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**Communication, Symbolic Communication, and Language: Reply to Seidenberg and Petitto**

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Seidenberg and Petitto's ( 1987) assertion that Kanzi and Mulika'slex.igram usage is not representa­ tional is evaluated by contrasting their abilities with Nim's. Kanzi and Mulika'sdata indicate that they (a) comprehend spoken English words; (b) can identify lexigram symbols when they hear these words; (c)can comprehend lexigram usage; (d) can use lexigrams when referents are absent and can, if asked, lead someone tothe referent; and (e) that all these skills were acquired through observation, not conditioning. Nim evidenced no comprehension of signs and could not use signswhen referents were absent. He was forced to sign and encouraged to imitate his teachers.Seidenberg and Petitto's negative experiences with Nim apparently led them to overgeneralize to all other apes, regardless of species, modality, or training history.Consequently, they unjustifiably disregard important compo­ nents of Kanzi and Mulika's comprehension data which demonstrate that their lexical knowledge could not have been acquired in an instrumental fashion.

The main thrust of Seidenberg and Petitto's ( 1987) critique focuses on the nature of Kanzi and Mu1ika's symbol usage. We view Kanzi and Mulika's symbol usage as representational, whereas they, as a result of their personal association with Nim, conclude that Kanzi's and Mulika's symbol usage must be sim­ ply instrumental. Is this difference in perspective an important one to resolve? Can it be dearly resolved on the basis of avail­ able data? The answer to both questions is yes.

The goal of the Language Research Center has been to de­ velop programs which go beyond the limitations of instrumen­ tally conditioned response patterns, to communications that are representational (Savage-Rumbaugh, 1986). The issue of representational symbol usage has been the focus of our re­ search program across the past JO years. While there is not space here to review that work indetail, it would seem appropri­ ate to cover some of the major findings.

Our initial work with common chimpanzees *(Pan troglo­ dytes)* Jed us to conclude that symbolic skills were acquired by chimpanzees only after considerable training (Savage-Rum­ baugh, 1979; Savage-Rumbaugh & Rumbaugh, 1979; Savage­ Rumbaugh, Rumbaugh, & Boysen, 1980). We found, in agree­ ment with Seidenberg and Petitto, that common chimpanzees tended to acquire symbols in a very instrumental manner.They learned symbols only when they could not otherwise obtain a desired object or event (Savage-Rumbaugh, 1986).

One critical language ski11 that our common chimpanzees

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lacked wasan ability to comprehend and respond reliably to the use of symbolsby others. Although research reports stated that Washoe and Nim understood many more signs than they pro­ duced, data were not presented to support these assertions (Gardner & Gardner, 1971; Terrace, 1979). The lack of recep­ tive capacity became evident to us as we attempted to establish symbolic communication between Sherman and Austin (Sav­ age-Rumbaugh, 1979, 1984). These attempts revealed that although Sherman and Austin were competent "senders" of symbolic messages, they were incompetent "listeners" or "re­ ceivers."

We analyzed a videotape of Nim's signing and found his lack of receptive skins to be self-evident (Savage-Rumbaugh & Sev­ cik, 1984.) It appeared that Nim could sign '"apple" and "ba­ nana" when he first saw these fruits. Yet later, when he was shown the same banana and asked "What'sthis?" hewas unable to decode the signed question. He answered "name,"apparently recalling that when Petitto had held up the banana previously she had signed "Name you name."Nim also evidenced an in­ ability to receptively decode the signs "apple" and "banana" when Pettito asked him to place a slice of banana with other slices of banana and a slice of apple with other slices of apple. His behavior clearly revealed that he had no idea what was being requested of him.

A number of published studies (Fouts, Fouts, & Schoenfeld, 1984; Gardner & Gardner, 1978) have asserted that chimpan­ zees spontaneously sign to one another. Indeed, photographs and videotape of chimpanzees signingin one another'spresence have been offered as evidence of this. What is lacking in each of these instances is an appropriate response on the part of the receiver that is clearly elicited by the sign and not by the context or nonverbal expressions of the animal.

We found it necessary to teach Sherman and Austin compre­ hension skills. However, once these skills were in place they could easily comply with simple comprehension tasks such as

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## selecting a banana from a group of foods, or sorting bananas with bananas, apples with apples, and so on. Not only could they carry out simple commands with the referent present, they could recall commands given while the referent was absent. travel to another room, locate the proper referent, and carry out the command (Savage-Rumbaugh, Rumbaugh, & Boysen, l978a, 1978b). Statements about future actions also began to appear (Savage-Rumbaugh, Pate, Lawson, Smith, & Rosen­ baum, 1983). This ability apparently never emerged in Nim or Washoe (or at least no data have been presented which demon­ stratesthat it did).

Sherman and Austin revealed that their lexigram usagefinally reached the representational level of functioning by showing that they could group, not just objects, but also lexigrams into proper superordinate categories even when the referents were absent (Savage-Rumbaugh, Rumbaugh, Smith, & Lawson, 1980). That is, they could sort lexigrams suchas *lever* and *apple* into categories of/oodor *tool* even when no apple, lever,or other foods or tools were present. They were able to categorize many such lexigrams correctly on the first trial of a blind test (Savage­ Rumbaugh, 1981). Crucial to this development of symbolic representation was the presence of both productive and recep­ tive skins and the emergence of statement capacities.

Petitto and Seidenberg apparently did not recognize the im­ portance of comprehension for the acquisition of language. Consequently, they concluded that Nim's symbol usage was completely instrumental (Petitto & Seidenberg, 1979). How­ ever, they generalized incorrectly from Nim to Sherman, Au tin, K.anzi, and Mulilca. Sherman's and Austin's training con­ tinued from where Nim'sleft off. They went on to comprehend symbolic messages, to make statements about intended actions, and finally to representational symbol usage (Savage-Rum­ baugh, 1986).

But what of Kanzi and Mulika? Because they were not trained as were Sherman and Austin, what evidence exists to show that their symbol usage is representational? Again, the key issue that Seidenberg and Pettito overlook is that of comprehen­ sion. Unlike all other chimpanzees, Kanzi and Mulika's symbol comprehension *preceded and guided* their symbol production. Their symbol acquisition followed the pattern of (a) compre­ hension ofthe spoken word, (b) comprehension ofthe lcxigram symbol, and (c)productive use of the lexigram symbol.

Because receptive acquisition of the spoken word occurred spontaneously, it cannot be even partially explained by an in­ strumental account. Kanzi and Mulika learned to comprehend spoken English words without any direct consequences. Com­ prehension of spoken words was not mediated by, nor linked to, any desired outcome such as food or travel. For example, the first spoken word that Kanzi clearly comprehended was "light." Comprehension was initially evidenced by his running to the light switch whenever we said anything about turning the lights off or on. Before he understood the word, he would go over to the light switch only when he observed us approach it He was al'ways allO'Wed to watch this process whenever he wanted and we generally turned the lights off and on several times until he lost interest.

Later, as Kanzi began to display comprehension of other words, his response to the word "light" broadened to permit comprehension of requests such as "Kanzi, can you show me

the light?", "Can you bring me the light (also used for a flash­ light)?", and "Can you turn the light on?" Again, responses to such request'! provided no special consequences and did not permit Kanzi to obtain desired outcomes that he would not oth­ erwise have received.

The ability to carry out such requests was often one of the

clearest indications that Kanzi or Mulika understood a spoken word; however,there were also other contexts in which this abil­ ity appeared. Often they simply changed their behavior when they heard a particular topic being mentioned. For example,

..strawberry" (like most other words) seemed to be acquired first as a response to the spoken English word "strawberry." Wild strawberries grow in patches around the lab. Kanzi no­ ticed this and began to consume them. As Kanzi started to com­ prehend the word "strawberries," he began to rush over and search avidly for strawberries when anyone commented, "Kanzi, I see some strawberries over here."A bit later,onecould simply mention something about goingto look for strawberries, and Kanzi would change his direction of travel and head di­ rectly for a strawberry patch.

It was after Kanzi evidenced comprehension of the spoken English word that the strawberry lexigram wasadded to his key­ board. The acquisition of the lexigram *strawherrn* asdescribed in Savage-Rumbaugh, McDonald, Sevcik, Hopkins, and Rub­ ert ( l 986), took place when comprehension of the spoken word was already established. Thus, Kanzi recognized something about the spoken word "strawberry" that wascommon to many situations long before he ever used the lexigram symbol with any positive result. At this time Kanzi also comprehended En­ glish words for many other edible things that grew out-of-doors (i.e., mushrooms, blackberries, privet berries, leaves, wild mus­ cadines, etc.), and could find these foods if they were men­ tioned, even when he had no interest in obtaining a particular food for himself.

He demonstrated this capacity in the blind test reported on page 227 of Savage-Rumbaugh et al. (1986). Kanzi showed no interest in requesting to travel to two of the food sites during this test. Consequently, the experimenter asked Kanzi to lead her to these two locations and he did so correctly. It took 10-15 min to travel to these places in the forest, and Kanzi had to select the right path at many points. Upon arrival, however, Kanzi showed no interest in eating any of the food located at the sites and received no reward .

Seidenberg and Petitto ( J 987) seek to differentiate between Kanzi's performance on vocabulary tests and his communica­ tive use oflexigrams in naturalistic exchanges. What they seem­ ingly fail to undemand is that Kanzi and Mulika's ability to perform as they do on these tests is a direct function of knowl­ edge acquired during naturalistic exchanges. They were not taught to pair certain words with certain lexigrams for these tests.

If Kanzi and Mulika did not comprehend a lexigram that was used during naturalistic exchanges, they were *not* able to pass formal tests of comprehension for that lexigram because there was no formal training on lexigrams in either setting. There are many lexigrams that they do not know.They do not understand these lexigrams when we use them (though they often under­ stand the spoken English word), they fail when tested on these lexigrams, and typically, they do not use these lexigrams them-

selves.Ifthey do attempt to use them, their usage is often inaP­ propriate.

They are able to pass formal tests on a given lexigram *only* when they also show evidence of comprehending that same lexi­ gram in naturalistic exchanges. Comprehension often appears long before they ac!ually use the lexigrams themselves.

The data in Tables 1, 2, *5,*and 6 of Savage-Rumbaugh et al. ( l986) support this contention. It can be seen that Kanzi and Mullica comprehended many lexigrams during formal tests that were not listed as vocabulary items.Kanzi pas.sed comprehen­ sion tests on 64 lexigrams when his vocabulary consisted of only 44 items. The difference for Mulika was even greater.She passed comprehension tests on 42 items when her vocabulary con­ sisted of only 6 items. In addition, Mulika was *able to identify,* in all three test conditions, *lexigrams tluu she had never used.* Because she had no training on the test items before the test and because she had not used these lexigrams in naturalistic exchanges, her knowledge of these items had to be based upon information gained as she observed others use the Jexigrams. Clearly, the data do not support Seidenberg and Petitto's posi­ tion that Kanzi and Mulika learned lexigrams solely to mediate desired outcomes.

Seidenberg and Petitto's view that Kanzi's symbol usage is strictly instrumental led them to make the prediction that if the outcome of Kanzi's utterances were altered, his symbol usage would alter concurrently.In fact, many natural occurrences do modify the conditions in which K.anzi finds himself and he must modify his communications accordingly. As Seidenberg and Petitto suggest, such events should provide insight into the na­ ture of Kanzi'ssymbol usage.

Recently, we bad the opportunity to observe such an occur­ rence.As was reported, Kanzi can ask to visit hismother at any time and he usually does so by using the lexigrarn for *Matata* and gesturing toward the colony room where she is housed. He had originally learned to ask to go to this area by using the lexi­ gram *colony room.* Across time, a number of different animals have been housed in the colony room, including Matata, Sher­ man, Austin, and two orangutans. Thus, Kanzi has used the symbols *Matata, Sherman, Austin, orangs,* and *colony room* as a means of requesting a visit to this area.Once he is in the col­ ony room he can visit whomever he wishes by running over to their enclosure. Most often, he requests to go to the colony room by saying "Matata." Seidenberg and Petitto would argue that Kanzi does not know that the "Matata" lexigram repre­ sents his mother, but rather that he anticipates the consequence of getting to go to the area where Matata can be found, as a consequence of touching the "Matata" lexigram. They would also assert that even though he has more than one means of asking to go to this area, there is no reason to believe that his *Sherman* lexigram represents Sherman, his *Austin* lexigram represents Austin, and so on.

To the contrary, when Sherman and Austin were moved to a new building, K.anzi immediately ceased using either of their lexigrams asa means of asking to visit the colony room area. If he requested "Austin" he always led appropriately to the new building where Austin and Sherman were housed. lf K.anzi'sre­ quest was denied because it was too cold to go outdoors, he would often modify it by using the 1exigrams *Austin TV* and gesturing toward the television set. Thus, he used Austin's lexi-

gram to ask to see a representation of Austin on TV, clearly revealing that he had not confused the lexigram with the place. On many occasions he has also commented "Austin" upon see­ ing Austin appear on the television. In these instances the exper­ imenter agrees that it is Austin on the TV, but nothing further happens as a result of Kanzi'susage of the symbol. More impor­ tant, Kanzi shows no behavior, such as pointing to the door or asking to go outside, which would suggest that he is using the *Austin* lexigram to ask to go to the place were Austin would be found.

Similarly, when Matata was transferred to the Yerkes Field Station for breeding purposes, Kanzi immediately ceased using *Matala* as a way of asking to go to the colony room. He began to use the *colony room* lexigram again. However, on the first day of her return, he again asked to go the colony room area by saying "Matata!"On ensuing days, he began to produce combi­ nations such as "Matata grouproom" and "Matata grab here(g)" (grab is a game chimpanzees play) to indicate that he would prefer to have Matata come to where he was, rather than to visit her.Such combinations were never modeled for him and could only have reflected his own motivations. He could not have formed these combinations if the *Matata* lexigram was as­ sociated only with the consequences of being allowed to go the colony room area and not with Matata herself.

Seidenberg and Petitto suggest that Kanzi's use oflexigrams shows no differentiation between object and event, as in his use of *juice* both to ask to go to the location and for the liquid. It should be noted that Kanzi shows this sort of general usage only for locations where the only salient activity is that of finding food. He does not do this when referring to locations where a variety of activities occur.

Kanzi'sbroad use oflexigram terms for food sites in the field is much like someone living on a farm who says "go to the apple tree,"or "meet me atthe grape vine."Other location lexigrams, such as *grouproom, trailer, childside,* and *Sue's office,* are differentiated from the food which might be placed there. These locations are salient for reasons other than food alone. When K.anzi does want to travel to these locations for food, he will frequently make combinations such as "trailer peanut" to indi­ cate that he wants to goto the trailer to get peanuts (Greenfield

& Savage-Rumbaugh, 1986).

Seidenberg and Petitto also raise the objection that much of Kanzi's symbol usage centers around the topic of food. To sup­ port this contention, they tallied the number of food-related utterances in the Appendix. They failed to note that, as stated in Savage-Rumbaugh et al. (1986), many of the utterances had to be deleted due to space limitations. Those that remained were not presented as a random sample, rather, they were pur­ posefully selected to show how K.anzi used such utterances to control his movements about the forest. In fact, food is not his most frequent topic of conversation . A more appropriate data base for Seidenberg and Petitto to have referenced would have been Table 3 of Savage-Rumbaugh et al. (1986). Here Kanzi's most frequent two and three word utterances were listed in the order of their frequency of occurrence. Of the 25 most frequent two and three word utterances, *none* was related to the topic of food; *all* were related to social games. The majority of Nim 's utterances were related to food however, and Seidenberg and Petitto seem to have incorrectly overgeneralized from their ex-

Table 1

*Communicative Function*

Modality Emotion Agree Answer Request Comment Total

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Lexical |  | 4 | 2 | 25 |  | 32 |
| Gestural |  |  | 3 | 20 |  | 23 |
| Vocal | 41 | 26 | 30 | 68 | 158 | 323 |
| Lexical/gestural |  |  |  | 6 |  | 6 |
| Lexical/vocal |  |  | 3 | 9 | 3 | 16 |
| Gestural/vocal |  |  | 6 | 13 |  | 20 |
| Total 41 | | 32 | 44 | 141 | 162 420 | |

*Note.* The category of "emotional" vocalizations includes expressions

of happiness, solicitations of affection and attention, and whimpering.

perience with Nim. The fact that Kanzi's most frequent utter­ ances are not about food is particularly striklng in light of the fact that his environment isdesigned to foster travelling to food sites as the major activity of each day.

A final point that Seidenbergand Petitto make isthat most of Kanzi and Mulika's utterances are requests; furthermore, they suggest that those utterances which we classify as statements are dubious. In order for a usage to be coded as a statement or a comment Kanzi must either make it clear that he is not asking fortheobject orevent (by refusing it if offered), orhe must carry out the action on his own. Thesejudgments are straightforward and depend upon overt behavior on Kanzi's part in aJl cases. For example,in the following observation (taken from the data base) Kanziis not making a request and thisis self-evident from hisbehavior:

Kanzi is sitting and eating near the keyboard. He stops eating and touches the Matata lexigram, then vocalizes to Matata who is in the next room. She answers back. JCan7j makes no gesture to sug­ gest that he is requesting a visit to Matata. To make certain, the experimenter queries "? go Matata." Kanzi ignores the question, touches the lexigramfood and resumes eating.

We agree with Seidenberg and Petitto that most of Kanzi's lexigram usage is request based and that this is not true of nor­ maJ children. However, we believe that this is a function of the output modality rather than a sign of cognitive incompetence. To use the keyboard, Kanzi must stop what he is doing, move acr0$ space to the keyboard,and touch a symbol.

This requirement prohibits the kind of commenting typically seen in children who generally comment on an action or an ob­ ject while engaged in active behavior, such as saying "down" while fallingdown (Greenfield & Smith, 1976). However, Kanzi does produce frequent vocal comments. Although it is not yet appropriate to translate these vocalizations into "words,''their communicative function, in context, is quite clear and often similar to what would be termed "commenting" in a human child.

For the purposes of presenting a more complete picture of how Kanzi uses the three communicative modalities available to him, 2 hr of videotape were reviewed and all of Kanzi's com­ municative episodes were recorded. A ..communicative epi­ sode" was defined as any vocal, gestural, or lexical attempt on Kanzi's part to communicate with another party.The results of that analysis, which are shown in Table 1, revealed that of the 420 episodes in which Kanzi responded communicatively dur-

ing this 2-hr period, 48 were lexical (or lexical plus vocal) and 359 were vocal (or lexical plus vocal or gestural plus vocal). Kanzi's overriding perference for communication is the vocal modality.AdditionaJly,where the function of a given communi­ cative episode is to comment on ongoing events, Kanzi'sis al­ most exclusively vocal. Similarly, when the communicative function is that of answering, disagreeing, or expressing emo­ tion, Kanzi relies most heavily on the vocal modality. A few examples should help make this clear.

1. Kanzi is working on a video game task using a joystick to control the movement of acursor on a screen. When he success­ fully completes this, the experimenter says "You did a good job." Kanzi looks at the experimenter and *comments,* "uhh um umm."
2. The experimenter is starting to pour some kool-aid in a bowl for Kanzi when he walks away,bowl in hand. She says, "I was going to put some kool-aid in your bowl, do you want some?"Kanzi *answers,* "unnn" then stops and waits while look­ ing at the bowl.
3. Kanzi is looking out the door when he sees Rose returning after she had left to get him a surprise. He sees Rose coming before anyone else does and *comments.* "uh ooah" as he goes to the dooi; looking at Rose. Others look out the door in re­ sponse to see what Kanzi was commenting about.
4. When Rose enters he *requests* the surprise by gesturing toward her pocket while vocalizing, "engggh."
5. Kanzi sits down to try the video game again and *comments* as he watches his cursor get closer to the target, "ooah ah engh ungh."
6. While Kanzi is vocalizing to Matata, the experimenter comments that several days ago Matata bit Kanzi. Kanzi looks back toward the experimenter and responds with the *comment,* "un huh."

The data shown in Table I suggest that Kanzi prefers the vo­ cal modality and is attempting to use it in a broader manner than the lexical modality. The use of the vocal channel to com­ municate such messages is all but absent in *Pan troglodytes* (Savage-Rumbaugh , Romski, Hopkins, & Sevcik, in press). This absence accounts, in part, for Seidenberg and Petitto's ( 1987) conclusion that the only form of communication which Nim (a *Pan troglodytes}* demonstrated was the "request." Kanzi, on the other hand, as a member of a different species, appears to be able to utilize a wider array of communicative functions in the vocal modality. Unfortunately, he lacks the ability to produce the many consonants needed to render such sounds readily discriminable to the normal human ear.

Kanzi'stendency to engage in a broader array of communica­ tive functions using the vocal modality indicates that the re­ quest-statement dichotomy that Seidenberg and Petitto offer to contrast child and chimpanzee is better evaluated in terms of a difference in output modality. Certainly if children had to walk across the room and then search among several hundred printed words each time they wanted to make a comment, their comments would become considerably less frequent.

In conclusion, the data do not support Seidenberg and Pet­ itto's ( 1987) perspective. Rather, they demonstrate that Kanzi and Mulika's symbol usage is clearly representational and that an account based on instrumental conditioning principles can­ not explain either their symbol acquisition or their use. The

data also reveal that Kanzi and Mulika's symbol usage shares many properties of word usage with that seen in young children, that the most frequent topic is social play rather than food, and that the differences regarding the relative proportion of state­ ments and requests are, at least in part, a function of output modality rather than the linguistic incompetence of Kanzi or Mulika.

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