

# HOW NIM CHIMPSKY CHANGED MY MIND

BY H. S. TERRACE

"Language is no longer the exclusive domain of man," declared an excited ape researcher not long ago. Psychologist Terrace set out to prove it. But after a five-year study of Nim, he says: "I am now dubious . . ."

*"... there was no attraction for me in imitating human beings; I imitated them because I needed a way out, and for no other reason. . . . And so I learned things, gentlemen. Ah, one learns when one has to; one learns when one needs a way out; one learns at all costs."*

"A Report to an Academy"  
—Franz Kafka

In Kafka's short story, a chimpanzee explains how the gift of language made him feel human. For the past decade, a number of psychologists have been presenting evidence that real apes have acquired this gift. According to their reports, more than a dozen chimps, two gorillas, and an orangutan have learned extensive vocabularies in one or another visual language. Even more intriguing are claims that the apes have mastered a fundamental aspect of human language: the ability to create sentences.

How persuasive is the evidence for such claims? The researchers themselves have been clearly positive about their conclusions, which have been the focus of much discussion

both in scientific journals and in the popular press.

According to Beatrice and R. Allen Gardner, who trained a female chimp named Washoe in American Sign Language (ASL), "the results of Project Washoe presented the first serious challenge to the traditional doctrine that only human beings have language." David Premack, who trained a juvenile female chimp, Sarah, to use a series of plastic chips representing words, has reported that "Sarah comprehended (and in a few cases produced) sentences formed by a process more demanding than that of combining phrases." And Duane Rumbaugh,

who taught another female chimp, Lana, to communicate with symbols displayed on a computer terminal and called lexigrams ("Yerkish"), has argued: "Apes spontaneously string word units (signs, lexigrams) together. Additionally, they learned prescribed grammatical rules for ordering strings, thereby demonstrating at least elementary syntactical ability."

If these claims are valid, I might agree with Penny Patterson of Stanford University, whose experience in teaching sign language to a gorilla named Koko led her to declare that "language is no longer the exclusive domain of man." After a five-year re-

search project of my own, however, I am skeptical about such pronouncements. When I began my study with a male chimp called Nim Chimpsky, I hoped to demonstrate that apes can, indeed, form sentences. I wanted to go beyond the anecdotal evidence reported by other studies and show that grammatical rules are needed to describe many of an ape's utterances.

Initially, the regularities I observed in thousands of Nim's communications



Nim makes the sign for nose on cue from author Terrace and Ernie the Muppet.

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in sign language suggested that he was, in fact, using a grammar. However, after analyzing videotapes of his “conversations” with his teachers, I discovered that the sequences of words that looked like sentences were subtle imitations of the teacher’s sequences. I could find no evidence confirming an ape’s grammatical competence, either in my own data or those of others, that could not be explained by simpler processes.

**T**he sentence and the word are the two basic features of human language that separate it from other forms of animal communication. In contrast to the fixed character of most animal sounds, the word is flexible in meaning. Many species of birds, for instance, sing one song when in distress, another when courting a mate, and still another when asserting territorial rights. It does not appear possible to teach birds to produce different songs in these situations.

But human language is most distinctive because of its use of the sentence. A sentence expresses a particular meaning with a set of words and phrases that stand in a particular grammatical relationship to one another. Unlike words, whose meaning can be learned one by one, most sentences are not learned individually. Instead, children master grammatical rules that allow new meanings to be created by arranging or inflecting a set of words, or by substituting one word for another. Having mastered a few subject-verb-object sequences, such as *John hit Bill*, a child readily produces other subject-verb-object sequences without explicit training, such as *Bill hit John*, *John ate the apple*, *Bill chased the cat*, and so on. Psychologists, psycholinguists, and linguists agree that knowing a human language entails knowing a grammar. How else can one account for a child’s ultimate

ability to create an indeterminate number of meaningful sentences from a finite number of words?

In their first efforts to determine whether chimpanzees have similar capabilities, researchers quickly discovered that the chimps could not reproduce spoken language. These failures might be explained by anatomical limitations of the chimpanzee’s vocal tract: it is incapable of producing the broad range of sounds that constitute spoken human language. That is one reason why experimenters attempted to teach them visual languages such as Yerkish and ASL.\*

Washoe, Sarah, and Lana each acquired vocabularies of more than 100 words in their respective languages. Their trainers interpreted these words as they would corresponding words in human languages: names of people, objects, actions, attributes, and various relationships. In more recent studies, other apes have acquired similar vocabularies. Penny Patterson recently reported that Koko has acquired a vocabulary of more than 400 signs of ASL.

The words learned by each of these apes were symbolically arbitrary, in the sense that it was not generally possible to infer their meanings from their form. In Sarah’s language, for example, the word *apple* is a triangular piece of blue plastic. In Yerkish, the word *apple* is a nonsense geometric form on a red background. In ASL, *apple* is made by pressing the knuckle of the index finger into the cheek and twisting forward.

Apes can undoubtedly master larger

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\*It is estimated that ASL is used by more than 500,000 deaf and hearing people in the United States alone. This makes ASL the fourth most frequently used language in the country (after English, Spanish, and Italian). Recent research on sign language shows that it can express any concept or idea that can be expressed in spoken language. Other distinct sign languages exist in many countries: England, France, Israel, China, and Japan, to name a few.

vocabularies and learn them at a faster rate than, say, dogs. However, a dog who learns some arbitrary posture in order to beg, or responds to his master’s command to sit, also demonstrates that it can understand arbitrary words. There is virtually no evidence, though, that domestic animals can produce sequences of the “words” they have been taught, at least not in any systematic manner.

Given that apes have been observed to produce sequences such as *Washoe more eat*, *water bird*, *Mary give Sarah apple*, *please machine give Lana apple*, it is natural to ask whether such sequences were generated by a grammar. It is difficult to answer this question, if for no other reason than that linguists have yet to devise a decisive test of whether a sequence of words constitutes a sentence. Even if an animal produced such a sequence, we could not conclude that it was a sentence. A well-known hypothetical experiment shows why:

Imagine a monkey who has not been taught anything about language pressing the keys of a typewriter in a random manner. Some small fraction of what it types might make sense to an English-speaking reader. In theory, the monkey’s typing could even include a phrase or a sentence written by Shakespeare. It is gratuitous to attribute grammatical competence to a monkey because of a few chance responses on its typewriter. When viewed in the larger perspective of the monkey’s total output, meaningful sequence is seen as a chance utterance.

Another way to perform this experiment is to train the monkey to produce specific sequences in order to obtain a reward. Monkeys, pigeons, and chimpanzees can readily learn such tasks. So can human beings, as when they learn to dial a phone number.

What is important to recognize about variations of the monkey-at-the-typewriter experiment is that nei-

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## “We recorded more than 20,000 of Nim’s sign combinations. At first, many seemed to be primitive sentences.”

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ther the symbols nor the relationships between the symbols have specific meanings. Although the words and word order may be meaningful to an English speaker, they may be meaningless to the animal producing them.

This is not to say that Sarah and Lana did not understand how to use certain symbols in order to obtain a piece of apple. That they clearly could do. What is at issue is whether the chimps related the symbols to their nonverbal understanding of why they were given the food. In sentences like *Mary give Sarah banana* or *machine give Lana Coke*, that understanding does not appear to be based on a perception of the symbols *Mary* and *machine* as subjects, *of give* as a verb, and *of Sarah* and *Lana* as indirect objects. The only symbols that Sarah and Lana varied systematically were the names of the rewards they sought to obtain: *Coke*, *banana*, *movie*, and so on. If Sarah and Lana did not know the meanings of the first three symbols of the sequences they produced, it is erroneous to suppose that they understood the relationship between the symbols. Yet it is just that type of knowledge that would allow one to regard Sarah’s and Lana’s sequences as sentences rather than as a sequence of three nonsense symbols *A*, *B*, and *C*, and one meaningful symbol *X*.

Washoe combined many of her signs without being trained specifically to do so, producing sequences such as *more drink* and *open hurry*. When shown a swan for the first time by Roger Fouts, her main trainer, Washoe signed *water bird*. Since such combinations were not learned by rote training and Washoe was not required to make any of them, Fouts and the Gardners interpreted them as elementary sentences.

That conclusion seems premature, for a number of reasons. One is a flaw in the Gardners’ system of recording data. With one minor exception, they

recorded Washoe’s combinations in only one order: in most cases, this was the order that would be followed in English. But that was not necessarily the order in which she signed. Thus, the combinations *more drink* and *drink more* were both recorded as instances of *more drink*. Since Washoe learned that either *more* or *drink* would be rewarded, it is not surprising that both signs occurred in the same utterance. But *more* and *drink* may not be related grammatically.

Typically, Washoe had to be drilled about the names and attributes of things in her environment. Her response to *what that?* was usually a name; to the question *color that?*, she would respond with an attribute. For answering correctly, the chimp was rewarded with tidbits of food, hugs, brief bouts of tickling, and signed praise. From the account of the occasion when Washoe signed *water bird*, there is no way of knowing why she made these signs. When asked *what that?* in the presence of a swan, she may have first responded *water*. If that was not what the trainer had in mind, it is reasonable to expect that, as a result of previous vocabulary drills, she would then have signed *bird*, which was also appropriate to the situation.

Even if Washoe’s signs were not evoked by questions, one cannot conclude that she created a new meaning by combining the signs *water* and *bird* in a novel manner. Before doing so, it would be necessary to know if she combined other adjectives and nouns in the same way; for example, *red* and *crayon*, or *big* and *doll*. Without such information, there is no way of knowing whether *water* and *bird* are unrelated signs, each appropriate to its context, or a “true” (adjective plus noun) construction.

To decide whether a signing ape can create a sentence, it is necessary to have a record of *all* its utterances during a study. The investigator must

look for evidence that a grammatical rule, such as sign order, was used to communicate different meanings. For example, how frequently did *more* precede the names of a variety of objects and actions when the chimp seemed to want more? How frequently did adjectives precede or follow nouns? Without a thorough record, we are left with only anecdotal examples of an ape’s ability to create sentences—which may not have much more credibility than a passage from Shakespeare typed by a monkey.

**T**he goal of Project Nim, which I started in 1973, was to collect and analyze a large corpus of a chimpanzee’s sign combinations. The subject of the study was an infant male chimpanzee who was born at the Oklahoma Institute for Primate Studies. I chose the name Nim Chimpsky in honor of the well-known linguist who has argued that language is innate and unique to the human species. (Of course, I also had in mind the irony that would result if Nim could, indeed, create sentences.)

Nim was one week old when he was flown to New York in December 1973. He lived initially in a researcher’s home in Manhattan, and later with three of his teachers in a university-owned mansion in the Riverdale section of the Bronx. Nim became the sole student in a small classroom I designed for him in the psychology department at Columbia University. The classroom allowed his teachers to focus his attention more easily than they could in his home. It also provided good opportunities to introduce him to many activities conducive to signing, such as looking at pictures, drawing, and sorting objects.

At home, Nim was treated like a young child. He slept on a loft bed in his own room and was toilet trained by the age of two and a half. My purpose

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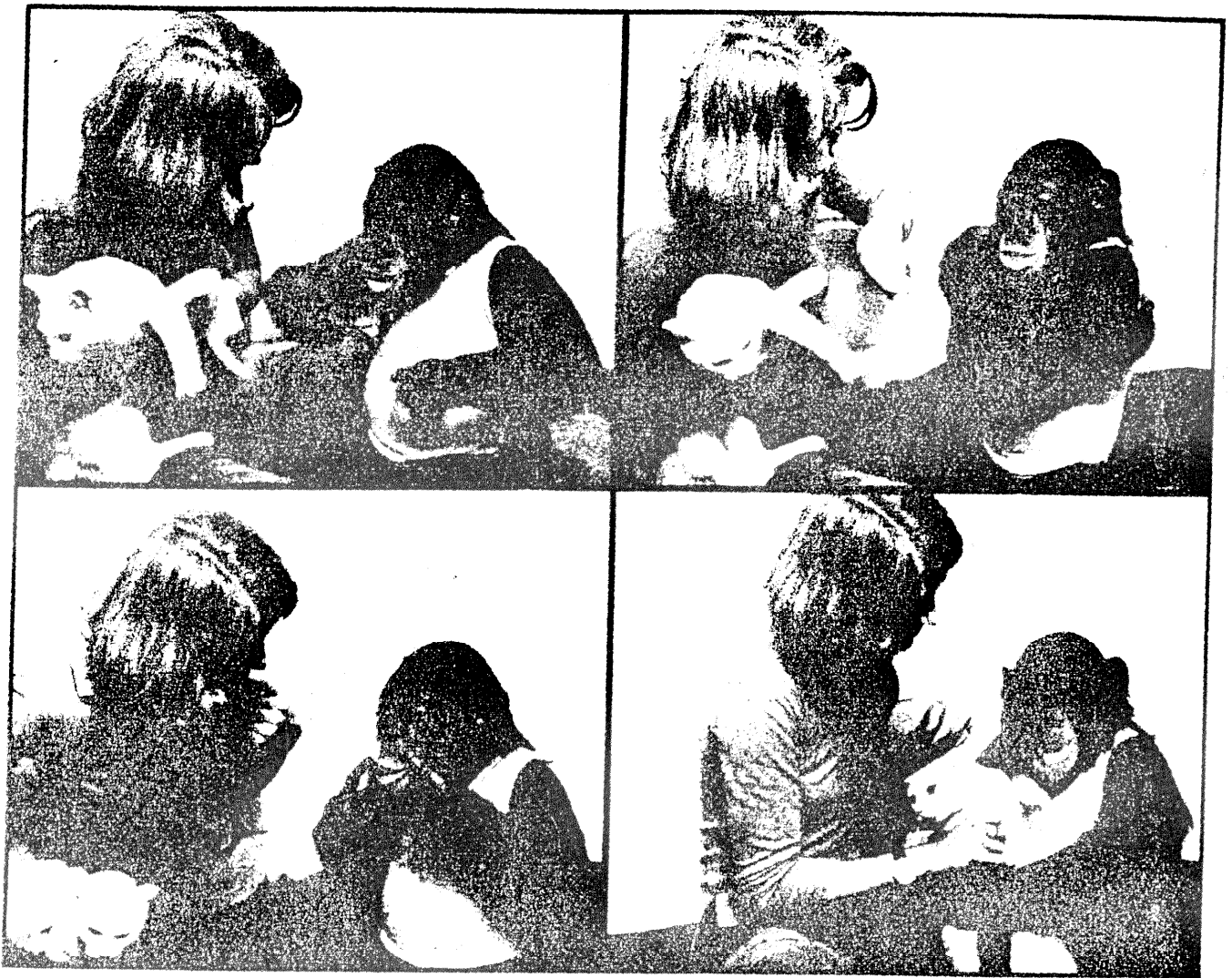
was not to make Nim into a middle-class chimpanzee, but rather to provide him with as many opportunities to sign as possible. Situations in which Nim liked to behave as his teachers did—by dressing, helping to prepare meals, or cleaning up the house—provided natural opportunities for learning signs.

Nim formed particularly close at-

tachments to certain members of the project. I maintained a strong and continuous bond with him throughout the project. During the first 18 months, Stephanie LaFarge, the experienced chimp mother with whom he lived, was the central person in his life. Following his move to Riverdale, he became closely attached to Laura Petitto, an outstanding teacher who

supervised his care at home and in the Columbia classroom. After Laura left, when Nim was 34 months old, he became closely attached to two other resident teachers, Bill Tynan and Joyce Butler.

During the four years he lived in New York, Nim was taught by more than 60 volunteer teachers, as we were unable to pay enough to keep a small



*Nim with researcher Susan Quinby, in one of the sequences indicating the chimp's responses were being cued by his teachers. Nim is making the signs for me (upper left), hug (upper right), cat (bottom left), which at first seemed clearly to be a sentence. When author Terrace reexamined the sequence of photographs some*

*time afterward, he saw the teacher was signing you when Nim was signing me, and she was signing who when the chimp was signing cat. (In drills, Nim had learned to sign cat after who). Since photos do not show continuous movements, however, it's not certain that the teacher's signs preceded the chimp's.*

## “By age three, a child stops imitating its parents’ utterances; by four, Nim’s imitations grew to 54 percent.”

group of skilled, permanent caretakers. At least six people were needed to work with Nim, since it was hard for any one of them to sustain the energy needed to focus his attention and anticipate his reactions for more than five or six hours a day; also, every hour spent with Nim required at least an hour of preparation and record keeping. Because of Nim’s emotional reactions to the many changes in personnel, it became increasingly difficult to command his attention.

Both at home and in the classroom, Nim’s teachers kept careful chronological records of what he signed. During each session, the teacher dictated into a cassette recorder as much information as possible about Nim’s signing and the context of that signing. A one-way window in a wall of the classroom and a concealed opening below that window allowed the project members to observe and videotape Nim and his teachers without being seen. The videotapes proved to be invaluable, enabling us to reevaluate Nim’s performance and to look at details that took too long for teachers to describe during the limited time they had available for dictating.

Nim learned to express 125 signs during the 44 months of the project. Two of the most interesting ones were the signs for *angry* and *bite*, which he often displayed to a person he was about to attack while exhibiting a clear warning of aggression—his lips drawn back to expose his teeth, his hands raised over his head, and his hair standing on end. Having signed *angry* or *bite* in these situations, however, the physical expressions of Nim’s anger subsided. If this observation can be confirmed with other chimpanzees, an important use of human language will have been duplicated by apes: expressing an emotion through symbols rather than physical acts.

Nim learned to sign *dirty* when he needed to use the toilet. He also

learned that this sign had a reliable effect on his teachers’ behavior: the teacher interrupted whatever he or she was doing and took him to the bathroom. On many occasions, Nim signed *dirty* right after he had been taken to the bathroom. At other times, he signed it and then showed no interest in using the toilet. The misuse of *dirty* was often accompanied by a slight grin and an avoidance of eye contact. Typically, it occurred when Nim did not want to cooperate with his teacher or was given a new teacher. Like a child saying, “I need to go to the bathroom” when he or she doesn’t have to go, Nim used the sign *dirty* to manipulate his teachers’ behavior.

Other apes have also learned to use the sign *dirty* to express a need to use the toilet. Indeed, it is claimed that both Washoe and Koko have signed *dirty* as an expletive. Washoe signed *dirty* in the presence of a macaque monkey she did not like, and *dirty* Roger when Roger Fouts refused to take her for a walk. Koko signed *you dirty bad toilet* when she was unjustly accused of having damaged a doll.

Fouts and Penny Patterson have interpreted this use of the word as evidence that apes are capable of cursing. However, a simpler explanation suffices: notice that each presumed use of *dirty* as an expletive occurred in trying situations and that the sign *dirty* was a reliable way, actually the most reliable way, to get the teacher to remove the ape from those situations.

**D**uring a two-year period, Nim’s teachers recorded more than 20,000 of his utterances that consisted of two or more signs. Almost half were two-sign combinations, of which 1,378 were different from one another.

One characteristic of Nim’s two-sign combinations led me to believe they were primitive sentences. In

many cases, Nim used particular signs in either the first or the second position, no matter what other sign he combined it with. For example, *more* occurred in the first position in 85 percent of the two-sign utterances in which *more* appeared (such as *more banana*, *more drink*, *more hug*, and *more tickle*). Of the 348 two-sign combinations containing *give*, 78 percent had it in the first position. There were 946 instances in which a transitive verb (such as *hug*, *tickle*, *give*) was combined with *me* and *Nim*, and in 83 percent of them, the transitive verb occurred in the first position.

These and other regularities in Nim’s two-sign utterances were the first demonstrations of a reliable use of sign order by a chimpanzee. By themselves, however, they do not justify the conclusion that they were created according to grammatical rules: Nim could have simply imitated what his teachers were signing, although at first such an explanation seemed doubtful—for a number of reasons. Nim’s teachers had no reason to sign many of the combinations Nim had produced. Nim asked to be tickled long before he showed any interest in tickling his teacher; thus, there was no reason for the teacher to sign *tickle me* to Nim. Likewise, Nim requested various objects by signing *give + x* (*x* being whatever he wanted) long before he began to offer objects to his teachers. More generally, all of Nim’s teachers had the clear impression that his utterances typically contained signs that we had never used with him.

Other explanations of the regularities of Nim’s two-sign combinations were possible. But the statistical analyses showed that they did not result from Nim’s preferences for using particular signs in the first or second positions of two-sign combinations. And the sheer number of Nim’s combinations—and the regularities in them—makes implausible the hypothesis

## “Chimp ‘language’ appears to have the sole function of requesting rewards that can be got only by signing.”

that Nim, like a monkey at a typewriter, was combining signs at random.

**T**he more I analyzed Nim's combinations, the more certain I felt that I was on solid ground in concluding that they were grammatical and that they were comparable to the first sentences of a child. It was not until Nim was returned to Oklahoma Institute for Primate Studies (when our funds ran out) that I became skeptical of that conclusion. Ironically, it was my newly found freedom from data-collecting and from teaching and looking after the chimp that allowed me and other members of the project to examine Nim's use of sign language more thoroughly.

What emerged from our new analyses was a number of important differences between Nim's and a child's use of language. One of the first facts that troubled me was the absence of any increase in the length of Nim's utterances. During the last two years that Nim was in New York, the average length of his utterances fluctuated between 1.1 and 1.6 signs. That performance is like what children do when they *begin* combining words.

As children get older, the average length of their utterances increases steadily. This is true both of children with normal hearing and of deaf children who sign. After learning to make utterances relating a verb and an object (*eats breakfast*), the child learns to link them into longer utterances relating the subject, verb, and object (*Daddy eats breakfast*). Later, the child learns to elaborate these utterances into statements such as *Daddy didn't eat breakfast*, or, *When will Daddy eat breakfast?*

Despite the steady increase in the size of Nim's vocabulary, the mean length of his utterances did not increase. Although some of his utterances were very long, they were not, as

a rule, very informative. Consider, for example, his longest, which contained 16 signs: *give orange me give eat orange me eat orange give me you*. While a child's longer utterances expand upon the meanings of shorter utterances, this one does not. Furthermore, the maximum length of a child's utterances is related very reliably to their average length. Nim's showed no such relationship.

The most dramatic difference between Nim's and a child's use of language was revealed in a painstaking analysis of videotapes of Nim's and his teacher's signing. A doctoral dissertation written by Richard J. Sanders, one of his teachers, showed that Nim's signing with his teachers bore only a superficial resemblance to a child's conversations with his or her parents. What is more, only 12 percent of Nim's utterances were spontaneous—that is, 88 percent were preceded by a teacher's utterance. A significantly larger proportion of a child's utterances is spontaneous. But even if there were no differences in spontaneity, there were differences in creativity.

As a child gets older, the proportion of utterances that are full or partial imitations of his or her parent's language decreases from less than 20 percent at 21 months to almost zero by the time the child is three years old. When Nim was 26 months old, 38 percent of his utterances were full or partial imitations of his teacher's. By the time he was 44 months old, the proportion had risen to 54 percent.

As children imitate fewer of their parents' utterances, they begin to expand upon what they hear their parents say. At 21 months, 22 percent of a child's utterances add at least one word to the parent's prior utterance; at 36 months, 42 percent are expansions of the parent's prior utterance. Fewer than 10 percent of Nim's utterances recorded during 22 months of videotaping (the last 22 months of the proj-

ect) were expansions. Like the mean length of his utterances, this value remained fairly constant.

The videotapes showed another distinctive feature of Nim's conversations that we had been unaware of. He was as likely to interrupt his teacher's signing as not. In contrast, children interrupt their parents so rarely that interruptions are all but ignored in studies of their language development. A child learns readily what one takes for granted in a two-way conversation: each speaker adds information to the preceding utterance and each speaker takes turns in holding the floor. Nim rarely added information and showed no evidence of turn-taking.

None of the features of Nim's discourse—his lack of spontaneity, his partial imitation of his teacher's signing, his tendency to interrupt—had been noticed by any of his teachers or by the many expert observers who had watched Nim sign. Once I was sure that Nim wasn't imitating what I signed *precisely*, I had felt that it was less important to record the teachers' signs than it was to capture as much as I could about his signing: the context and specific physical movements, what hand he signed with, the order of his signs, and their appropriateness.

We found in our photographs examples of situations in which the teacher's signs had prompted Nim's signs. A careful examination of the series on page 71, which was suggested by the results of our discourse analysis, revealed that Nim's teacher was signing *you* while Nim was signing *me*; she was signing *who* while he was signing *cat*. Because these were the only four photographs taken of this discourse, we cannot specify just when the teacher began her signs. It is not clear, for example, whether the teacher signed *you* simultaneously or immediately prior to Nim's *me*. It is, however, unlikely that the teacher signed *who?* after Nim signed *cat*.