# 3 Structure in a Manual Communication System Developed Without a Conventional Language Model: Language Without a Helping Hand[1]

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## THE ROLE OF LINGUISTIC INPUT IN LANGUAGE DEVELOPMENT

What are the environmental constraints on language acquisition? Will language emerge under any external conditions (e.g., will a child learn language from a radio in a closet?), or are there statable limits on the flexibility of human language acquisition? Observations of natural language development in children do not usually bear directly on the question of flexibility, since most children acquire language under comparable conditions, namely, at an early age most children are exposed to the language of their culture as spoken by the adults around them. These conditions quite clearly suffice for language development in the child raised by human beings. At the other extreme, the lack of these conditions is correlated with an absence of language development: Children raised by wolves and bears

[1] This research was supported by grants from the Spencer Foundation through the University of Pennsylvania, and through the University of Chicago, and by funds from the Social Sciences Division of the University of Chicago. I was supported by the NICHHD Training Grant (HD 00337) and by an AAUW Fellowship during a portion of this work. Sections of this work were presented at the Conference on Sign Language and Neurolinguistics, Rochester, New York, 1976 and at SRCD, New Orleans, 1977.

a ball. Some of the toy actors acted on toy objects (e.g., the dog hits a turtle, Santa pedals a bike, Mickey Mouse eats spaghetti with a fork); other toy actors performed objectless acts (e.g., Donald Duck walks, the frog jumps, the butterfly flies).

**Static toys.** These toys resembled the characters in the mechanical action toys. The child could either comment on the static toy's perceputal characteristics, or comment on the actions its "look-alike" toy performed. We often tried to force a choice between a static toy and its active likeness (e.g., Santa vs. Santa pedaling a bike) in order to encourage comments on either perceptual or action characteristics.

**Difficult toy.** This toy was difficult to operate and required that the player position a coin on a gun barrel and pull a trigger below. If done correctly, the coin shoots forward and lands in a bank. The toy was presented when both experimenters were with the child so that he had the opportunity to request one of the experimenters to initiate an action. In other words, the situation made it very likely that the child would specify the initiator (agent) of his choice.

**Pictures.** The toy set included colorful hand-drawn pictures of all of the individual parts of the action toys (e.g., a picture of Santa, a separate picture of his bike; a picture of Mickey Mouse, a picture of his spaghetti, a picture of his fork). The child could then comment on the role of each of the toy parts played in the total action (e.g., eater versus eaten). Furthermore, since one toy (e.g., Mickey Mouse) often played more than one actor role in the set of toys (e.g., walker, eater), the child could potentially comment on either or both of these roles. The pictures were presented before the toys and again after the toys to allow the child to comment on the individual parts before and after seeing them in action.

**Picture book.** When time, interest and patience permit, the experimenter either showed the child a picture book containing many examples of common and unusual objects and events or a family photograph album. The children were, in general, very responsive to pictures and photographs.

The set of toys thus incorporated several techniques to elicit communication. First and foremost, there was the appearance of new and exciting toys. Moreover, the set provided choices the children could make, changes that the children might not expect, and problems that the children might have with seemingly simple devices.

The videotapes of the play sessions were transcribed according to a system of coding categories. Since this coding system is crucial to the interpretation of the results, coding decisions and criteria are examined in detail in the next section (but see Feldman, Goldin-Meadow, & Gleitman [1978] for a more explicit account of the rationale behind the coding methodology).



## THEORETICAL BASIS OF THE ANALYSIS AND DERIVATION OF CODING CATEGORIES

How does one begin a description of the deaf child's communication system? The problem lies, in some sense, in entering the system. After all, there is no established language model towards which the deaf child's system is developing. Consequently, there are no hints from a conventional system that might guide initial descriptions. As a result, the description procedure necessarily becomes a bootstrap operation. It begins with preliminary decisions on how to categorize the gestures produced by deaf subjects (e.g., how to isolate gestures from the stream of motor behavior, how to segment those gestures, how to describe them and assign them meanings).

The preliminary categories are based on two sources. The first is the descriptions of spoken language, particularly child language, and the growing number of descriptions of conventional sign languages. Second, and perhaps more importantly, is intuitions about the motoric forms and the semantic meanings of the gestures produced by deaf subjects.

Having established preliminary categories, these categories were used to transcribe the videotapes. The usefulness of these categories was tested in two ways. First, are the categories reliable? Reliability has been established between the experimenter and a second coder who was not at the original taping sessions. The agreement scores between these two coders are in general quite high, suggesting reliable categories. These scores will be presented separately later in the chapter when each coding category is described.

The second test of the categories is to ask if these particular categories result in coherent descriptions of the deaf child's communication system. These descriptions comprise the second half of the results section. The claim made here is that if a description based on these particular coding categories turns out to be coherent, this fact is partial evidence for the categories themselves. Consider the following example. Suppose we applied the semantic categories *PATIENT* and *ACT* to the deaf child's gestures. If we then discovered a pattern based on those categories (e.g., a sign-ordering rule following, say a *PATIENT–ACT* pattern), we have some evidence that those particular categories, patient and act, are part of the deaf child's communication system. The very existence of the pattern confirms the existence of the categories, since the former is formulated in terms of the latter.

There is, of course, the possibility that these patterns and categories are products of the experimenter's mind rather than the child's. However, this study is no more vulnerable to that possibility than are those investigating spoken child language. After all, adult experimenters may all be incapable do not spontaneously begin to speak (Brown, 1958; Lenneberg, 1967). Is it possible then that the **only** conditions which permit a child to develop language are those in which adults expose the child to data from a shared human language?

This study investigates human language learning flexibility with respect to one particular learning condition found in all natural language learning situations but in none of the feral situations: the role of linguistic input. It is obvious from the outset that young children exposed to different parent languages are able to learn these distinct languages readily. It seems quite clear then that, when available, linguistic input plays a significant role in language acquisition. But we can still wonder what the nature of that role is, and whether that role is or is not a necessary one.

## Variations in Linguistic Input

The role of linguistic input in accounting for language acquisition has at times been minimized on the grounds that the speech the child hears, as it resembles adult-to-adult talk, is too unruly (containing false starts, mumbles, and ungrammatical sentences) for the young child to abstract language organization from it (Chomsky 1965). However, this argument is weakened by a closer examination of the speech that is actually addressed to children. Studies of speech to children have consistently shown that this speech (christened "motherese" by Newport, Gleitman, & Gleitman 1977) is actually far less garbled and complex than was originally supposed (Snow 1972; Farwell 1973; Phillips 1973; Newport 1976; see also Shatz & Gelman, 1973, and Sachs & Devin, 1973, for evidence that even young children can use this special kind of speech to yet younger children). "Motherese," therefore, cannot a priori be considered a poor language teaching device on the grounds of complexity. Nevertheless, it must be pointed out that apparently neat and orderly input to the child need not be the cause of neat and orderly output from the child. Indeed, orderly mother input is as likely to be a reflection, as a cause, of orderly child output.

To address the question of the actual effect of adult language input on child language output, one must in some systematic way vary the child's language input and subsequently observe the utterances of the child over the course of time. Studies which address this issue are of two types: those which concentrate on the natural range of variation in everyday speech to children, and those whose primary object is to extend the range of variation by manipulating linguistic inputs to children.

In a study of natural speech to children, Newport *et al.* (1977) correlated natural variation in mother speech with variation in the rate of child language development. Although it is admittedly difficult to prove cause and effect in a correlational study, Newport *et al.* found that language properties could be divided into two types along the dimension of responsiveness to input conditions: (1) those properties whose rate of acquisition is affected by the small natural variations in linguistic input (environment–sensitive properties such as the inflectional structure of English, for example, the verbal auxiliary and plural formation), and (2) those whose rate of acquisition is relatively impervious to the natural variation found in child language environments (environment–insensitive properties such as the items for expressing basic propositional structure). Thus, linguistic input appears to be selectively effective in shaping child output under natural language learning conditions.



There are, however, certain difficulties of interpretation associated with studies of mother speech in natural environments. Primarily, as Newport *et al.* point out, it is possible that all of the language properties they isolate are sensitive to some sort of variation in linguistic input, but that the range of variability in their samples of mother speech was too narrow to show such effects. In other words, all of the samples might have provided sufficient input to exceed a minimal amount of necessary input. Once beyond this threshold, variation in input might be inconsequential in predicting variability in acquisition. Thus, negative effects in studies of speech in natural environments can be interpreted only cautiously as noneffects of linguistic input.

Given the small amount of variation in natural speech to children, it would seem that we can determine the limits on human language learning flexibility only by increasing the range of variation in input. This can be done by providing either a richer or poorer linguistic environment than that found in nature. Some studies of the effects of input enrichment on language growth rates do exist. Nelson, Carskaddon, and Bonvillian (1973) have successfully used a manipulation technique of this sort. Specifically, they enriched the child's environment with expansions and recast sentences and observed the subsequent course of his language development. They found selected effects of input manipulation on a particular syntactic property, auxiliary growth. It is noteworthy that Newport *et al.* also hypothesized that the auxiliary was one of the environment–sensitive language properties.

Note, however, that while studies using enrichment techniques clearly provide interesting data on the positive effects of linguistic input on acquisition, these enrichment studies cannot bear on the threshold problem. After all, if the language that children naturally hear already provides the threshold amount of input necessary for certain language properties to develop, enrichment procedures obviously will not have a further effect on the development of those properties. Yet those same properties could still be sensitive to a reduction in linguistic input more drastic than ever observed in nature. Thus, as in studies of natural speech to children, negative effects in studies of speech in enriched language environments can also be interpreted only cautiously as noneffects of linguistic input.

The alternative approach to the flexibility question is to remove the linguistic input and observe the subsequent course of linguistic development. If there is some threshold amount of orderly linguistic input necessary for the child to develop certain language properties, these properties should not develop in a child lacking linguistic input. If, however, linguistic input is not necessary for the development of a certain property, we should expect this property to emerge ex nihilo in the communications of this child without input. Thus, in contrast to studies of speech in natural and enriched environments where noneffects of linguistic input must be inferred from negative results, in a deprivation study the **presence** of a particular property in a child's language is positive evidence for the noneffects of linguistic input.

Of course, radical deprivation manipulations of this sort cannot be performed deliberately, but some have nevertheless been performed inadvertently. We have already mentioned reports of children who have been brought up by animals (see Brown, 1958, for an account of this literature). Other children have been reared by human beings under inhumane conditions. For example, Rigler and Rigler (1975) studied a girl who had been isolated and confined to a small room with no freedom of movement and no human companionship for the first 13 years of her life. Under these circumstances of extreme linguistic, social, and sensory deprivation, language did not develop. However, it is obvious that these studies say little about the effect of linguistic isolation per se on language development: Language was only one of the many human factors missing in these circumstances.

## The Study of Deaf Children of Hearing Parents

My approach to the problem of flexibility in language acquisition has been to study a population of children whose environments are entirely normal, save for the lack of significant input from conventional language models. The subjects were deaf children whose hearing losses prevented them from making use of the oral language environment around them. Moreover, these children were not exposed to a conventional manual language (such as Signed English or American Sign Language) by their hearing parents, but were instead educated by the "oral" method (i.e., extensive training to lipread and vocalize without audio feedback). At the time of the study, these subjects had benefitted very little, if at all, from their oral training. Thus, they were lacking usable input from conventional oral or manual language models. Our goal was to determine if these children, despite their deficient linguistic input, would nevertheless develop communication systems which resemble natural language.



Previous work on deaf children of hearing parents had indicated that a deaf child could use gestures to communicate without the benefit of a conventional language model. Deaf children who are orally trained have often been observed to gesture spontaneously to one another (Fant, 1972; Lenneberg, 1964; Moores, 1974; Tervoort, 1961). These gestures are referred to as "home signs." The existence of home signs suggests that linguistic input is not necessary for a child to begin to communicate with others.

Home signs, however, have not been previously studied as language systems. We therefore do not yet know if linguistic input is necessary for a child to communicate in a **structured** fashion. As a result, this analysis will focus on the structural aspects of deaf children's home signs. This heuristic leaves open the vexed question of whether or not home sign is a full-fledged natural language—it deals only with how similar to a language the home signs are. The direction of work has been to determine which linguistic properties found in natural languages can also be found in home sign. These structural properties can be presumed to be insensitive to the absence of conventional linguistic input.

The home signs of deaf subjects have both lexical and syntactic–semantic properties and comprise a language system in this sense (Goldin-Meadow & Feldman, 1977; Feldman, Goldin-Meadow, & Gleitman, 1978. Specifically, subjects were able to develop lexical signs to refer to objects, actions, and attributes. For example, one child swatted his fist in the air to describe the hitting action he and his mother used to knock block towers over. Several children held fists to their mouths and "chewed" to describe either the act of eating or edible items. Moreover, subjects also developed the ability to concatenate their signs into phrases that conveyed semantic relations among objects, actions, and attributes. For example, one child pointed at a block tower and then signed HIT (i.e., fist swat in air) to indicate that he had just hit the tower. In another example, the same child signed HIT, then pointed at his mother to request her to perform the hitting.

The home signs of deaf subjects also form a natural language system when developmental criteria are considered. In particular, in at least the early stages of acquisition, deaf children develop their sign system in a sequence comparable to the hearing child's pattern of acquiring spoken language (Goldin-Meadow & Feldman, 1975; Feldman *et al.*, 1978). The deaf children were at first limited to producing one sign at a time, just as the hearing child is limited at a certain period to producing only single words.

Moreover, deaf children produced their single signs in contexts comparable to the contexts in which the hearing child produced his single words (Bloom, 1973; Greenfield & Smith, 1976). The deaf children then progressed to a two-sign period, comparable to the hearing child's two-word period (Brown, 1973). During this time, the deaf children produced phrases that conveyed semantic relations and contained a substantial number of different lexical items. The present chapter concentrates primarily on semantic relation phrases produced during the deaf children's two-sign period. More specifically, it concentrates on the semantic content and the syntactic structure of these phrases.

Finally, there are preliminary data on the deaf children's next developmental period, the period during which they produced multi-sign phrases to convey conjoined relations. For example, during this time one child pointed at a picture of a bird beak, pointed at his own mouth, then pointed at the place where he was going to put the picture. The child had, in one phrase, commented on the mouth-like features of the bird beak picture as well as on its new location. Hearing children go through a comparable stage in which they conjoin and embed relations in one phrase (Brown, 1973).

Thus a deaf child with virtually no conventional linguistic input can develop a communication system which is language-like in many respects. In this chapter the ways in which semantic relations are conveyed in the communication systems developed by six deaf children of hearing parents are examined. First it is determined if semantic relations are conveyed in a structured fashion in these systems. Since semantic structure is found in the content of communications and syntactic structure is found in both the underlying and surface levels of these communications, it is then asked how these structures resemble those of child language in general. From there, the implications of the results of these inquiries for theories on the processes of language acquisition are explored.

## METHOD

### Subjects

The six deaf children in the study, four boys (Dennis, Chris, David, and Donald) and two girls (Kathy and Tracy),[2] were recruited by obtaining names of deaf children from private speech therapists and from oral schools for the deaf in the Philadelphia area. Each child's parents were contacted and permission was obtained to observe and videotape each child over a period of time. Although the children included in the study differed in age

[2] The names of the subjects have been changed.



**TABLE 3.1 Subjects' Ages at Each Session in Years and Months**

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

(see Table 3.1), in number of siblings (from zero to four), in race, and in socio-economic background, they did share two characteristics necessary to be included in this study. First, none of the children could rely on oral language for communication. Second, none was exposed to any conventional sign language system.

**Hearing abilities and oral language training.** All of the children had received hearing evaluations at medical centers in the Philadelphia area. They were all judged congenitally deaf with no other physical or cognitive deficits. In one case, the cause of deafness was determined to be prenatal rubella; in the other five cases, the cause of deafness was unknown. The medical reports indicated that all the children had moderate to profound hearing losses, that is, losses of 31 to 100 dB. Five of the children wore hearing aids. The aid improved each child's hearing, but not sufficiently to allow the natural acquisition of oral language (i.e., acquisition without oral training). Dennis did not wear a hearing aid during the study, but did acquire an aid later.

Five of the children attended oral preschools. Dennis did not begin school until after we concluded our observations. Kathy, Chris, and Tracy all attended one oral preschool, while David and Donald attended another preschool in the Philadelphia area. At the time of our observations Kathy and Chris could neither read lips nor produce identifiable verbal words, although both produced sounds in what seemed like a haphazard fashion. Donald, David, and Tracy also verbalized haphazardly, but in addition they reliably produced verbal names in constrained situations for a very few objects, for example *horse*, and *bird*. None of the children was able to produce two concatenated verbal words (i.e., a verbal sentence).

**Manual language training.** The children received no formal training in a standard sign language either in school or at home, nor were they even exposed to standard sign languages in either environment. The children's parents knew neither American Sign Language nor Signed English. Even the older deaf siblings of two of the children knew no sign language. Kathy's sister, who was congenitally deaf, and Donald's sister, who was not, were both doing quite well in the oral program: they could lipread and speak relatively well, but knew no sign language. Donald's hearing siblings, one twin and two older children, were ignorant of sign language, as were David's and Dennis's older hearing siblings. Tracy and Chris had no siblings.

In sum, these deaf children had not been exposed to conventional sign language. However, some of the parents did gesture spontaneously to their children, although the preschools requested them not to. It is clear that the linguistic input these children received was radically reduced compared to the normal input. Whether it was zero is a question that cannot be answered, although it is further discussed later in this chapter. All that is, in fact, necessary to address a question of language learning flexibility is that linguistic input be greatly diminished with respect to the normal input. For these children this was clearly the case.

## Procedure

Ideally, each child should have been observed under the same controlled conditions. However, some of the data were collected while developing a method of study. As a result, the testing circumstances were not as well controlled as they might have been. For example, the interval between observation sessions varied considerably both within and across children. Nevertheless, the data from these early sessions were included for several reasons. First, the early data often include valuable longitudinal information. In addition, the results do not seem to have been affected by the difference in the procedures used over the course of the study. For example, in the beginning of the study each child played with the same small set of toys. Over the course of the study, the set of toys was enlarged to give the child ample opportunity to converse about many topics. We were concerned that the changes in the toys might have produced spurious developmental changes in the child's language. That is, the children might have conversed about different relations as they got older simply because the toys changed in later interviews. However, even with the enlarged set of toys the younger children were less conversant than the older children. Thus, the variability in stimuli did not seem to have altered the results. Consequently, all of the data collected on each child are included and differences in data collection are overlooked.

The six deaf children were observed longitudinally over variable periods of time. The number of observation sessions varied from 2 to 11, with an interval between sessions of 6 to 10 weeks.[3] Each session was

[3] One major departure from this schedule occurred between Donald VII and VIII, a period



videotaped and lasted from 1 to 2 hours. Two female experimenters were present at all sessions; one experimenter taped while the second interacted with the child. Usually the child's mother, and occasionally a sibling, was also present during the sessions and interacted with the child. The sessions involved play with the child using a standard set of toys.

The goal when playing with the child was to elicit communication. Thus, a set of attractive and manipulable toys was present during each session. For the early part of the study, the set included the following toys: a zoo toy consisting of cages, plastic animals, and keys used to unlock the cages to free the animals; containers of Play-Doh; a Dapper Dan doll dressed in a cowboy outfit; two jars of bubble soap, one empty and one full; a frog that jumped when a bulb was squeezed; and a miniature school house, equipped with toy furniture and pupils.

Over the course of the study the set of toys grew to insure that the child had ample opportunity to communicate about varied topics. Dennis was the first subject and never played with the enlarged set of toys. All of the other children were observed playing with the enlarged set at least twice. The types of toys included in the enlarged set and the method of toy presentation were as follows:[4]

**Transparent box.** The child was shown several small toys in a transparent box (e.g., fork, merry-go-round, rabbit). Since the toys were visible but inaccessible, the child had to refer to them at a distance, without touching them.

**Puzzles.** The child was shown a puzzle that was then overturned to allow the child to reconstruct it. While the child was putting the puzzle together, the experimenter surreptitiously exchanged one puzzle piece for another of identical shape but different identity. For example, with the puzzle of a barefoot boy, we exchanged the boy's bare foot for a booted foot. On another trial, his hatless head was exchanged for a head with a hat. If the children showed some surprise at the novel pieces, other pieces were offered, all of which fit the puzzle but were not included in the original. This procedure was designed to elicit both comments on and requests for the puzzle pieces.

**Action toys.** The experimenter showed the child a series of mechanical toys that performed actions and a series of static toys that portrayed actions. For example, the set included a Santa Claus who swung on his trapeze when a button was pushed and a static Santa Claus frozen in the position of catching

of 11 months. We temporarily suspended visits to Donald because he was very uncooperative in sessions VI and VII.

[4] A complete list of the toy stimuli used in this study is found in Goldin-Meadow (1975) and Feldman (1975).

of finding anything but language-like structure in a child's communication. Although this problem can never be completely avoided, the following assumption allows us to proceed: A coherent description of the deaf child's communications is more likely to be accurate (i.e., "true" of the child) than is an incoherent description. That is, if a category turns out to "make sense of," or organize, the child's communications (e.g., by forming the basic unit of a pattern), we are then justified in isolating that category as a unit of the system and in attributing that category to the child. In sum, the consistency of the results described later in this chapter justifies the establishment of the coding categories described herein.

## Extracting Communicative Gestures from the Stream of Motor Behavior

The first task is to isolate communicative gestures from the stream of ongoing motor behavior. The problem is to discriminate acts that communicate indirectly (e.g., pushing a plate away, which indicates that the eater has had enough) from those acts whose sole purpose seems to be to communicate (e.g., a stop-like movement produced in order to suggest to the host that another helping is not necessary). Since we do not consider every nudge or facial expression produced by the deaf subjects to be a communicative gesture (no matter how much information is conveyed), we are forced to develop a procedure which isolates only those acts used for deliberate communication.

Lacking a generally accepted behavioral index of deliberate or intentional communication (see MacKay [1972] for an illuminating discussion of this problem), we have decided that a communicative gesture must meet both of the following criteria. First, the motion must be directed to another individual. This criterion is satisfied if the subject makes an attempt to establish eye contact with the communication partner (the criterion was strictly enforced unless there had been recent previous communication with eye contact such that the child could assume the continued attention of his partner). Second, the gesture must not be a direct motor act on the partner or on some relevant object. As an example, if the subject attempts to twist open a jar, he has not made a sign for "jar" or "open" even if in some sense he is, by this act, trying to get the experimeter to do something (i.e., to help him open the jar). But if the subject makes a twisting motion in the air, with his eyes first on the experimenter's eyes to establish contact, a communicative gesture has been made.

Once isolated, the gestures were recorded in terms of the three dimensions used in describing signs of American Sign Language (see Stokoe, 1960): the shape of the hand, the location of the hands with respect to places on the body or in space, and the movement of the hand or body.



Each videotaped session was transcribed either by one of the original experimenters or a trained research assistant. In order to establish reliability, a selected sample of videotape (the second reel of session VIII) of David, the most advanced subject, was transcribed by an experimenter who had been at the original taping session and by a trained coder who had not. Reliability scores were derived for both the isolation and description of gestures. In the videotape sample lasting approximately 45 min, 91%[5] of the gestures identified by either of the two coders were identified and similarly described by both coders (yielding 335 reliably coded gestures).

## Segmenting Signs and Sign Phrases

Once having isolated gestures from the surrounding motor context, the next step is to determine the units appropriate for the system. There are two segmentation questions. First, are there grounds for dividing one long complicated gesture into word-like or **sign** units? Second, are there grounds for parsing sequences of these sign units into still larger organizations? That is, can these signs be said to be concatenated into sentence-like units which we call **phrases**? The criteria we use to divide gestures into sign units and phrase units are as follows.

### DEFINING A SIGN

Distributional criteria (see Bloomfield, 1933; Harris, 1951) for sign segmentation were employed whenever possible. Specifically, a gesture was considered to be composed of two signs if each of those signs occurred separately in other communication contexts. However, distributional criteria alone were insufficient for segmenting signs, primarily because there was no corpus extensive enough for these purposes. Therefore, an intuitive criterion based on the motor organization of the gesture was also used. A single sign was a continuous, uninterrupted flow or a single motor unit. This motor flow, though difficult to describe (particularly without an established descriptive system of motor organization), was nevertheless easy to note, especially because of the change or break in the flow of movement preceding and following the sign. For example, suppose a child produces a twisting movement, then, breaking the twist, points to the table.

[5] Nods, head shakes and other gestures which were not used to refer to things and events, but served only a modulation function, were eliminated from this reliability calculation, since they are not included in the analyses in this study.

The twist movement is, in some unformalizable sense, self-contained, as is the pointing movement; these movements, therefore, comprise two units, which are called signs. The results described later in this chapter suggest that these segmentation criteria isolate sign units that feed into the structural description of the deaf child's communication system, that is, the criteria isolate units which seem to be appropriate for the system.

Reliability was established for assignment of sign boundaries in the following way: Within the set of gestures identified by both coders in the videotape sample, there were 335 sign boundary decisions to be made and there was 93% agreement between two coders on these decisions.

#### DEFINING A PHRASE

The most obvious determinant of phrase boundaries was timing: If two signs were uninterrupted by an appreciable time interval, they were candidates for being "within a phrase." However, these potential phrases then had to meet a second criterion in order to be considered a phrase: the return of hands to neutral signing space (i.e., the relaxation of the hands in front of the body that signals the end of a phrase). For example, if a child pointed to a toy and then, without bringing his hands to his chest or lap, pointed to the table, the two pointings were considered "within a phrase." The same two pointings, interrupted by a pause of the hands near the chest, would be classified as two isolated signs. This second criterion was initially used because "return to neutral position" marks sentence boundaries in American Sign Language (see Stokoe, 1960). We continue to use this criterion as well as the timing criterion because they seem to be valid for describing the deaf child's communication system. That is, when these criteria are used to define phrases, a coherent description of the system is produced.

Using these criteria, a reliability score for assignment of phrase boundaries was established as follows: In the gestures identified by both coders in the videotape sample, there were 327 decisions about sign concatenation into phrases to be made and there was 95% agreement between the two coders on these decisions.

### Assigning Lexical Meanings to Signs

The subjects produced two types of signs differing in form.[6] **Deictic** signs were typically pointing gestures. These pointings maintained a constant kinesic form in all contexts and were used to single out objects,

[6] The child produced a third kind of sign, which served modulation functions. These sign markers (e.g., head nods and side-to-side headshakes) are notionally similar to words like *yes* and *no* in English. Markers are not considered in the analyses presented in this chapter.



people, places, and the like in the surroundings. In contrast, **characterizing** signs were stylized pantomimes whose iconic forms varied with the intended meaning of each sign. For example, a fist pounded in the air as someone was hammering, or two hands flapping in the presence of a pet bird both were considered characterizing signs. Reliability on classifying signs into these two sign types was quite high; the two coders agreed on 97% of the 327 classification decisions that could be made in the videotape sample.

Our next step was to assign lexical meanings to these sign types. The problems here are comparable to those that arise in assigning meanings to a hearing child's words. Consider an English-speaking child who utters the phrase *duck walk* as a toy Donald Duck waddles by. Adult listeners assume that since the child has used two distinct phonological forms, *duck* and *walk*, he intends to convey two different meanings, that is, to talk about two semantic aspects of the event in front of him, the feathered object and the walking action. Specifically, it is assumed that the child's *duck* refers to the **object** and that his *walk* refers to the **action** of that object. In a comparable leap of faith, when our deaf subjects produce the sign phrase "point–at–duck walking–motions," it is assumed that since the deaf child has used two distinct motor forms—the deictic point and the characterizing walking motions—he also intends to convey two different meanings about the event in front of him. Specifically, we assume that the deictic pointing at the duck refers to the **object** and the characterizing walking motions refer to the **action** of that object.

Note that in attributing lexical meanings to the hearing child, it is assumed that the child's particular lexical meanings for the words *duck* and *walk* coincide with adult meanings for these words. In general, we assume that nouns refer to objects, people, places, and the like and that verbs refer to actions, processes, and so forth. This decision, although difficult to justify (for discussion, see Braine, 1976), is bolstered by data from the child's language system taken as a whole. To the extent that the child has mastered other aspects of the adult system that are based on the noun–verb distinction, he can plausibly be said to have mastered the distinction in the instance of lexical meanings.

At this same stage of the lexical meaning assignment procedure for the deaf subjects, we have also to make assumptions. However, as there is no adult language model to guide us, the decision criteria behind the inferential assumptions for the deaf subjects must obviously differ from those for the hearing child. For the deaf children's gesture system, sign form is used as a basis for lexical assignment decisions. We assume, in general, that deictic signs (e.g., pointing at the duck) refer to objects, people, and places, and that characterizing signs (e.g., the walking motions in the air) refer to actions and attributes (see the following discussion). This decision is motivated and justified by a number of lines of argument that will be elaborated below.

#### GLOSSING DEICTIC SIGNS

The assumption in assigning lexical meanings to deictic signs was that the child's pointing sign was, in fact, intended to make reference, and that the referent of that deictic sign was a person, place, or thing (and not an action or an attribute). This assumption is motivated as follows. When pointings are included in analyses as noun-like lexical items, the deaf children's sign system looks remarkably similar, both semantically and syntactically, to the hearing child's early spoken language. Semantically, the referents of the deaf children's deictic signs can be described in terms of precisely those categories which can be used to describe the referents of the hearing child's nouns (see Feldman, Goldin-Meadow, & Gleitman, 1978). Syntactically, as will be shown later, deictic signs appear to play the same role in the deaf children's sign phrases as nouns play in the hearing child's spoken sentences. For these reasons, we feel justified in including pointing signs as noun-like lexical items in our analyses.

Note that these deictic signs, like pro-forms in English (e.g., *this* or *there*), effectively allow the child to make reference to any person, place, or thing in the present (remarkably, the deaf child appears to be incapable of taking full advantage of this latitude, and instead acquires only as limited a noun vocabulary as the hearing child at a comparable stage, see Feldman *et al.*, 1978). Further, as with the hearing child's pro-forms, context is essential for the interpretation of deaf children's deictic signs. In fact, using context as a guide, it turns out to be relatively easy to determine the referents of deictic signs reliably. In the 180 signs identified by both coders as deictics in the videotape sample, there was 93% agreement between the two coders on the lexical meanings of these signs.

It should be recognized that the relationship between the pointing sign and its referent is, at some level, quite different from the relationship between a word and its referent. The pointing sign, unlike a word, serves to direct a communication partner's gaze toward a particular person, place, or thing; thus, the sign explicitly specifies the location of its referent in a way a word (even a pro-form) never can. The pointing does not, however, specify what the object is, it merely indicates where the object is. That is, the pointing is "location-specific," but not "identity-specific," with respect to its referent. Single words, on the other hand, are often "identity-specific" (e.g., *cat* and *ball* serve to classify their respective referents into different sets) but not "location-specific," unless the word is accompanied by a pointing gesture.



#### GLOSSING CHARACTERIZING SIGNS

In contrast to their "location-specific" points, the deaf child's characterizing signs were "identity-specific." Recall that the characterizing sign is an iconic sign whose form is related to its referent by apparent physical similarity (e.g., a fist pounded in the air refers to the act of hammering). Through its iconicity the characterizing sign can specify the identity of its referent, but, like words and unlike pointing, the sign cannot specify its referent's location.

Using both sign form and context as a guide to lexical meaning assignment, it was easily established that subjects could gesture about actions with their characterizing signs. For example, one child held a fist near his mouth and made chewing movements while someone was eating lunch (*EAT*); another twisted his hand over an imaginary jar in order to request that his mother twist open the jar lid (*TWIST*). Similarly, sign form and context allowed us to establish that the children could gesture about perceptual attributes with their characterizing signs. For example, one child distinguished between a large and a small kangaroo by holding his flat palms parallel to each other and wide apart (*BIG*).

Occasionally, sign form and context did not lead to the same lexical meaning assignments. For example, one child gestured the characterizing twist to identify a picture of a jar, while another indicated round, stubby appendages on the head to identify Mickey Mouse's ears. Sign form suggests that the 'twist' sign refers to an action and that the 'round' sign refers to an attribute; context, however, suggests that the two signs are both nominals, referring to the jar and to the ears, respectively. The decision in these situations was to assume that the form of the sign gives its lexical meaning (i.e., *TWIST, ROUND*), and that context provides information about the way the sign is used (i.e., identification of an object in each instance).[7] Thus, in the example of the "twist" used with the picture of the jar, although the child is indeed identifying an object with his characterizing sign, he is nevertheless using an action feature to identify that object. It is, therefore, assumed that he is conveying an action characteristic of that object (i.e., that it can be twisted by someone, or that one can twist it). Consequently an action lexical meaning was assigned to the twisting sign. In general, we attribute to the child the lexical meaning related most closely to the form of the sign.

This assumption requires further justification. In conventional languages such as American Sign Language or English, signs and words are (metaphor aside) handed down to us ready-made. We as sign users or word

[7] See Feldman (1975) for further discussion of functional analyses of the deaf children's signs.

users may therefore not always be aware of the etymological history of a name, and thus may not realize, for example, that the sign for a girl in American Sign Language, "thumb drawn along the chin," was originally chosen because it represented the ribbon on a young girl's bonnet (Frishberg, 1975). Similarly, we may be quite surprised to discover the underlying justification for some common English words. (For example, skyscrapers are so named for their literally sky-scraping characteristics.) Names such as "girl" in Sign or "skyscraper" in English each has some nonarbitrary relationship to its respective referent. But how are we to know when to attribute knowledge of this relationship to an individual? After all, any given individual may or may not have had the "eureka" experience resulting in insight into a particular word's origin.

There is, however, one instance in which we can be quite confident that we are rightfully attributing such derivational knowledge to an individual: the instance when that individual is the inventor of the name. The first user of "skyscraper" was undoubtedly aware of the relationship between the celestial aspiring object and its name. Indeed, he selected the name to emphasize just that relationship. Similarly, on these grounds we feel justified in attributing to our deaf subjects knowledge of the relationship between action and attribute sign forms and their respective referents, precisely because these children are themselves the sign inventors. The young child himself chooses to identify, or name, if you will, a particular object in terms of either its action features or its perceptual attributes. Thus, at the very least, the child can be said to have noticed and to have explicitly communicated about those particular action and attribute features of the object. It is, therefore, these explicit action and attribute sign movements that we take to be the basis of the characterizing sign's lexical meaning (see Feldman *et al.*, 1978 for further discussion of this issue).

One consequence of this attention to sign form as the basis for lexical meanings is that we are able to extract more information from our deaf children's sign phrases than one could ever possibly hope to infer from an equally long string of a hearing child's words. For example, when the hearing child identifies an object by saying, *that ball* (glossed, 'that is a ball'), the adult listener might infer several things from the word *ball*: 'that is round', or 'that is thrown', or 'that rolls', or indeed any aspect at all of ballness, including some aspects which, though second nature to adult users of *ball*, may be totally foreign to the speaking child's experiences. Adults cannot possibly determine what, if anything, the speaking child means about the ball from these words alone. In contrast, the form of the deaf child's characterizing signs, if taken literally, allows us readily to discriminate among these several meanings. For example, the deaf child might point at the ball, then draw a circle in the air (the sign *ROUND*) to convey 'that is round'; or he might point at the ball, then make a throwing motion in the air (*THROW*) to convey 'that can be thrown by someone'; or he might point at the ball, then trace with his hand the forward motion of the ball as it would roll along the ground (*ROLL*) to convey 'that can roll'.



It is important to point out that the inferred lexical meanings of the deaf children's characterizing signs are almost always readily apparent. When sign form is taken literally to assign lexical meanings to characterizing signs, reliability is quite high: Within the set of gestures identified by both coders, there were 132 characterizing sign lexical decisions to be made and 94% of the time the two coders agreed on these lexical decisions.

For single signs in one–sign phrases, analyses went no further than assigning a lexical meaning to each sign. But for signs occurring in multisign phrases, analysis went one step beyond to assign relational meanings, in case–grammatical terms, both to the individual signs of each phrase and to the phrases themselves. Since this matter is more of a conclusion than a coding category, discussion of relational meaning assignment is postponed to the next section, where the domain of analysis for this study is also described.

## CATEGORIZATIONS OF RELATIONAL MEANINGS

### Defining the Domain of Analysis

The goal of this study is to investigate the particular semantic relations the deaf child conveys in his spontaneously generated communication system. In principle, semantic relations can be conveyed in a single sign or word unit. For example, the one-word utterance *yours* conveys the possession relation. However, a single word or sign, even in context, frequently does not provide enough information for an observer to determine the relation (see Bloom, 1973, for further discussion). For example, consider the child who says *rabbit* when a rabbit with very long ears hops by. In this situation, the observer can reasonably assume that the child wants to say something about the rabbit, but he is still faced with the problem of determining exactly what the child wants to say about the rabbit. That is, he cannot determine whether the child wants to talk about an attribute of the rabbit (e.g., the ears), or an action of the rabbit (e.g., hopping), or its existential rabbitness.

Since it is difficult to determine the particular relation conveyed by a single unit, we have limited the data base of this study to multisign phrases. Here the task of semantic identification is made easier as the additional signs in the phrase narrow down the field of possible interpretations. In the rabbit example, if the child were to say *rabbit hop*, the observer would be relatively certain that the child is referring to the action relation. Appendix A presents the number of phrases produced by each deaf child in each session, classified according to the number of signs per phrase. Only phrases containing two or more signs will be included in the data base of this study.

The data base therefore consists of multisign phrases that convey semantic relations, that is, multisign phrases that convey relationships between (or among) objects, actions, or attributes.[8] For example, several of the children produced the following phrase to comment on the action usually performed on a particular object:

(1) *drum picture—BEAT* ('one **beats drums**')[9] [David, VIIIa, 5]

For this particular study, we describe only a segment of our collected data: those phrases which convey **one** relation. That is, we leave aside complex phrases conveying two or more relations. Phrase (2) is an example of a complex phrase that is excluded from the particular analyses presented in this chapter. David produced this four-sign phrase while looking at his sister after his mother gave him and his sister each a plastic knife:

(2) *knife₁–David—knife₂–sister* ('she/mother gave **knife₁** to **me/David**; she/mother gave **knife₂** to **you/sister**') [David, IVa, 136]

David had, in effect, conjoined two transfer relations within one phrase and thus produced a complex phrase with two relations. In general, the children produced many more simple one-relation phrases than complex multi-relation phrases. Dennis, Kathy, Chris, Tracy, Donald, and David produced, respectively, 4, 11, 8, 10, 12, and 223 complex phrases, representing 10%, 17%, 14%, 12%, 7%, and 30% of all of the phrases they produced.[10]

[8] One type of multi-sign phrase is omitted here: repetition combinations that consist of one sign repeated. An example of a repetition combination occurs when the child points at a book and then, without breaking the flow of movement, points again at the same book. In general, there were very few repetition phrases. The children produced between 0 and 12 such phrases throughout the entire time of this study.

[9] The following conventions will be used in describing examples:

(1) The example should be read from left to right; the sign that occurs first in the temporal sequence is the first entry on the left.
(2) The referents of deictic signs are in lowercase letters (e.g., *drum*).
(3) Capitalized words (e.g., *BEAT*) are glosses for the referents of characterizing signs. A description of each sign is found either in Appendices B through G or in a footnote.
(4) The sentence in parentheses is an English gloss of the phrase. The boldface words stand for those referents that are explicitly signed in the phrase; the remaining words stand for referents that are omitted from the phrase and must be inferred from context.
(5) The information in brackets indicates the name of the child who produced the phrase (e.g., David), the session in which he produced the phrase (e.g., VIIIa), and the transcription number of the phrase (e.g., 5).

[10] Some of the children's phrases were uninterpretable, either because context was insufficient to determine the child's intended meaning (if any), or because the videotaped picture was not clear enough to determine what the child was pointing at. Uninterpretable phrases ranged from 10–16% of the phrases the children produced.



In sum, the data base for this study consists of all of the multisign phrases conveying only one relation that were produced by our six subjects during the observation sessions. The relational categories used to classify these phrases are described in the next section, along with reliability scores for each category. Each phrase in the analysis was reviewed by two coders, and any disagreement between these coders was resolved by discussion. The few phrases for which agreement could not be reached were classified as uninterpretable.

## Two Classes of Phrase Types: Action and Attribute

The deaf children in this study produced two basic classes of phrase types: actions and attributes. An action phrase is used to request the execution of an action, or to comment on an action that is being, has been, will be, or can be executed. Phrases (3) and (4) are examples of action phrases.

(3) *HIT–mother* ('**you/mother hit** blocks') [David IVa 81]
(4) *MARCH–soldier* ('**he/soldier marches**') [Chris III 117]

An attribute phrase is one which is used to comment on the perceptual characteristics of an object. Phrases (5), (6), and (7) are examples of attribute phrases.

(5) *elephant trunk picture–LONG* ('**elephant trunk** is **long**') [Tracy I 141][11]
(6) *black train–black car* ('**black train** resembles **black car**') [David IVa 40]
(7) *picture of soldier–soldier* ('**picture** resembles **soldier**') [Donald IXa 97]

Reliability scores were established for classifying action and attribute phrases as follows: 66 such classification decisions were made in the videotape sample used to establish reliability and there was 96% agreement between two coders on these decisions.

The deaf child's action phrases can be profitably described in terms of semantic **elements** that combine to form semantic **relations**.[12] A description of these elements and relations follows.

[11] LONG = index finger slides down from nose in U-shaped curve.

[12] A complete list of all of the one-relation action phrases produced by each child can be found in Appendices B through G. A detailed description of the attribute phrases produced by the deaf children can be found in Goldin-Meadow (1975 and in forthcoming reports).

### Semantic Elements: Predicates and Cases

Following Fillmore (1968) we isolate two types of semantic elements in the deaf child's action phrases: predicates and cases. Each phrase can be viewed as a miniature drama whose plot is given by the verb or predicate and whose players, in their various roles, are given by the cases. Each relation of a phrase may have only one predicate, but may have several cases. Since the data base is limited to phrases with one relation, it is limited to phrases with one predicate: Consider the following example of predicates and cases in the deaf child's communication system.

(8) *food–EAT–Susan* ('you/Susan will eat food') [David Vb 130]

The characterizing sign *EAT* conveys the predicate of this phrase and the deictic signs *food* and *Susan* convey the cases.

The method of predicate and case assignment was an outgrowth of Bloom's (1970) "method of rich interpretation," in which semantic predicates and cases are assigned to words (or signs, in our study) by observing the phrase's relationship to ongoing events. For example, if the hearing child says *Mommy doll* while his mother is dressing the doll, Bloom would claim the child's intent was to communicate 'Mommy dresses doll.' *Mommy* then would be assigned an actor case in the sentence, while *doll* would be assigned a patient case; the act predicate *dresses* would be classified as unsaid, but implied by the context.

We follow Bloom in assigning to each sign within a phrase a semantic predicate or case according to its presumed function in the phrase. For example, if the deaf child pointed first at mother, then at the doll while mother was indeed dressing the doll, the actor case would be assigned to the first pointing (at mother) and the patient case to the second pointing (at the doll). But suppose the same two concatenated pointings were produced while the child handed the doll to the mother. The first pointing at mother is then assigned the recipient case, while the one at the doll remains the patient case.

Using this method of rich interpretation, it was determined that the predicates in the deaf child's action phrases were acts which were always conveyed by characterizing signs.[13] The cases in these action phrases were

[13] Since the data base is limited to phrases with one relation and therefore to phrases with one predicate, note that it is also limited to phrases with at most one characterizing sign. A characterizing sign identifies an object or action by specifically conveying a relational aspect of that object or action. For example, *THROW* (curved palm arcs forward in air) conveys the "throwability" of an object or the act of throwing. Thus, when two characterizing signs are concatenated, two relational aspects are necessarily conveyed and the phrase is then classified as a complex multi-relation phrase. For example, *THROW–GIVE*, meaning perhaps 'you give me that which can be thrown by someone,' or 'you give me that which I will throw,' is a complex phrase and is not included in the data base for this study.



patients, recipients, actors, and places, each of which was always conveyed by a deictic sign. Note that the decision to classify characterizing signs as act predicates and deictic signs as the various cases is a natural outgrowth of our lexical meaning assignments (see earlier for the details and justification behind these lexical decisions). Definitions of these predicates and cases, along with illustrations appear below (the defined element is set ***boldface italic*** in each example).

Act Predicate: The act that is carried out to effect a change of either state or location.

(9) *car–**GO*** ('car should go there') [David, VIIa, 169]
(10) *bubbles–**BLOW*** ('one blows bubbles') [Dennis, IV, 104]

Patient Case: The object or person which is acted upon or manipulated.

(11) ***duck**–TWIST* ('you/Susan twist duck') [David, Ia, 300]
(12) ***cookie**–GIVE* ('she/sister give cookie to me/David') [David, Ib, 46]

Recipient Case: The locus or person toward which someone or something moves, either by transporting himself/itself, or by being transferred by an actor.

(13) *duck–**Susan*** ('you/sister give duck to her/Susan') [David, Ib, 12]
(14) *hat–**head*** ('you/Susan put hat on mother's head') [Chris, II, 299]
(15) *David–**garage*** ('I/David go into garage') [David, VIa, 141]

Actor Case: The object or person which performs an action in order to change its own state or location, or to change the state or location of an external patient.

(16) *GO AROUND–**Pinocchio*** ('Pinocchio did go around') [Donald, XIa, 116]
(17) *WALK–**duck**–WALK–**duck*** ('you/duck will walk') [Kathy, VIIa, 24]
(18) *SHOOT–**Kathy*** ('I/Kathy will shoot toy gun') [Kathy, VIIb, 114]
(19) ***sister**–napkin* ('you/sister put cookie on napkin') [David, Ib, 60]

Place Case: The locale where an action is carried out, but which is not the endpoint of a patient's or actor's change of location.

(20) *Susan+CHEW–**kitchen**+CHEW* ('you/Susan will chew lunch in kitchen') [David, IVa, 177]
(21) ***track**–PUT TOGETHER* ('you/Lisa put together blocks on track') [David, Va, 158]

Animate versus inanimate cases. In the definition of the recipient case, inanimate and animate recipients are combined. That is, people and places are considered equivalent, in the sense that they are both endpoints of a relocation action. The justification for making no distinction between animate and inanimate recipients is on the following grounds.

1. Animate recipients and inanimate recipients function alike in the child's communication system. That is, we find that the same set of rules can describe phrases with either type of recipient. In some sense, then, there is no justification for dividing the category along the animate dimension.
2. In many languages, the same inflection or preposition is used for both dative (which includes our animate recipients) and spatial (our inanimate recipients) locatives (Anderson, 1971). Indeed, Kurylowicz (as reported by Anderson, 1971) states, about the origin of the dative in Indo-European, that "the dative is generally nothing less than an offshoot of the loc[ative] used with personal nouns."

Animacy is also an issue in our definition of the actor case. Usually an actor is animate, but not always. An actor must be perceived by the gesturer to have its own motivating force. In some situations, actor assignment was straightforward (e.g., "*HIT–mother*" meaning 'you/mother hit blocks'). In other situations, however, it was not so easy to decide if the child considered a particular object to be self-motivating. There were some inanimate objects (i.e., inanimate according to an adult's judgment) that a child might consider to be self-propelling and therefore animate (e.g., a picture of an airplane—do children think that airplanes fly themselves?—or a duck that walks, but only when its key is twisted). These ambiguous phrases were dealt with operationally, using the form of the child's characterizing sign as a guide.

1. An object was judged to be an **actor** if the characterizing sign conveying the act predicate in the phrase portrayed the action of the object. For example, the forward motion of the car in example (9) and the walking motion of the duck in example (17) classify both the car and the duck as actors.
2. An object was judged to be a **patient** if the characterizing sign for the act predicate portrayed an action that is done on the object. For example, the twisting motion the child might use to operate the duck in example (11) classifies the duck as a patient.

If the act predicate was not explicitly signed in the phrase in question, the phrase was considered ambiguous and not further classified. There were very few questionable phrases lacking explicit act predicates.

The inference that the child views certain inanimate objects as actors was supported by results. Inanimate actors (inanimate from an adult's point of view) functioned the same as animate ones in the child's system. That is, they could be described by the same set of rules as those actors the adult considered animate.[14]

Reliability scores were determined for assigning predicates and cases to action phrases as follows. In the reliability videotape sample, there were 115 decisions made on semantic element assignment and 97% agreement between the two coders on those decisions.



## Semantic Relations: Transfer, Transform, Transport, and Perform

The set of elements described in the preceding section comprises the units of the deaf child's semantic relations. A relation is defined in terms of sets of permissible elements. An element is permissible in a particular relation on two grounds. First, if (on some intuitive level) an element is a necessary component of a relation, it is potentially permissible in that relation. For example, the actor, patient, and act elements can be permissible in a phrase expressing an "eat" notion simply because a plausible account of the physical act of eating concept includes a doer (actor), a done-to (patient), and a chewing–swallowing–digesting action which relates the two (act). Eating cannot possibly occur without both an eater and an eaten. In contrast, only the actor and the act are permissible in a phrase expressing a "dance" notion simply because dancing requires that a doer (actor) perform a leg-moving, body-swaying motion (act), but certainly does not require that a done-to (patient), other than the dancer himself, be involved. Second, if an element is considered to be a necessary component of a particular relation and also can be found in the deaf child's sign repertoire, it is considered permissible in that relation. For example, the source case is intuitively part of the notion of transfer (I moved book from table to stool). However, the deaf children never produced explicit signs for the source case. Consequently, the source was not considered permissible in the deaf child's relations produced at this period.

Using these guidelines, four types of relations were isolated in the deaf child's phrases. Each relation is defined and illustrated below (the permissible elements are boldfaced in each definition).[15]

[14] Bloom, Lightbown, and Hood (1975), in their descriptions of hearing children learning English, appear to have made a similar coding decision with respect to inanimate actors (again, inanimate from an adult's point of view). In particular, they permit inanimate objects to be actors, as in the following example. Peter at time IV was watching the reels of a tape recorder and said, *tape go round.* Bloom *et al.* (1975:11) consider *tape* to be an actor and *go round* to be an action.

[15] Each of these relations can underlie phrases which express ongoing actions, potential actions, or completed actions.

**Transfer relation:** An act by an **actor** on a **patient** that results in the patient's transfer to a **recipient** (either a locus or person).
(22) *book–GIVE–David–book*[16] ('you/mother **give book** to *me/David*') [David VIIb 88]
(23) *car–MOVE* ('you/Heidi **move car** to me/Dennis') [Dennis IVb 148]
**Transform relation:** An act by an **actor** on a **patient** which affects the state of that patient, either temporarily or permanently.
(24) *cookie–CHEW* ('I/David am **chewing cookie**') [David Ib 22]
(25) *bubble wand–mother* ('**you/mother** blow **bubble wand**') [Kathy Va 32]
**Transport relation:** An **act** by an **actor** which results in the actor's own relocation at a new **recipient** (either at a new locus, or near a new person).
(26) *balloon picture–GO UP* ('**balloon goes up** to sky') [Donald XIa 64]
(27) *bridge–FALL* ('**bridge fell** to floor') [David IVa 176]
**Perform relation:** An act by an **actor** which affects the actor's own state and not the state of an external patient.
(28) *lion picture–ROAR* ('**lions roar**') [Tracy I 168]
(29) *father*–[ss]–*SLEEP* ('No. **he/father sleeps**')[17] [David IVa 178]

Note in examples (22)–(27) that not all of the permissible elements have to be explicitly signed for coding a particular relation. The method of rich interpretation is used to determine relations. That is, the signs the child produces in context determine the relation he intends to convey. For example, consider a child who is watching a toy mouse eat spaghetti. The child points at the mouse and then produces the characterizing sign *EAT*. He has explicitly signed the actor case (the mouse) and the act predicate (eat). We infer from the context that he is conveying a transform relation and that he has omitted from his phrase the sign for the patient case (the spaghetti).

Reliability scores were determined for assigning relation types to phrases as follows. There was 94% agreement between two coders on the 51 relation assignment decisions made in the videotape sample.

In sum, the deaf children convey four different types of action relations in their sign phrases. The four relations are similar in that each relation permits a predicate, the act. The relations differ, however, with respect to the number and types of cases they permit. If we classify these relations according to number of permissible cases, we find that the deaf child conveys **three-case** relations (transfer), **two-case** relations (transform and transport), and **one-case** relations (perform). If we now classify relations according to types of permissible cases, we find that the deaf child produces both **transitive** relations, relations permitting the patient case (transfer and transform), and **intransitive** relations, relations which exclude the patient (transport and perform). The significance of these two types of classifications will become apparent as we examine the children's phrases in the next sections.

[16] Note that occasionally an element may be signed more than once in a phrase, as is "book" in example (22). These repetitions do not affect classification according to relation.

[17] [SS] = side-to-side headshake; the headshake marker is functioning anaphorically in this phrase and is negating the preceding phrase: roughly glossed, 'Father is not eating; he is sleeping.'



## STRUCTURE IN THE DEAF CHILD'S REPRESENTATION OF SEMANTIC RELATIONS

The coding categories used to describe the deaf child's communication system have passed our first test. The categories are reliable. We turn now to our second test of the categories: Do these categories result in a coherent description of the deaf child's communication system? We find that these categories do indeed yield a description of a **structured** communication system. We have isolated structure on several levels of analysis and each type of structure is found in natural spoken languages developed by hearing children. These examples of structure not only lend support to the categorization scheme, but, more importantly, suggest that a child in impoverished language learning conditions can develop a communication system that is structured in ways similar to natural languages.

### Structure in Semantic Content

#### ACTION VERSUS ATTRIBUTE PHRASES

The deaf children in this study tended to produce action phrase types more often than attribute phrase types (see Table 3.2, which presents the proportions of action and attribute phrases produced by each child). Note that five of the six children in the study conformed to this pattern.

The cross-sectional data presented in Table 3.2 also suggest a developmental pattern. The younger children (Dennis, Kathy, and Chris, all under three years, 6 months throughout the study) produced proportionately fewer attribute phrases than the older children (David, Tracy, and Donald, all over three years, 6 months at some point in the study). On the basis of these cross-sectional data, the younger deaf child appears to be less likely to convey attribute phrases than the older deaf child. Longitudinal data support this inference. Two of the three children who did not produce either action or attribute phrases at the beginning of the study began to produce action phrases before attribute phrases. Kathy began action production in session II and attribute production in session VI; Donald began action

**TABLE 3.2 Action and Attribute Phrases**

| *Child* | *Action phrases* | *Attribute phrases* | *Static phrases*[a] | *Total one-relation phrases* |
|---|---|---|---|---|
| Dennis | .87 | .10 | .03 | 31 |
| Kathy | .86 | .09 | .05 | 42 |
| Chris | .70 | .26 | .04 | 43 |
| Donald | .63 | .36 | .01 | 145 |
| David | .58 | .37 | .05 | 437 |
| Tracy | .38 | .57 | .05 | 65 |

[a] These phrases could not be classified as either action or attribute phrases. A phrase was considered to be static if the phrase 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, pointing 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 such problems of interpretation, these phrases were classified separately. Note, however, that static phrases make up a small proportion of the total one-relation phrases produced by the children.

production in session II and attribute production in session VIII. However, Dennis did produce two attribute phrases in session I, but did not begin action production until session II. In general, then, the cross-sectional and longitudinal data suggest that the deaf child begins to convey action relations before attribute relations, but that, over time, attribute production does increase relative to action production.

## ACTION RELATIONS: TRANSFER, TRANSFORM, TRANSPORT, PERFORM

Structure exists not only in the two classes of phrase types the children produced, but also in the types of action relations they produced. Table 3.3 presents the cross-sectional evidence for such structure: the proportions of transfer, transform, transport, and perform relations produced by each child throughout the study. The children produced transfer and transform relations (both transitive relations) more frequently than transport and perform relations (both intransitive relations).

In addition, longitudinal data suggest that intransitive production increases relative to transitive production over developmental time. Dennis, Kathy, and Donald all produced transitive phrases during session II, but Dennis did not begin intransitive production until session III, Kathy until session IV, and Donald until session IX. Even during session IX, only 17% of Donald's action phrases were intransitive, but later (in session XI) as many as 42% of his action phrases were intransitive. David produced transitive phrases during session I, but did not begin intransitive production



**TABLE 3.3 Action Relation Phrases**

| | *Transfer phrases* | *Transform phrases* | *Transport phrases* | *Perform phrases* | *Total action phrases* |
|---|---|---|---|---|---|
| Dennis | .59 | .37 | .04 | .00 | 27 |
| Kathy | .53 | .31 | .08 | .08 | 36 |
| Chris | .57 | .23 | .07 | .13 | 30 |
| Donald | .48 | .37 | .09 | .05 | 91 |
| David | .38 | .40 | .15 | .07 | 253 |
| Tracy | .08 | .56 | .12 | .24 | 25 |

until session III; during sessions III and IV David produced only one intransitive phrase per session (11% of his action phrases), but by sessions VII and VIII he was producing 23 and 19 such phrases, respectively (32% of his action phrases). The longitudinal data from the other two children do not bear directly on this developmental question, since both Chris and Tracy produced transitive and intransitive phrases during session I.

In sum, it appears that the deaf child conveys relations that permit patient cases (i.e., transitive relations) before he conveys relations which do not permit the patient (i.e., intransitive relations). Moreover, intransitive phrases become proportionately more frequent relative to transitive phrases as the child develops. Thus there is development in the relational typology of the deaf children's signing. Evidence for a division of transitive relations into transfer and transform and a division of intransitive relations into transport and perform will be presented later.

## SEMANTIC ELEMENTS: CASES AND PREDICATES

We turn now to the semantic elements produced by the deaf children. By and large, the children tended to sign only two elements per phrase: Dennis, Kathy, Chris, Donald, David, and Tracy each produced 24, 31, 26, 82, 228, and 23 two-element phrases, representing 88%, 93%, 89%, 97%, 92%, and 96%, respectively, of each of their total action phrases.[18] Each

[18] Some action phrases could not be classified according to semantic elements. In particular, for some phrases, the imprecision of the pointing sign prevented determining which particular case the child intended to convey. For example, a child who wanted his mother to give him a toy might point toward his mother holding the toy and then produce the characterizing sign for GIVE (open palm with the palm up). From our vantage point, we could not determine whether the child meant 'that–GIVE' (patient–act) or 'you–GIVE' (actor–act). In fact, the child may have intended to incorporate both interpretations into his phrase. The percentages of such phrases ranged from 0 to 8% of the total action phrases produced by the children; these phrases are not included in the calculations of two-, three-, or four-element phrases, nor are they included in Table 3.4.

child produced some three-element phrases and David produced a few four-element phrases.

A look at the particular elements the children signed (see Table 3.4) shows that elements differed in frequency of occurrence. The place case was rarely produced in either two-element or three-element phrases. On the other hand, the patient, recipient, and actor cases and the act predicate were all produced frequently. Note, however, in the two-element phrases described in Table 3.4, that all of the three possible pairings of patients, recipients, and acts occurred fairly often, while the actor case occurred frequently only when concatenated with the act predicate.

The actor case is, thus, combined relatively infrequently with certain elements. The actor is, however, produced by all of the children at one time or another. We return to this problem of the infrequent actor in the next section where we show that the rare instances of actor production can in fact be predicted on the basis of a hypothetical underlying structure.

## Underlying Structure

It was earlier suggested that the deaf child conveys four different types of action relations, each of which can be defined in terms of configurations of predicates and cases. The relations differ from one another with respect to the hypothetical number of cases they permit with each act predicate. Specifically, transfer relations are hypothesized to permit three cases, for example, I[actor] give[act] book[patient] to mother[recipient]. Transform and transport relations are hypothesized to permit two cases, for example, I[actor] eat[act] apples[patient], or I[actor] go[act] to corner[recipient].

**TABLE 3.4 Action Phrases with Two Signed Elements**[a]

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

[a] This table includes all two-element action phrases regardless of the order of the elements in the phrase. For example, the column marked "PA" includes phrases in which patients precede acts, acts precede patients, patients and acts are signed simultaneously, and also phrases in which one or both elements are repeated. The proportions do not sum to 1.00 because from 5 to 10% of the phrases contained three elements 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 phrases (3% and 2% of their action phrases, respectively) and Tracy produced one Actor–Place phrase (4% of her action phrases).



Perform relations are hypothesized to permit one case, for example, I[actor] dance[act]. Since not all of these elements need appear in the surface form of a given phrase, the definitions hypothesize an underlying structure for phrases that is often richer than the surface form of those phrases. We will now attempt to justify the particular configurations (i.e., three-case, two-case, one-case) hypothesized by showing how surface structure in the deaf child's phrases is systematically related to these underlying configurations.

The surface measure used to look at underlying configurations is production probability. Production probability is a measure of the child's propensity to sign explicitly an element in those phrases where the element is hypothetically applicable. For example, consider a phrase which conveys a transfer relation involving a boy (actor) giving (act) a ball (patient) to his dog (recipient). A child in the two-sign period is unable to sign explicitly in one phrase all of these four semantic elements: he is at this time limited to a two (or rarely three) sign output. The child is thus forced to include in his signed phrase some elements (for example, *ball–dog*) and exclude others (in this instance, *boy–GIVE*) which might have been thought equally likely to appear. Production probability for a given element represents the likelihood that that element will be included in the surface forms of those phrases in which the element is hypothetically permissible.

Production probability is determined for each semantic element by first classifying all of the deaf child's two-element phrases according to the relation conveyed by that phrase. This determination is made on the basis of linguistic and nonlinguistic evidence. For example, a phrase about giving books to mother is classified as transfer, a phrase about eating apples is classified as transform, a phrase about going to the corner is classified as transport, and a phrase about elephants dancing is classified as perform. Production probability for each element is then calculated separately for each relation hypothesized to have a different underlying configuration. For example, production probability for the actor case in phrases with three-case underlying configuration (transfer relations) would be the number of two-element transfer phrases with explicitly signed actors divided by the total number of two-element transfer phrases. Production probability for the actor case in phrases with two-case underlying configurations (transform and transport relations) would be the number of two-element transform and transport phrases with explicitly signed actors divided by the total number of two-element transform and transport phrases.

### ACTOR PRODUCTION PROBABILITY

It might be expected that production probability for any particular element, in this instance, the actor, would be constant across all relation types. That is, a child would produce a sign for actors with some constant probability, irrespective of the type of action relation performed by that actor (e.g., giver, eater, goer, dancer).

The data in Figure 3.1 do not support these expectations. Each child's actor production probability in phrases with two explicitly signed elements is shown in that figure for each of the three configurations hypothesized to underlie the deaf child's four relation types. Note that actor production probability is not constant across the three types of configurations. Rather, for all six children, actor production probability appears to vary systematically with configuration type. Actor production is more likely in phrases with one-case underlying configurations (conveying perform relations) than in phrases with two-case underlying configurations (conveying transform and transport relations). Moreover, actor production is more likely in phrases with two-case underlying configurations than in phrases with three-case underlying configurations (conveying transfer relations).

To account for these data, it must be assumed that elements that do not appear in the surface forms of the deaf child's phrases can influence those which do. Furthermore, on the basis of these data, the deaf child possesses three different configurations of elements that underlie and therefore influence the surface structures of his phrases.

We are, in essence, hypothesizing that for a two-sign child there will be competition among underlying elements for the limited number of spaces in surface structure. According to this hypothesis, the total number of underlying elements should have some effect on the probability of any particular element appearing in surface structure. The fewer elements underlying, the better chance of any one element making it to the surface. Thus, phrases with small underlying configurations, such as the one-case perform relation phrases, should contain elements with relatively high production probabilities. As the underlying configurations of phrases increase in size, that is, as underlying configurations change from one-case to two-case to three-case, production probabilities should decrease accordingly. Figure 3.1 reveals that the likelihood of actor production decreases systematically with the hypothesized one-case, two-case, and three-case underlying configurations. To account for these facts of surface structure, we therefore attribute an abstract level of representation, called underlying structure, to the deaf child's sign system.

If correct about the competition hypothesis and about these three particular underlying configurations, we would also predict that in the child's longer phrases (i.e., in phrases with three explicitly signed elements) the same general pattern of actor production would emerge, but accompanied by an overall rise in level of actor production. Figure 3.2 summarizes the data in Figure 3.1 for phrases with two explicit elements and presents



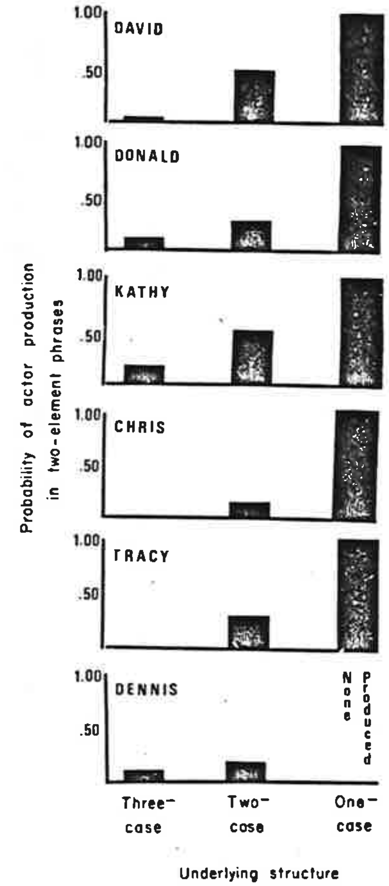


**Figure 3.1** Actor production probability in two-element phrases as a function of underlying structures. Probabilities are based on the total number of two-element phrases of each structure type produced by each child; the totals for David are three-case = 88, two-case = 123, one-case = 17; for Donald 40, 37, 5; for Dennis 13, 11, 0; for Chris 14, 8, 4; for Kathy 16, 12, 3; and for Tracy 2, 15, 6.

comparable data on phrases with three explicit elements. Both predictions are verified. The production probability of actor cases does indeed rise with the inclusion of a third signed element in the phrase. Moreover, this overall increase conforms to the pattern found in two-element phrases with the expected increase in production probability in two-case phrases. With competition reduced, actors are always signed in three-element phrases with one-case and two-case underlying structures, but are still relatively unlikely in three-element phrases with three-case underlying structure.[19]

[19] It is almost, but not quite, a tautological outcome of the coding procedure that the actor is always explicitly signed in phrases hypothesized to have one-case underlying structures. Recall that one-sign phrases were excluded from the data base for this study. It would seem then that one-case relation phrases, which are hypothesized to permit only two elements (e.g., baby–sleep), could not be counted in this study unless these phrases contained both elements

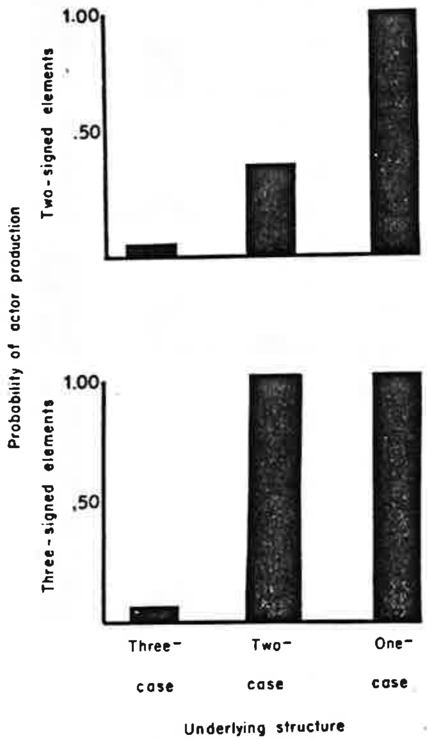


**Figure 3.2** Actor production probability in two-element versus three-element phrases as a function of underlying structures. Probabilities are based on the total number of two- and three-element phrases of each structure type produced by all six children; the total for two-element phrases are three-case = 173, two-case = 206, one-case = 35; for three-element phrases 15, 12, 1.

## ACT PRODUCTION PROBABILITY

The problem of underlying structure was investigated by examining the production probabilities of the actor case for two reasons. First, the actor was signed sometimes but not all the time, thereby providing the variability necessary for the phenomenon to become apparent. Second, the actor was hypothesized to be permissible in each of the four relations types, thereby allowing the competition phenomenon its greatest degree of expression.

explicitly signed. However, it it just possible, under this coding scheme, that a one-case phrase could have the actor (or act) omitted and also be included in the data base. This situation could have occurred if the optional place case were explicitly signed in a phrase conveying a perform relation. For example, the subject could have gestured "SLEEP-bed" or "baby-bed" as ways of indicating 'baby sleeps in bed.' But this never happened, so the appearance of both actor and act in one-case relations is 100% (see Figure 3.1 and Table 3.5). Given the dependence of this fact on the coding procedure, the importance of Figure 3.1 (and Table 3.5) centers particularly on the effects for two-case and three-case relations, as well as in the comparison of Figure 3.1 with Figure 3.2. In fact, it did turn out that a child produced the place case in three-sign phrases conveying one-case relations (see Figure 3.2). The surface form of such a phrase includes the actor, the act, and the place (e.g., David VIIIa 139: *elephant picture–DIVE–water picture,* a comment on a picture of an elephant diving while in a pool of water).



The act predicate is also hypothetically permissible in each of the four relations; moreover, the act is not always signed whenever it can be. Consequently, we now examine the probabilities of act production to see if these probabilities also reflect posited underlying configurations.

Table 3.5 presents the probabilities of act production in two-element phrases for each of the three underlying structures. Act production probability is higher across the board than actor production probability, but for four of the six children, it follows th same pattern. That is, act production is most likely in phrases with one-case underlying structure, less likely in phrases with two-case underlying structure, and least likely in phrases with three-case underlying structure.

Act production in three-element phrases is also consonant with our notions of underlying structure. A three-element phrase, in effect, raises the limit on surface structure, thereby reducing the competition in three-case underlying structures. Consequently, act production in three-element phrases should be quite high for all three underlying structures. The data verify these predictions. Analyzed across all six subjects, the probability of act production in three-element phrases was 1.00 for phrases with any of the three types of underlying structures.

## PATIENT PRODUCTION PROBABILITY

Patient production probability provides further evidence of underlying structure. Since patients are not hypothesized to be permissible in phrases with one-case underlying structures, patient production is examined only in phrases with two-case and three-case underlying structures (see Table 3.6). The pattern is evident in five of the six children: Patient production is more likely in phrases with two-case underlying structure than in phrases with three-case underlying structure, reflecting the effect of competition from other cases in the latter instance.

**TABLE 3.5 Act Production Probability**[a]

| | *Three-case relations* | *Two-case relations* | *One-case relations* |
|---|---|---|---|
| David | .47(88)[b] | .87(123) | 1.00(17) |
| Donald | .75(40) | .94(37) | 1.00(5) |
| Dennis | .46(13) | .73(11) | —(0) |
| Chris | .71(14) | 1.00(8) | 1.00(4) |
| Kathy | .81(16) | .75(12) | 1.00(3) |
| Tracy | 1.00(2) | .80(15) | 1.00(6) |

[a] The data base for this analysis includes action phrases in which two elements are explicitly signed.

[b] The numbers in parentheses represent the total number of phrases with three-case, two-case, and one-case underlying structures produced by each child during the study.

TABLE 3.6 Patient Production Probability[a]

| | Three-case relations | Two-case relations |
|---|---|---|
| David | .78(88)[b] | .83(88) |
| Donald | .53(40) | .90(29) |
| Dennis | .85(13) | 1.00(10) |
| Chris | .64(14) | 1.00(7) |
| Kathy | .63(16) | .87(9) |
| Tracy | 1.00(2) | .85(13) |

[a] The data base for this analysis includes action phrases in which two elements are explicitly signed.

[b] The numbers in parentheses represent the total number of transitive phrases with three-case and two-case underlying structures produced by each child during the study.

In sum, we have found a systematic relation between the hypothesized underlying structures and the actual likelihood of actors, acts, and patients appearing in surface structure. The systematic relation itself constitutes evidence for the proposed underlying structures.

## Surface Structure

### PRODUCTION PROBABILITY AS A SURFACE MARKING DEVICE

We have shown in the previous section that the production probability for each case varies systematically with underlying structure. That is, each individual semantic case is progressively less likely to be signed as the number of elements in the underlying structure increases. However, it turns out that, across all underlying structures, certain cases are more likely than others to be signed when they can be signed. In fact, each of the three major cases in the deaf child's system appears to have a characteristic level of production probability.

Table 3.7 presents the conditional production probability of cases, that is, production probability for each case figured in terms of only those phrases which permit that case. It is apparent that, for all six children, the patient case is the most likely case to appear in the surface structure of any of the phrases in which it is permissible (i.e., in transfer and transform phrases). Moreover, for five of the six children the recipient case was the next most likely case to be signed when it could be, and the actor case was the least likely case to be signed when it could be. Thus, across all relation types, each of the three cases is characterized by an overall level of production probability: Patients have high production probability, recipients medium production probability, and actors low production probability.

In sum, the characteristic level of production probability associated with each case contributes to surface regularity in the deaf child's phrases. In this



TABLE 3.7 Conditional Production Probability of Cases[a]

| | Patient | Recipient | Actor |
|---|---|---|---|
| Dennis | .91(23)[b] | .64(14) | .17(24) |
| Kathy | .68(25) | .47(19) | .35(31) |
| Chris | .76(21) | .60(15) | .19(26) |
| Donald | .75(69) | .48(48) | .21(82) |
| David | .81(176) | .57(123) | .32(228) |
| Tracy | .87(15) | .00(4) | .52(23) |

[a] The data base for the analysis includes action phrases in which two elements are explicitly signed.

[b] The numbers in parentheses represent the total number of phrases which permit patient, recipient, or actor cases produced by each child during the study.

sense, then, production probability level functions as a syntactic device which marks the deaf child's cases (see Feldman, Goldin-Meadow, & Gleitman [1978] for a more extensive discussion of production probability as a syntactic device).

### SIGN ORDER AS A SURFACE MARKING DEVICE

We have just seen that production probability for a given element determines, at least in part, whether or not the deaf child will sign that element in the surface structure of his phrases. We now find that the surface forms of the deaf child's phrases are further determined by a second surface marking device, the ordering rule. Given that a certain element will appear in the surface structure of a phrase, ordering rules determine where in the phrase the element will tend to appear.

The deaf children expressed their action relations by following syntactic ordering rules: they tended to sign certain elements before others in their two-sign phrases. For example, when producing a two-sign phrase containing a patient and an act, the deaf child was more likely to produce the sign for the patient before the sign for the act.

Sign order data for the most frequent types of phrases (i.e., for phrases containing pairings of patients, recipients, and acts) can be found in Figure 3.3, which presents the number of two-sign phrases classified according to the order of each element in the phrase.[20] All children always produced patients before recipients in their two-sign phrases, for example, "book-mother," requesting that the book be given to mother. Not all the children

[20] All phrases containing pointings at pictures are excluded from this ordering analysis because the children tended to point at pictures before producing other signs. The pictures pointed at were most often facsimiles of objects playing the patient role; thus, we would have, perhaps artifactually, inflated patient-first orderings if these phrases were included. As a result, Tracy is not included in this analysis because she produced very few phrases conveying action semantic relations that did not contain points at pictures.

showed ordering tendencies for the remaining pairs of elements, but those children who did all showed them in the same direction (but see below). Certain of the children tended to produce patients before acts, as in the above example *drum–BEAT* (David $\chi^2 = 5.48, p < .04$; Dennis $\chi^2 = 7.36, p < .01$). In addition, some tended to produce acts before recipients (e.g., "GIVE-mother" again requesting transfer of an object to mother). David always followed this act-recipient ordering and Donald showed a strong tendency in the same direction ($\chi^2 = 10.28, p < .001$).

These tendencies of our deaf subjects to order elements in their two-sign phrases can be summarized with the following sign order rules:[21]

$$\text{Phrase} \longrightarrow \text{Patient} \begin{Bmatrix} \text{Act} \\ \text{Recipient} \end{Bmatrix}$$

$$\text{Phrase} \longrightarrow \text{Act–Recipient}$$

A more parsimonious description (i.e., fewer rules) of the same data would be:

(Choose any two elements maintaining order)
Phrase $\longrightarrow$ (Patient)(Act)(Recipient)

In addition to indicating that the children structure their phrases, the presence of ordering rules based on predicates and cases is further evidence for the existence of the predicate and case categories themselves. That the children consistently order these categories suggests that, at some processing level, these categories exist for the children. The above order data document evidence for three categories: patients, recipients, and acts.

Although Chris did not appear to have a consistent order for patients and acts, closer inspection of his phrases revealed an ordering tendency completely unique to him. When Chris's patient/act phrases were divided into those conveying transfer relations (e.g., *book/GIVE*) versus those conveying transform relations (e.g., *cookie/EAT*), competing ordering tendencies emerged. Specifically, Chris tended to put patients before acts in transform phrases (*cookie–EAT*), producing six patient–act transform phrases and only one act–patient transform phrase. However, he tended to put acts before patients in transfer phrases (*GIVE–book*), producing four

[21] The following conventions are used in describing order rules:

1. $\rightarrow$ indicates that the symbol on the left can be rewritten as the symbol(s) on the right. The order of the symbols on the right must be maintained in the rewriting process.
2. {} indicates that either of the symbols in the braces, but not both, can be chosen in the process of rewriting.
3. ( ) indicates that the symbol in the parentheses is optional, that is, can be chosen or not in the rewriting process.



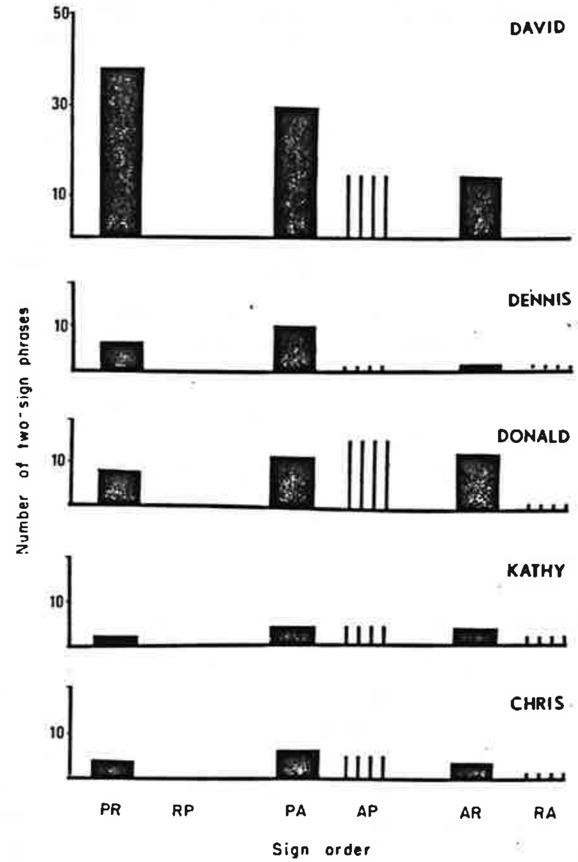


**Figure 3.3** Number of two-sign phrases classified according to the order of each element in the phrase. P = patient, A = act, R = recipient.

act–patient transfer phrases and no patient–act transfer phrases. These two tendencies appear to be reliably different in Chris's system (probability < .05 by Fisher Exact Test). Moreover, these two sets of patient/act ordering rules distinguish between transfer and transform relations and provide further evidence for these two relational categories in Chris's system.

## FORM-BASED ORDER RULES

An alternate description of at least some of the children's sign orders might be proposed. This description would be based not on the semantic element analysis presented above, but rather on an analysis of the form of the signs, that is, deictic signs versus characterizing signs. For example, a "characterizing first–deictic second" strategy might be proposed as an adequate, nonsemantic, description of two-sign action phrases.

One argument against such a form–based rule is the strength of the patient–recipient ordering tendency. Since both patients and recipients are deictic signs, a form-based rule would predict random ordering of these cases. However, as was shown in Figure 3.3, patients are consistently ordered before recipients.

Further, a form-based rule is not well supported by the overall ordering data. Table 3.8 presents the number of two-sign action phrases in which deictics occurred in first or in second position and the number of two-signs phrases in which characterizing signs occurred in either position. There is no essential difference in the number of phrases in which each type of sign occurred in first and second position for David, Chris, and Kathy. Thus, these children do not appear to have a general ordering strategy based on sign form.

The remaining two children provide at best only partial support for form-based rules. Dennis tended to put characterizing signs in second position ($\chi^2$ = 6.23, $p < .02$), a tendency that does, in fact, explain his patient–act orders. However, since Dennis produced only two act/recipient phrases, we cannot test the generality of this "deictic first-characterizing second" rule. For Dennis, we therefore cannot decide between a semantic-element and a sign-form analysis of his patient-act ordering rule.

In contrast to Dennis, Donald tended to put deictic signs in second position of his two-sign phrases ($\chi^2$ = 4.70, $p < .05$), and characterizing signs in first position ($\chi^2$ = 7.04, $p < .01$). Thus, Donald's act–recipient order can equally well be described as a "characterizing first–deictic second" order. However, if Donald were following such an order based on sign form, he should put his characterizing signs for acts before his deictic signs for patients (i.e., to have an act-patient order). In fact, he does not. Thus, even Donald's data provide no strong evidence for ordering rules based on sign form.

**TABLE 3.8 Deictic and Characterizing Sign Orders in Two-Sign Phrases**

| | *Deictic signs* | | *Characterizing signs* | |
|---|---|---|---|---|
| | *In first position* | *In second position* | *In first position* | *In second position* |
| Dennis | 21 | 12 | 2 | 11 |
| Kathy | 13 | 15 | 10 | 10 |
| Chris | 10 | 15 | 12 | 7 |
| Donald | 22 | 39 | 29 | 12 |
| David | 90 | 91 | 40 | 39 |



In general, it appears that a semantic element analysis of the order data better describes the children's phrases. We therefore suggest that the predicate/case level is a more fruitful one on which to analyze sign orders in surface structure in these children's phrases.

### ACTOR ORDER RULES

What is the surface position of the actor in the deaf children's two-sign phrases? Since the deaf children produced only a small number of phrases containing the actor case, we must be cautious in making any inferences about actor-ordering rules from these data. The data that do exist suggest that actors do not tend to occupy consistent positions when paired with other elements. Overall, actors are just as likely to occur in the first position in a two-sign phrase as in the second position. David produced 17 actor-first phrases versus 21 actor-second phrases; comparable figures for Kathy, Chris, Dennis, and Donald are respectively, 3 versus 4, 0 versus 3, 3 versus 1, and 3 versus 1. Although suggestive of nonorder, these data do not definitively decide the issue of actor ordering. This issue is taken up again in the next section, where the deaf child's actor category is reanalyzed.

## Organizational Structure

Syntax can be defined as the principles of arrangement of word units in sentences; syntactic devices are then those devices which serve to produce these surface arrangements (Lyons, 1971; Gleason, 1961). The surface regularities of English, for example, are partially produced by two common syntactic devices: word order (e.g., *Jim hit Jules*, where the position preceding the verb often, but not always, marks the actor and the position following the verb tends to mark the patient), and prepositions (e.g., *I went to the store* where *to* marks the recipient role).

One important function of syntactic devices in natural adult languages is to distinguish among the various roles nouns can play in sentences. In the above example of a transitive sentence, the word order device distinguishes the actor role of the first noun (*Jim*) from the patient role of the second noun (*Jules*). When two nouns are present in the surface form of a sentence, as is generally the situation in transitive sentences, it is particularly important that the two noun roles be distinguishable on some grounds. When there is only one noun present in the surface form of a sentence, as in intransitive sentences (e.g., *elephants dance*), it is of course less crucial that the actor role of the single noun be marked.

In general, natural languages can be classified according to how they mark the single noun role (actor) of intransitive sentences with respect to the two noun roles (actor and patient) of transitive sentences. Specifically, certain languages, called ergative languages, mark intransitive actors like transitive patients, and mark transitive actors differently from both. In contrast, accusative languages mark intransitive actors like transitive actors, and mark patients differently from both (Fillmore, 1968).

It was shown in the previous section that, like natural languages, the deaf children's communication system has at least two syntactic devices that produce surface regularities: (1) production probability, which determines the likelihood of a case appearing in the surface level of a phrase, and (2) sign order, which determines the position of a case in the surface level of a phrase. In the next sections, it will be shown that the deaf subjects' communication system uses its two syntactic devices to mark the intransitive actor like the patient and to mark the transitive actor differently from both. Thus, the deaf children's sign system is ergative.

### ERGATIVE VERSUS ACCUSATIVE LANGUAGES

To elaborate on the ergative pattern as it is found in natural languages, we may contrast ergative languages with English, a language which has an accusative case marking pattern. The hallmark of the distinction between ergative and accusative languages is the manner in which the intransitive actor is marked. Consider the intransitive phrase *You go to the corner*. In this phrase, the intransitive actor *you*, in some sense, has a double meaning. On the one hand, *you* refers to the goer, the actor, the effector of the going action. On the other hand, the *you* refers to the gone, the patient, the affectee of the going action. At the end of the action, *you* both *have gone* and *are gone*, and the decision to emphasize one aspect of the actor's condition over the other is somewhat arbitrary.

In English, we choose to emphasize the effector properties of the intransitive actor by marking it like other effectors. For example, the intransitive actor "you" in *You go to the corner* is marked just like the transitive actor "you" in *You eat grapes*. That is, both actors precede the verb. In contrast, ergative languages emphasize the affectee properties of the intransitive actor by marking it like other affectees (i.e., patients). Thus, the intransitive actor of a going relation (you) is marked just like the transitive patient of an eating relation (grapes). An English sentence following an ergative pattern might be, *Go you to the corner*, in which the "you" actually does seem to have an affected rather than effecting sense.

In sum, accusative languages highlight the effector properties of the intransitive actor by grouping it with transitive actors, while ergative languages highlight the affectee properties of the intransitive actor by grouping it with transitive patients. Below we provide evidence of ergativity in the deaf child's system by showing how the child's two syntactic devices, production probability and sign order, are each used to create an ergative case-marking pattern.



### PRODUCTION PROBABILITIES

We have already characterized the patient as a case which is likely to be signed in a phrase, and the actor as a case unlikely to be signed. The next step is to reanalyze the actor case to determine production probabilities for intransitive actors versus transitive actors. Since it has previously been shown that production probabilities are not independent of underlying structure, we must select phrases which have similar underlying structures to compare production probabilities for the cases in question. Both transform and transport relations have two-case underlying structures and are therefore ideal for comparison. Recall that the transform relation permits actor, act, and patient elements (e.g., *he eats apples*); this relation is transitive. The transport relation permits actor, act, and recipient elements (e.g., *he goes there*) and is intransitive. Now we can compare production probabilities for the actor and patient cases in these two relation types.

If the deaf child's system were accusative, the production probabilities for both the intransitive and the transitive actor should be similar to each other, and should differ from the production probability for the patient. Alternatively, if the deaf child's system were ergative, the production probabilities for the intransitive actor and for the patient should be similar; moreover, this production probability should differ from the production probability for the transitive actor.

Table 3.9 presents the data. It is apparent that these deaf children marked intransitive actors like patients, and not like transitive actors, with respect to production probability. That is, the children were as likely to sign

**TABLE 3.9 Actor and Patient Production Probabilities in Two-Case Relation Phrases (Transform and Transport)**[a]

| | *Transitive actor* | *Intransitive actor* | *Patient* |
|---|---|---|---|
| David | .28(88)[b] | .80(35) | .83(88) |
| Donald | .10(29) | .75(8) | .90(29) |
| Dennis | .20(10) | 1.00(1) | 1.00(10) |
| Chris | .00(7) | 1.00(1) | 1.00(7) |
| Kathy | .44(9) | .67(3) | .77(9) |
| Tracy | .30(13) | 1.00(2) | .85(13) |

[a] The data base for this analysis includes actiôn phrases in which two elements are explicitly signed.

[b] The numbers in parentheses represent the total number of phrases with two-case underlying structures that permit transitive and intransitive actors and patients.

the intransitive actor case as they were to sign the patient case in their two-element phrases. In contrast, all of the six children were likely to omit the transitive actor case. Thus, the "you" in *You go to the corner* would be just as likely to be signed as the "grape" in *You eat grapes*; and both would be much more likely to be signed than the "you" in *You eat grapes*. With respect to production probability, then, the deaf children's system appears to emphasize the affectee (and not the effector) properties of the intransitive actor. That is, the system is ergative.[22]

SIGN ORDER

According to the ordering rule which describes the deaf children's phrases, the patient case tends to appear in the first position of two-sign phrases containing patients, acts, and recipients. Recall that there was no particular consistent ordering for actors. We now reanalyze the actor data to determine if there are consistent ordering tendencies for intransitive actors that are distinct from orderings for transitive actors.

According to the ergative hypothesis, if there are any ordering tendencies, intransitive actors should resemble patients and occupy first position,[23] whereas transitive actors should differ and, presumably, occupy second position. The fact that the deaf children produced very few actor phrases makes this analysis particularly tentative. Only David produced a sufficient number of actor phrases to be analyzed in this way. As predicted, David tended to sign intransitive actors in first position (10 phrases with the intransitive actor in first position versus 5 with the intransitive actor in second position) and transitive actors in second position (16 phrases with the transitive actor in second position versus 7 with the transitive actor in first position) (Fisher exact probability = .05). Thus, David would tend first to point at the actor, (you) and then sign *GO* (i.e., *you–GO*) in conveying *You go to the corner*, just as he would tend first to point at the grape before signing EAT (i.e., *grape–EAT*) in conveying *You eat grapes*. In contrast, David would be likely first to sign EAT and then point at the actor (you) (i.e., *EAT–you*) in conveying *You eat grapes*. These ordering differences suggest ergativity, especially as they tend to confirm the production probability data. Intransitive actors follow the same ordering tendency as patients, whereas transitive actors follow their own distinct ordering tendency.

In sum, the deaf children have developed syntactic techniques (i.e., production probabilities and sign orders) that mark, and therefore structure, a relationship among intransitive actors, transitive actors, and patients. Moreover, the children have structured this particular relationship in precisely the same way as some natural languages do (i.e., as in ergative languages, intransitive actors are syntactically marked like patients, and not like transitive actors).

[22] The fact that actor production probability differs in the two two-case relation phrases (transport and transform) raises the possibility that transport and transform relations should not both be described as having two-case underlying structures. However, the act predicate, hypothesized to be permissible in the underlying structure of both relations, was just as likely to occur in transport phrases (production probability = .88, analyzed over instances for all six children) as it was in transform phrases (.87). This similarity in production probability across the two types of relations is exactly what would be predicted if we assigned the same two-case underlying structure to each of the two relation types. Allowing this interpretation of transport and transform relations, the production probability data taken as a whole then suggest that the deaf child, in effect, has two different types of actors, transitive actors and intransitive actors. It is important to note that the original claim that surface structure varies systematically with underlying structure still holds even if the production probabilities for transitive and intransitive actors are considered separately. In particular, for transitive actors, production probability in three-case phrases was lower (.06) than production probability in two-case transform phrases (.21). For intransitive actors, production probability in two-case transport phrases was lower (.80) than production probability in one-case phrases (1.00).

[23] Note that intransitive actors and patients can never occur in the same phrase (e.g., one cannot say *I slept the apple*). Thus, both intransitive actors and patients could always occupy first position without conflicting with one another.



## Summary: A Patient-Based System

Structure in the deaf child's communication system has been described on four different levels. We now show that these structures taken together as a whole present a coherent picture of the deaf child's communication system. In particular, many aspects of the system described in previous sections appear to center around the patient role. The following facts about the deaf children's communication system demonstrate that the system is "patient-based."

**Content.** The deaf children conveyed transitive relations, that is, relations permitting the patient case, earlier in development than intransitive relations (relations excluding the patient). Thus, in terms of what they communicate, the children sign about actions on objects (or patients) before they sign about actions which involve no objects.

**Production probability.** The patient case had the highest conditional production probability of all of the elements in the deaf child's system. Thus, whenever the patient case could potentially be signed (which was quite often, since transitive relations were so frequent), the patient was very likely to be signed.

**Ordering rules.** The deaf children tended to sign the patient case in first position of their two-sign phrases. If "coming first" reflects psychological importance, as it might at this age, the patient case once again assumed a primary role.

**Case grouping.** The deaf children syntactically marked the intransitive actor like a patient, not like a transitive actor. Since a priori the intransitive actor can reasonably be categorized with either the transitive actor or with the patient, this demonstrated preference of the deaf child further substantiates the predominance of the patient case in his language system.

In sum, the relational concept "patient" appears to assume importance in many facets of the deaf child's communication system.

## DISCUSSION

We have discovered that deaf children of hearing parents, though essentially deprived of all standardized linguistic input, can spontaneously develop a gestural communication system. Analysis reveals that the deaf child's communication system is language-like in many respects. Thus, our data suggest that a system which has language-like properties can be developed by a child under relatively impoverished language learning conditions.

We turn next to the demonstration that the deaf child's ability to create a communication system is in many ways comparable to the hearing child's ability to acquire spoken language from a linguistic model. In order to argue that data on the deaf child bear on the question of how the hearing child normally acquires language, both parallel structures and parallel development must be shown.

### Comparison to the Acquisition of Conventional Languages

#### SEMANTIC CONTENT: ACTION AND ATTRIBUTE RELATIONS

Bloom, Lightbown, and Hood (1975) have reported that young hearing children learning English convey both action and attribute relations early in speech development, and furthermore that they convey action phrases earlier in development than attribute phrases. There is, in fact, widespread agreement that children learning conventional languages talk about both action and attribute relations early in development (Brown, 1973; Bowerman, 1973). Even children learning a conventional manual language (American Sign Language) appear to express both action and attribute relations early in their linguistic development (Newport & Ashbrook, 1977).

Bloom *et al.* have also shown that the hearing children in their study produced types of action relations that turn out to be comparable to our deaf children's action relation types. The hearing children produced transi-



tive and intransitive locative action phrases (comparable to the deaf child's transfer and transport relations, respectively) and transitive and intransitive action phrases (comparable to the deaf child's transform and perform relations, respectively). However, Bloom *et al.* did not find, as was found with the deaf children, that the hearing children developed transitive relations prior to intransitive relations. In fact, there is no mention at all of a developmental difference between transitive and intransitive relations in any of the hearing child language literature. We return to this difference between the deaf and hearing groups in a later section.

Finally, there is great similarity between the deaf subject's and the hearing child's semantic elements. In particular, in the early stages of development, the hearing child produces words for both verbs and adjectives (Brown, 1973; Bloom, 1970), comparable to deaf subjects' signs for act and attribute predicates, respectively. Moreover, the hearing child frequently produces words for the patient, recipient, and actor cases (Brown, 1973) just as deaf subjects often produce signs for these cases. The similarities even extend to omissions: The hearing child infrequently produces words for the place case, or for the benefactive case (e.g., *I made the cake for her*), just as deaf children also infrequently produce signs for cases such as these. Thus, in terms of the content of communications, the hearing child and deaf subjects have much in common.

#### UNDERLYING STRUCTURE

There have been several different accounts of underlying structure in the literature of the hearing child's language acquisition. Antinucci and Parisi (1973) suggest that their hearing subject (Claudia) possesses underlying representations that are more complex than her surface forms. They attempt to demonstrate, through a simple prompting technique, that the various underlying elements of a particular relation can be brought to the surface. For example:

Claudia: *Doll.*
Mother: *What are you giving the doll?*
Claudia: *Cookie.*

The child first mentions the recipient case and after prompting mentions the patient case. Similarly, in the next example, the child first mentions the act predicate, and then the act plus the recipient case:

Claudia: *Give.*
Mother: *Who to, to the doll or to Claudia?*
Claudia: *Give Claudia.*

However, as Schlesinger (1974) and Braine (1976), among others, point out, these data do not convincingly argue for underlying structure. Claudia could well be attending to only one aspect of the situation at a time; her verbalization would then reflect only the aspect to which she is attending (i.e., the salient aspect) and not to the entire set of aspects which make up the relation. Prompting might merely prod the child to change the focus of her attention, and consequently, her verbalizations to another (and for her, not necessarily concurrent) aspect of the situation. Thus, prompting data such as these can never provide strong evidence that, for the purposes of communication, the child simultaneously considers all of the aspects of the relation (e.g., *mother–give–cookie–Claudia*) as part of a unified underlying structure.

However, more convincing evidence for underlying structure in the hearing child's oral language development is found in Bloom (1970) and Bloom, Miller, and Hood (1974). Bloom *et al.* (1974) show, through statistical analyses, that the constituents (or semantic elements in our terms) that appear in the surface forms of their children's utterances are not randomly selected. Rather, there appears to be systematic variation among the surface constituents. Furthermore, the analyses presented in Bloom (1970) suggest that at least some of this systematic variation is accounted for by underlying structure.

Bloom (1970) imputes to her hearing subjects an underlying structure that includes items that are not expressed in the children's surface forms. As evidence for this claim, Bloom notes that the hypothesized underlying items that are deleted from the surface forms of certain utterances did appear in the surface forms of other utterances at the same moment in development. When these items were missing from surface structure, they were missing because of an output constraint on the child's utterances (a maximum length, all of Bloom's subjects being at the "two-word" stage). For example, even though subject noun phrases appeared in the surface forms of the affirmative sentences uttered by these children, for example *mommy sock*, subject noun phrases did not appear in the children's negative sentences (which include the extra word *no* or *not*). Since the inclusion of the negative in a sentence involves producing one extra morpheme, one of the other underlying elements (e.g., the subject or the object of the sentence) must be deleted to reduce the sentence to the required length. The thrust of this argument is that the existence of underlying elements in the hearing child's language explains, at least to some extent, the regularities of their surface structure.

Further evidence for underlying structure in hearing children comes from reanalyzing these data in terms of the framework used to describe the deaf child's spontaneous sign system. Indeed, using our techniques we find



**TABLE 3.10 Patient and Act Production Probabilities in Phrases Produced by Four Hearing Children[a]**

| | Patient[b] | | Act[c] | |
|---|---|---|---|---|
| | *Three-case relations* | *Two-case relations* | *Three-case relations* | *Two-case relations* |
| Gia | .68(88)[d] | .74(334) | .78(88) | .88(456) |
| Peter | .55(83) | .90(3[illegible]1) | .82(83) | .99(401) |
| Eric | .52(69) | .87(218) | .87(69) | .97(400) |
| Kathryn | .89(152) | .87(447) | .83(152) | .97(656) |

[a] The data for this analysis are from Bloom *et al.* 1974 (from Table 5 for Gia II through VI; Table 7 for Peter IV through IX; Table 4 for Eric II through VI; and Table 6 for Kathryn I through IV).

[b] Termed *object* in Bloom *et al.* (1974).

[c] Termed *verb* in Bloom *et al.* (1974).

[d] The numbers in parentheses represent the total number of two-element (or two-constituent, in Bloom *et al.*'s terms) phrases with three-case and two-case underlying structures that permit either patient or act elements produced by each child throughout the study.

that the hearing child not only produces phrases with underlying structures, but he also shares particular underlying structures with deaf children.

Table 3.10 displays the data (from Bloom *et al.*, 1974) pertinent to this point. From it we can readily infer that the hearing children appear to have both three-case and two-case underlying structures.[24] The argument for the existence of these structures in the hearing child runs precisely parallel to that for the deaf child: The children studied by Bloom *et al.* were less likely to produce patients and acts in phrases with three-case underlying structures than in phrases with two-case underlying structure.[25] These findings are borne out in three of the four hearing children for the patient case (for the fourth child, the production probabilities are the same for both structures) and in four out of four children for the act predicate. Thus, by positing three-case and two-case underlying structures, we are able to explain, at least in part, the hearing child's patient and act production probabilities, just as for the deaf child.

## SURFACE STRUCTURE: ORDERING RULES

Sign order was a predominant syntactic device used by the deaf children to convey their semantic relations. Word order seems to be a predominant

[24] Intransitive phrases (Agent-Action) that could have had one-case underlying structures were not included in the analyses presented in the Bloom *et al.* (1974).

[25] In Bloom *et al.*'s terminology, phrases with three-case underlying structure are agent–locative action–object–place phrases (comparable to our transfer phrases); their phrases with two-case underlying structure are agent–action–object phrases (comparable to our transform phrases) and mover–locative action–place and patient–locative action–place phrases (comparable to our transport phrases).

syntactic device used by hearing children to convey semantic relations early in their linguistic development. Other devices, for example inflectional endings or prepositions, are generally unavailable to the hearing child at this age.[26] The generality of this word order phenomenon in hearing children has led Slobin (1973) to postulate that a language-acquiring child is equipped with an elementary operating principle: Pay attention to the order of words and morphemes in the model language. Slobin might argue that Bloom's subjects (1970) tend to order actors before patients (e.g., *mommy sock*, where mommy is putting on the child's sock) precisely because, in English, actors tend to precede patients.

Obviously, our deaf population, lacking a conventional linguistic model, cannot avail itself of this hypothetical operating principle. It is striking that order exists in their phrases nevertheless. This finding suggests that the use of order as a syntactic device is an active strategy on the part of the child, with or without a linguistic model. Of course, when exposed to a linguistic model, a child will ultimately adopt a particular order influenced not only by his own inherent ordering strategy, but also by the particular orders found in the adult language which surrounds him. We take up this issue again in the following sections.

## SURFACE STRUCTURE: CASE MARKING PATTERNS

Recall that the deaf subjects marked patients and intransitive actors alike in terms of ordering rules as well as production probabilities. Specifically, both patients and intransitive actors tended to occur in first position of two-sign phrases, and also tended to be explicitly signed whenever possible. These characteristics led us to label their spontaneous system as ergative. What can be said of the case marking patterns of young hearing children? Ultimately hearing children acquire the case marking patterns of their language models; that is, they eventually produce either an ergative or an accusative pattern depending upon which occurs in the adult tongue that surrounds them. But what of developmental stages along the way?

Following Slobin's operating principle, the hearing child's ordering rules for patients and actors should follow adult models, even from the earliest stages. Thus, the hearing child learning English, an accusative language, ought to group intransitive actors with transitive actors, at least with respect to ordering rules. The data on children learning English suggest that this is so: Both intransitive and transitive actors tend to precede the verb, in

[26] The issue has been raised that not all children may follow word-order rules in their early phrases (Brown, 1973; Bowerman, 1973). Further, there is some doubt that all those children who do use order have order rules based on the same categories (Braine, 1976). However, most of the data suggest that most children use word order to convey semantic relations most of the time.



contrast to the position of the patient case which tends to follow the verb (Braine, 1976; Bloom, 1970).

Although it is likely that the young child's **ordering** patterns are dictated by his linguistic model, it is far less reasonable to suppose that case **production probability** patterns are modeled in the same way. Case production probability, after all, is a phenomenon which is inherently dependent upon the young child's apparent length limitation. At early stages, children appear to be forced to choose between explicitly saying the patient or the actor, precisely because the child at this stage is limited to a two- or three-word sentence length. Adults, of course, have no such length constraints on their utterances, and even speakers of Motherese do not produce such abbreviated utterances as *mommy sock*.[27]

From these considerations, the young child might be predicted to be less influenced by his adult linguistic model in production probability patterns than in ordering patterns. The data, in fact, confirm this hypothesis. Young English learners, like deaf children and unlike adult English speakers, tend to group intransitive actors with patients with respect to production probabilities. Table 3.11 presents a reanalysis of the data presented in Bloom *et al.* (1974) for young speakers acquiring English at the two-word stage.[28] The patient (or object in Bloom *et al.*'s terminology) was as likely to be explicitly mentioned as the intransitive actor (or mover, or patient).[29] Furthermore, the transitive actor (or agent) was much less likely to be explicitly spoken than either the patient or the two intransitive actor cases.[30]

[27] In fact, English does permit the actor to be omitted in certain sentences, such as imperatives. However, to account for the pattern reported here, we would have to make the unlikely prediction that caretakers are far more likely to produce transitive imperatives (*Eat the peas*) than intransitive imperatives (*Go over there*).

[28] Note that only those phrases with two-case underlying structure are included in this reanalysis. Bloom *et al.*'s Agent-Action-Object phrases are transitive and are comparable to our transform phrases; their Mover-Locative Action-Place and Patient-Locative Action-Place phrases are intransitive and are comparable to our transport phrases.

[29] In Bloom *et al.*'s classification scheme, a patient in Patient-Locative Action-Place relations differs from an object in Agent-Locative Action-Object-Place relations in two ways: 1) patients precede verbs, *lamb go in there*, and objects follow verbs, *Gia away a lamb*; and 2) patients occur with verbs like *go* and *fall*, but objects occur with verbs like *put* and *away*.

[30] As can be seen in Table 3.11, Bloom *et al.* make a distinction between "movers" and "patients" in two-case transport relations: A mover transports itself (e.g., *I go down*) while a patient is transported (e.g., *lamb go in there*). This distinction is based on the experimenters' intuitions about the causes of movement, and may not reflect the child's views. Particularly since three of the four children appear to treat intransitive movers as patients (both transitive and intransitive) in terms of production probability, it might be hypothesized that the child makes no distinction between movers and patients and views movers more as "being affected by movement" than as "effecting" movement. However, Peter's data do not completely fit this ergative pattern (but note that neither do the data fit an accusative pattern). In terms of production probability, Peter appears to treat movers of intransitive relations (*I get down*) like

**TABLE 3.11 Actor and Patient Production Probabilities in Two-Case Relation Phrases Produced by Four Hearing Children**[a]

| | *Transitive actor*[b] | *Intrasitive actor*[c] | | *Transitive patient*[d] |
|---|---|---|---|---|
| Gia | .43(334)[e] | .74(77) | .75(45) | .74(334) |
| Eric | .14(218) | .89(65) | .67(117) | .87(218) |
| Kathryn | .17(447) | .50(111) | .70(98) | .87(447) |
| Peter | .10(311) | .76(34) | .11(56) | .90(311) |

[a] The data for this analysis are from Bloom *et al.* (1974); specifically, from Tables 4, 5, 6 and 7.
[b] Termed *agent* in Bloom *et al.* (1974).
[c] The first column is Bloom *et al.*'s *mover;* the second is their *patient.*
[d] Termed *object* in Bloom *et al.* (1974).
[e] The numbers in parentheses represent the total number of two-element phrases with 2-case underlying structures which permit transitive and intransitive actors and patients, produced by each child throughout the study.

The grouping pattern seen in Table 3.11 is exactly what is found in the deaf child's sign phrases: Intransitive actors resemble transitive patients in terms of production probability, and differ from transitive actors.[31] Thus, where the linguistic model does not constrain the child, that is, in case production probabilities, the hearing child learning English seems to have ergative tendencies, as do our deaf subjects. However, where the linguistic model does provide a clear pattern, that is, in ordering rules, the English learning child exhibits the accusative tendencies of his model.

## SUMMARY

In sum, the deaf subjects' communication system does indeed resemble that of the hearing child. These similarities at the relational level of analysis are evident despite differences in the two systems at the lexical level of analysis. Recall that, as we discussed earlier, the deaf children's signs and the

patients of transitive relations (*open drawer*), but not like patients of intransitive relations (*lamb go in there*).

[31] The data in Bloom *et al.* (1974) resemble our data on actor production: Their subjects were more likely to omit the actor than any other case. On the other hand, the data in Brown (1973), Bowerman (1973) and Braine (1976) appear on the surface to contradict our findings: The subjects they describe produce a large number of actor–act phrases. However, recall that the actor is expected to be frequent in intransitive relation phrases. Thus, these data do not necessarily mean that the actor has a high priority for these children, if their actor–act phrases are primarily intransitive. Bloom *et al.* have reanalyzed Bowerman's data and found that many of the actor–act phrases she reported are, in fact, intransitive. Moreover, may of the phrases reported by Braine also appear to be intransitive, although additional context is needed to make decisions about several of the phrases. Thus, the low priority of the actor may be a more general phenomenon than it appears at first analysis.



hearing child's words differ in terms of the referential information each conveys. Specifically, the deaf children's deictic pointing is "location-specific" and therefore differs from the hearing child's noun; moreover, the deaf children's characterizing sign is iconic and, in this respect, different from the hearing child's verb. In addition, the criteria for lexical meaning assignment differ in this study and in studies of hearing children: This study relies on sign form; child language researchers typically rely on the word's function in adult grammar.

Nevertheless, despite these differences in the criteria for lexical meaning assignment and in the nature of lexical items themselves, the same topics are conveyed and the same formal classes of structure convey them in both the deaf and hearing children's communication systems. Both systems have underlying structures, production probability syntactic devices, and sign order syntactic devices. Moreover, within each of these formal classes of structure, the deaf and hearing children have certain substantive structures in common. Both children's systems have the same particular configurations underlying the surface forms of their phrases (i.e., three-case, two-case underlying structures). In both systems the production probability syntactic device produces patient-based case markings. Interestingly, the one difference in substantive structures between the two systems is found in ordering rules: The deaf child without a conventional linguistic model has a patient-based ordering rule; the hearing child follows the ordering rules of his linguistic model, be they patient-based or not.

Data from our deaf children suggest that a child's early communication system, when uncontaminated by a conventional linguistic environment, will be patient-based: Both ordering rules and production probabilities give priority to the patient case over other cases. A linguistic model, when available, may override the patient-based ordering tendencies of the child with its own ordering regularities. However, when no guide is offered by the linguistic environment, as is the situation for production probability patterns, the patient-based tendencies of the child emerge with or without a conventional language model.

The similarities between the deaf children's and the hearing child's systems are of interest primarily because they suggest that the data from our deaf children may be relevant to questions of the processes and factors involved in normal language acquisition. The deaf children in and of themselves are of particular interest to acquisition questions because they appear to be developing a language-like system without the benefit of a conventional linguistic model. Because the nature of deaf children's input is central to any inferences about language acquisition drawn from this study, we turn next to the issue of input to the deaf children.

## The Deaf Child's Sign Environment

Deaf children were included in this study only if they could not acquire oral language naturally and if they had no exposure to a conventional sign language. Thus, the sign system created by these subjects was developed without the benefit of such conventional systems. However, it is possible that the subjects' parents communicated with their children by unconsciously creating their own sign system (unconsciously, because the subjects' parents were committed to oral education) that was then imitated by our subjects. In fact, some mothers of the subjects did use gestures with their children. To determine whether the children or their caretakers first developed the system described here, we transcribed the gestures produced by the mothers of two of the subjects during the first four interviews. The same coding procedures were used for the mothers' gestures as for the children's and mother was compared to child in lexicon and sign phrases.

**Lexicon.** There were no obvious differences between mother and child in their tendencies to point to objects. Since pointing is common in all mother-child interactions, subjects may very well have learned to point from those around him. But deictic pointing is only a subset of the lexicon of this system. More revealing comparisons between mother and child emerge when characterizing signs and sign phrases are examined.

Both mothers produced some characterizing signs; over the course of four sessions they produced as many different types of characterizing signs as their children (see Table 3.12, Column 1). However, as can also be seen in the table, mother and child did not appear to have developed the same characterizing lexicon: only 25% of the characterizing signs produced by mother and child were common to both. Further evidence for the child's ability to develop characterizing signs on his own comes from the fact that the children invented iconic signs for stimulus toys and actions they had not previously seen.

**TABLE 3.12 Mother–Child Comparison of Number of Characterizing Signs Produced during Sessions I–IV**

| | Types[a] | | | Tokens[b] | | | |
|---|---|---|---|---|---|---|---|
| | | | | Alone | | In phrases | |
| Subject | Child | Mother | In common | Child | Mother | Child | Mother |
| David | 56 | 54 | 18 | 107 | 90 | 47 | 9 |
| Dennis | 25 | 23 | 5 | 50 | 58 | 18 | 3 |

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



**Sign phrases.** The mothers also produced sign phrases conveying semantic relations, but they produced fewer such phrases than their children. Over the course of the four sessions under consideration, David and Dennis produced 127 and 42 such phrases, respectively, while their mothers produced only 43 and 13, respectively (see Table 3.13). Furthermore, the mothers began producing sign phrases at some time later than their children did. Both children produced a number of these sign phrases in Session I. But David's mother produced only 3 such phrases in Session I (compared to David's 27), and Dennis's mother did not begin production at all until Session II. Thus, there is no evidence that the children learned to produce sign phrases to express semantic relations by imitating their mothers' signs and there is some evidence to suggest that the children developed their sign phrases independently.

Finally, the children were more likely to integrate their characterizing signs into their sign phrases than were their mothers. The mothers produced as many characterizing signs in one-sign phrases as their children, but far fewer characterizing signs in multi-sign phrases (see Table 3.12, Columns 2 and 3). Consequently, these data suggest that the children did not learn to integrate their characterizing signs into their phrases by imitating their mothers' productions.

In general, the mothers' gestures were less explicit than their children's. For example, one of the deaf subjects might point to his sneakers and then to the stairs when he wants his sneakers put on the stairs. In contrast, his mother would be more likely to tilt the sneakers themselves toward the stairs in a global gesture incorporating the object. Thus, the mother–child comparison data now available suggest that the deaf child's system is certainly different from, and is possibly more advanced than, his mother's gestures. The data might be taken to suggest that, if anything, the mother is learning the sign system from her child, and not the reverse.

In sum, our deaf subjects develop their sign systems without the guidance and direction of a conventional language model. Moreover, they also seem to develop the system without the benefit of an ad hoc sign model.

**TABLE 3.13 Number of Phrases Per Session Produced by Mother and Child**

| | David | | Dennis | |
|---|---|---|---|---|
| Session | Child | Mother | Child | Mother |
| I | 27 | 3 | 3 | 0 |
| II | 40 | 6 | 4 | 1 |
| III | 6 | 12 | 18 | 4 |
| IV | 54 | 22 | 17 | 8 |
| Total | 127 | 43 | 42 | 13 |

It is certain, in any case, that they develop such a system without the rich linguistic input the hearing child normally receives. Nevertheless, the deaf subjects' and the hearing child's communication systems are remarkably similar. We focus now on the implications of these similarities.

## The Noneffects and Effects of Linguistic Input on Language Development

Analyses and comparisons up to this point support the following generalization: with or without a conventional language model, in words or in signs, children during the early stages of language acquisition communicate about the same conversational topics and use the same formal devices to structure these communications. We now discuss this generalization and whether or not such a generalization can be applied to the later stages of language development, first in terms of the semantics of communications, and then in terms of the formal structure of these communications.

### SEMANTICS OF COMMUNICATIONS

As we might have expected, the young language-acquiring child does not appear to need a conventional language model to guide him in his choice of conversational topics. The young child, hearing or deaf, converses about attribute relations and several types of action relations (actions with and without effects on an object, actions with and without movement toward a new location). Moreover, in conversing about action relations, the young child signs or speaks explicitly about the central figures in these action relations; that is, those who act (actors), those who are acted upon (patients), and those who are acted toward (recipients). On the other hand, at this same moment in development, the child refrains from explicitly mentioning what are assumed to be the less central components of action relations, for example, the time and place of an action, the benefactor of an action, the instrument of an action, and the like.

Our results here receive support from those in the literature on linguistic environment. By correlating mother speech at time I with child acquisition rate from time I to time II, Newport *et al.* (1977) show that the development of basic propositional structure (specifically, the number of true verbs and noun phrases incorporated into each sentence) appears to proceed independently of variations in linguistic input. These aspects of propositional structure, which Newport *et al.* hypothesize to be insensitive to variations in linguistic environment, are found in the deaf subjects' signs (in semantic predicates and cases) and are developed without a linguistic environment. Taken together, these findings suggest that the semantic



structure of early language appears to be due to predispositions of the child (most likely, predispositions to encode linguistically what he knows best), rather than to variations in the linguistic environment.

Although the basic semantic structure of communications appears relatively impervious to variations in linguistic input at the early stages of language development, it is not unreasonable to suppose that semantic structure becomes more sensitive to variations in linguistic input as language learning proceeds. Thus, we might reasonably expect certain gaps in semantics as our deaf subjects grow older. In fact, there is already some evidence that the deaf subjects' lack of a conventional language model has had effects on the semantics of their communications. Recall that there was a developmental delay in the appearance of intransitive relations (that is, actions without objects) in the deaf children's sign system. A comparable delay is not reported for the hearing child learning a conventional spoken language (Bloom *et al.*, 1975; Goldin-Meadow, Seligman, & Gelman, 1976), nor for the deaf child learning a conventional sign language (Newport & Ashbrook, 1977). We suggest that our deaf subjects' relatively late acquisition of intransitive relation phrases is due to the fact that intransitive signs are difficult to create in a manual modality. We recall that the subjects must create signs because they lack conventional linguistic input; they must create manual signs because they are deaf.

To elaborate on this hypothesis, in order to create a sign for the transitive act "hit," all the child need do is, literally, "pull back" from the object of the hitting action and perform the action in vacuo, removed from the object. Thus, in the HIT sign (closed fist swatted in air), the child's hand need represent nothing more than his hand pretending to act on an object. In contrast, to create a sign for the intransitive act "walk," the child can do either of two things: He can use his hand metaphorically, that is, his rhythmically moving fingers can stand for walking legs; or he can create a whole-body sign, for example, wiggle his entire body to simulate walking.

Impediments to both these inventions are readily apparent. In the first instance, the ability to allow the hand or fingers to stand for the walker, runner, or jumper, or other actors undoubtedly requires more cognitive sophistication than allowing the hand simply to represent the hand, as it would do in the iconic gesture for hitting. Alternatively, the clumsy whole-body sign for walking violates certain manual–visual constraints on sign systems—the sign extends beyond the circumscribed area around the face and upper chest where most signing in conventional sign languages occurs (Siple, 1973) and where most of these subjects' signing occurs as well. Thus, both options for inventing intransitive signs in the manual modality appear to have difficulties not found in transitive sign creation. Parenthetically, of the two options, it appears that the second poses fewer problems for the young children in this study, as the children's early intransitive signs were, in fact, whole-body signs (e.g., *WALK* = feet walk in place).

To summarize this hypothesis, the deaf child's semantics of communications may be affected by the absence of linguistic input simply because an absent input forces the child to invent symbols on his own. As pointed out in the preceding paragraph, this symbol creation process, which is carried out by the deaf child in the manual modality, may be particularly difficult to execute for intransitive relations.[32] Thus, at this point in the deaf subjects' development, the absence of linguistic input appears to have had some effect, albeit small (only a slight delay in the onset of one relation type), on the semantics of his communications.

### THE FORMAL STRUCTURE OF COMMUNICATIONS

Not unexpectedly, the early stages of semantic development turned out to be essentially independent of variations in conventional linguistic input. It is rather more surprising to discover that the early development of a structured representation of these semantic contents is also independent of variations in conventional linguistic input. With or without a conventional language, the young child, hearing or deaf, uses formal devices to structure his communications. In particular, at the early stages of language development, both groups of children use at least two syntactic means—ordering devices and production probability devices—to structure the surface forms of their systems. Moreover, the underlying meanings of the child's early communications are also structured, and it is this structure that is systematically related to the surface features of the child's system (specifically, to the production probabilities of semantic elements). Thus, even without a conventional structured input, the child will produce a structured output in order to communicate.

Up to this point the role of linguistic input has been characterized negatively: A child need not be exposed to a conventional language model in order to develop a structured communication system. But what if the child is exposed to a conventional language model? What role does this

[32] An alternative hypothesis to account for the absence of intransitive phrases in the deaf children's sign system posits the effect of an absent linguistic input not on the child's ability to convey intransitive relations, but rather on his ability to conceptualize these relations. According to this "Whorfian" hypothesis, deaf subjects would communicate about intransitive relations later than the child learning a conventional language simply because the deaf children, lacking linguistic input, begin to conceive of these notions later than the conventional language learner does. Whichever of the two hypotheses turns out to be correct, the point to be stressed is that the absence of linguistic input does seem to have had some effect on deaf subjects' content of communications.



model then play in the process of language acquisition? Quite clearly, one function of a conventional language model is to shape the substantive rules of the child's language system. A child may come to the language learning situation with, for instance, a tendency to order symbols. But the substantive ordering rules which this child will eventually learn will be the rules of English if he hears English, Japanese if he hears Japanese, and so on.[33] We have shown here that without a conventional linguistic model the child's ordering rules will tend to be patient-based, as will the rest of his communication system. With a model, however, the ordering rules will follow the particular orders provided by that model. Thus, at the very least, conventional language models serve to separate English-speakers from Japanese-speakers from French-speakers, a worthwhile end from the point of view of the Tower of Babel.

There is additional evidence from the literature on linguistic environment that a conventional language model can have a substantial effect on the development of language structures. Newport *et al.* (1977) in their study of the effects of Motherese, have shown that the development of grammatical functors, such as nominal inflections and verb auxiliaries, is sensitive to variations in mother speech. Using a different technique (an enrichment manipulation), Nelson *et al.* (1973) found a similar result: Enriching a child's linguistic environment with expansions and recast sentences produces selected effects on that child's auxiliary growth. It is precisely these inflectional structures for which there is no evidence in our deaf children's signs. It may be that, for the development of these structures, the linguistic environment is absolutely necessary.

We have now outlined a set of linguistic structures whose acquisition appears to require a linguistic environment and a second set of structures whose acquisition appears independent of a linguistic environment. There may indeed be a middle ground. Some of the language structures whose invention is spontaneous at the early stages of language development may eventually lag in complexity behind those structures developed by children

[33] With no language model to provide conventional linguistic regularities, the deaf children must clearly find their ordering regularities elsewhere. One possibility is that they induce their sign orders from the manual modality. For example, the deaf child may induce his patient–recipient sign ordering tendency from his motoric acts on the world. If the child wishes to transfer an object from one location to another, he must first situate the object and then move it to its new location; in other words, the object (or patient) occurs before the location (or recipient) in the child's manual motor action patterns. McNeill (1974) has argued that motor action schemas of this sort play an important role in organizing a child's phrases even when that child communicates orally and has a language model. He maintains that the structure of the action schemas through which the young child represents his world gives structure to the utterances which the child uses to describe this world.

exposed to linguistic input. Such structures are not yet identified, but as it is unreasonable in the extreme to expect each deaf child on his own to create a language as sophisticated as American Sign Language, these deficiencies will surely appear. When they do, the opportunities for analysis of the cognitive–linguistic interface will become readily apparent.

## SUMMARY AND CONCLUSIONS

The sign system developed by the deaf children in this study resembles other child languages in many respects. This resemblance is of particular interest because it is somewhat unexpected—unexpected because the deaf children had no conventional language models to guide their development, and because, having no conventional adult language to guide analyses, different assumptions were used in classification procedures than are usually made in other child language studies. Thus, when similarities exist in the descriptions of the children's systems, they are found despite our differences in assumptions, and despite the children's differences in language model input. The fact that the results have countered initial expectations has implications for studies and theories of language acquisition, implications that are summarized as follows.

### Descriptive Categories

Since the methods of the study of language acquisition are for the most part interpretive, requiring inferences from both nonlinguistic and linguistic data (e.g., Bloom's method of rich interpretation), researchers are always open to the claim that descriptions of child language describe structure in the adult experimenter's head, not structure in the child's head. Although the results presented here cannot refute this claim, they make the claim less likely. In particular, we have changed some of the ground rules of the descriptive enterprise by changing some of the assumptions underlying classification procedures, yet the outcome of the enterprise remained unchanged. This consistency of description despite inconsistency of method lends validity to child language description in general, and validity to these descriptions in particular.

One outcome of this study, then, is the confirmation of certain descriptive findings already in the child language literature, as well as the introduction of new findings that can be explored more generally in child language studies. Specifically, these results support the use of a semantic analysis (with units such as relation types, cases, predicates, and the like) to describe child language. With respect to surface structure, we have found supporting evidence for syntactic ordering rules; moreover, we have found evidence for an additional syntactic marking device, production probability. With respect to underlying structure, the results support those previous studies that posited underlying structures in child language. The primary contribution of this study has been to suggest that patterns of the surface marking device (production probability) can be used as evidence for the existence of particular underlying structures. From an analysis of these data, we suggest that certain notions that underlie phrases (e.g., transfer, transform, transport, perform) appear to have a greater linguistic (and perhaps more generally cognitive) reality than was heretofore recognized. Finally, we have suggested that case markings (e.g., surface order markings, production probability markings) can be considered at a broader level to determine if children use their syntactic marking devices to systematically group cases according to particular patterns (e.g., accusative or ergative patterns).



### The Flexible Process and Constrained Output of Language Learning

The fact that our deaf subjects had no conventional language yet still developed a language-like system allows some conjectures about the nature of language learning. Language learning is a flexible process with respect to linguistic input; that is, under widely varying input conditions, language acquisition still proceeds. There is evidence from other studies that language learning is flexible with respect to internal factors as well. For example, Lenneberg (1967) 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 and that the language learning capacity early in life survives radical pathologies, such as organic damage to the speech centers in the brain. Thus, language learning appears to be relatively indifferent to individual differences in intelligence and relatively immune to early pathology. Indeed, to date few conditions, either external or internal, have been conclusively shown to be crucial for the learning of language.

This study has added to the evidence that the process of language acquisition is flexible with respect to certain environmental conditions. However, at the same time it calls attention to the fact that the output of this flexible process is remarkably constrained: All children, under vastly varying conditions, acquire the same formal language system during the early stages. Why should there be such consistency? The puzzle of language acquisition has been considered by some theorists (e.g., Chomsky, 1965; Fodor, Bever, & Garrett, 1974) to center around exactly this issue. Even if present, linguistic input, no matter how neat or messy, under-determines the child's output. That is, the language samples that the child hears support a very large number of different generalizations about the language that the child is acquiring. What then narrows down the field of possible generalizations for the child?

It may not be unreasonable to suppose that the child, hearing or deaf, brings to the language learning situation certain predispositions that narrow down the field of potential languages to be acquired. These predispositions need not be mysterious, particularly in the early stages of language acquisition. For example, the fact that the child has four semantic elements in the underlying structure of his phrases when he begins to talk or sign about transfer relations could merely reflect that child's four-part organization of transferrals (i.e., the giver, the given, the given-to, the giving-act) apart from language. Similarly, the child's low actor production probability might be an outgrowth of the child's own view of the communication setting. The child might think, as Greenfield and Smith (1976) have suggested, that the actor is more obvious from the context than the object acted upon (the patient), and therefore, for communicative economy, the child would be less likely to explicitly mention that actor in his here-and-now type of conversations. Of course, as underlying structure becomes less transparently related to surface structure, as in adult grammars, there may be less cause to attribute cognitive or social underpinnings such as these to language structures.

Whatever the explanations of the substantive structures constituting human language, the fact of structured early communication without structured conventional linguistic input is clearly demonstrated here. Even under adverse circumstances, the human child has the natural inclination and the capacity to develop a structured communication system. It is this capacity to make do under less than perfect conditions that allows us to conclude that humans are prepared for language learning, even when their linguistic environments are not prepared for them.

## ACKNOWLEDGMENTS

I thank Heidi Feldman, Rochel Gelman, Henry Gleitman, Lila Gleitman, Janellen Huttenlocher, William Meadow, and Elissa Newport for their clarifying thoughts on nascent sign languages. Thanks also go to Rosalind Charney, Louise Cherry, and Martha McClintock for reading earlier versions of this manuscript, to Lisette Tefo, Barbara Gray, and Lorraine Stepneski for their help in transcribing videotapes, and to the children in the study and their families for their continued cooperation and friendship.

## APPENDIX A: NUMBER OF PHRASES PRODUCED BY EACH CHILD CLASSIFIED ACCORDING TO LENGTH

| *Child and session* | *Number of signs per phrase* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9+* |
| David | | | | | | | | | |
| I | 155 | 31 | 5 | | | | | | |
| II | 101 | 40 | 7 | | | 1 | | | |
| III | 49 | 8 | | | | | | | |
| IV | 198 | 43 | 11 | 7 | 1 | | 1 | | |
| V | 265 | 110 | 45 | 22 | 7 | 6 | 1 | 2 | 3 |
| VI | 129 | 51 | 12 | 5 | 1 | 1 | | | |
| VII | 260 | 131 | 32 | 23 | 9 | 1 | 3 | | 1 |
| VIII | 393 | 116 | 52 | 27 | 8 | 5 | 1 | 4 | 2 |
| Total | 1550 | 530 | 164 | 87 | 26 | 14 | 6 | 6 | 6 |
| Donald | | | | | | | | | |
| I | 10 | 2 | | | | | | | |
| II | 40 | 2 | | | | | | | |
| III | 6 | 1 | | | | | | | |
| IV | 34 | 3 | | | | | | | |
| V | 44 | 6 | | | | | | | |
| VI | 61 | 3 | 2 | | | | | | |
| VII | 24 | 1 | | | | | | | |
| VIII | 128 | 27 | 4 | 2 | | | | | |
| IX | 288 | 52 | 15 | 2 | | | | | |
| X | 203 | 15 | | | | | | | |
| XI | 168 | 39 | 4 | 1 | | | | | |
| Total | 1006 | 151 | 25 | 5 | | | | | |
| Kathy | | | | | | | | | |
| I | 30 | | | | | | | | |
| II | 64 | 1 | | | | | | | |
| III | 83 | 8 | 1 | | | | | | |
| IV | 39 | 1 | | | | | | | |
| V | 72 | 8 | | | | | | | |
| VI | 93 | 13 | 4 | 3 | | | | | |
| VII | 113 | 10 | 1 | 2 | | 1 | | | |
| VIII | 93 | 11 | 6 | | | | | | |
| IX | 85 | 10 | 1 | | | | | | |
| Total | 672 | 62 | 13 | 5 | | 1 | | | |
| Chris | | | | | | | | | |
| I | 111 | 13 | 4 | 1 | | | | | |
| II | 129 | 18 | 1 | 1 | | | | | |
| III | 138 | 19 | 4 | 2 | | | | | |
| Total | 378 | 50 | 9 | 4 | | | | | |
| Dennis | | | | | | | | | |
| I | 68 | 3 | | | | | | | |
| II | 32 | 6 | | | | | | | |
| III | 118 | 14 | 4 | | | | | | |
| IV | 72 | 17 | 1 | | | | | | |
| Total | 290 | 40 | 5 | | | | | | |
| Tracy | | | | | | | | | |
| I | 136 | 36 | 6 | 2 | | | | | |
| II | 212 | 31 | 8 | 1 | 1 | 1 | | | |
| Total | 348 | 67 | 14 | 3 | 1 | 1 | | | |

## APPENDIX B1: DAVID'S ACTION PHRASES PRODUCED DURING SESSIONS I–VIII[34]

### Transfer Phrases

PATIENT-ACT

Ib 46 *cookie–GIVE* (she/sister **give cookie** to me/David)[35]
80 *cards–GIVE* (you/sister **give cards** to me/David)
82 *GIVE–cards–GIVE* (she/sister **give cards** to me/David)
167 *object–GIVE–object* (you/sister **give object** to me/David)
IIa 46 *Play-Doh–GIVE* (you/Heidi **give Play-Doh** to me/David)
b 35 *crown–GIVE* (you/sister **give crown** to me/David)
IVb 189 *hat–GIVE* (you/Susan **give hat** to me/David)
Va 74 *toys–PUSHAWAY* (I/David will **pushaway toys** to there)
b 70 *ball–GIVE–ball–GIVE* (you/Susan **give ball** me/David)
112 *orange–ROLL* (you/Susan **roll orange** to here)
142 *GIVE–lemon* (you/Susan **give lemon** to me/David)
VIa 142 *toybag–LIFTIN* (you/Grandma **liftin toybag** to carriage)
VIIa 18 *TRANSFER–letter* (I/David **transferred letter** here)
29 *GIVE–that–GIVE* (you/Heidi **give that** to me/David)

[34] The phrases included in this and all the following appendices are organized according to relation type, and according to the explicitly signed semantic elements in the phrases irrespective of sign order.

[35] The transcription conventions used in this and all the following appendices are as follows:

1. Each phrase is identified according to the session number (e.g., I) and the tape reel (e.g., b) in which it occurred, and according to its number in the original transcription (e.g., 46).
2. The example should be read from left to right; the sign that occurs first in the temporal sequence is the first entry on the left.
3. The referents of deictic signs are in lower case italic letters (e.g., *cookie*).
4. Capitalized words (e.g., GIVE) are glosses for the referents of characterizing signs. A description of each sign is found in section 2 of each of the appendices, B through G.
5. The sentence in parentheses is an English gloss of the phrase. The boldface words stand for those referents which are explicitly signed in the phrase; the remaining words stand for referents which are omitted from the phrase and which must be inferred from context.
6. Markers, which have not been included in the analyses of this study, occur in some phrases and are shown in brackets in these appendices (e.g., [nod], [SS]). The following abbreviations are used:

| | | |
|---|---|---|
| SS | = | side-to-side headshake to indicate some form of negation. |
| nod | = | up and down head nod to indicate approval or affirmation. |
| MO | = | mouth opens wide to indicate surprise. |
| flip | = | two hands, held out at sides, flip from palm down to palm up to indicate doubt. |
| B reject | = | flat palm flapped in air to indicate rejection or disapproval. |
| naughty | = | fist with extended index finger waved diagonally in air to indicate disapproval. |
| tap | = | flat palm tapped on a person to attract attention. |



38 *GIVE–letter* (you/Heidi **give letter** to me/David)
327 *mask–PUTON* (you/Mother **put mask** on face)
VIIIa 86 *piece–GIVE* (you/Heidi **give piece** to me/David)
308 *toys–PUSHAWAY* (you/Heidi **pushaway toys** to there)
336 *GIVE–GIVE–toy* (you/Heidi **give toy** to me/David)
398 *ball–MOVE* (you/Heidi **move ball** to here)
b 152 *motorcycle–GIVE–motorcycle* (you/Susan **give motorcycle** to me/David)
207 *card–GIVE* (you/Susan **give cards** to me/David)
212 *GIVE–cards* (you/Susan **give cards** to me/David)
231 *cards–GIVE* (you/Susan **give cards** to me/David)

PATIENT–RECIPIENT

Ib 12 *duck–Susan* (you/sister give **duck** to **her/Susan**)
13 *duck–Susan* (you/sister give **duck** to **her/Susan**)
55 *cookie–napkin* (you/sister put **cookie** on **napkin**)
58 *cookie–napkin* (you/sister put **cookie** on **napkin**)
59 *cookie–napkin* (you/sister put **cookie** on **napkin**)
94 *bubbles–table* (you/mother put **bubbles** on **table**)
95 *bubbles–table* (you/mother put **bubbles** on **table**)
IIa 156 *hole–key–hole–key* (I/David put **key** in **hole**)
159 *key–hole–key* (I/David put **key** in **hole**)
b 19 *crown–head* (you/Susan put **crown** on my **head**)
21 *crown–head* (you/Susan put **crown** on my **head**)
23 *crown–David* (you/Susan give **crown** to **me/David**)
31 *crown–David* (you/sister give **crown** to **me/David**)
IVb 205 *kitchen–knife–kitchen* (I/David will put **knife** in **kitchen**)
289 *banana–Susan* (I/David will give **banana** to **you/Susan**)
296 *banana–banana–sister* (I/David will give **banana** to **her/sister**)
Va 1 *socked foot–shoes* (one puts **socked feet** into **shoes**)
81 *track–here* (you/Lisa put **track here**)
138 *hand–block* (you/Lisa put **hand** on **block**)
139 *blocks–tower* (you/Lisa put **blocks** on **tower**)
b 40 *ball–David* (you/Susan give **ball** to **me/David**)
103 *ball–here* (you/Susan bounce **ball** to **here**)
212 *here–here–glass–here* (you/mother put **glass here**)
259 *floor–glass–floor* (I/David will move **glass** to **floor**)
VIa 3 *paper–David* (you/sister give **paper** to **me/David**)
6 *sister–paper* (can I/David give **paper** to **her/sister?**)
40 *frog–floor* (you/Heidi put **frog** on **floor**)
175 *man+boat* (I/David will put **man** in **boat**)
176 [*SS*]–*man+boat* (I/David can't put **man** in **boat**)
203 *foot–ground* (you/Heidi put doll's **foot** on **ground**)
b 60 *pictures–sheet* (you/Heidi put **pictures** in **sheet**)
VIIa 31 *toy–lap* (you/Heidi put **toy** in my **lap**)
45 *bag–here* (you/Heidi put **bag here**)
54 *toy–village* (you/Heidi put **toy** in **village**)
260 *pieces–*[*flip*]*–puzzleboard pieces* (you/Heidi put **pieces** in **puzzleboard**)
VIIIa 23 *piece–puzzleboard* (I/David will put **piece** in **puzzleboard**)
30 *piece–piece–puzzleboard* (I/David will put **piece** in **puzzleboard**)
60 *hat–head* (one puts **hats** on **heads**)
70 *piece–puzzleboard–*[*SS*] (I/David can't put **piece** in **puzzleboard**)
71 *piece–puzzleboard–*[*flip*](I/David can't put **piece** in **puzzleboard**)
111 *juice–David* (she/mother gave **juice** to **me/David**)

395 *head–stem* (you/Heidi put **head** on **stem**)
435 *penny–gun* (you/Heidi put **penny** on **gun**)
438 *penny–gun* (you/Heidi put **penny** on **gun**)
b 36 *penny–slot–penny* (you/Heidi put **penny** in **slot**)

ACT–RECIPIENT

Ib 106 *GIVE–GIVE–David* (you/mother **give** bubbles to **me/David**)
158 *box bottom–PUT–box bottom* (you/Susan **put** cover on **box bottom**)
IIIb 109 *GIVE–David* (you/brother **give** bubbles to **me/David**)
132 *GIVE–David* (you/brother **give** Play-Doh to **me/David**)
IVa 7 *PUTIN–yellowpiece* (you/mother **put** cherry in **yellowpiece**)
125 *PLACE–closet* (you/Heidi **place** coat in **closet**)
Va 225 *GIVE–David* (you/Lisa **give** stick to **me/David**)
b 96 *here–here–BOUNCE–here* (you/Susan **bounce** ball to **here**)
98 *BOUNCE–here* (you/Susan **bounce** ball to **here**)
VIb 28 *GIVE+palm–GIVE* (you/Heidi **give** grape to my **palm**)
VIIb 2 *GIVE–David* (you/sister **give** mask to **me/David**)
13 *GIVE–hole* (you/Heidi **give** key to **hole**)
17 *GIVE–hole–[naughty]–GIVE* (you/Heidi **give** key to **hole**)
VIIIa 89 *GIVE–GIVE–here* (you/Heidi **give** piece **here**)
354 *GIVE–David* (you/Heidi **give** bell to **me/David**)
417 *GIVE–palm* (you/Heidi **give** penny to my **palm**)
b 42 *GIVE–palm* (you/Heidi **give** gum to my **palm**)

RECIPIENT–ACTOR

Ib 60 *sister–napkin* (**you/sister** put cookie on **napkin**)
VIIIb 245 *Susan–David* (**you/Susan** give motorcycle to **me/David**)

PATIENT–ACT–RECIPIENT

Vb 79 *crackers–GIVE–David–GIVE–crackers–GIVE* (you/mother **give crackers** to **me/David**)
115 *cupcake–ROLL–here* (you/Susan **roll cupcake** to **here**)
VIIa 42 *object–MOVE–village–object* (you/Heidi **move object** here onto **village**)
b 88 *book–GIVE–David–book* (you/mother **give book** to **me/David**)
VIIIa 309 *toys–PUSHAWAY–there–toys* (you/Heidi **pushaway toys** to **there**)
366 *mouse–there–MOVE* (you/Heidi **move mouse** to **there**)
b 40 *GIVE–gum–mouth* (you/Heidi **give gum** to my **mouth**)

PATIENT–RECIPIENT–ACTOR

VIIIb 261 *glass–David–glass–kitchen–glass* (**I/David** will transfer **glass** to **kitchen**)

## Transform Phrases

PATIENT–ACT

Ia 300 *duck–TWIST* (you/Susan **twist duck**)
b 22 *cookie–CHEW* (I/David am **chewing cookie**)
86 *bubbles–BLOW* (one **blows bubbles**)



IIa 117 *bubbles–PUFF* (can I/David **puff bubbles?**)
IVa 68 *BLOW–bubbles–[nod]* (can I/David **blow bubbles?**)
127 *can–TURNOVER* (you/sister **turnover can**)
128 *TURNOVER–can–TURNOVER* (you/sister **turnover can**)
Va 48 *PEDAL–bike picture* (one **pedals bicycles**)
54 *bike picture–PEDAL* (one **pedals bicycles**)
60 *ladder picture–CLIMB* (one **climbs ladders**)
62 *ladder picture–CLIMB* (one **climbs ladders**)
65 *ladder picture–CLIMB* (one **climbs ladders**)
73 *horse–RIDE–horse* (one **rides horses**)
76 *ice cream cone picture–LICK* (one **licks ice cream cones**)
140 *block*–SETUP (I/David will **setup blocks**)
179 *CLIMB–ladder* (one **climbs ladders**)
180 *ladder–ladder–CLIMB* (one **climbs ladders**)
205 *PEDAL–bike picture* (one **pedals bicycles**)
217 *lawnmower picture–PUSH* (one **pushes lawnmowers**)
b 170 *TILT–glass picture* (one **tilts glasses**)
178 *knife picture–MOVE BACK and FORTH* (one **moves back and forth knives**)
179 *SCOOP–SCOOP–spoon picture* (one **scoops spoons**)
180 *knife picture–MOVE BACK and FORTH* (one **moves back and forth knives**)
210 *EAT–orange* (one **eats oranges**)
VIa 25 *big kangaroo–CRADLE+[SS]–big kangaroo* (one doesn't **cradle big kangaroos**)
138 *door–RAISE–door–RAISE–door–RAISE* (you/Heidi **raise door**)
145 *OPEN–package* (you/Heidi **open package**)
146 *package–OPEN* (you/Heidi **open package**)
b 16 *foot–TWIST APART* (you/Heidi **twist apart** doll's **foot**)
61 *pictures–TAKE OUT–pictures* (you/Heidi **take out pictures**)
VIIa 95 *carrot picture–NIBBLE* (rabbit **nibbles carrot**)
315 *TAKEOFF–glasses–TAKE OFF–glasses–TAKE OFF–glasses* (you/Heidi **take off** your **glasses**)
322 *TAKE OFF–glasses* (you/Heidi **take off** your **glasses**)
b 3 *TAKE OFF–mask* (you/Heidi **take off** your **mask**)
4 *DEPRESS–key* (you/Heidi **depress key**)
5 *key–DEPRESS–key* (you/Heidi **depress key**)
29 *EAT–food–EAT–food–EAT* (one **eats food**)
42 *banana picture–EAT* (one **eats bananas**)
46 *LICK–ice cream picture* (one **licks ice cream cones**)
62 *grape–EAT* (one **eats grapes**)
80 *key picture–TWIST* (one **twists keys**)
100 *CRADLE–baby picture–CRADLE* (one **cradles babies**)
170 *CRADLE–baby picture* (one **cradles babies**)
VIIIa 5 *drum picture–BEAT* (one **beats drums**)
9 *drum picture–BEAT* (one **beats drums**)
48 *bangs–PUSHUP* (you/Susan **pushup** your **bangs**)
136 *toothbrush picture–MOVE BACK and FORTH* (one **moves back and forth toothbrush**)
145 *car picture–STEER–car picture* (one **steers cars**)
159 *shovel picture–SHOVEL UP and DOWN* (one **shovels up and down shovels**)
201 *HOLD and SPRAY–hose picture–HOLD and SPRAY* (one **holds and sprays hose**)
202 *ladder picture–CLIMB–ladder picture–CLIMB* (one **climbs ladders**)
223 *baby picture–CRADLE* (one **cradles babies**)
230 *icecream picture–LICK* (one **licks icecream cones**)
249 *motorcycle picture–REV–motorcycle picture–REV–motorcycle picture* (one **revs motorcycles**)
394 *ACTON–toy* (can I/David **acton toy?**)

b 11 *guitar–STRUM* (santa **strums guitar**)
35 *lever–DEPRESS* (you/Heidi **depress lever**)
63 *PEDAL–bike picture* (one **pedals bicycles**)
176 *paddle picture–PADDLE* (one **paddles paddle**)
222 *cards–PICKUP* (you/Susan **picked up cards**)

ACT–ACTOR

IVa 81 *HIT–mother* (**you/mother hit** blocks)
97 *HIT–mother* (**you/mother hit** blocks)
b 337 *mother–PATTYCAKE* (**you/mother pattycake** hands)
Va 171 *EAT–Lisa* (will **you/Lisa eat** lunch?)
b 10 *EAT–Lisa* (**you/Lisa** will **eat** lunch)
133 *EAT–Lisa* (**you/Lisa** will **eat** lunch)
134 *EAT–Heidi* (**you/Heidi** will **eat** lunch)
135 *EAT–Susan* (**you/Susan** will **eat** lunch)
158 *bear picture–MOVE BACK and FORTH* (**bear moves back and forth** toothbrush)
182 knife picture–*CUT* (**knives cut** food)
VIIIa 265 *David–DON* (**I/David** will **don** my vest)
294 *TILT–David* (**I/David** will **tilt** glass)

PATIENT–ACTOR

Ia 299 *Susan–duck* (**you/Susan** fix **duck**)
IIb 11 *wand–David* (**I/David** will blow **wand**)
IVb 322 *David–hand* (can **I/David** pattycake your/mother's **hand?**)
Va 177 *bridge–Lisa* (**you/Lisa** knocked over **bridge**)
216 *book–David* (**I/David** will open **book**)
234 *toy–Heidi* + [*nod*] (**you/Heidi** pull **toy**)
b 137 *food–Susan* (**you/Susan** will eat **food**)
VIIb 9 *Heidi–door* (**you/Heidi** open **door**)
VIIIa 412 *toy–Susan–toy* (**you/Susan** work **toy**)
431 *toy–toy–Heidi* (**you/Heidi** work **toy**)
b 20 *gum machine–Heidi* [*nod*] (**you/Heidi** work **gum machines**)
31 *gum machine–Heidi* (**you/Heidi** work **gum machine**)
122 *cowboy picture–straw picture* (**cowboy** sips **straw**)

ACT–PLACE

VIIb 35 *EAT–kitchen* (one **eats** food in the **kitchen**)
53 *outside–PUSH* (will you/Daddy or I/David **push** lawnmower **outside?**)
Va 158 *track*–PUT TOGETHER (you/Lisa **put together** blocks on **track**)

PATIENT–ACT–ACTOR

Va 53 *car picture–STEER–David* (**I/David steer cars**)
111 *car–STEER–car–STEER–Lisa* (**you/Lisa steer cars**)
b 130 *food–EAT–Susan* (**you/Susan** will **eat food**)
VIIIa 150 *lawnmower picture–PUSH–David* (**I/David push lawnmower**)
b 121 *cowboy picture–cup picture–TILT* (**cowboy tilts cup**)



ACT–ACTOR–PLACE

IVa 177 *Susan +CHEW–kitchen +CHEW* (**you/Susan** will **chew** lunch in **kitchen**)
Vb 156 *bear picture–basin picture–WASH* (**bear washes** face in **basin**)

PATIENT–ACT–ACTOR–PLACE

VIIIb 145 *SIP–cowboy picture–straw picture–SIP–cup picture* (**cowboy sips straw** in **cup**)
178 *paddle picture–David–downstairs–David–paddle picture–PADDLE–downstairs–David* [*flip+SS*](**I/David paddle** the **paddle downstairs**)

## Transport Phrases

ACT–ACTOR

Va 46 *truck–DRIVE* (**truck drives** to there)
109 *whistle–MOVE ALONG* (**whistle** should **move along** to here)
117 *MOVE ALONG–whistle* (**whistle** should **move along** to here)
176 *bridge–FALL* (**bridge fell** onto floor)
b 213 *glass–FALL–glass* (**glass** could **fall** onto floor)
VIa 87 *GO–baggage car picture* (**baggage car goes** to there)
VIIa 110 *people picture-GO* (**people go** into airplane)
112 *airplane picture–FLY UP* (**airplane flies up** to there)
113 *airplane picture–FLY UP* (**airplane flies up** to there)
115 *blimp picture–FLY UP* (**blimp flies up** to there)
116 *airplane picture–FLY UP* (**airplane flies up** to there)
117 *airplane picture–FLY UP* (**airplane fli~s up** to there)
119 *car picture–GO* (**car goes** to there)
120 *scooter picture–GO* (**scooter goes** to there)
145 *train picture–GO* (**train goes** to there)
146 *lawnmower picture–GO* (**lawnmower goes** to there)
169 *car–GO* (**car** should **go** to there)
333 *mother–COME* (**you/mother** should **come** to here)
VIIIa 146 *SLIDE–sled picture–SLIDE* (**sled slides** to there)
180 *oar picture–FALL* (**oar falls** to water)
181 *oar picture–FALL* (**oar falls** to water)
363 *MOVE ALONG+[SS]–mouse–MOVE ALONG* (**mouse** should not **move along to here**)
b 21 *gumball–MOVE ALONG* (**gumball** should **move along** to there)
23 *MOVE ALONG–gumball* (**gumball** sh~uld **move along** to there)
34 *MOVE ALONG–gumball* (**gumball** should **move along** to there)

ACT–RECIPIENT

VIIb 131 *GO AWAY–old house picture–GO AWAY–old house picture* (we/family **go away** to **old house**)
132 *old house picture–GO AWAY* (we/family **go away** to **old house**)
164 *old house picture–GO AWAY* (we/family **go away** to **old house**)

RECIPIENT–ACTOR

VIa 140 *us–garage+[SS]* (**us/Heidi and David** do not go into **garage**)
141 [*SS*] *David–garage* (No. **I/David** go into **garage**)
VIIIa 205 *cat picture–trampoline picture* (**cat** jumps to **trampoline**)

ACT–PLACE

VIIa 100 *ladder picture–GO UP* (one goes up there on ladders)
b 69 *GO UP–ladder picture* (one goes up there on ladders)
VIIIa 167 *ladder picture–GO UP* (one goes up there on ladders)
168 *ladder picture–GO UP* (one goes up there on ladders)

ACT–RECIPIENT–ACTOR

Vb 110 *banana–MOVE ALONG–here* (banana should move along to here)

ACT–ACTOR–PLACE

VIIIa 148 *FALL–leaf picture–outside–FALL* (leaves fall to ground outside)

## Perform Phrases

ACT–ACTOR

IIIb 77 *WING–bird* (bird wings)
IVa 178 *father–[SS]–SLEEP* (No. father sleeps)
VIa 41 *frog–JUMP* (frog jumps)
114 *merry-go-round picture–GO AROUND* (merry-go-rounds go around)
VIIa 98 *seesaw picture–RISE UP* (seesaws rise up)
105 *bear picture–PULL UP* (bear pulls up)
106 *merry-go-round picture–GO AROUND* (merry-go-rounds go around)
114 *helicopter rudder picture–GO AROUND* (helicopter rudders go around)
182 *WALK–mouse* (mouse should walk)
254 *balloon picture–FLOAT* (balloons float)
VIIIa 11 *balloon picture–FLOAT* (balloons float)
15 *balloon picture–FLOAT* (balloons float)
105 *DANCE–elephant picture* (elephant dances)
110 *balloon picture–FLOAT* (balloons float)
172 *fish picture–SWIM* (fish swim)
176 *fish picture–SWIM* (fish swim)
238 *Indian picture–POWOW–Indian picture* (Indians powow)

ACT–ACTOR–PLACE

VIIIa 139 *water picture–DIVE–elephant picture–water picture* (elephant dives in the water)



## APPENDIX B2: CHARACTERIZING SIGNS IN DAVID'S ACTION PHRASES PRODUCED DURING SESSIONS I–VIII

| *Gloss* | *Description*[36] | *Occurrences*[37] |
|---|---|---|
| 1. ACT ON | Two A hands, pull back toward self | VIII(1) |
| 2. BEAT | Two A's beat in air | VIII(2) |
| 3. BLOW | O at mouth with lips pursed, blow | I(1), IV(1) |
| 4. BOUNCE | O moves in downward motion at a 45° angle, then moves up at a 135° angle | V(2) |
| 5. CHEW | mouth opens and closes | I(1), IV(1) |
| 6. CLIMB | Two A's climb up in air | V(4), VIII(1) |
| 7. CRADLE | Two A's, arm folded across chest, rock arms from side to side | VI(1), VII(2), VIII(1) |
| 8. CUT | B, palm perpendicular to floor, moves in back and forth motion | V(1) |
| 9. DANCE | Down on all fours, two B palms dance on floor | VIII(1) |
| 10. DEPRESS | G plunged downward | VII(2), VIII(1) |
| 11. DIVE | Two 5's palms touching, tilt forward | VIII(1) |
| 12. DON | Two A's arch forward from shoulders to chest | VIII(1) |
| 13. DRIVE | A glides horizontally | V(1) |
| 14. EAT | O at mouth, touching lips | V(7), VII(4) |
| 15. FALL | B flops over | V(2), VIII(3) |
| 16. FLOAT | B, palm down, rises vertically into the air | VII(1), VIII(3) |
| 17. FLY UP | B rises into air at a 45° angle | VII(5) |
| 18. GIVE | B, palm parallel or perpendicular to ground, arm extended slightly | I(5), II(2), III(2), IV(1), V(4), VI(1), VII(6), VIII(11) |
| 19. GO | B, palm down, slides along | VI(1), VII(6) |
| 20. GO AROUND | B, arm extended, goes around in jerky movements making a circle | VI(1), VII(2) |
| 21. GO AWAY | B moves in an arc out to side | VII(3) |
| 22. GO UP | G moves up into air | VII(2), VIII(2) |
| 23. HIT | A swats in air | IV(2) |
| 24. HOLD & SPRAY | Two A's, one on top of the other, move side to side | VIII(1) |
| 25. JUMP | B, palm down, raises up in quick movement | VI(1) |
| 26. LICK | A at mouth, tongue licks | V(1), VII(1), VIII(1) |
| 27. LIFT IN | Two B's raise up, then move down toward object | VI(1) |
| 28. MOVE | G or B moves back and forth in air | VII(2), VIII(2) |

[36] The signs in this and all following appendices are described in terms of American Sign Language handshapes. The following abbreviations are used (Stokoe, Casterline, & Croneberg, 1965):

A = closed fist
B = flat palm
C = hand arcs in a semi-circle
D = extended index finger, other three fingers and thumb form small circle
G = fist with extended index finger
L = index finger and thumb in right angle
O = fingertips meet thumb forming a circle
5 = palm with fingers spread

[37] In this and all following appendices, Roman numerals indicate the sessions during which the sign was produced; the numbers in parentheses represent the total number of tokens of this sign produced during that session.

| | | |
|---|---|---|
| 29. MOVE ALONG | G moves along path | V(3), VIII(4) |
| 30. MOVE BACK & FORTH | A, palm down, moves horizontally back and forth | V(3), VIII(1) |
| 31. NIBBLE | C at mouth, lips move very quickly in chewing motion | VII(1) |
| 32. OPEN | O twists in take off motion | VI(2) |
| 33. PADDLE | A, arm extended forward, moves quickly up and down | VIII(2) |
| 34. PATTYCAKE | Two B's, palms vertical or perpendicular to ground, held in air | IV(1) |
| 35. PEDAL | Pedal motion with legs | V(3), VIII(1) |
| 36. PICK UP | C moves up and closes | VIII(1) |
| 37. PLACE | B, palm down, move toward object | IV(1) |
| 38. POW WOW | B taps open mouth several times | VIII(1) |
| 39. PUFF | Puffs with mouth | II(1) |
| 40. PULL UP | Two A's, palms down, both slide up, then jerk down | VII(1) |
| 41. PUSH | Two A's, palms down, move horizontally back and forth | V(1), VII(1), VIII(1) |
| 42. PUSH AWAY | B, palm perpendicular to the ground, push movement | V(1), VIII(2) |
| 43. PUSH UP | G flicks up | VIII(1) |
| 44. PUT | B, palm down, pat in air | I(1) |
| 45. PUT IN | B, palm down, fingers tap toward object | IV(1) |
| 46. PUT ON | C, palm facing object, moves toward object | VII(1) |
| 47. PUT TOGETHER | Two O's, out to sides and arms separated, move forward and together | V(1) |
| 48. RAISE | B, palm down, moves up | VI(1) |
| 49. REV | Two A's, each out to the side at shoulder level, quickly turn under in place | VIII(1) |
| 50. RIDE | Two A's, held together in front of trunk, body bobs up and down | V(1) |
| 51. RISE UP | B, palm down, rises up slowly | VII(1) |
| 52. ROLL | B, palm down, brushes along floor | V(2) |
| 53. SCOOP | A, twists at wrist and moves up to mouth | V(1) |
| 54. SET UP | O set down in air | V(1) |
| 55. SHOVEL UP & DOWN | Two A's, one on top of the other, move together up and down | VIII(1) |
| 56. SIP | O at mouth, suck in | VIII(1) |
| 57. SLEEP | Two B's, palms touching, held at cheek and head tilted to one side | IV(1) |
| 58. SLIDE | B, palm down, dips down, then up | VIII(1) |
| 59. STEER | Two A's move in steering motion in air | V(2), VIII(1) |
| 60. STRUM | B strums on chest | VIII(1) |
| 61. SWIM | B, palm perpendicular to ground, wiggles in forward movement | VIII(2) |
| 62. TAKE OFF | O jerks away from object | VII(3) |
| 63. TAKE OUT | A twists in air | VI(1) |
| 64. TILT | C tilts toward mouth | V(1), VIII(2) |
| 65. TRANSFER | G, pointed downward, moves in air toward object | VII(1) |
| 66. TURN OVER | G twist over | IV(2) |
| 67. TWIST | D twists in air | I(1), VII(1) |
| 68. TWIST APART | Two O's twist apart | VI(1) |
| 69. WALK | A bobs on floor | VII(1) |
| 70. WASH | Two B's, palms facing in, move in rubbing motion in air | V(1) |
| 71. WING | Two B's, out to sides, flapping movement | III(2) |



## APPENDIX C1: DONALD'S ACTION PHRASES PRODUCED DURING SESSIONS I–XI

### Transfer Phrases

PATIENT–ACT

| | | |
|---|---|---|
| II | 71 | *GIVE–jar* (you/Robin **give jar** to me/Don) |
| II | 16 | *wand–GIVE–wand* (you/brother **give wand** to me/Don) |
| IV | 53 | *object–GIVE* (you/Robin **give object** to me/Don) |
| Vb | 29 | *microphone–GIVE* (you/Heidi **give microphone** to me/Don) |
| | 32 | *microphone–GIVE* (you/Heidi **give microphone** to me/Don) |
| c | 3 | *GIVE–doll* (you/Heidi **give doll** to me/Don) |
| | 7 | *GIVE–candy bag* (you/brother **give candy bag** to me/Don) |
| | 9 | *GIVE–candy bag* (you/brother **give candy bag** to me/Don) |
| VI | 101 | *helicopter–GIVE* (you/Heidi **give helicopter** to me/Don) |
| VIIIa | 17 | *toy bag–GIVE* (you/Heidi **give toy bag** to me/Don) |
| IXb | 120 | *GIVE–penny* (you/Susan **give penny** onto gum machine) |
| | 151 | *GIVE–penny* (you/Susan **give penny** onto gum machine) |
| Xa | 95 | *GIVE–Mickey Mouse* (you/Heidi **give Mickey Mouse** to me/Don) |
| | 124 | *GIVE–bicycle* (you/Heidi **give bicycle** to me/Don) |
| b | 57 | *[MO+SS+flip] GIVE–other piece* (No. you/Heidi **give** other **piece** to me/Don) |
| | 60 | *puzzle piece [+nod]–GIVE* (Yes. you/Heidi **give** that **piece** to me/Don) |
| XIa | 92 | *GIVE+box [+SS]* (no. you/Heidi **give box to** me/Don) |
| | 98 | *GIVE–box* (you/Heidi **give box** to me/Don) |

PATIENT–RECIPIENT

| | | |
|---|---|---|
| IV | 44 | *lid–can* (I/Don will put **lid** on **can**) |
| | 65 | *balloon–mouth* (you/Robin put **balloon** in your **mouth**) |
| IXa | 103 | *drum–bear* (you/Heidi put **drum** on **bear**) |
| | 162 | *toy head–stick* (you/Heidi put **toy head** on **stick**) |
| b | 75 | *penny–bottle* (you/Susan transfer **penny** to **bottle**) |
| Xb | 22 | *penny [+MO]–gun* (you/Heidi put **penny** on **gun**) |
| | 81 | *duck–table* (you/Heidi put **duck** on **table**) |

ACT–RECIPIENT

| | | |
|---|---|---|
| Vc | 5 | *GIVE–Don* (you/brother **give** candy bag to **me/Don**) |
| VIII | 53 | *GIVE–puzzle board* (you/Susan **give** piece on **puzzle board**) |
| | 54 | *GIVE–puzzle board* (you/Susan **give** piece on **puzzle board**) |
| IXb | 93 | *GIVE–gun* (you/Susan **give** penny onto **gun**) |
| | 122 | *GIVE–gum machine* (you/Susan **give** penny onto **gum machine**) |
| | 127 | *gum machine–GIVE* (you/Susan **give** penny onto **gum machine**) |
| | 129 | *GIVE–gum machine* (you/Susan **give** penny onto **gum machine**) |
| | 136 | *GIVE–gum machine* (you/Heidi **give** penny onto **gum machine**) |
| | 146 | *GIVE–gum machine* (you/Heidi **give** penny onto **gum machine**) |
| | 150 | *GIVE–gum machine* (you/Heidi **give** penny onto **gum machine**) |
| Xa | 9 | *GIVE–puzzle board* (you/Heidi **give** puzzle piece onto **puzzle board**) |
| b | 56 | *GIVE–puzzle board* (you/Heidi **give** puzzle piece onto **puzzle board**) |

PATIENT–ACTOR

IXb 186 *gum machine–Susan–gum machine* (you/Susan give gum machine to me/Don)

RECIPIENT–ACTOR

IXa 110 *[shrug]–Heidi's hand–bear* (you/Heidi put drum on bear)
b 79 *Susan's hand–gun* (you/Susan put penny on gun)

PATIENT–ACT–RECIPIENT

IXb 82 *gun–penny–GIVE* (you/Susan give penny onto gun)

## Transform Phrases

PATIENT–ACT

VIIIa 83 *TIE–laces* (you/Susan tie my laces)
92 *horn picture–BLOW* (one blows horns)
97 *drum picture–BEAT* (one beats drums)
b112 *food picture–EAT* (one eats food)
113 *glass picture–TILT* (one tilts glasses)
115 *birthday cake picture–EAT* (one eats cakes)
171 *ice cream cone picture–EAT* (one eats ice cream cones)
IXa 38 *cat picture–PET* (one pets cats)
48 *pants picture–DON* (bear dons his pants)
88 *drum picture–BEAT* (soldier or bear beats drum)
90 *gun picture–SHOOT* (man shoots gun)
93 *cup picture–LIFTOFF* (one could liftoff cup)
131 *[MO]+tape–TAKEOFF* (you/Heidi takeoff tape)
132 *[MO]+tape–TAKEOFF* (you/Heidi takeoff tape)
139 *STRUM–cello* (santa strums cello)
b 41 *straw picture–SIP* (cowboy sips straw)
85 *gun–SHOOT* (you/Susan shoot gun)
Xa 63 *BLOW–bubbles* (can I/Don blow bubbles?)
XIa 71 *guitar picture–STRUM* (one strums guitars)
79 *SUCK–straw* (cowboy sucks straw)
112 *knob–TWIST* (you/Heidi twist knob)
145 *SQUEEZE–toy* (can I/Don squeeze toy?)
156 *straw–SIP* (brother is sipping straw)
b 55 *oxen picture–RIDE* (bear rides oxen)

ACT–ACTOR

VIIIa 150 *bear picture–WASH* (bear washes his face)

PATIENT–ACTOR

VIIIa 80 *Susan–laces* (you/Susan tie my laces)
IXb 193 *Don–gum machine* (I/Don will pick up gum machine)



ACT–PLACE

IXb 53 *cup picture–SIP–cup picture* (cowboy sips straw in cup)
207 *cup picture–SIP* (cowboy sips straw in cup)

PATIENT–ACT–ACTOR

VIIIb 169 *animal picture–TILT–cup picture* (animal could tilt cup)

## Transport Phrases

ACT–ACTOR

IXa 59 *rabbit picture+[MO]–GO UP–rabbit picture* (rabbit goes up to there on seesaw)
80 *airplane picture–FLY UP* (airplanes fly up to there)
81 *airplane picture–FLY UP* (airplanes fly up to there)
XIa 60 *GO–car picture* (cars go to there)
64 *balloon picture–GO UP* (balloon goes up to there)
b 206 *kite picture–GO UP* (kite goes up to there)

ACT–RECIPIENT

IXa 73 *MOVE–there* (you/Heidi move to there)
b 135 *MOVE–gum machine* (you/Heidi move to gum machine)

## Perform Phrases

ACT–ACTOR

IXa 57 *raccoon picture–TURN* (raccoon turns)
XIa 52 *WALK–duck picture* (duck walks)
67 *butterfly picture–WING* (butterfly wings)
116 *GO AROUND–Pinocchio* (Pinocchio did go around)
b 200 *owl picture–WING* (owls wing)

## APPENDIX C2: CHARACTERIZING SIGNS IN DONALD'S ACTION PHRASES PRODUCED DURING SESSIONS I–XI

| Gloss | Description | Occurrences |
|---|---|---|
| 1. BEAT | 2 A's beat in air | VIII(1), IX(1) |
| 2. BLOW | Index & thumb held at mouth, lips pucker, puff | VIII(1), X(1) |
| 3. DON | B, palm up, scoops forward & up slightly | IX(1) |
| 4. EAT | O at mouth, bobs in & out, bites (optional) | VIII(5) |
| 5. FLY UP | G rises at 45° angle into air | IX(2) |
| 6. GIVE | B, palm parallel or perpendicular to ground, arm extended slightly | I(2), II(1), III(1), IV(1), V(6), VI(1), VIII(2), IX(10), X(6) |
| 7. GO | B, perpendicular to ground, moves sideways in air | XI(1) |
| 8. GO AROUND | O circles in air | XI(1) |
| 9. GO UP | G rises straight up in air | IX(1), XI(2) |
| 10. LIFT OFF | A rises up at 45° angle, then down to ground | IX(1) |
| 11. MOVE | B moves back & forth in air | IX(2) |
| 12. PET | B strikes gently | IX(1) |
| 13. RIDE | 2 A's held together in front of body, bob up & down | XI(1) |
| 14. SHOOT | L closes in air several times | IX(2) |
| 15. SIP | Index & thumb held in air, or mouth, sucks in | IX(3), XI(1) |
| 16. SQUEEZE | 2 O's squeeze in air | XI(1) |
| 17. STRUM | B strums in air | IX(1), XI(1) |
| 18. SUCK | pucker lips, suck in | XI(1) |
| 19. TAKE OFF | B, palm up, twists over in air | IX(2) |
| 20. TIE | O moves down in air, then in small circles | VIII(1) |
| 21. TILT | C tilts toward mouth | VIII(2) |
| 22. TURN | C turns upside down in air | IX(1) |
| 23. TWIST | B, palm down, parallel to ground, twists in air | XI(1) |
| 24. WALK | 2 B's walk in air | XI(1) |
| 25. WASH | 2 A's rub eyes | VIII(1) |
| 26. WING | 2 B's flap at sides, shoulder height | XI(2) |

## APPENDIX D1: KATHY'S ACTION PHRASES PRODUCED DURING SESSIONS I–IX

### Transfer Phrases

PATIENT–ACT

IIIa 109 *[tap]–sandwich–GIVE* (you/Susan **give sandwich** to me/Kathy)
Va 61 *bubble jar–GIVE* (you/Heidi **give bubble jar** to me/Kathy)
VIa 77 *toy–GIVE* (you/Heidi **give toy** to me/Kathy)
VIIa 27 *GIVE–bag* (you/Heidi **give bag** to me/Kathy)
48 *GIVE–toys* (you/Heidi **give toys** to me/Kathy)
58 *GIVE–battery* (you/Heidi **give battery** to me/Kathy)
b 97 *GIVE–candy bag* (you/mother **give candy bag** to me/Kathy)



PATIENT–RECIPIENT

IIIa 12 *keys–head* (you/mother put **keys** on your **head**)
VIIIb 25 *picture–table* (you/Heidi put **picture** on **table**)

ACT–RECIPIENT

Va 37 *GIVE–jar* (you/mother **give** wand to **jar**)
VIIa 56 *GIVE–battery case* (you/Heidi **give** battery to **battery case**)
VIIIa 20 *GIVE–puzzle board* (you/sister **give** piece to **puzzle board**)
23 *MOVE–puzzle board* (you/Heidi **move** piece to **puzzle board**)
66 *santa–MOVE* (you/sister **move** horse onto **santa**)

ACT–ACTOR

IVb 11 *Lisa's arm–GIVE* (**you/Lisa give** grape to me/Kathy)

PATIENT–ACTOR

IIa 4 *mother+dog* (**you/mother** threw **dog** onto floor)

PATIENT–ACT–RECIPIENT

VIIIb 58 *GIVE–piece–puzzle board* (you/Heidi **give piece** to **puzzle board**)
IXa 37 *MOVE–puzzle–Kathy* (you/sister **move puzzle** to **me/Kathy**)

### Transform Phrases

PATIENT–ACT

III 41 *pea picture–CHEW* (one **chews peas**)
VIII 44 *key–[tap]–TWIST* (you/Susan **twist key**)
IXa 24 *drum picture–STRUM* (one **strums drums**)
54 *balloon string picture–HOLD* (one **holds balloon strings**)
58 *guitar picture–STRUM+[nod]* (one **strums guitars**)

ACT–ACTOR

VIIb 114 *SHOOT–Kathy* (**I/Kathy** will **shoot** gun)
IXa 66 *scissors picture–CUT[nod]* (**scissors cut** objects)

PATIENT–ACTOR

Va 32' *wand–mother* (**you/mother** blow **wand**)
32 *wand–mother* (**you/mother** blow **wand**)

## Transport Phrases

ACT–RECIPIENT

VIIb 163 *television–MOVE* (you/Heidi **move** to **television**)

ACT–ACTOR

IVa 45 *toy–MOVE* (**toy** can **move** there)

RECIPIENT–ACTOR

VIIb 146 *Heidi's leg–chair* (**you/Heidi** sit down on **chair**)

## Perform Phrases

ACT–ACTOR

VIIa 24 *WALK–duck–WALK–duck* (**you/duck** will **walk**)
34 *WALK–mouse* (**you/mouse** will **walk**)
VIIIb 42 *object picture–SCAMPER* (**object scampers**)

## APPENDIX D2: CHARACTERIZING SIGNS IN KATHY'S ACTION PHRASES PRODUCED DURING SESSIONS I–IX

| *Gloss* | *Description* | *Occurrences* |
|---|---|---|
| 1. CHEW | Mouth opens wide, tongue out touching upper lip | III(1) |
| 2. CUT | Thumb & index finger form V and cut in air | XI(1) |
| 3. DO | B palm flap toward actor | V(1) |
| 4. GIVE | B extended to desired object | III(1), IV(2), V(1), VI(2), VII(5), VIII(2) |
| 5. HOLD | A in air in hold position | IX(1) |
| 6. MOVE | B or G moves back & forth in air | IV(1), VII(4), VIII(2), IX(1) |
| 7. SCAMPER | 5 finger crab walk | VIII(1) |
| 8. SHOOT | O pulls back in air | VII(1) |
| 9. STRUM | B strums on chest | XI(2) |
| 10. TWIST | O twists in air | VIII(1) |
| 11. WALK | 2 B's flap alternately in air, then slap knees | VII(2) |



## APPENDIX E1: CHRIS'S ACTION PHRASES PRODUCED DURING SESSIONS I–III

## Transfer Phrases

PATIENT–ACT

I 89 *GIVE–toy* (you/Heidi **give toy** to me/Chris)
90 *GIVE–toy+[nod]* (you/Heidi **give toy** to me/Chris)
93 *GIVE–toy+[nod]* (you/Heidi **give toy** to me/Chris)
100 *GIVE–duck* (you/Heidi **give duck** to me/Chris)
186 *toy–GIVE–toy* (you/Heidi **give toy** to me/Chris)

PATIENT–RECIPIENT

II 116 *floor–[nod]–santa toy* (you/Susan put **santa toy** on **floor**)
299 *hat–mother's head* (you/Heidi put **hat** on mother's **head**)
305 *motorcycles–hat* (I/Chris will put **motorcycles** in **hat**)
306 *motorcycles–hat–motorcycles–hat* (I/Chris will put **motorcycles in hat**)

ACT–RECIPIENT

II 296 *mother–TRANSFER+[nod]* (you/Heidi **transfer** watch to **her/mother**)
III 5 *GIVE–table* (you/mother **give** drink to **table**)
6 *GIVE–table* (you/mother **give** drink to **table**)
9 *[B reject+SS] GIVE–Chris* (No. you/Heidi **give** my drink to **me/Chris**)
50 *MOVE–table* (you/Heidi **move** soldier to **table**)

PATIENT–ACT–RECIPIENT

II 147 *box–TRANSFER–toys+[nod]* (you/Susan **transfer toys** to **box**)
III 20 *puzzle piece–MOVE–board–MOVE* (you/Heidi **move piece** to **board**)

## Transform Phrases

PATIENT–ACT

I 99 *toy–LIFT OUT+[nod]* (you/Heidi **lift out toy**)
II 217 *pictures–LEAF THROUGH* (you/Heidi **leaf through pictures**)
276 *package paper–TAKE OFF–[nod]* (you/Heidi **take off paper**)
IIIa 129 *string–PULL* (one can **pull string**)
197 *PEDAL+[nod]–bicycle* (one or santa **pedals bicycles**)
221 *video knob–TWIST* (Barbara **twisted video knob**)
b 24 *television knob–TWIST* (you/Heidi **twist television knob**)

## Transport Phrases

ACT–ACTOR

I 74 *[nod]–water picture–SPRAY UPWARD* (**water spray upward** to house)

ACT–RECIPIENT–ACTOR

I 75 *SPRAY UPWARD–water picture–house picture* (**water spray upward** to **house**)

## Perform Phrases

ACT–ACTOR

II 196 *CIRCLE–santa on bike* (**santa circles**)
III 28 *pinwheel picture–CIRCLE* (**pinwheels circle**)
117 *MARCH–soldier* (**soldier marches**)
222 *MARCH–soldier* (**soldier marches**)

## APPENDIX E2: CHARACTERIZING SIGNS IN CHRIS'S ACTION PHRASES PRODUCED DURING SESSIONS I–III

| *Gloss* | *Description* | *Occurrences* |
|---|---|---|
| 1. CIRCLE | G circles in air | II(1), III(1) |
| 2. GIVE | B arm extended | I(5), III(3) |
| 3. LEAF THROUGH | G flicks up in air several times | II(1) |
| 4. LIFT OUT | B, palm up, moves up & down in air | I(1) |
| 5. MARCH | arms & legs stiffly move back & forth in air | III(2) |
| 6. MOVE | B moves back & forth in air | III(2) |
| 7. PEDAL | hands in handlebar position & feet circle in air | III(1) |
| 8. PULL | Index & thumb pinch together & pull back in air | III(1) |
| 9. SPRAY UPWARD | fist opens to 5 as hand rises | I(2) |
| 10. TAKE OFF | O jabs up & down | II(1) |
| 11. TRANSFER | G sweeps downward or sideways in air | II(2) |
| 12. TWIST | 5 or A twists in air | III(2) |

## APPENDIX F1: DENNIS'S ACTION PHRASES PRODUCED DURING SESSIONS I–IV

## Transfer Phrases

PATIENT–ACT

II 28 *wand–GIVE* (you/Robin **give wand** to me/Dennis)
IVb 146 *car–GIVE* (you/Heidi **give car** to me/Dennis)
148 *car–MOVE* (you/Heidi **move car** to me/Dennis)
77 *clay–MOVE* (you/Heidi **move clay** to me/Dennis)



PATIENT–RECIPIENT

II 1 *key–hole* (I/Dennis will put **key** in **hole**)
IIIa 47 *mother's clay–floor* (you/mother put your **clay** on **floor**)
127 *bubbles in $jar_1$–$jar_2$* (you/mother move **bubbles** to **$jar_2$**)
161 *soda–Dennis* (you/mother give **soda** to **me/Dennis**)
b 196 *clay–outside* (I/Dennis will put **clay outside**)
197 *clay–outside* (I/Dennis will put **clay outside**)

ACT–RECIPIENT

IVa 71 *GIVE–empty* jar (you/mother **give** bubbles to **empty jar**)
b 136 *car–GIVE* (you/mother **give** man to **car**)

PATIENT–ACTOR

IIIa 72 *mother–fruit* (**you/mother** give **fruit** to me/Dennis)

PATIENT–ACT–RECIPIENT

III 128 *bubbles in $jar_1$–$jar_2$–MOVE* (you/mother **move bubbles** to **$jar_2$**)
IV 70 *empty jar–MOVE–bubbles in full jar* (you/mother **move bubbles** to **empty jar**)

PATIENT–ACT–ACTOR

IIIa 71 *mother–fruit–GIVE* (**you/mother give fruit** to me/Dennis)

## Transform Phrases

PATIENT–ACT

II 41 *wand–PUFF AT* (I/Dennis can **puff at wand**)
III 100 *jar–TWIST–jar–[flip]–jar* (you/Susan **twist jar**)
IV 4 *lid–PULL OFF* (you/Heidi **pull off lid**)
6 *lid–TWIST OFF* (you/Heidi **twist off lid**)
57 *nail–HAMMER* (you/mother **hammer nail**)
87 *box–TAKE OUT* (you/Heidi **take out box**)
88 *TAKE OUT–box* (you/Heidi **take out box**)
104 *bubbles–BLOW* (one **blows bubbles**)

PATIENT–ACTOR

IIIa 60 *mother–fruit* (**you/mother** pick up other **fruit**)
61 *mother–fruit* (**you/mother** pick up other **fruit**)

## Transport Phrases

RECIPIENT–ACTOR

IIIa 36 *outside–Dennis–[nod]* (**I/Dennis** will go **outside**)

## APPENDIX F2: CHARACTERIZING SIGNS IN DENNIS'S ACTION PHRASES PRODUCED DURING SESSIONS I–IV

| Gloss | Description | Occurrences |
|---|---|---|
| 1. BLOW | puffs in air | IV(1) |
| 2. GIVE | B arm extended toward desired object | II(1), IV(3) |
| 3. HAMMER | B moves up & down on object | IV(1) |
| 4. PUFF AT | lips tight & loosen twice, verbalization | II(1) |
| 5. PULL OFF | 5 pulls back off object | IV(1) |
| 6. MOVE | G moves back & forth | III(1), IV(3) |
| 7. TAKE OUT | B palm up taps up & down on side of bag | IV(2) |
| 8. TWIST | B, parallel to ground, twists over jar | III(1) |
| 9. TWIST OFF | G flips over in air | IV(1) |

## APPENDIX G1: TRACY'S ACTION PHRASES PRODUCED DURING SESSIONS I–II

### Transfer Phrases

PATIENT–ACT

IIa 139 *GIVE–soldier–GIVE* (you/Susan **give soldier** to me/Tracy)
b 67 *cowboy–MOVE* (you/Heidi **move cowboy** to me/Tracy)

### Transform Phrases

PATIENT–ACT

I 2 *HOLD–telephone–HOLD* (one **holds telephones**)
18 *telephone picture–HOLD* (one **holds telephones**)
19 *HOLD–telephone* (one **holds telephones**)
92 *ladder picture–CLIMB–[flip]* (no one **climbs** this **ladder**)
127 *baggage picture–LIFT* (one **lifts baggage**)
151 *knife picture–MOVE BACK AND FORTH–knife picture–MOVE BACK AND FORTH* (one **moves back and forth knives**)
155 *spoon picture–SCOOP TO MOUTH* (one **scoops to mouth spoon**)
174 *toothbrush picture–MOVE BACK AND FORTH* (one **moves back and forth toothbrushes**)
II 42 *drum picture–BEAT* (one **beats drums**)

ACT–ACTOR

IIa 124 *Susan–TWIST* (**you/Susan twist** key)
b 108 *dog–HIT* (**you/dog** did **hit** me/Tracy)

PATIENT–ACTOR

I 111 *horse picture–TRACY* (**I/Tracy** rode a **horse**)
IIb 109 *rear end–mother* (**you/mother** did hit my/Tracy's **rear end**)



### Transport Phrases

ACT–ACTOR

I 123 *picture of pig–GO OUT* (**pig goes out** to there)

ACTOR–PLACE

II 91 *santa picture–chimney picture–santa picture–chimney picture–santa picture–chimney picture* (**santa** goes down to there in **chimney**)

ACT–ACTOR–PLACE

II 92 *santa picture–chimney picture–GO DOWN* (**santa goes down** to there in **chimney**)

### Perform Phrases

ACT–ACTOR

I 168 *lion picture–ROAR* (**lions roar**)
169 *lion picture–ROAR* (**lions roar**)
171 *lion picture–ROAR* (**lions roar**)
172 *lion picture–ROAR* (**lions roar**)
219 *ferocious animal picture–ROAR* (**ferocious animals roar**)
220 *octopus picture–WRIGGLE* (**octopuses wriggle**)

## APPENDIX G2: CHARACTERIZING SIGNS IN TRACY'S ACTION PHRASES PRODUCED DURING SESSIONS I–II

| Gloss | Description | Occurrences |
|---|---|---|
| 1. BEAT | 5 beats in air | II(1) |
| 2. CLIMB | index & middle finger climb upward | I(1) |
| 3. GIVE | B palm up, arm extended | II(1) |
| 4. GO DOWN | 5 palm down, moves vertically down in air | II(1) |
| 5. GO OUT | G moves sideways in air several times | I(1) |
| 6. HIT | B palm perpendicular to ground slaps in air | II(1) |
| 7. HOLD | A held at ear | I(3) |
| 8. LIFT | 5 rises and lowers slightly in air, fingers wiggling | I(1) |
| 9. MOVE | B moves back & forth | II(1) |
| 10. MOVE BACK AND FORTH | A fist moves back & forth | I(2) |
| 11. ROAR | 5 palm facing out in claw position & roars | I(5) |
| 12. SCOOP TO MOUTH | A moves to mouth | I(1) |
| 13. TWIST | A twists in air | II(1) |
| 14. WRIGGLE | 5 fingers wiggle in air | I(1) |