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On the Evidence for Linguistic Abilities in Signing Apes

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F. Patterson (*Brain and Language*, **5**, 56–71) described signing behavior by a gorilla, Koko, which she interpreted as evidence for linguistic abilities in apes. We evaluate her claim with respect to her evidence, additional evidence from other ape language studies, and studies of the sign language of the deaf. We conclude that her report does not include the appropriate data or analyses and that her conclusions are unjustified. Ape signing shows little resemblance to either the speech of hearing children or the signing of deaf children. Some nonlinguistic interpretations of this behavior and methodological issues are considered.

In a recent issue of this journal, Patterson (1978) described the signing behavior of a gorilla subject she had trained. The conclusion she draws from this study is a radical one: ". . . language is no longer the exclusive domain of man." In common with the Gardners, who taught the chimpanzee Washoe (Gardner & Gardner, 1969, 1971, 1975), she believes that apes have learned communicative systems which share significant features with American Sign Language (ASL), the manual–visual language of the North American deaf. This belief is widespread, both within the psychological community (as evidenced by the discussions of ape language in the introductory textbooks) and within the general public (as evidenced by popular television programs on the topic). In this paper, we evaluate Patterson's claims with respect to her evidence and additional information drawn from other ape language studies and studies of ASL in deaf children and adults. We conclude that the strong claim that studies such as Patterson's demonstrate language abilities in nonhuman primates is in error, and that the data cited in support of this claim are compatible with weaker nonlinguistic interpretations.

For an extended discussion of ape signing, see Seidenberg and Petitto (in press). Some of this work was initiated while Laura Petitto was at the Salk Institute for Biological Studies and the University of California, San Diego. She wishes to thank Ursula Bellugi and Edward Klima for the opportunity to work with them and study sign language. We are also very grateful to H. S. Terrace and T. G. Bever. The authors alone are responsible for the contents of this paper. Send reprint requests to M. Seidenberg, Psychology Department, Columbia University, New York, NY 10027.

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Patterson's paper is similar in style and content to those of the Gardners, Fouts (1972, 1977), and others who have studied signing in apes, and her conclusions are nearly identical to theirs. Thus, much of our analysis can be applied to other studies of this kind.

One of the major problems with Patterson's study is that it presents very little data. While several large corpora of the utterances of children have been published (e.g., Bloom, 1973), there is as yet no corpus of any ape's signing behavior. That is, Patterson fails to provide a substantial number of transcribed utterances. Rather, she relies upon individual examples to support her interpretations. In the absence of a corpus of utterances, however, these examples are impossible to interpret. One cannot determine whether they have the functions which Patterson attributes to them, or whether they resulted from the ape acting as a "random sign generator" which happened to emit sequences that could be selectively chosen to illustrate particular points. This sampling problem vitiates Patterson's claim that certain combinations demonstrated that Koko possessed the ability to creatively combine signs into novel utterances. Those who assert that apes have shown linguistic abilities have invariably relied upon examples such as Washoe's signing *water bird* for duck. In the absence of a large corpus, however, these examples are subject to multiple interpretations. Patterson's claim that *cookie rock* was a creative description of a stale sweet roll loses much of its force if Koko also produced utterances such as *cookie tickle*, *cookie hat*, and *toothbrush cookie* in similar contexts. The largest corpus of utterances from any signing ape, that of Terrace, Petitto, and Bever (1976a,b) shows that their subject, a chimpanzee named Nim Chimpsky, did in fact combine each vocabulary sign with a large number of other signs. Although each of the resulting combinations could be interpreted metaphorically, a simpler interpretation is that he merely combined signs randomly. The correct interpretation depends on other information—an accounting of the frequencies with which signs occurred in combination with one another, the contexts in which combinations occurred, the content of the teachers' signing—which Patterson fails to provide. Without this information, the importance of her examples cannot be ascertained.

Patterson's discussion of her *cookie rock* example provides some measure of this problem. She states, "Although Koko has produced uninter-

pretable strings (as do some children), most of her utterances are appropriate to the situation and some are strikingly apt" (p. 88). She then cites some "interpretable" examples, including *cookie rock*; the "uninterpretable" strings are not described. It is the case that only "interpretable" sequences are ever documented in the reports on ape signing. Only by presenting an unedited corpus of responses, however, could Patterson's assertion be validated.

Patterson's quantitative data are also limited. The primary data are a table of Koko's cumulative vocabulary, which increased steadily. Patterson is vague about the methodology used in gathering this information. She states that in the early stages of the project, she relied upon diary notes; later, observations were audiotaped and sessions were videotaped. She does not specify which type(s) of records contributed to her vocabulary count and other data, or whether the diary records were obtained during sessions or afterward. In general, such observational data pose a problem of overattribution which necessitates the use of very careful procedures. Observers may attribute meanings or grammatical functions to movements or utterances which the subject did not intend, using their own knowledge of a language and nonlinguistic contextual information. It has frequently been noted, for example, that parents overattribute linguistic competence to their children. Avoiding mistaken or ill-motivated attributions of linguistic competence is a continuing methodological problem in the study of language acquisition (cf. Bloom, 1970, 1974; Clark, 1973a; Bloom & Lahey, 1978, for discussion). Patterson's data collection procedures perhaps encourage over-attribution because each observer is apparently free to establish his or her own criteria concerning the well-formedness and meaning of Koko's signs. No attempt is made to evaluate or standardize these criteria. Hence, the reliability of Patterson's data is a function of the unknown degree of sensitivity and consistency exhibited by Koko's observers. This degree of subjectivity is not an obligatory feature of observational studies; attributions can be independently evaluated by having videotapes transcribed by multiple observers and cross-verified. Patterson instead appears to have relied primarily on diary data recorded during a session or shortly afterward. Our experiences with a signing chimpanzee indicate that these methods are both much less satisfactory than videotape transcription, since the teacher is intensely involved with the subject during the session, and recollection afterward may not be veridical.

These issues aside, Patterson's cumulative total of signs is interesting only if the signs were in fact utilized with the attributed meanings. Since there is no single test which would establish that the signs were used meaningfully, verification of this assumption requires information from a variety of sources concerning the structure, function, and usage of signs. In conjunction with such information, the cumulative total of signs might possess some meaning. In its absence, however, the vocabulary count is merely ambiguous.

The claim that apes utilize reduced forms of human language rests upon demonstrating that the signs have similar meanings for both ape and experimenter. In Patterson's report and those of the Gardners, however, there is an obvious failure to confront the question of meaning, or consider what evidence might justify the attribution of specific meanings to signs. Two general observations are used to motivate their attributions: first, a correspondence is noted between the form of the apes' behaviors and the form of signs in ASL. Second, it is noted that signs generally appeared in "appropriate" contexts (i.e., they were correlated with certain actions or objects). Neither of these observations provides compelling linguistic evidence, however.

The ape sign language researchers (especially the Gardners) appear to attach great importance to the observation that the apes' behaviors show some resemblance to signs in ASL. In fact, more evidence exists concerning the *forms* of the apes' signs than their *use* of them. The logic operating here appears to be this: when children exhibit these behaviors, meanings and grammatical functions are attributed to them. Since the apes learn similar behaviors, similar attributions are in order. There are at least two problems with this argument, however. First, it is not the form of certain behaviors which qualifies them as "linguistic." Although mynah birds can master the forms of certain spoken utterances, we do not attribute linguistic functions to them because there is no indication that their sounds have the conceptual bases and communicative functions of words in human languages. The distinction between speech and language cannot be abandoned simply because the channel of communication is visual. Second, the apes' behaviors resemble signs in ASL only superficially. The single correspondence is in the use of hand configurations; however, signs in ASL are defined along several other parameters which are not utilized by signing apes (see below).

Even at the level of hand shapes, the degree of correspondence is questionable. An unspecified number of Koko's hand shapes were reduced or modified from the citation forms in ASL because of the ape's lack of manual dexterity and other limitations. From Patterson's discussion (pp. 80–86), it appears that she modified Koko's signs extensively, and that the resulting formational criteria for any given sign were quite loose. She states, "For example, *water* and *rubber* are simplified from the W and X hand configurations [in ASL], respectively, to a forefinger extended from a loose or compact fist" (p. 80). It is clear that Patterson tolerated variations in the form of an individual sign which in ASL would change its meaning entirely. Note that signs modified in this manner are not ASL signs. More importantly, her examples lead one to question how

she could unequivocably determine the "meaning" of a particular hand shape. How, for example, did she determine whether Koko was signing *water* or *rubber*? Similarly, many of Koko's signs were apparently formed by merely pointing (e.g., *this, that, there, you,* etc.). How were these signs differentiated? Patterson glossed one hand movement as the sign "comegimme." *Come, give,* and *me* are three semantically distinct words; in ASL they are physically distinct signs. It appears in this case that Koko used a beckoning gesture which was compatible with both "come" and "gimme" interpretations. Patterson's hedging on the interpretation of this behavior is inconsistent with her assignment of very specific meanings to other signs (e.g., *pound,* in the sense of striking something), and her fine distinctions between highly semantically related signs (e.g., *candy* and *sweet*).

From Patterson's description of her sign modifications, it appears that their effect was to make Koko's signs more homogeneous in structure. This suggests that she relied largely on contextual information in determining the meaning of an individual sign. This would be a rich source of mistaken attributions, since there is no evidence that Koko utilized the same contextual information in producing her signs as Patterson used in interpreting them.

Another group of Koko's signs were "created" by the animal. These were natural ape gestures which Patterson glossed as signs, although they show almost no resemblance to the corresponding signs in ASL. We return to these below.

It is apparent, then, that the argument from the form of the ape's utterances and the form of signs in ASL is quite weak.

The second general observation is that the apes used signs in "appropriate" contexts. However, systematic descriptions of the contexts in which utterances occurred (i.e., the objects or actions that were the referents of particular signs, the eliciting behavior of the teacher, the content of the teachers' signing) are conspicuously absent from both Patterson's report and those of the Gardners. As a result, the critical facts that cannot be determined are these: in judging that an ape used signs "appropriately" in referring to objects, what range of stimuli were permitted as the referents for individual signs, how many signs were accepted as the "correct" names for individual objects, and what were the nature and frequency of errors? How often was a sign correctly used in naming an object or action, how often was the sign used with reference to other objects or actions, and how often were inappropriate signs used to refer to an object or action? In the absence of this information, the claim that the apes "in general" use signs in appropriate contexts is devoid of empirical content.

This observation is ambiguous in another respect as well. The apes could sign contextually appropriate utterances by nonlinguistic means, for

example, imitation. They would merely have to imitate some or all of their teachers' inputs in order to satisfy this general criterion. The possibility that a large proportion of Nim's utterances were produced in this manner is being evaluated by Sanders (Note 1). Note that in none of the published reports on ape signing is any consideration given to the content of the teachers' inputs and their effects on the apes' responses. Although the use of imitation in teaching signs is mentioned by Patterson, the possibility that Koko produced a large proportion of her utterances in this manner is not. Clearly, experimental tests of the apes' abilities to produce contextually appropriate utterances must be devised which control for this possibility. Transcriptions could also be used to determine whether an ape's utterances were highly correlated with its teachers'.

Because Patterson glosses Koko's signs as possessing quite specific meanings, one might assume that the correlations between signs and "appropriate" objects or actions were quite close. Perhaps the hand shape glossed as *tree* was consistently formed in the presence of exemplars from this class of objects, and much less often in the presence of others. Again, however, we are forced to rely upon the author's assertion that the signs were generally used "appropriately," since the contexts in which they occurred are not documented.

Patterson's anecdotal discussions of Koko's use of individual signs do not extend this observation substantially. These discussions largely concern the ape's "overgeneralizations" in the use of signs. She cites, for example, Koko's use of *tree*, which was learned "with reference to acacia branches and celery [and] overgeneralized to asparagus, green onions, and other tall thick objects presented vertically" (p. 83). The putative importance of this example is that children show such overgeneralizations in the acquisition of nominal terms, permitting the inference that they have acquired a concept such as "tall green object." However, in the absence of a detailed characterization of Koko's use of the *tree* sign, the importance of Patterson's example is lost. Fundamental questions are left unanswered: were Koko's "overgeneralizations" specific to objects physically (or conceptually) related to trees, or did she use the sign with reference to a wide range of stimuli, some unknown (and possibly small) proportion of which were related to trees? How consistently were trees or any other objects labeled with the sign *tree*? How often were other signs (e.g., *banana*) incorrectly used to refer to trees? Numerous studies of child language have provided such evidence; they show that the child's overgeneralizations follow a small number of developmental sequences (see Clark, 1973b, for review). Because these sequences are observed, we can infer the kinds of strategies children use in acquiring lexical items, and trace the growth of their cognitive and linguistic abilities. In the case of apes such as Koko, no developmental sequence can be seen because their use of a sign is not documented at any stage.

A consistent pattern of overattribution is seen throughout Patterson's paper. She ascribes very specific meanings to the ape's signs without presenting any discussion of the criteria which led her to conclude that the ape intended these meanings. By attributing specific meanings to Koko's utterances, similarities to human language use are implied where none may in fact exist.

Consider some examples. Patterson attributes to Koko knowledge of the sign *please* (the Gardners attribute this to Washoe as well). The grammar of *please* has interested linguists for some time. We know from Sadock (1974), Gordon and Lakoff (1971), and others that its use follows some very subtle grammatical constraints. Although Koko and Washoe formed hand configurations which their trainers glossed as *please*, no comparison of their use of these signs with the use of *please* in English or ASL is provided. Thus there is no evidence of even the remotest resemblance. Yet by glossing a response as *please*, such a correspondence is implied.

The sign *sorry* is also attributed to Koko and Washoe without any description of its use. The signing chimpanzee studied at Columbia, Nim Chimpsky, also used a hand configuration glossed as *sorry*. This gesture was largely under the control of his teachers' threats. If they appeared ready to punish him, he would sign *sorry*. This sign appeared almost exclusively in contexts where such threat was imminent. We do not mean to suggest that this example is uninteresting; it may be that Nim learned to mediate threatening interactions in a manner unavailable to apes in the wild. However, the inclusion of this sign on lists of the apes' vocabularies—without documentation of its use—leaves the possibly disingenuous implication of a deep isomorphism with the use of *sorry* in English or ASL.

These examples raise the following question: what knowledge do Patterson or the Gardners intend to ascribe to the ape who "knows" these signs? Does the animal who signs *please* understand the human's system of social interaction [e.g., rules of the type described by Goffman (1959), Lakoff (1973), Grice (1975), and others]? Does it understand the concept of politeness? Or was the sign merely a meaningless behavior which the apes learned to emit because it would be highly reinforced or facilitate the presentation of reinforcers? As Bates (1976) has demonstrated, it is possible to empirically study the child's acquisition of polite forms of speech. Bates cites a wide range of data which trace the acquisition of several polite forms (including *please*) in Italian children. She interprets her data within a theory of the child's developing pragmatic competence.

The pattern of overattribution seen in the cases of *sorry* and *please* is seen throughout Patterson's paper, and the reports on ape signing in general. The apes are credited with the knowledge of signs whose meanings are quite abstract (e.g., *happy, sad, good, bad, silly, funny, please, sorry, clean, dirty, quiet, can't, hurry, listen, note, pour, light, big, mine, small*, etc.). Each of these attributions entails strong claims about the apes' cognitive capacities—their perception of the world, ability to make comparative judgments, awareness of self and others, conceptual skills, ability to consciously monitor their own behaviors, and the like—which are vastly underdetermined with respect to the evidence provided. The extensive overattributions in the case of these signs, whose meanings are not exemplified by simple actions or objects, call into question the reliability of Patterson's other attributions as well.

The Gardners—although not Patterson—provide another source of information in support of their attributions of meaning. They performed double-blind vocabulary tests which required Washoe to sign the name of an object (or picture) which the experimenters could not see (Gardner & Gardner, 1971). Washoe's ability to sign particular hand configurations in the presence of particular objects or pictures (or exemplars from classes of objects) has been taken as crucial evidence for chimpanzee language abilities. However, this characterization of the naming process is quite sterile. It suggests that any animal which could be trained to execute a specific behavior in the presence of particular objects would possess the naming ability.

It is quite plausible to assume that even pigeons have this ability. Herrnstein, Loveland, and Cable (1977) have shown that pigeons can give the appearance of having learned simple concepts (e.g., discriminate pictures of trees from pictures of other objects). It would be trivial to teach them to pair the pecking of a particular colored light with the presentation of a picture of a tree. They would then be said to "name" the picture under the above characterization. Furthermore, the ability of Herrnstein et al.'s pigeons to discriminate trees from other objects extended to literally thousands of exemplars. Hence, they possess the capacity to "name" a potentially infinite class of objects.[1]

As this reductio ad absurdum suggests, the analysis of the naming

[1] Several other aspects of the Herrnstein et al. (1977) experiment have interesting implications for ape sign language research. Given the well-known fact that pigeons will generalize a response to physically similar eliciting stimuli, one wonders whether pigeons who had learned the concept "tree" would overgeneralize to pictures of physically related objects (e.g., celery or asparagus) in the manner that Koko overgeneralized her use of *tree* to these objects. Herrnstein et al. note that their birds could discriminate trees from celery. However, the important question is whether a higher proportion of their errors (false positives) would be to stimuli physically or conceptually related to trees. Herrnstein et al.'s experiment was not designed to answer this question. Nonetheless, we expect that such overgeneralization would occur. In light of these considerations, Koko's overgeneralizations can perhaps be interpreted most simply as a stimulus generalization phenomenon, of the type seen in pigeons, obviating the need to invoke language or meaning at all.

process in the ape signing literature is quite superficial. It reflects a failure to recognize the distinction between name and concept. As Nelson (1977) states,

> The basic developmental task [of the child] is to elaborate the cognitive structure and to learn how to match it to the encountered linguistic structure. In other words, the child's task is to develop conceptions and acquire semantics to match.

Discussions of ape language focus on their ability to learn the "semantics" (i.e., hand configurations or "signs"). Unless there is evidence that concepts are mapped onto these movements, their status is simply that of other arbitrary operants.[2]

Note that if these behaviors are merely arbitrary operants, other comparisons to the behavior of standard laboratory animals such as rats and pigeons should be fruitful. Following the Gardners' precedent, Patterson compares the behavior of her gorilla exclusively to the language behavior of humans. The comparisons to lower animals which would provide a necessary baseline for such comparisons are entirely lacking, however, and there have been no attempts to teach laboratory animals the types of sequences learned by the signing apes. Studies such as that of Herrnstein et al. (1977) suggest that pigeons may be capable of discriminating letograms in the Yerkish "language" taught to Rumbaugh's chimp Lana (Rumbaugh, 1977). An experiment by Straub, Seidenberg, Terrace, and Bever (in press) suggests that pigeons may be capable of learning sequences whose structure and function are similar to those of "linguistic" apes (see also Terrace, 1978). These comparisons must be performed in order to evaluate all possible interpretations of ape signing.

Another type of overattribution is seen as well. Each ape's vocabulary includes signs such as *pick* (signed by picking a part of their anatomy), *hug* (signed by hugging), *tickle* (signed by tickling), *kiss* (signed by kissing), *scratch* (signed by scratching), and others. The term "sign" is, in fact, inappropriate since, in contrast to signs, these behaviors do not stand for or represent any referent; they are simply activities exhibited by wild apes (Van Lawick-Goodall, 1968, 1971). In the sign language projects, however, they are glossed as lexical items, with attendant linguistic implications. Estimates of the size of the apes' vocabularies are inflated

[2] The Gardners' vocabulary tests raise other questions as well. First, the results have never been published in toto. Selected aspects of Washoe's performance are described in Gardner and Gardner (1971, 1974), but a comprehensive account of her behavior has not been published. From these descriptions we cannot determine which signs were tested, what test stimuli were used (e.g., what objects were used to test signs such as *clean* or *hurry*?), at what levels Washoe performed, or what types of errors were made. We leave aside problems with the behavioral theory of meaning implied by this test (see Fodor, 1977) and simply note that the discussions of naming and reference in philosophical semantics (e.g., Kaplan, 1972; Kripke, 1972) indicate that the question of naming presents some issues which these sign language researchers fail to confront.

when such activities are glossed as "signs." These behaviors can be termed "linguistic" only under a definition so broad that it would fail to distinguish between human language and the behaviors of many lower animals.

Such examples suggest that neither Patterson nor the Gardners attempt to distinguish between the apes' natural behaviors and their acquired signs. All of the apes' communicative behaviors (and some other ones as well, e.g., scratching) are together glossed as "signs." A coherent discussion of what the apes in these projects have learned, however, requires some independent consideration of their natural modes of communication. This is considered only in passing in the ape signing literature. Patterson notes that:

> Several signs in Koko's vocabulary that appeared without training closely resemble the ASL signs for "come" or "give me," "go," "hurry," and "up." These gestures have been seen in untrained gorillas and may be natural gorilla gestures. They are used by Koko in situations where the meaning seems obvious, and although they are not quite the correct ASL gestures for the corresponding words, I have accepted Koko's forms and transcribe them as though they were correct. (p. 83)

Similarly, the Gardners have stated that:

> We would . . . expect to find natural gestures [in the behavior of chimpanzees] and some of these should be similar to the signs of ASL. If there were more complete information about the natural gestures of captive and wild chimpanzees it would be easier to identify them. Under the circumstances we know that a few of Washoe's gestures could have appeared without specific training, and we guess that this was so for some others. (Gardner & Gardner, 1974, p. 137)

The degree to which Koko's or Washoe's natural gestures were similar in form to ASL signs is uncertain. The sign *hurry* provides a good example of the distinction between an ASL sign and a naturally-occurring gesture in ape behavior. *Hurry* has a very specific form in ASL, requiring a considerable degree of manual dexterity.[3] This sign has no exact counterpart in the natural behavior of apes. Patterson appears to have glossed as *hurry* a behavior exhibited by wild apes when they are excited. The ape lifts its arms and rapidly shakes its hands with limp wrists (see Patterson's Fig. 12). This activity appears in a variety of contexts (e.g., when the ape is agitated, when an object it wishes to possess is being withheld, etc.). Glossing this behavior as the sign *hurry* entails the assumption that the animal is requesting a companion to speed the performance of an implied activity. There is no evidence whatsoever that the animal intends to

[3] *Hurry* is formed in ASL as follows. Hand configuration: index and middle fingers extended from a clenched fist (both hands); location: arms at side of body, arms bent at elbow, palms facing each other; movement: repeated up and down thrusts at the wrists. Koko's *hurry* sign (see Patterson's Fig. 12) also violates ASL grammar because it occurs outside the signing space.

communicate such a request when performing this excitatory behavior. Hence, Patterson's attribution is unjustified.

It is clear that an important experimental control is missing here. In order to deconfound the apes' natural communicative behaviors and the "signs" which they learn, the behavior of an experimental (signing) ape must be compared with that of a control (nonsigning) ape. Two subjects could be raised from infancy in similar environments, given the same amount of interaction with the same humans, and participate in the same types of activities. The experimenters could attempt to teach signs to one ape, and communicate with the other through nonlinguistic vocal and/or nonvocal means. A comparison of experimental and control subjects would then provide an empirical basis on which to judge what the signing ape had learned.

Patterson's and the Gardners' discussions make it clear that they do not distinguish among "gesture," "sign," and "ASL sign." This conceptual confusion is at the heart of the mistaken conclusion that the apes show "linguistic" abilities and utilize ASL. A brief digression on terminology may clarify matters.[4]

The word "gesture" is not a technical or theoretical term. It refers to any movement of the face or body used communicatively. Gestures are termed "paralinguistic" (Duncan, 1969) to distinguish them from linguistic forms such as words. Although sign languages such as ASL are frequently termed "gestural," this imprecise use of the term leaves the misleading impression that they are primarily mimetic or pantomimic. Since the structure of sign languages is not well known, Patterson's use of the vague term "gesture" (as in her title: "The Gestures of a Gorilla: Language Acquisition in Another Pongid") contributes to confusion over both the nature of ASL and the behavior of the apes.

The term "sign" is used in several senses, the most widely accepted being those of Peirce (1932) and Morris (1946). Peirce (1932) defined three types of signs (icons, indices, and symbols) which vary in the relationship between the form of the sign and its referent. In this semiological use of the term, not all signs are linguistic. Smoke, for example, is a sign which indexes fire; in Peirce's theory of signs it is indexical. The word *smoke*, however, is a symbol. Not all signs are symbols, then, and not all symbols are linguistic.

The use of the term "sign" in connection with the units of American Sign Language is somewhat narrower. The structure of each sign in ASL is quite specific, determined by the grammar of the language. Signs are

[4] The terminology of semiology and sign language is far from standard. Many classifications exist other than those we will discuss, and interpretations of these terms vary widely. Nonetheless, as we define these terms, certain differences between the apes' behaviors and signing in ASL should become clearer.

defined along four parameters: location, orientation, hand configuration, and movement (Klima & Bellugi, 1979). The number of primitive elements or distinctive features within each of these is limited; Lane, Boyes-Braem, and Bellugi (1976), for example, have identified 11 basic hand configurations (dez). The phonology and morphology of sign structure and the fact that several types of visual information are used simultaneously distinguish the forms of signs in ASL from paralinguistic gestures. Thus, very few "gestures" are ASL signs, although ASL signs may contain "gestural" elements.

The degree of abstraction between the form of an ASL sign and its meaning varies. This is a matter of continuing research (and some controversy).[5] Bellugi and Klima (1976; Klima & Bellugi, 1979) have distinguished among iconic, abstract, and pantomimic signs in ASL (although this taxonomy is not universally accepted and other types of signs exist as well). Note that this taxonomy is *not* isomorphic with Peirce's taxonomy of signs in the semiological sense of the term. Although both Peirce and Bellugi and Klima term some signs "iconic," the term is used in somewhat different senses. For Peirce, "Anything whatever, be it quality, existant individual, or law, is an Icon of anything, in so far as it is like that thing and used as a sign of it" (Peirce, 1932). Thus both a photograph and a model of a building are icons of the actual building. Iconicity in ASL signs is far more restricted. These signs are defined along the same visual parameters as other ASL signs; however, the form of the sign schematically represents some aspect of the sign's meaning. This relationship may be quite deep. For example, the sign *shoe* is formed by touching two closed fists together side by side with palms down; it is iconic because the motion may be taken to represent clicking two heels together. Bellugi and Klima (1976) have in effect operationally defined iconic signs in two experiments with naive, nonsigning subjects. They found that the meanings of iconic signs cannot be guessed by naive observers, but once given their meanings, they generally agree on their representational bases. For example, subjects could not guess the meaning of the sign for *wood*; however, once told its meaning, they could agree that its basis was "sawing a log." The set of iconic ASL signs is a subset of the much larger set of iconic signs in the Peircean sense.[6]

[5] See papers from the Symposium on Sign Language, MIT, April, 1978.

[6] The existence of iconicity in ASL is sometimes used to argue that it violates one of Hockett's "design features" of human languages (Hockett, 1963) (i.e., the requirement that the forms of linguistic elements be arbitrary with respect to their meanings). This is an issue of some complexity, much beyond the scope of this paper. Note, however, that there is no evidence at this time that the iconicity of signs has any function in the perception, production, or remembering of signs. It has been argued that iconicity is merely a vestige of diachronic processes of sign evolution and reduction (Frishberg, 1975; Battison, 1974), although the matter is again far from settled. It may also be that iconicity is important in the

A set of the apes' signs appear to be indexical (in Peirce's sense). Thes include *eat*, *me*, *you*, *go*, *come*, *brush*, *groom*, *up*, *down*, *give*, *this*, *that there*, and others. The apes also formed each of these by a simple gestur many apparently involve the use of pointing (e.g., they signed *me* b pointing to themselves, *you* by pointing to another, *eat* by pointing to th mouth, *this*, *that* and *there* by pointing to objects, *up* by pointing up, *dow* by pointing down, etc.). Signs formed by pointing are indexical becaus they relate to the actions or objects they denote by being a part of them Each of these signs is contiguous with its denotatum or a physical sampl of it. The claim that the apes used pointing in these ways is a very strong one, since primatologists have not shown agreement on the use of point ing by wild apes (see DeVore, 1965; Jay, 1968; Menzel & Johnson, 1976 The further claim that they used pointing to communicate several semat tically distinct concepts is difficult to document, and unsupported i Patterson's report. If Koko and Washoe used intentional pointing, th would place their communicative behaviors at a level far beyond that o other animals.

In any case, these indexical signs are quite primitive relative to the leve of abstraction seen in human languages. In spoken languages, of cours words are largely symbolic in form, rather than indexical. Some ASL signs are indexical, but they may be distinguished from the apes' indexica signs (if the latter exist) because their structure and use are under gram matical control. The use of pointing, for example, one source of indexical ity in ASL, is not free and unbounded—as is the apes' behavior—bu rather is constrained by various aspects of the grammar of ASL. The sign *me* and *you* may be signed indexically (by pointing) in ASL in certai contexts; however, they are also communicated through nonindexica means (e.g., incorporation of pronouns into verbs) under other circum stances. Thus, the means by which *me* and *you* are expressed is dete mined grammatically. This use of pointing is part of a complex rule governed system which includes establishing loci (Klima & Bellugi, 1979).[1]

The general point is that the existence of representational (i.e., iconic pantomimic, indexical) information in ASL perhaps should not b

acquisition of signs. Furthermore, as Bellugi and Klima (1976) note, the iconic aspect of signs are suppressed through several means; other expressive devices in the langua camouflage this limited representational information. Also note that it has been argued (e.g., by Werner & Kaplan, 1963) that words in spoken languages are not entirely arbitrary in form either (see also Liberman & Prince, 1977). For further discussion of these issues, se Seidenberg and Petitto (in press).

[1] Certain words in spoken languages may be used to refer to objects or locations; these are deictic elements or shifters. However, the words themselves are symbols. Deictic process in both spoken and signed languages are more complex than merely pointing. See, fo example, Fillmore, 1975.

weighted heavily, since it is only one aspect of a grammatical system in which abstract information and numerous expressive devices are utilized as well. The degree of nonarbitrariness in the apes' signs becomes important precisely because they do not utilize these expressive devices and because their behavior does not follow such grammatical rules.

Perhaps the most important fact is that the apes' indexical signs and other behaviors are tied to the presence of objects or the on-going occurrence of activities. There has been no test, and hence there is no evidence, of the apes' abilities to use signs which are displaced relative to their referents. In the absence of such evidence, their behavior cannot be equated with human language use.

To summarize this discussion, activities such as picking or scratching are not signs under any sense of the term, although Patterson glosses them as such. Many of the apes' natural communicative behaviors (commonly termed "gestures") may show some resemblance to the paralinguistic "gestures" utilized by humans, although this is itself an unresolved empirical issue. Signs in ASL are highly determined in their structure; few if any of the apes' natural communicative behaviors are close in form to them. Although some of the apes' behaviors may be similar to some of the formational components of ASL signs (phonological or cherological elements; Stokoe, Casterline, & Croneberg, 1975), there is no indication that any of their gestures show the exact configurations of hand shape, movement, orientation, and location which characterize signs in ASL. Although Patterson uses the observation that the apes' gestures are "similar" to signs in ASL to support her contention that they were used linguistically, this similarity exists at a very primitive level.

The differences between the apes' behaviors and signing in ASL are profound. It is the failure to seriously consider the structure of ASL and human languages in general which yields the conclusion that apes can learn aspects of them. These differences are especially clear when the deaf child's use of ASL is compared to the apes' behaviors. Deaf children use sign language to converse, ask questions, generate ideas, learn, comment about the world around them, and relate to other people. Their signing is spontaneous, interactive, and inquisitive. All available information—including our own experiences with a signing chimpanzee—indicates that the apes' signing is reactive, manipulated, coerced. Signing must be imposed on these animals, and maintained through the use of intensive, intrusive training procedures.

Deaf children begin to learn the structures and expressive devices of adult ASL at very early stages in the acquisition process (Hoffmeister, Moores, & Best, 1974; Petitto, Note 2; Klima & Bellugi, 1979). For example, signers use the space around them (the "signing space") in many ways, one of which is termed "establishing loci." In a conversa-

tion, a signer will locate a noun (e.g., the name of a person, object or location) in the signing space by pointing or signing at a particular (metaphoric) location. Among other functions, this elegant system permits pronominal reference to be accomplished by merely re-pointing to the same location in space. The use of loci is governed by syntactic rules; thus, it is ungrammatical in some cases to sign the name of an object rather than point to its locus in space, much as it is sometimes ungrammatical in English to fail to pronominalize. In deaf children, use of the locus system is acquired progressively (Petitto, Note 2). At early stages, they will sign on or toward an actual object or location, moving around a room if necessary, rather than placing it within the signing space. In discussing an activity completed at his school, one deaf child who we studied signed in the school's general direction (out of the signing space and over his shoulder) rather than placing it at a metaphoric location in the proximal signing space. Over time, he brought his signs into the signing space and learned to use abstract loci. Although the apes in the signing projects were intensively trained for a period of years, purportedly in ASL, they never acquired use of this system. In the deaf child, it emerges through nonintrusive, natural conversation; it is not explicitly taught.

Another device in ASL is the use of eye gaze, facial expressions, and body shifts in conjunction with signed utterances. These serve a wide variety of linguistic functions, and follow a complex set of grammatical rules (see, for example, Liddell, 1978). While primates use facial expressions and eye gaze as part of their natural conmunicative system (van Lawick-Goodall, 1968; Hewes, 1976), they are not used conventionally to modulate sign meanings, as in ASL. This again suggests that signing apes are not utilizing ASL; it also suggests that there may be constraints on the malleability of the ape's natural communicative system which should be investigated further.

The claim that the apes utilize ASL requires evidence that they use the structures and expressive devices which characterize the language. No such evidence exists. In fact, the discussions of ASL in the ape signing literature are uniformly superficial. Patterson describes ASL as "the gestural language used by the deaf in North America [which] consists of both a rule-based syntactic system and a lexicon or vocabulary of signs, analogous to spoken language" (p. 74). This is a highly simplified view of both spoken and signed languages. Some of Patterson's other statements about ASL are misleading. In discussing the issue of word order (p. 91), she quotes Bellugi (1975) as stating that "American Sign Language has relatively free word order within the basic phrases." In Patterson's context, this leaves the mistaken impression that sign order is free in ASL. However, the issue of sign order is much more complex than Patterson acknowledges (see McIntre, Note 3).

In the same discussion she states that:

> certain signs [in ASL] may be produced simultaneously, thus leaving word order indeterminate. Koko began signing words simultaneously during the first few months of the project . . . and now frequently signs as many as three or four words at the same time, for example "me-up-hurry" . . . and "hurry-pour-there-drink". Adult signers rarely exploit this possibility in daily discourse; in fact, they may plan or even rehearse simultaneous signing for use in wit or poetry. (Bellugi, 1975)

Patterson is somewhat unclear about the facts of ASL. Signs in ASL are almost never produced simultaneously in the sense of a lexical sign being produced by each hand independently at the same time. Signers may rapidly shift from one hand to the other and one sign may flow into another, but forming two distinct lexical signs at once is difficult and rarely done. Rather, signers may modify the form of a single sign or combine elements of two signs into a single unit in order to convey multiple *meanings* simultaneously. It is the deliberate exploitation of visual ambiguity which Klima and Bellugi (1975) have observed in the wit and poetry of signing in ASL. Wit derives from the fact that the multiple meanings may be related in a humorous way.

Bellugi (1975; Klima & Bellugi, 1979) uses the term "simultaneous" in another sense differing from Patterson's. Information which in spoken languages such as English is expressed sequentially (i.e., through the linear ordering of morphemes) is communicated nonsequentially in ASL. The modulations and inflections on signs which convey such information are superimposed on the citation form of the sign, that is, they are part of its occurrence, and hence simultaneous with it. There is no evidence that the apes learned modulations or inflections on signs. Thus, Bellugi uses the term "simultaneous" in two senses which have no relevance to the apes' behavior.[8]

If the citation forms of ASL are followed, it is physically impossible to simultaneously sign "me-up-hurry" or "hurry-pour-there-drink." It is also questionable whether Patterson had any empirical basis on which to unambiguously ascertain that the ape was forming three or four semantically and, in ASL, physically distinct signs together.

[8] We should note that Patterson's quotation (p. 73) from Morton (1970) is also misleading. She cites Bever (1970) and Morton (1970) as having expressed ideas similar to her observation that "certain aspects of man's linguistic abilities are not species specific as previously assumed . . . but are based on cognitive capacities held in common with the chimpanzee." Her syntax leaves the impression that Bever and Morton believe that these underlying cognitive capacities are common to chimpanzees and humans. This is to thoroughly misconstrue these authors' views. Both observe that the structure of human languages is determined by the nature of human cognitive capacities; linguistic universals are a consequence of the fact that certain cognitive capacities are innate and universal. This is the force of Morton's statement (quoted by Patterson) that "what is innate is not language specific and that the universals (of language) are universals of cognition." Neither Bever nor Morton has suggested that these cognitive capacities are held in common with any other species; they explicitly *reject* this view.

Other confusions concerning ASL are seen in Patterson's assertion that she simultaneously used ASL and spoken English in communicating with Koko. The syntax of ASL is radically different from the syntax of English. Signing in ASL is distinguished from other types of signing (e.g., Signed English, Pidgin Signed English, Siglish, etc.) by its unique grammar (including its syntax). Even for hearing persons who are fluent in both languages, it is very difficult to speak an utterance in English while signing it in ASL syntax. English (*not* ASL) syntax is typically used when an utterance is both signed and spoken (as may occur in translating or interpreting). The use of ASL signs with English syntax is termed "Signed English;" it is not ASL nor is it a language but rather a code for representing English. It is questionable, then, whether Koko was provided with ASL as a model for her signing.

Note that the use of simultaneous manual–oral communication complicates the interpretation of Koko's behavior. In particular, it is difficult to evaluate the ape's ability to comprehend signs when multiple cues are available. Koko's behavior could occur in response to a sign, a vocalization, or some combination of the two, or to paralinguistic cues such as body movements and pointing. Sign production might also be tied to any of these (e.g., the ape could sign in response to spoken words). It is clear, then, that in the presence of both manual and oral cues, it would be possible for the ape to both respond to signs and produce them without comprehending the teachers' signed input. The ape's relative dependence on different types of information must be evaluated through careful empirical tests which control for cuing along different dimensions. Patterson does not provide such tests. In fact, none of the ape signing reports includes any test of the animals' abilities to comprehend signs; they are exclusively concerned with production. Thus there is no rigorous evidence that they understand any signs. Since comprehension is a fundamental aspect of linguistic communication, it is essential that such tests be performed.

Given the rich sources of nonlinguistic cuing in Koko's environment, considerable caution must be exercised before claiming that she comprehended a particular sign or was using it "spontaneously" and "appropriately."[9]

Rather than showing similarities to ASL, Koko's behavior resembles the prelinguistic communication of very young children. Bates (1976) observes that the early vocal and visual gestures of infants reflect their growing awareness of the pragmatics of communicative behavior (i.e., knowledge of relationships between the forms of communicative behaviors and the contexts in which they occur). They learn, for example, that sounds and movements can influence the behavior of others, and that

[9] For discussions of nonlinguistic cuing in tests of comprehension and production, see Clark, 1973a; Chapman, 1974, 1977; Bloom and Lahey, 1978.

they can effect certain ends by these means. Knowledge of the pragmatic functions of sounds and movements is acquired before the child understands the linguistic function of words. Bloom and Lahey (1978) state:

> As emphasized by Piaget (1954), the fact that children use the forms of social convention (speech and gesture) is not evidence that they are capable of the social and rational thought from which such conventions originate. . . . Thus, children perform social gestures and produce social (conventional) sounds as new means or resources for meeting their needs, without awareness of their origin or social significance. (p. 204)

A pragmatic analysis seems to fit ape signing quite well. The apes appear to have learned not the meanings and linguistic functions of their signs, but rather the consequences of particular acts of signing. They know that forming certain signs will have immediate benefits (e.g., someone will give them food or a toy, take them to the bathroom or perform some other positively reinforcing act). As the work of Piaget, Werner and Kaplan (1963), Bates (1976), and others indicates, it can be determined through sensitive longitudinal observation that the child's early gestures and words do not have specific meanings, but only a range of pragmatic functions. This describes the nature of ape utterances quite accurately.

Since Bates and others have hypothesized that the child's level of pragmatic and linguistic competence is a function of his stage in cognitive development, it would be extremely interesting to analyze the apes' communicative behaviors in terms of cognitive growth. One would expect the limitations on their communicative capacities to be related to limitations on their cognitive capacities. This is an important area for future study (see also Chevalier-Skolnikoff, 1976).

Patterson's other major conclusions concern the semantic and syntactic categories of Koko's signs. In Table 1, she has fit Koko's vocabulary signs into nine syntactic categories (e.g., proper nouns, pronouns, verbs, prepositions). Her Table 2 includes 11 semantic relations purportedly expressed by Koko's utterances (e.g, nominative, locative, genitive). The latter categories derive fron Fillmore's case grammar (1968) and have been widely used in analyses of child language (Brown, 1973). Patterson asserts that Koko's utterances expressed these syntactic functions and semantic relations but provides no discussion of the evidence which motivated her conclusions. It is remarkable that these are attributed without a minimum of evidence. Note that such classifications are by no means obvious; for example, how did Patterson determine the syntactic function of signs such as *bite* or *hug* which are ambiguous in adult speech between noun and verb senses? Similarly, as Bloom's famous *Mommy sock* example demonstrates, a single utterance may express multiple semantic relations. Determining which relation a child or ape expressed requires detailed contextual analyses which Patterson does not report. Hence, her distribution of signs into classes has no apparent basis in fact, and her comparisons to child language are invalid.

Because Patterson does not provide distributional analyses of Koko's signed utterances, it cannot be determined whether her sequences were heterogeneous or stereotypic; the raw number of signs produced is less impressive, of course, if they appeared in a relatively small number of standard chains, or were combined randomly. Distributional data would also reveal whether she had preferences for particular signs or classes of signs, and whether she utilized specific strategies in combining signs. Data from Gardner and Gardner (1975) and Terrace et al. (1976a,b) indicate, for example, that chimpanzee signing is highly repetitive. The Gardners eliminated one or more repetitions and other signs from 46% of Washoe's responses to a test of her ability to answer questions. Terrace et al.'s corpus indicates that Nim's signing was also highly repetitive (e.g., *banana me banana me give*). His strings of signs were as long as 20 including repetitions. Patterson notes that Koko's strings reached as long as 11, but provides no further analyses. The length of these strings is interesting in light of the typically telegraphic nature of the utterances of children (Bloom, 1970; Brown, 1973; Petitto, Note 2). While children in the early stages of language acquisition produce utterances that are reduced relative to the corresponding adult forms (e.g., *Mommy sock*), apes repetitiously expand. When children's utterances are long, they typically show hierarchical infrastructures which have never been demonstrated in ape sequences (Limber, 1977). Thus, when it is available, this type of information demonstrates substantial differences between the form of ape sequences and those of children.

Instead of providing systematic distributional data, Patterson presents anecdotes which suggest that Koko combined some signs in consistent linear orders. However, as with the *cookie rock* anecdotes, these examples are uninterpretable in the absence of other data. Although Patterson does not mention syntax explicity, her discussion of word order leaves the impression that Koko's linear ordering of certain signs provides evidence for her syntactic ability. However, the linear or temporal ordering of discrete behaviors is not the sine qua non of syntax. Rather, to demonstrate that Koko was using syntactic organization, Patterson must show that (a) individual signs have particular meanings, and (b) that different linear orderings of signs have different meanings (e.g., *You listen me* does not mean the same as *Me listen you*). As we have seen, there is good reason to doubt whether Koko's individual signs had the meanings ascribed to them, and there is no indication that different combinations had different meanings. Hence, there is no evidence for syntax or contrastive use of sign order at this time.

In summary, then, we have claimed that Patterson's conclusions are not supported by the appropriate data or analyses. The fragmentary data which she presents are subject to alternative interpretations which do not require the radical conclusion that apes are able to learn aspects of human languages, particularly ASL. What is seen throughout her paper (and discussions of ape "language" in general) is a failure to seriously consider the significant questions of psycholinguistics: what are languages, how do they differ from other communicative systems, how may they be analyzed, how are they learned, and how may we attribute a particular linguistic skill to a child or ape in the process of acquiring a language? In the absence of a serious discussion of these issues, the claim that "language is no longer the exclusive domain of man" is moot.

Finally, it is clear that apes are extremely intelligent, and that the study of their cognitive, communicative, and social behaviors may provide an important perspective on human behavior. It may be the case that current studies of ape signing underestimate their abilities by narrowly focusing on one aspect of their behavior (i.e., their ability to learn sign sequences). Further research on their natural abilities and behaviors may ultimately prove more revealing about both apes and humans than attempts to impose restricted forms of sign language upon them.

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