gesture order might be explainable as a function of sign form (points vs. characterizing signs), and that this analysis failed (for details, see Goldin-Meadow, 1977).

†The notation follows the usual in linguistic description. The brackets indicate that a single selection is required from the options listed within those brackets.

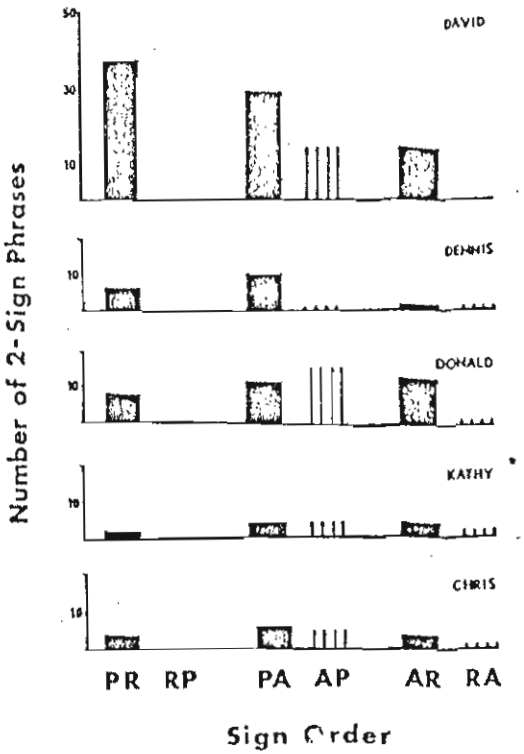

Fig. 1. Number of two-sign sentences classified according to the order of each element in the sentence. P = Patient, A = Act, R = Recipient.

(a) sentence → patient—act—recipient.

Now the brevity constraint operates to reduce the number of overt elements to two, in most instances. The resulting surface structure can be described:

$$\text{(b) sentence} \rightarrow \left\{ \begin{array}{ll} \text{patient} — & \left\{ \begin{array}{l} \text{act} \\ \text{recipient} \end{array} \right\} \\ \text{act} — & \text{recipient} \end{array} \right\}$$

That is, a two-word sentence consists either of a *patient* followed by either *act* or *recipient*; or of *act* followed by *recipient*. As for the *place* and *actor* cases, we have previously noted that they are relatively rare in appearance (p. 384). Now we find that these same infrequent elements are not restricted according to any clear ordering principle. (but see Goldin-Meadow (1977) for a suggestion that intransitive and transitive actors may be treated differently in this system; the manual language may be ergative). Both these facts suggest

that, syntactically, both *actor* and *place* are freely occurring optional category types that lie outside the core obligatory syntax. They behave syntactically like, say, sentential adverbs in English sentences.

Levels of Linguistic Representation

All natural languages that we know of are organized in terms of formatives at at least three levels: phonological elements, morphemes and sentences. The levels are organized hierarchically: each level, roughly, consists of integral sequences of formatives from the level below. That is, morphemes roughly are sequences of phonological segments; and sentences roughly are sequences of morphemes. If the deaf subjects' signed communications display these levels of representation, they share one more important formal linguistic universal with natural languages (see Hockett (1966) and Greenberg (1966) for discussion of linguistic levels in approximately this sense; but see also Fischer (1974) for a suggestion that some of these putative universals may be modality-specific). Evidence for these levels of representation in the deaf corpora has been presented already. That is, all the analyses presented rest on a series of coding decisions that isolated physical ("phonological"), sign (morphemic) and sentence units in the subjects' gesturing. To the extent that the findings were non-random, this is retrospective justification for the descriptive classifications themselves. The relevant facts are briefly reviewed here.

Evidence for Phonological Elements

Discussed earlier (p. 362, (1)) was the physical taxonomy of formal sign languages developed by Stokoe (1960), in terms of hand-shape, movement, and position of the hands on the body and in space (see also Lane *et al.*, 1976). It would not be surprising if the gestures of our subjects were physically organized in similar ways, for the historical sources of formal sign languages (excluding importations such as finger-spelling) were apparently motor-iconic pantomiming of the same sort whose genesis we are observing in this study (Frishberg, 1975; Battison, 1974). Further, the motor movements of any sign language must be at least in part consequences of limiting manual-visual organization in humans, just as natural language phonology is in part a consequence of articulatory-acoustic organization (Lieberman, 1969; Liberman, 1970). For these reasons, the outcome that our subjects' gestures were exhaustively and fairly reliably codable in terms of Stokoe's system was expectable: 84% of putative gestures were identically coded on these physical dimensions by both coders. However, the reliability of this coding is at best an indirect argument that there is a kind of phonological substrate in terms

of which the subjects' signs are mentally organized. Unfortunately, we do not have a formal physical taxonomy available at the time of writing.

However, we do have evidence at this level for sign and sentence boundary effects. The change in "flow of movement" at morpheme boundaries was readily observable and was reliably codable (93%; see p. 362). Further, all of the sentences on which the analyses on pp. 375-398 rest were isolated in terms of the appearance of a phonological sentence-boundary symbol: the return of the hands to neutral position in front of the body (p. 363). That is, to the extent that the boundary symbol picked out long forms that were susceptible to independent semantic and syntactic analysis, we can conclude that it functions to mark divisions at a higher level of linguistic organization.

Evidence of Morphemes

The distinction between morpheme and sentence is often cloudy in the speech of young children, and the same vagueness appears in our data. To some extent, the young subjects seem to use signs "holistically" (possibly: with sentential intent) rather than embedding them in longer structures that express semantic relations overtly. That is, the modal utterance of all our subjects was one sign long. Nonetheless, evidence for a distinction between sign (morpheme) and sentence in these data is very strong.

First, on physical grounds, coding of signs within putative sentences is reliable (p. 362, (2)).* Second, a distributional criterion for the morpheme is met: in 74% of sample instances, gestures characterized as signs within sentences were observed to occur either in isolation or within different sequences used by the same subject. Third, the semantic and syntactic analyses presented earlier cohere only on the assumption that the long gestures observed consist of formatives at approximately morpheme level. And finally the apparent referents of the individual signs (p. 381) are closely analogous to referents of concrete nouns and verbs in English.

Evidence for Sentences

Again, the evidence that the subjects organize their communications in terms of a level of representation above the sign is overwhelming. To deny this, one would have to claim that the findings for sign order and reduction of semantic roles were coincidences, or that similar findings would derive from

*This analysis was performed for David, session IV. Nineteen types of signs occurred during this session. Fourteen of those signs occurred in more than one context, either during the same session or in the previous sessions I-III. Notice that the percentage of signs that occurred in more than one context is very high (74%). It should not be expected that the subject will gesture every sign in his repertoire twice, as this analysis requires, during a few interview sessions. Thus the outcome suggests that the signs we isolated were systematically recurring units, and that they participated in varying sign combinations.

arbitrary sign groupings (different from the groupings obtained by use of the sentence boundary symbol). The systematicity of the semantic and syntactic descriptions argue instead that these subjects mentally organized sequences (usually pairs) of signs within a larger framework, closely analogous to the "telegraphic" sentences of young hearing children.

Summary: Syntactic Patterning without Explicit Models

The home sign system of the deaf subjects displays many of the structural organizing principles that also characterize the early speech of hearing children who receive a language model from the adults around them. The subjects use both gesture-order and reduction devices in externalizing their thoughts. As is true for spoken languages, and perhaps most true of all for languages as spoken by very inexperienced practitioners (little children and foreigners), the syntactic patterns are closely associated with relational semantic entities. The sign types (point and characterizing sign) approximately accord with a dichotomy between nominal and predicate (including predicate adjective) notions. Gesture order and reduction function in terms of relational semantic meanings. Similarly, though imperfectly, the categorial and syntactic patternings of English are also semantically relevant, so it is almost true that a noun is a person, place, or thing, and a verb is an action; and it is almost, but imperfectly, true that predicates of like meaning participate in like transformational manipulations. The fact that syntactic categories reflect semantic categories does not, of course, make the former non-syntactic nor the latter non-semantic.

Syntactic patterns in these subjects' gesturing apparently arise as a consequence of perceptual and production constraints found also in the instance of spoken language. Though the semantic elements of a propositional idea may be unordered in mental conception, still they must be temporally ordered in the sound stream or in the flow of manual gestures. This physically imposed sequencing comes to be exploited in systematic ways, by speakers of word-order languages and by at least some of our deaf subjects inventing their own gestured language. Also, problems in handling long sequences are apparently responsible for the patterned omission of certain aspects of the proposition. Thus we find the same forshortened rendering of propositions in the gesturing of deaf subjects as in hearing acquirers of spoken languages.

Finally, the formatives of the manual system of the deaf subjects are at three distinguishable levels of representation (phonological, morphological, sentential), hierarchically related to each other, similar again to the structural facts about spoken languages.

We concluded earlier (p. 376) that these subjects had successfully manifested an urge to communicate, and about the same matters talked about by hearing children of like ages. We believe the evidence just presented suggests that in structure also the home sign system looks suspiciously like familiar instances of novice language use. This outcome is surprising in part because the physical means of expression (hands and eyes) is different from the usual (mouth and ears) in language use. It is the more surprising because the context of learning is radically different from the usual. There is no fluent listener accurately comprehending the child's attempts, and there is probably not even an enthusiastically approving caretaker applauding the emergence of this gestural system. The parents of these subjects have serious commitments to the child's acquisition of spoken English, not home sign.

These results deserve to be considered in evaluating correlational studies that claim syntax acquisition can be accounted for as reflections of caretaker speech (see e.g. the collection of articles on this topic in Snow and Ferguson, 1977). It seems to us, based on the findings here (and many other studies, e.g. Bever, 1970; Slobin, 1975), that syntactic organization of language materials arises partly because of the interaction of semantic representations with the perceptual and memorial activities that are required to render these in modes (acoustic or visual) that are observable to listeners. In sum, we claim that the task of rendering propositions in real time to a communicative partner is an internal impetus for the appearance of syntax in child speech. We do not deny that the conventional use of word-order (and deletion) by one's mother is also an impetus for the use of such devices by the learner of English. But we hold that prior convention is not the whole story in understanding the formal nature of child language.

Developmental Patterns

We have so far seen that the home sign system of the deaf subjects is in content and syntactic form rather similar to the speech of hearing children. Here we ask whether there are similarities in developmental patterns as well. While there are some developmental changes in the manual system, these are neither neat nor very rousing. Some of the reasons for this are methodological, but some seem to be substantive.

Constraints on the Subject Population

It was not possible to find subjects at the very beginning of development. This is because it is hard to identify deafness in children at young ages, and

even harder to measure how profound the hearing loss is, owing to difficulties young children have in understanding and following instructions in audiometric tests. Usually, parents do not suspect that their children are deaf until it is clear that their language learning is delayed, and by that time they are usually over 2 years old. Only one of our subjects (Kathy, 17 months at the first interview) was identified to us earlier in life than this.

A partly symmetrical problem arises in finding usable subjects older than the ones we studied. Oral instruction begins for these subjects when they are about three. Our subjects in the older age ranges were already receiving such instruction (though none had yet made much progress with it; see p. 357), and they were coming into contact with other deaf youngsters. Assessment of the independent development of gesturing becomes progressively more contaminated by these factors as developmental time passes. Further, the exposure to English, through oralist training, can be expected to interfere with progress with the little-reinforced gestural system. Only two of the six original subjects (David and Donald) are continuing to show significant advances in manual language that seem on the face of it to be relatively uncontaminated by the competing system.

Nevertheless, within the age range we could observe, there was growth in the home sign system. But there were also some clear differences in the rate of development and in achievement level between these subjects and hearing children acquiring speech.

Syntactic Development: Increases in Sentence Length

All of the subjects except the youngest (Kathy, 17 months) gestured in two-sign sentences the first time we saw them, so we cannot document a pure "hologesture" stage directly. Kathy produced one two-sign sentence at interview II, when she was 18 months old. Donald was 24 months, Dennis 26 months, and David 34 months when first observed, and all already gestured in two-sign sentences. (Chris and Tracy were too old when first interviewed to contribute relevant data here.) Based on these observations, we can guess that the two-sign gesture emerges in these subjects late in the second year of life or early in the third. The facts are similar for hearing children. Lenneberg (1967, p. 130) reports the appearance of two-word sentences between 24 and 30 months, and many children begin to produce them as early as 18 months or so (see also Bloom, 1970, and many other sources).

However, once the deaf children come to convey semantic relations two signs at a time, they do not come to favor these two-sign forms. They still continue to gesture one sign at a time in the preponderance of instances, even

at 4 years of age.* As a consequence, the mean length of their gestures, in signs (the "MLG") remains very low (see p. 385). Only David (at 40 months) achieved an MLG above 1·5 during the course of study. This contrasts with the facts about hearing children. Bowerman (1975, p. 270) presents MLU data for seven hearing children (interviewed by herself or other investigators) speaking a variety of languages, who were at the two-word stage. Their ages were between 19 and 30 months. The MLUs of these subjects ranged from 1·30 to 1·50, already higher than that of the deaf subjects at similar ages. But moreover, Bowerman presents data for six youngsters who were even more advanced on the MLU measure (ranging from 1·60 to 2·00; some are the same children, now older, and some are not). Overall, these subjects fell into the same age ranges (between 18 and 28 months) and they characteristically used many three-word sentences. None of our deaf subjects' MLG falls into this higher range, even though some of them were 4 years old.

This comparative lack of growth in MLG should not be interpreted, however, to suggest that the subjects' sentence forms did not change with age. The upper bound on the deaf subjects' sentence length does increase as they grow older, as shown in Table XI. The upper bound for the children when younger was from one to four, but it was from four to seven for the older children, and David's was thirteen. But even so the one-sign utterance is still the most frequent, so MLG hardly rises.

Summarizing, the normal and deaf populations are similar in the developmental moment at which two-unit sentences emerge, and probably not too different in the moment at which even longer sentences are first produced. But the two populations are different in the *characteristic* length of sentences at all ranges, and this difference increases with increasing age.

Semantic Development

Table XII displays the proportion of *act* and *attribute* semantic relations conveyed by the sentences of each subject. The table documents a fact mentioned earlier (p. 383), that *action* semantic relations predominate for each subject. Similar findings appear in the literature for hearing children. Brown (1973, p. 174) reports that 12 children (interviewed by himself or other investigators, and ranging from 1·10 to 2·06 in MLU) from different cultures all conveyed action and attribute relations in their communications, but that the action relations predominated. Bloom *et al.* (1975) report that

*Differences in coding magnify some of the differences between MLGs and MLUs, as usually measured. We did not exclude single-point responses to pictures (which are very similar, in conversation, to one-noun responses to queries). Nonetheless, the MLGs are clearly depressed, compared to MLUs for children of this age. Lenneberg (1967, p. 130) reports that the grammatical complexity of speech from 4-year-old normals is roughly adult.

Table XI
Upper bound on sentence length, in signs"

	Age in months						
	15-20	21-26	27-32	33-38	39-44	45-50	51-53
ɔunger subjects:							
Kathy	1	4	4				
Dennis		2	3				
Chris		3	4				
lder subjects:							
David				3	9+	9+	9+
Donald			2	3		4	3
Tracy						4	5

ingle instances of a longer sentence were excluded (e.g. Kathy produced a single two-sign terance at 18 months and David produced a single six-sign utterance at 35 months; and these ere excluded from this table).

eir subjects, aged 19 to 25 months (MLUs from 1·0 to 2·5), all expressed ction relations well before they expressed attribute relations. Since our ubjects were interviewed at quite different ages, we can give no strong ocumentation of a similar effect for them. However, in so far as the data of able XII, which pools over all sessions, can be interpreted as revealing age fects, the results are similar: the three subjects (Kathy, Chris and Dennis) ll of whose data come at ages under 3·6 years produce proportionally more ction semantic relations than the three subjects (David, Donald and Tracy) hose age was over 3·6 sometime during testing.

In sum, there is weak evidence supporting the view that these subjects, like ormal youngsters, talk mainly about action at early ages, but begin to xpress attribute concepts increasingly with increasing age.

; Development of the Home Sign System "Normal"?

/e have commented on a number of developmental similarities between the eaf subjects and young speakers. The semantic relations they express first re the same (*actions* before *attributes*, previous section) and they express iese in terms of the same case relations (e.g. *patients* and *recipients*, but not *struments*, pp. 386-387), and similar lexical categories (concrete nouns and otion verbs, p. 378). The first-used syntactic devices also seem to be the ime as those reported for children learning English. Word-order is an early eployed device (p. 376) as is the omission of transitive *actors* in sentences hose predicate structure is complex (pp. 387-396). Sentences tend to be very

Table XII
Action and attribute sentences

	Action sentences	Attribute sentences	Static sentences"	Total one-relation sentences
Younger subjects:				
Kathy	0·86	0·09	0·05	42
Dennis	0·87	0·10	0·03	31
Chris	0·70	0·26	0·04	43
Older subjects:				
David	0·58	0·37	0·05	438
Donald	0·63	0·36	0·01	145
Tracy	0·38	0·57	0·05	65

"The sentences labeled "static" could not be classified as either action or attribute. A sentence was considered to be static if it could potentially be a comment on the static location or possession of an object. For example, consider a child who points at a picture of his brother and then points out the door. The child could either be commenting on the fact that his brother went outside (an action) or on the fact that his brother is now outside (static location). Similarly, a point at his own Halloween costume and then at himself could either be a comment on his having received the costume at one time (an action), or on his current possession of the costume (static possession). Because of these problems of interpretation, these sentences were classified separately. Note, however, that static sentences make up a small proportion of the total sentences produced by the children.

short (p. 384) and show increasing length, when measured in terms of upper bound, with increasing age (p. 402). Thus developmental orders for various contents and structures seem to be roughly similar without input as with input.

These parallels between our population and normal language learners seem somewhat odd on the face of it. There are four obvious reasons to expect differences in developmental patterns. First, the visual-manual modality may impose acquisition constraints different from those that characterize auditory-acoustic systems (though early results from an ongoing study by Newport and Ashbrook at San Diego, on the acquisition of ASL by deaf children of deaf parents, suggest many parallels between learning sign languages and spoken languages). Second, our subjects have no richly elaborated language system to learn; they must *create*, as well as *acquire*, a means of communication. Third, in so far as an actively teaching individual is implicated in the acquisition process (as suggested by Snow (1972) and others), one is lacking in this situation: though the caretakers are cognitively mature they are no more fluent than the children in the manual system. Finally, and probably most important, there is no clearly *co-operating* communicative partner. The adults around our subjects do not accept the

manual communicative mode in ways that would seem to be conducive to joint-active, attempts to specify and enrich the system. No conventions for expression seem to be adopted by mutual agreement. If the child makes a gesture, we do not observe the mother gesturing it in return. Even to the extent that the adults do gesture, they are quite inept, dependent on props, and often unaware that they are being expressive. If humans have the capacity to create communication systems on their own, this hardly seems the ideal situation in which to try to do so.

Given all these reasons to expect developmental differences, it is almost reassuring to discover that there are some. The developmental parallels between the deaf subjects and normals are not at all perfect. The similarities are at the beginning of development, but differences crop up increasingly later on. Primarily, the MLG of our older subjects is clearly depressed. Four-year-old hearing children with an MLU below 1·5 (like Tracy and Donald) are rare indeed; this attenuated growth is reason enough, in a hearing population, to suspect a long-term language or thought abnormality.

There is another apparent delay in language growth. We take it as obvious that 4-year-old hearing children express a variety of new case notions, such as the *instrument*. They talk of eating with spoons and hitting with hammers, and they do so in ways that conform to the rather complicated structural requirements for such expressions in English. Even Brown's (1973) much younger subjects produce a few instruments. But among our subjects, we have observed only David begin to gesture of such matters (he gestures, e.g., about digging with a shovel); and we cannot be sure that even he encodes this notion in structurally distinct ways (for further discussion, see following section). Again—similar to the instance of MLU—the onset time for certain basic notions is about the same in both populations, but the deaf subjects advance much more slowly, and not as far.

We have left aside discussion of a number of further properties of these children's gesturing, because the data were not presented in this chapter (see Goldin-Meadow (1977) and forthcoming reports on advanced stages of the home sign system). For completeness, further parallels can be found. For instance, our subjects show increasing tendencies, over time, to conjoin propositions within a single gestured sentence, though they have no overt morpheme of conjunction. There are also other non-parallels. For instance, these subjects never develop any means for creating complex morphemes from simple ones (there are no derivational devices) or marking tense, aspect, or case (there are no inflectional affixes, prepositions, etc.). This latter fact may be artificially magnifying the morpheme-length difference (MLU to MLG difference) between the deaf subjects and speakers of inflected languages. Highly inflected languages clearly yield inflated MLU counts, unless some way is found to make corrections for this (i.e. every

adjective, noun, etc. has an associated case-affix—even if the young speaker chooses the wrong one—so that each such lexical item consists of a minimum of two morphemes; see Williamson, forthcoming, on such problems in analyzing for MLU in children learning Malasian Tamil). Strict word-order languages will have comparatively lower MLUs, it would appear. At the extreme, pidgins (which are almost totally uninflected, a fact to which we will return) ought to show very depressed MLUs. There is little doubt that the home sign system is very like a pidgin (see discussion p. 408), and so yields comparatively low MLG counts. (But this cause is not, in our opinion, large enough to account for the magnitude of difference between our subjects' MLGs and hearing children's MLUs: there is a degree of pidginization, it seems, in all child language (Smith, 1973).)

A Note about David

We have so far claimed that parallels between the deaf and hearing populations are close at the beginning and less close at later stages of language development. But the subject David is very likely an exception to the rule that the home sign system must increasingly lag behind the emerging language system of children exposed to a culturally elaborated language. We do not know why David has gone so far. Perhaps he is the smartest of all our subjects, the William Shakespeare of the home sign system. Perhaps even though his caretakers are not fluent in the manual system, they may be more amenable to taking the role of communicative partners in manual gesturing. Whatever the reason, there is no doubt that David at the later observations could express himself very fluently about matters that interested him. Below we give an example of how David responded after being shown a picture of a snow-shovel. He gestured:*

(1) shovel[a]—dig[b]
(2) shovel—put-on-boots[c]—outside[d]—downstairs[e]—shovel—dig—put-on-boots
(3) David[f]
(4) dig—outside—snow[g]—shovel—snow
(5) dig—yes[h]
(6) shovel—downstairs—dig—downstairs

There is no difficulty in understanding David when one actually sees this

*David here produces a sequence of six sentences (each of which ends with the return of the hands to neutral position). The superscript on each sign type that we gloss in this example is actually rendered by the following gestures: (a) point to the picture of a shovel; (b) digging motions, hands holding an imaginary shovel; (c) hands pulling upward from toe to middle of leg; (d) point toward the door of the room; (e) jabbing points toward the floor—toward the basement where the shovel is stored; (f) point to his own chest; (g) arms held parallel, flat hands, palm downward; fingers flutter, as arms are gradually lowered to the sides; (h) nod: a sign-marker.

cene. He said that "The shovel is to dig with. I put on my boots and take the hovel from the basement and go outside and dig. Me! I dig when it snows utside and I shovel the snow. Yes, I dig. The shovel is kept in the basement, hat I dig with is kept down in the basement." This 4-year old does not have uch trouble in expressing himself.

Despite David's expressive capacities, we do not seek to claim (pending rther analysis) that David's *language* has become as complex as the nguage of a hearing 4-year-old, but only that his expressible thoughts are rowing more complex. This caveat simply reiterates the stance we have ssumed all through this discussion. We are chary of calling these expressive estures "language-like" unless it can be shown that they take place within a tructured system. We have shown this structure in the two- and three-word entence system of all the deaf subjects. Sufficient data on complex sentences y David (and Donald) are only now beginning to come in quantities fficient to allow similar analysis. Possibly David has elaborated his tructures to accommodate his now elaborate expressed thoughts. But ossibly he has not: the lexical items in the example above may be simply trung along in a row; he may have run out of syntactic means. So, pending rther analysis, we claim only that David's sentences have become longer nd meatier, but not necessarily more complexly organized. Still, here is at east one child who is communicating in very human ways, in the absence of omeone who is systematically showing him how to do so. What stronger vidence could be asked for in answer to the question whether there are ignificant internal predispositions in humans that are relevant to the mergence of language?

SUMMARY AND CONCLUSIONS

'e have studied the communicative system developed by young children who 're as radically deprived of language input as can be imagined, this side of ral children. We have found that these linguistically isolated individuals splay communicative skills that are language-like, despite their :privations. We conclude that there are significant internal dispositions in umans that guide the language acquisition process.

Surely some of these guides are quite general, and do not apply to nguage in particular. For example, the mental contents that are mmunicated about at various stages in the young child's life (e.g. the tions and motions of things and people, as opposed to perceptual ributes of those things and people) are surely consequences of general cognitive functioning, and not consequences of language-specific properties of mental organization. In contrast, the exploitation of sequence, the representation of content in terms of a hierarchically organized set of levels, and the adoption of regular principles for the selective omission of some material—all observed in the deaf subjects—seem to be specifically language-like, not variants of organization common to all higher-order mental functions. The emergence of these language-like formal means of representing thought by the deaf subjects without models suggests the existence of language organizing principles that account for the structure of their gesturing.

It is worth noting that many of the effects we have reported fit naturally with other demonstrations that language grows out of the construction of the human mind, rather than being solely an arbitrary system that is acquired "from without" by such minds. Newport *et al.* (1977) performed a correlational study to determine aspects of language learning that were more and less sensitive to the nature of external input (in their study, the properties of maternal speech). They found that the young child's tendency, over a 6-month interval, to express more and more of the content of thought in the speech-stream (i.e. the appearance of explicit lexical items conveying increasingly more of the required logic of sentences) was insensitive to aspects of the speech of different mothers at the beginning of the 6-month interval. For example, the elaboration of the child's sentence content was not correlated with the mother's MLU or sentence complexity when talking to the child, nor with her tendency to repeat, expand, etc. The parallel finding in the present study is that the subjects came to say longer and longer sentences with increasing age, expressing progressively more of the sentential logic, even though there was no model language user at all who they could copy.

Newport *et al.* found a different result for the rate of development in the inflectional structure of English (verbal auxiliary and plural formation). In this regard, the children's growth rate was evidently sensitive to properties of maternal speech. Specifically, children whose mothers had strong tendencies to front the verbal auxiliary (by asking yes/no questions) had children who acquired the auxiliary structure most rapidly. Here, where there seems to be a very specific and powerful effect of the language environment on language learning, there is no progress at all among the deaf subjects: they never "think of" such devices as inflectional affixes to mark number or time in their gesturing.

The results of this study were quite different from those reported in other studies of the effects of maternal speech on language learning. Most prior studies really do not measure child language growth as a function of caretaker speech. Rather, they simply describe mother-speech and child-

speech at various developmental moments, and argue inferentially from properties of these corpora tht the mother-style must have influenced the child-style. This kind of argumentation is not too convincing. There have been a few studies which were correlational in method. But again the findings of Newport *et al.* differ seriously from those achieved in other correlational studies. These differences derive chiefly from a difference in the method of analysis. Most of the studies in the literature report simple correlations between aspects of mothers' speech and aspects of children's speech, either at the same time, or measured some months later. Many such correlations can be found (Newport *et al.* found the same ones that are usually reported). The trouble is that cause and effect cannot be disentangled from these simple correlations: the nature of the child's speech might be the "cause" of the mother speaking in such-and-such a way to him, as easily as the nature of the mother's speech might be the "cause" of the child's learning to speak in such-and-such a way. (By analogy, one might measure the mother's angle of regard when she looks down at her tiny child. Then one could measure his growth during some succeeding interval. One will find (a) that the child grows; and (b) that the farther down the mother looked at time one, the more the child was likely to grow by time two. The reason is not that the looking down caused the child to grow. The reason is that the baseline size of various children differed at the first measurement and, the smaller you are—on the average—the faster you grow, for growth curves decelerate over time.) Newport *et al.* made a statistical correction for this problem. They partialled out differences in the age and stage (on each linguistic measure) of the subject children; simple correlations were then performed, using these double-partialled data, between the mother's speech style at time one and the child's growth rate between time one and time two. There were now many fewer correlations. Generally, the result was that language-universal aspects of child language (i.e. its marking of substantive content) were insensitive to the observed differences in maternal speech style; but language-specific aspects of inflectional morphology (i.e. the verbal auxiliary and nominal inflection structures) were sensitive to differences in maternal speech style.

Summarizing, where Newport *et al.* were able to show a significant role played by properties of the external model, the present study shows a non-effect: no learning without the external model. In contrast, where Newport *et al.* found insensitivity to the maternal environment, we find progress among the deaf subjects (though, to be sure, it is sometimes slow). The two studies taken together, then, begin to disentangle two kinds of factor in language learning: those that are direct consequences of the input and those that seem to come from inside the novice himself.

Some supporting evidence for the distinction just made comes from studies

that at first seem far afield. Labov (1971) and Sankoff and Laberge (1973) have reported on some expressive and structural properties of Tok Pisin, a New Guinea pidgin now becoming creolized. Roughly, a *pidgin* is a contact-vernacular which is nobody's native language; it is called a *creole* at the point when its use becomes general, and it acquires native speakers. Pidgins emerge, often among adults, in a setting where the speaker's own language does not serve the purposes of communication, for the listener speaks a different language. To handle this problem (under circumstances where contact is not general enough to motivate acquiring the other language) the two parties devise a "simplified" expressive means—the pidgin. It seems fair to call this setting, like the one in the present study, a situation in which language is being created, though here certainly not from scratch. It is curious that Tok Pisin is characterized by the use of word-order as the preferred device for marking the semantic roles, by a relative absence of multi-propositional sentences, and by relative simplicity of inflectional apparatus; and the process of creolization in Tok Pisin is marked by the development of devices for sentence embedding, and a change from optional adverbial marking of time toward obligatory tense marking within the verb-phase.

The analogy between development in Tok Pisin and in child speech is quite clear, and it was noted and discussed in a very important seminal paper by Slobin (1975). The analogy to the deaf subjects' gesturing is also transparent: in *their* language-like creation too, the semantic roles are marked by word-order and there is an absence of inflectional apparatus and multi-propositional sentences.

Slobin (1975, based on data from Broch 1927), provides the even stronger example of Russenorsk, a minimal pidgin spoken by Norwegian fishermen to the Russian merchants with whom they trade (on the relatively rare occasions when the ice melts on the Norwegian Sea). Even though one of the parent languages, Russian, is highly inflected, Russenorsk, a primitive system with novice (though adult) speakers, has almost no inflectional apparatus. There is one major exception, an affix on verbs which distinguishes them from nouns. Slobin comments that a clear distinction between noun and verb may be a minimal structural requirement, if a language is to be efficiently expressive. Russenorsk also marks the basic distinction among the semantic roles by a syntactic device, word-order. Again, Slobin suggests an analogy to first-language acquisition, where word-order is commonly deployed early, and where the more complex aspects of inflection are learned relatively late. The analogy to the deaf subjects' home sign system is also suggestively close. These subjects too mark the semantic roles in terms of word-order restrictions. Furthermore, they too differentiate the forms of nouns (points) from the forms of verbs (characterizing signs,

pantomimes). Thus similar means for encoding meaning are adopted by speakers of pidgins, young first-language learners, and the deaf signers in the manifest absence of relevant input data. Novice communication seems to have well-defined formal properties, under a variety of circumstances, despite differences in users (adult vs. child), and differences in modality and environment (deaf vs. speaking children).

Now looking at studies yet farther afield, it is interesting to ask what happens where a fully-known language is rendered in a new modality. The history of writing affords some hints about what happens to language when its users are cast rather into the role of novices, this time because a system which they have fully elaborated and controlled is recast in a visual, rather than acoustic modality. It is at the least a curiosity that early writing systems rarely rendered the inflectional aspects of the spoken languages which they transcribed, but left them out (Gelb, 1952; and see Gleitman and Rozin, 1977, for discussion in a similar context). In contrast, the early writing systems pretty well marked word-order constraints by convention (i.e. by mapping them onto left-to-right or some other visual order). Similarly, it appears that novice readers of English have great trouble getting meaning out of the forms that render inflectional material (e.g. the *-ed* that marks the past tense; Labov, 1970). In contrast, they have significantly less trouble in getting the meaning out of formal devices that render word-order (i.e. they easily understand that left-to-right order on the page is a mapping of temporal order in the speech stream; Rozin *et al.*, 1971; Rozin and Gleitman, 1977) and substantive content (e.g. the visual forms that mark words like *dog* or *run*; Labov, 1970; Rozin and Gleitman, 1977). These novice readers are experts in all these matters (inflections, word-order, substantives) in the context of speech and hearing. But when cast into the role of novices learning visual language, they have special difficulties with the inflectional materials again. Once more, we note the parallel here with home sign: the novice deaf subjects make progress in creating signs for substantive and verbal notions (the points and characterizing signs) and in deploying word-order, but their gesturing is uninflected.

Summarizing, a number of lines of evidence suggest a significant role in novice communication of dispositions to organize language materials in certain ways.

A final point lest we be misunderstood. To say that the character of language is affected by internal predispositions, as we do based on the evidence of the deaf children and other studies just cited, is not to deny a significant role also for structured properties of the input data and properties (affective and communicative) of caretakers. It is good to have a mother. Language learning will differ, depending on how that mother talks, a fact which has not been in doubt at least since the incident at the tower of Babel. The findings presented here conflict only with claims that have appeared in the literature to the effect that the contributions to language learning from internal dispositions in the learner are minimal and nonspecific.

We believe that progress in understanding the language learning feat depends seriously on disentangling two kinds of descriptive facts: those that are accountable on an "inside-out" view and those that are "outside-in". There is every reason to suppose that the laws underlying learning new and arbitrary materials (such as lists of nonsense syllables or The Pledge of Allegiance) differ materially from the laws underlying learning that which is prefigured in internal representations (such as mathematical relations, and universal aspects of the structure of language). This point is reminiscent of some recent findings in the field of animal learning. It appears that, the clamor of 70 years of behaviorism notwithstanding, different species of animals are biologically "prepared" to learn certain associations much more readily than others (Seligman, 1970). Thus pigeons rapidly learn to hop from one perch to another so as to avoid a shock but will take just about forever if the required avoidance response is to peck at a key (Bolles, 1975). Some kinds of preparedness, to learn certain things and not others, may be built into humans just as it is wired into pigeons, with language-use as natural to the one species as hopping-off-perches is to the other.

With the aim of contributing to an unraveling of these components in language acquisition, we have tried to resurrect the deprivation paradigm described by Herodotus, and perhaps to take a step beyond.

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