Representation of Action through Iconic Gesture in a Captive Lowland Gorilla[1]

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The invention, usage, and transmission of arbitrary symbols for representing actions, events, objects, and con-

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cepts is a hallmark of human language, whether visual or verbal. It is probable that these arbitrary symbols originally arose from the iconic, or picture-like, depiction of actions and objects, with the initial reference faded and altered over years. To learn when the potential for iconic depiction arose in human ancestors is therefore important for our understanding of the evolution of language.

It is likely that the earliest iconic depiction by human ancestors was of actions rather than objects, since it is representation of action that we find in the gestures of extant apes. A laboratory study of the gestures of captive pygmy chimpanzees (*Pan paniscus*) not language-trained or extensively exposed to human enrichment reported that these apes iconically depict the motion desired of another ape. Two types of iconic gesture were described for the *Pan paniscus* subjects. Both types of gesture depicted the action the signaler wanted from another pygmy chimpanzee, but they appeared to differ in level of abstraction; for some gestures, hand movements touched the recipient, whereas others were performed in space (Savage-Rumbaugh, Wilkerson, and Bakeman 1977). Gestures of either of these types can potentially express one of two different kinds of intent: (1) that of the signaler for his own actions, often called "incipient action" or "intention movements," or (2) the action desired of an animal *other* than the signaler. Gestures expressing intent and desire require awareness on the part of the signaler of the potential acts and intentions of the recipient (Savage and Rumbaugh 1977; see Whiten and Byrne 1991). For the pygmy chimpanzees, it was clear that gestures depicted action desired of the recipient of the gestures, as different gestures resulted in the recipient's positioning him- or herself in different ways. The recipient of the gesture as well as the signaler had to be able to recognize that gestures may represent action called for on the recipient's part and translate the gesture into physical action (Savage-Rumbaugh, Wilkerson, and Bakeman 1977). This probably follows from the fact that the perceptual ability to interpret directional locomotion is a basic primate as well as human characteristic (Perrett et al. 1989).

Though no study has been done of the visual communication of the common chimpanzee in terms of iconicity, descriptions in the literature imply that *Pan troglodytes* probably does use such gestures. For instance, Van Hooff notes (1973:93), "During courtship a male might 'beckon' by stretching his arm and then making sweeping movements toward himself." Van Hooff (1973:157) speculates on the development of such a gesture and states: "This and other gestures may be gestural pictograms that owe their functionality to the contextual insight of both interacting partners." Earlier, Kohler (1925: 319–20) observed:

> A considerable proportion of all desires is naturally shown by direct imitation of the actions which are desired. Thus, one chimpanzee which desires to be accompanied by another, gives the latter a nudge, or pulls his hand, looking at him and making the movements of "walking" in the direction desired. One who wishes to receive bananas from another, imitates the movement of snatching or grasping, accompanied by intensely pleading glances and pouts. The summoning of another animal from a considerable distance is often accompanied by a beckoning very human in character. The chimpanzee also has a way of "beckoning with the foot," by thrusting it forward a little sideways and scratching with it on the ground. . . . Rana, when she wanted to be petted, stretched her hand out towards us, and at the same time clumsily stroked and patted herself, while gazing with eager pleading. Another obvious method of invitation is for an ape to assume or indicate in his own person whatever movements he would perform in the activity he wishes the other to undertake. . . . in all cases their mimetic actions are characteristic enough to be distinctly understood by their comrades.

Though Kohler's usage of the term "imitation" might be questioned today, the result of whatever learning processes took place in his study group appears to be iconic gesture.

For gorillas there has been little study of gestural or visual communication in the field beyond Schaller's (1976 [1963]) and Fossey's (1983) descriptions of species-typical displays of mountain gorillas (*Gorilla gorilla beringei*). Study of captive lowland gorillas (*G. gorilla gorilla*) has also focused on species-typical actions such as chestbeating (Redshaw and Locke 1976), though Gomez (1990) has looked more closely at gaze and gesture in one young gorilla. Up to now, therefore, it has appeared that the potential for iconic representation originated during that recent phase of human evolution shared only with chimpanzees. This paper reports the use of iconic gestures by a captive adult male lowland gorilla (*G. gorilla gorilla*) that questions that assumption.

METHODS

Definition of gestures. The term *gesture* is here used for all discrete, nonlocomotor limb and head movements that appeared to be communicative, regardless of receptive sensory modality. Initially, all gestures, whether visual, tactile, or auditory (but nonvocal), were catalogued. The aim was then to define different functional classes of these gestures.

To be defined as actively *communicative*, a movement should ideally be intentionally directed to another individual. Eye contact, however, is not a suitable criterion to impose for gestural communication, as peripheral vision may suffice to receive a visual message and, further, for some gestures auditory or tactile reception may take precedence. Here gestures were initially considered communicative if two or more gorillas were in proximity and social interaction was taking place or immediately preceded or followed the gesturing.

For *tactile* communication, gestures may be defined as different from ordinary motion in that they involve transformations of purposive behaviors so that they are no longer mechanically effective and communicate a specific desire, intent, or feeling (Bretherton and Bates

1979, Goldin-Meadow 1984, Gomez 1990). For example, lightly brushing a hand downward on another's body to indicate a desire for downward movement on another's part would be a tactile gesture, as opposed to the direct action of forcefully pushing the other down. A purely *visual* gesture with similar function would be performed by a downward motion of the hand and arm in the space in front of the signaler's body while having the visual attention of the other.

Both the tactile and visual examples above would qualify as *iconic* gesture. We refer to a gesture as iconic when its motion path in space or on another animal's body follows a path of movement or form of an action which is inferred to be desired of another animal by a gesturing animal. We can infer that a gesture may be depicting intentions regarding others' actions, as distinguished from incipient action of the signaler, by the fact that the depicted act (for example, moving the body down) itself does not come to be performed by the signaler, and the gesture is quite discrete and different from the action itself (a hand motion as opposed to a whole body motion). If a gesture (unless tactile) is performed when a recipient's visual attention is available and is repeated or amplified with more gestures if response is not immediately forthcoming, then this interpretation is further supported.

Subjects and setting. Information about each of the gorillas in the San Francisco Zoo group at the time of the study is given in table 1. None of these gorillas had any instruction in human modes of communication, though they interacted daily with keepers and zoo visitors. In this study, 13-year-old Kubie was the subject, and 7-year-old female Zura was the gorilla with whom he interacted.

The San Francisco Zoo's outdoor gorilla enclosure is large and naturalistic (area 2,300 m^2, 38 × 50 m at maximum parameters). It is completely covered with grass and other vegetation and contains large, climbable live trees as well as several dead trees, large stumps, and two fake-rock "hills" including arches and cavelike areas. The enclosure is below ground (and viewer) level except for one windowed viewing area where gorillas and humans can interact face to face.

During the period of study reported here the door to the gorillas' indoor quarters was kept open to a width that allowed free entry and exit by the two younger females but was too narrow for the males and the older female (see Kerr 1993). All the females readily climbed the large trees in the enclosure, and the youngest and the oldest female were frequently up in trees. The older male never climbed trees; the younger male did so only upon rare occasions.

Study methods. Observations for this study were made between October 1988 and September 1989 on an average of one morning a week for approximately three hours. Videotaping was done on a "focal behavior" basis, recording continuously any and all social interaction where it was possible to use the video camera. The study team consisted of a camera operator and a researcher (JET) who would scan the activity taking place and suggest to the camera operator the most relevant area to film. If there was interaction occurring between more than one pair of gorillas, the interaction deemed most likely to contain gestural communication was followed. Because virtually all of the gesturing recorded occurred during play sessions between Kubie and Zura and very little in agonistic or feeding contexts or between other gorillas, the choice of subjects was usually easy. If there was no apparent interaction and the gorillas were all resting or spatially separated, the camera was turned off. This technique resulted in a total of 22 hours of videotape of gorilla social interaction. The videotaped records include verbal commentary about context, and diary-style written notes were taken about any relevant events which the camera was unable to record. The quietness of most gorilla vocalizations rendered analysis of any vocal component of communication impractical. Equipment used was a JVC Super VHS video camera.

Each filmed instance of gesture was catalogued on the Filemaker Pro computer program. A gesture was recorded as only one instance if it was rapidly repeated consecutively several times in the same form. Gestures that were partially obscured or too dark on the video to see clearly were discarded. For this study a set of the 9 most frequent gesture types of the young silverback Kubie was chosen for further analysis (table 2). (These ges-

TABLE 1
Gorillas of the San Francisco Zoo as of March 1989 (Midpoint of the Study)

Name	Sex	Age	Birthplace and Rearing	Parents
Bwana	Male	31	Wild-born, Cameroon	Unknown
Pogo	Female	31	Wild-born, human-reared in Cameroon	Unknown
Kubie (Mkubwa)	Male	13	Captive-born, mother-reared in San Francisco	Bwana and Jackie
Bawang	Female	8	Captive-born, nursery-reared in Cincinnati	Ramses and Amani
Zura	Female	7	Captive-born, nursery-reared in Columbus	Oscar and Toni
Shango	Male	Newborn	Captive-born, mother-reared in San Francisco	Kubie and Bawang

TABLE 2
Kubie's Gestures (Study Set)

Gesture Type	Number of Instances by Kubie	Description
Tactile close-range		
Tactile-close	64	Any touching of the recipient's body with directional indication but short of force to move the body. Includes hand moved down the back vertically or across horizontally, patting, gentle pulling of a hand, pushing away, and others
Tactile longer-range		
Tap other	83	P: body of other gorilla, most often head or chest C: open hand or fingers bent at knuckles M: fingertips or knuckles contact body of other gorilla then quickly move away
Head		
Head nod	100	Head moves abruptly downward and then returns to vertical position
Limb silent, touching signaler		
Chest fist pat	22	P: chest C: one cupped hand M: hand taps chest lightly, no audible effect
Armswing under	39	P: ends between legs at genital area C: open hand or both hands M: arm swings from space in front of body back to body under genital area
Limb silent, not touching signaler	41	P: space in front of or at sides of the body C: one or both relaxed, open hands
Armshake		M: arms and hands shaken loosely with rotational motion; may vary from prolonged motion of entire upper body to minimal motion of hand(s) shaken from wrists
Audible, touching signaler		
Chestbeat	39	Chest is slapped with alternating open palms, audible effect
Audible, hitting surfaces Backhand	30	P: any environmental surface C: fist M: back of hand hits surface forcefully, audible
Knock	22	P: any environmental surface C: fist M: knuckles or side of hand hit surface, usually audible

NOTE: P, place (on body, in space, etc.); C, hand configuration; M, motion (direction, force) of gesture.

tures are only a subset of some 30 gesture types which have been catalogued for the San Francisco gorilla group [Tanner 1993].)

RESULTS

A number of aspects of Kubie's gestures were chosen for more detailed observation from video. Raw frequencies upon which the chi-squares are based can be found in table 3, which is a summary of these analyses.

To learn which gesture types might be intentional visual signals, we examined *whether Zura could see the gesture performed by Kubie.* If the two were face to face (even if one face was not itself visible on the video), the gesture was counted as having the recipient's visual attention. There was significant variation in degree of visual attention, from 39% to 100% ($\chi^2[8] = 80.8$, $p < .001$, among the nine gesture types. They appeared to fall into three attentional groups: a high visual attention group consisting of five silent limb and head gestures, a medium visual attention group of the three audible gestures, and a low visual attention group of tactile-close gestures alone. After the division of the chi-square table into these three categories, further tests failed to reach significance ($\chi^2[4] = 7.3$, $p > .1$); ($\chi^2[2] = 2.1$, $p > .3$), supporting this categorization.

To learn about the possible motivation of gesture types, we recorded *whether a gesture by Kubie was accompanied by his playface.* The proportion of accompanying playfaces for each gesture type varied from 0% to 70% among the nine gesture types ($\chi^2[8] = 83.0$, $p < .001$). These appeared to fall into three groups: a group of three silent limb gestures for which there was a high proportion of gestures accompanied by a playface, the

TABLE 3
Summary of Results for Study Set of Kubie's Gesture Types

Gesture Type	Percent Performed with Visual Attention of Zura	Percent When Kubie Has Playface	Percent in which Contact Resulted within 5 Seconds	Contexts of Most Frequent Use (Proximity)
Tactile-close	39 (n = 25/64) low*	15 (n = 9/62) low*	(Contact criterion not applicable here) 66% of time Zura's body moves in signaled direction	Mating positioning (very close)
Tap other	83 (n = 62/75) high*	57 (n = 32/56) high*	69 (n = 54/78) high*; 76% of contacts by Zura	Tree tag, nest-and-stump chases (medium)
Head nod	88 (n = 84/95) high*	32 (n = 23/71) medium*	63 (n = 63/100) high*; 78% of contacts by Zura	Nest-and-stump chases, bag tug (medium to close)
Chest fist pat	83 (n = 15/22) high*	11 (n = 2/19) low*	59 (n = 13/22) high*; 77% of contacts by Zura	Tree tag, nest-and-stump chases (medium)
Armswing under	100 (n = 36/36) high*	70 (n = 19/27) high*	79 (n = 30/38) high*; 80% of contacts by Zura	Bag tug, tree tag (medium to close)
Armshake	88 (n = 29/33) high*	59 (n = 16/27) high*	67 (n = 24/36) high*; 71% of contacts by Zura	Bag tug, rock wall keep-away (close and mixed)
Chestbeat	65 (n = 19/29) medium*	0 low*	6 (n = 2/34) low*; high (70%) rate of change of gaze and/or activity	Nest and mountain trading (least)
Backhand	68 (n = 15/22) medium*	5 (n = 1/21) low*	39 (n = 11/28) medium*	Rock wall keepaway (mixed)
Knock	47 (n = 8/17) medium*	6 (n = 1/16) low*	21 (n = 4/19) medium*; high (78%) rate of change of gaze and/or activity	Tree tag (medium)

NOTE: Number on left in parentheses is number of gestures fitting the named criteria; number on right is the total of gestures used in the analysis (which may differ from total in table 2 for reasons of visibility on video of the element under study).
*Statistically significant.

silent gesture *head nod* by itself, and a group of the remaining five gestures for which an accompanying playface was infrequent. After the division of the chi-square table into these three groups, further tests failed to reach significance ($\chi^2[2] = 1.4$, $p > .3$; $\chi^2[4] = 5.6$, $p > .2$), supporting this categorization.

To identify the immediate function of gesture types, we observed *whether a gesture by Kubie led to contact with Zura within 5 seconds.* "Contact" meant that the gorillas' bodies actually touched in play activity, usually wrestling and biting, within the 5-second limit. The gesture may or may not have been followed by other gestures before contact took place. The proportion of each gesture type followed within 5 seconds by contact in play varied from 6% to 79% ($\chi^2[8] = 77.3$, $p < .001$). There appeared to be a high-contact group of the five silent limb gestures, two medium-contact gestures, and two very low-contact gestures. Dividing the chi-square table into these three groups, further tests failed to reach significance ($\chi^2(4) = 3.9$, $p > .3$; $\chi^2[1] = 1.7$, $p > .1$; $\chi^2[1] = 0.2$, $p > .5$). For the high-contact gestures, on the average, 76.4% of contacts were made by Zura rather than Kubie. (The above test was not applied to tactile-close gestures, where contact was already established. For these, 66% of the time a tactile-close gesture led to the result that Zura moved her body, or let it be moved, in the direction Kubie indicated.)

For the three gestures most often accompanied by playfaces simultaneous with the gesture (see table 3), we examined *the relative effectiveness of playfaces alone, gestures alone, and gestures with playface in achieving contact with Zura.* Compared with cases in which neither gesture nor playface occurred (yet the two gorillas were in visual proximity), gesture alone was highly significantly associated with subsequent contact within 5 seconds ($\chi^2[1] = 15.9$, $p < .001$). Comparing Zura's activity *preceding* Kubie's playface alone with Zura's activity *preceding* Kubie's gesture alone or gesture + playface (combined categories), there was a highly significant difference ($\chi^2[1] = 50.2$, $p < .001$). An approach by Zura to Kubie almost always immediately *preceded* Kubie's playface alone. Gestures, whether alone or with playface, were almost never preceded by an approach by Zura but rather by her remaining apart, resisting, or backing away from Kubie.

There was no significant difference between the *consequences* of a playface alone and a gesture + playface. However, there was a significant difference between gesture alone and gesture + playface ($\chi^2[1] = 11.6$, $p < .01$), with gesture + playface more associated with subsequent contact with Zura.

Finally, to learn whether use of gesture types varied with the situation, we investigated *whether the proportion of each gesture type varied during different play*

session contexts between the partners. There was very significant variation in the distribution of gesture classes within six different "game" contexts ($\chi^2[20] = 241.7$, $p < .001$) which are described further in the discussion of gesture types and classes which follows.

GESTURE TYPES AND CLASSES

Tactile gestures at close range. Tactile-close gestures had a high*[2] success rate in promoting cooperative action by getting Zura to move her body or, equally often, allow her body to be moved in the direction indicated by the gesture, when Zura had the option of getting up and leaving rather than cooperating in any way.

These gestures were made by Kubie's touching Zura's body when the two gorillas were within easy arm's reach of each other, seated close together or with one or both gorillas standing quadrupedally (or tripedally, when gesturing). The gestures indicated direction by such means as moving a hand or arm down the recipient's body (back, side, or other location); patting downward (on the head, back, or bottom); pushing the head down gently; moving a hand or arm across the recipient's waist or back, toward the gesturer; lightly tapping, poking, or knocking on a body part (thigh, elbow) in a certain direction (down, away, up); pushing away gently; holding, then releasing a body part (arm, hand, foot) to stop motion; pulling gently on a body part (hand, foot), then releasing it, indicating motion toward signaler; holding and shaking a body part to indicate motion of the recipient.

In spite of the close proximity of the gorillas for these gestures, a low* proportion were performed with Zura's visual attention available. These gestures occurred both during play and when Kubie attempted to get Zura into a position suitable for mating and/or estrus checking. The relative seriousness of the pursuit of body positioning was indicated by the low* level of accompanying playfaces by Kubie for tactile-close gestures.

Tactile gestures at longer range. Another type of tactile gesture was labeled *tap other.* This was a quick contact and withdrawal of Kubie's knuckles or open hand on Zura's body. In the great majority of cases contact was made with the head or chest area. Tap other did not usually seem to be performed in a manner which exerted any directional force on Zura, nor was it a "hitting" action. It was quite stylized in the quick withdrawal of the hand, usually extended at arm's length, and often performed when in bipedal or quadrupedal motion.

Tap other was usually* accompanied by Kubie's playface. This gesture occurred at highest frequency in two medium-proximity game contexts, both of which involved "keepaway" activities with trees and stumps as barriers for hiding and chasing and Kubie's nest of burlap bags as a "home base." Tap other usually* required Zura's visual attention and resulted in a high* degree of subsequent play contact. Of these contacts, the majority were made by Zura.

Tap other was sometimes followed by armswing under, a gesture directed by Kubie to his own genital area (see figs. 1–3). In these cases tap other may have served to point out that Kubie desired Zura's visual attention to continue to be directed to him. It also seemed to notify her that she was to be the object or agent of further action. In other cases tap other seemed to indicate exchange of roles in chases. A variation performed with a distinctive "up and off" motion sometimes ended rounds of games as Kubie withdrew.

Head nod. Head nod was the most frequent of all Kubie's gestures. It was usually* performed when he had Zura's visual attention and resulted in a high* level of play contact. A playface only occasionally* accompanied this gesture. Head nod was most frequent in medium- to close-proximity games; one was a "nest-and-stump" chase game, the other a closer-proximity game, "bag tug," in which Kubie remained with at least one foot constantly on his bag nest and Zura made approaches attempting to "steal" a bag from him.

Head nod may have served to capture attention where a tactile signal was impractical because Kubie had an object in his hand, was in quadrupedal locomotion, or was already gesturing with his hands or Zura was too far away to touch. In fact, one of these circumstances was the case in every instance of a sample of 44 head nods reviewed. The downward movement of head nod traced a motion path to Kubie's body, where further gestures could be noticed or attention given to direct engagement in play.

Silent limb gestures, touching signaler. Another gesture which seemed to direct attention to Kubie himself was labeled *chest fist pat.* Though superficially similar in form to chestbeating, it was quite distinct. It did not involve the circular slapping motion of chestbeating but was rather a gentle and silent patting motion on the chest with a single partly closed hand. Chest fist pat was usually* performed when Zura's visual attention was available and was seldom* accompanied by a playface, and contact was the result in a high* proportion of instances. The gorillas' keeper reported that Kubie's father, Bwana, for many years used the same gesture in interaction with keepers when requesting desired food (Mary Kerr, personal communication).

Armswing under was another gesture in which Kubie touched his own body, in this case between his legs. Kubie performed armswing under exclusively when he had Zura's visual attention, and this gesture had the highest* rates of accompanying playfaces and of resultant contact. Armswing under appeared at highest frequency in close- to medium-proximity game contexts, as did tap other, head nod, and chest fist pat. As we have said, armswing under was frequently combined with tap other in a single cohesive phrase. Its motion path led to Kubie's genital area, obviously a salient anatomical location for male/female interaction and bonding. A closely related gesture that had a sample too small for analysis here was *patting the genital area* without the

2. Descriptive terms with asterisks reflect statistically significant findings.

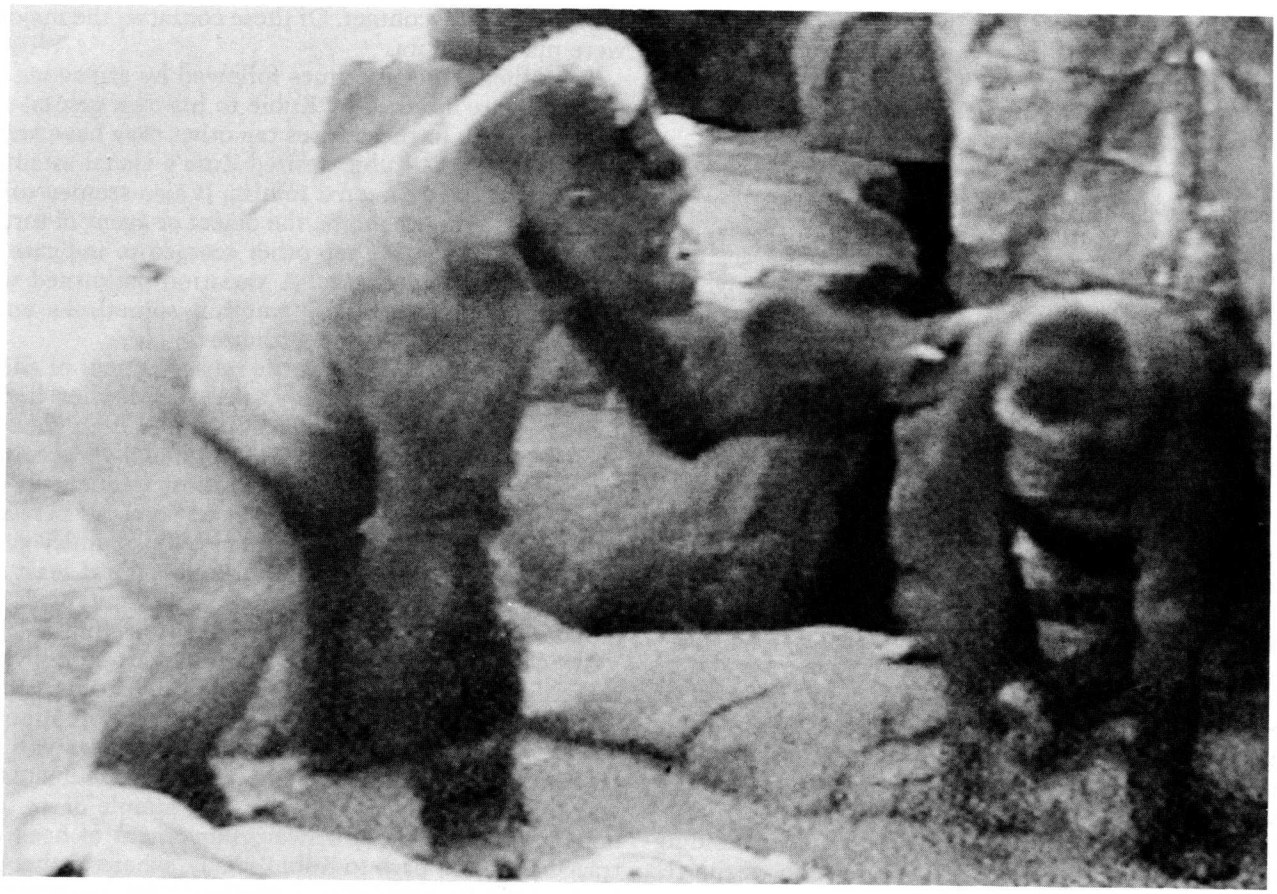

FIG. 1. Tap other *("you")*.

armswing under. The complete phrase, however, was more common and was effectively a three-part imperative statement with locational modifier: "Tap other/armswing under/(touch genital area)" (usually accompanied by playface), which might perhaps be roughly "translatable" as "you/come to me/for sexual contact play."

Silent limb gesture, not touching signaler. Armshake varied a great deal in form, from minute flicks of a single hand to large motions of both arms and sometimes, simultaneously, other parts of the body. It was seen at highest frequency in two game contexts, "bag tug" and "rock wall keepaway," both of which involved elusive keepaway tactics by one or the other of the partners. Armshake was usually* performed by Kubie with a playface when he had Zura's visual attention, and a high* degree of contact resulted.

In Kubie and Zura's interactions armshake often alternated from one gorilla to the other and was sometimes simultaneous. It was often performed not only by the gorilla beginning an approach but by one gorilla just as the other one began to move; perhaps armshake may sometimes represent the gesturer's readiness for motor activation and at other times be a reflection of another's visible activation. When performed by both gorillas simultaneously, armshake seemed to indicate agreement upon readiness for action in play.

Though forms of armshaking have been seen occasionally at other zoos, armshaking seems to have developed into a tradition in the San Francisco group. Records of the group's earlier history indicate that at times all members of the group have engaged in armshaking (Parker 1993).

Audible gestures touching signaler. The species-typical *chestbeat* is highly audible; chestbeat was in the majority of cases performed without visual attention, was never accompanied by a playface, and had a low* resulting rate of immediate contact in play. Nevertheless, Kubie's chestbeat frequently resulted in the direction of Zura's gaze toward him and/or a change in Zura's locomotor activity (as per Redshaw and Locke 1976). Chestbeat was the most frequent in a game where the gorillas were the most distant from each other of all the game contexts, trading places between Kubie's nest on the ground and the top of a large rock "mountain."

Audible gestures hitting surfaces. Kubie frequently hit the ground, rocks, or trees with a fist. Two categories were distinguished. *Backhand* appeared to be a more forceful expression, often a protest, always audible, and often done in the course of bipedal locomotion. *Knock,*

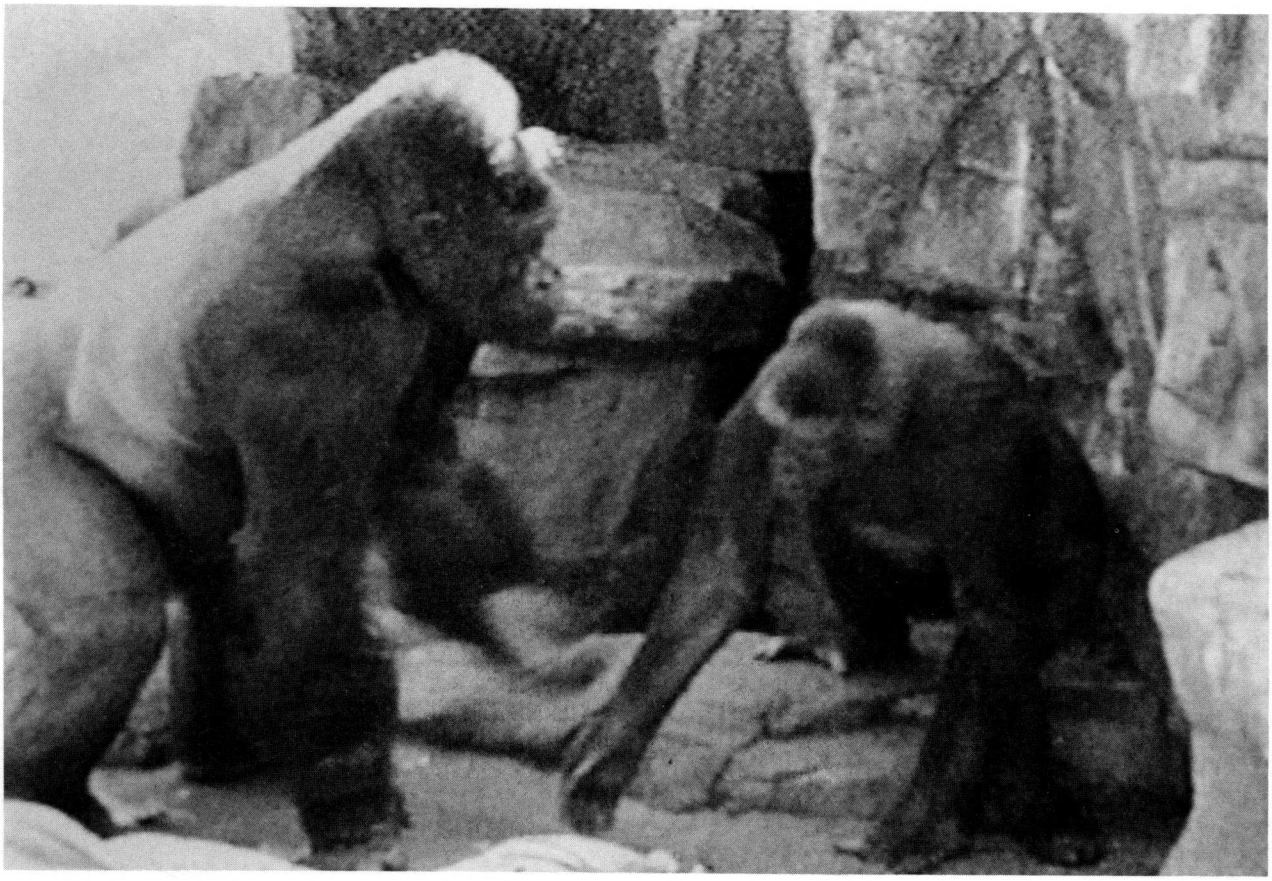

FIG. 2. Armswing under *("come")*.

hitting with the side or knuckles or the fist, was done with less force, was often audible but not as loud and more often performed seated or from a quadrupedal stance. Both were performed with medium* rates of visual attention from Zura, followed only occasionally* by play contact, and seldom* accompanied by a playface from Kubie. Backhand and knock appeared in highest proportions in mixed and medium-proximity game contexts in locations involving trees or rock walls. They affected Zura's approach or changed her locomotor activity more often than they resulted in actual contact with Kubie. Additionally, knock in some cases seemed to indicate, or at least draw attention to, a particular occasion. In several cases Zura proceeded to the exact spot that had been pounded, even though Kubie moved before she arrived.

location

DISCUSSION

The spontaneous behavior of a zoo-housed male gorilla, Kubie, shows a wide range of gestures, not all of which are part of the species-typical gorilla repertoire. Many are performed primarily when the interactant is already paying visual attention, and none of these high-visual-attention gestures has been regularly reported for other gorilla groups (Ogden and Schildkraut 1991, Schaller 1963, Fossey 1983, and personal observations of the authors at numerous zoos and in Rwanda). Several are intentional iconic gestures, not simply incipient actions ("intention movements") of Kubie. These gestures do not predict Kubie's own future actions but instead illustrate, by "drawing" a path of motion in space or on the body, future actions desired *of the interactant*—here a younger female, Zura. When Zura occasionally fails to respond the gesture is often repeated or strengthened or further gestures made. Other gesture types seem to serve a deictic function, indicating Kubie, the signaler, or Zura, the recipient, as actor or object of action or sometimes indicating locations in the environment for shared focus of attention in play.

These findings raise several questions. If gorillas have the potential for intentional signaling by iconic and deictic gesture, why do most gorillas not do so? What range of information can be communicated in this way? How might Kubie have acquired his repertoire and Zura her understanding of it?

Asking why most gorillas do not develop elaborated gestural communication is equivalent to asking why Kubie, in particular, did do so. We believe several factors may be important, in combination setting up conditions

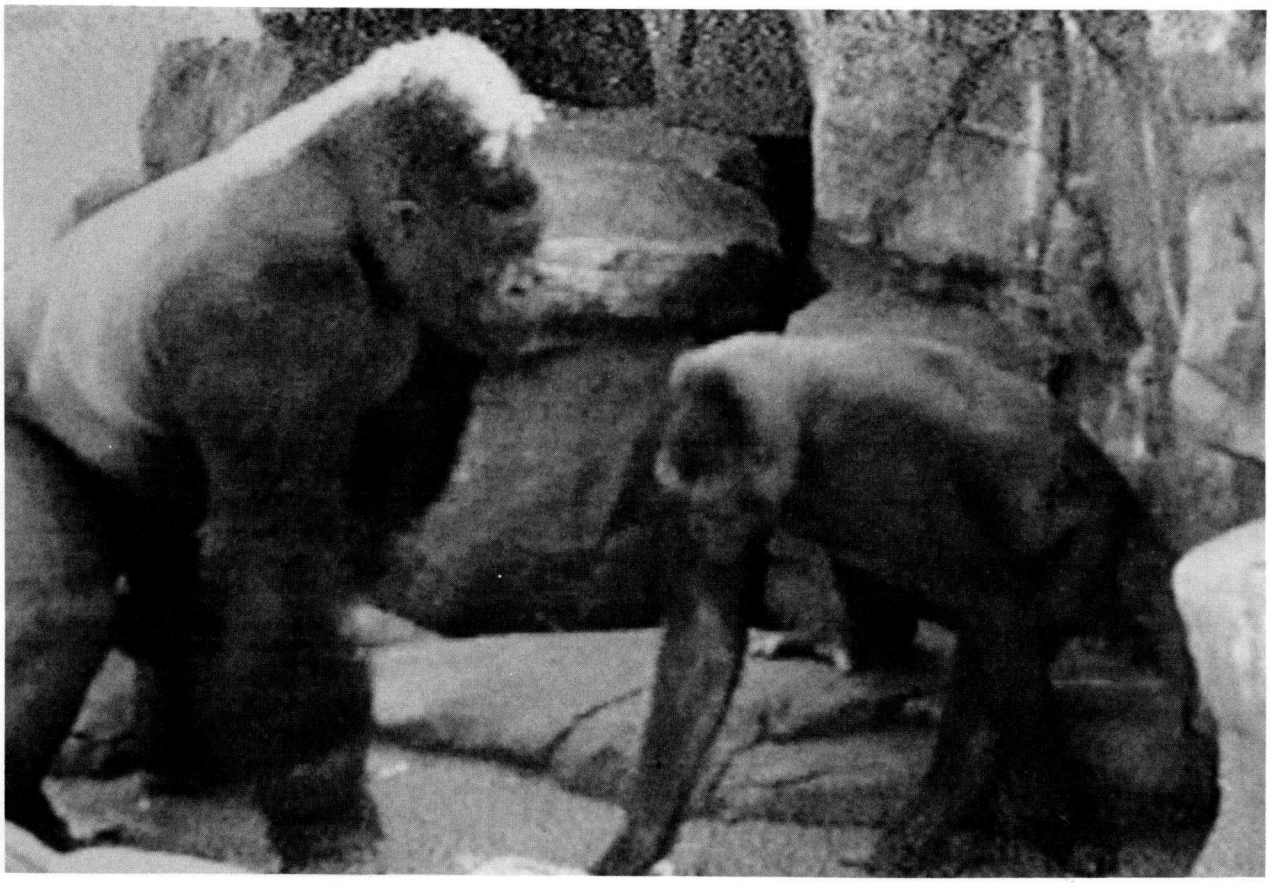

FIG. 3. Armswing under *to genital area ("here").*

in which gestural communication would be highly advantageous. In most zoos and in many free-living groups of gorillas, only one adult male is present. The San Francisco gorilla group was unusual in including two mature silverback males. The likelihood of interference from the older male meant that Kubie needed cooperation from females in order to interact with them (see Tanner and Byrne 1993 for a detailed narrative example). It is probably no coincidence that all gestures which led to a high degree of contact and cooperation were silent and would therefore not have attracted the attention of the other male.

In addition, the San Francisco Zoo's policy of leaving the door from the outdoor to the indoor enclosure open to a width through which the females but not the large males could enter meant that coercion could not be effective. If a male's action became too aggressive or forceful, the females could simply leave and go indoors or climb the large live trees, which were seldom climbed by the males, probably because of their greater weight. Gestures, however, gently indicating the male's desires for the female's position and activity, were not liable to cause the females to terminate interaction.

Another factor was that Zura was a young and not very experienced or cooperative partner. This was also the case for one of Savage-Rumbaugh's gesturing pygmy chimpanzees (Savage-Rumbaugh, Wilkerson, and Bakeman 1977) and for one of the Río Grande Zoo gorillas to be described below. Zura was the only play partner available for Kubie at the time of the present study because Bawang, Kubie's preferred female, was pregnant and gave birth. Earlier, Kubie as an adolescent was also confronted with a very uncooperative partner, the older female Pogo, and then too used gestures to promote her cooperation (unpublished film by Sandra Keller, Friends of the Zoo, 1984).

Though no other detailed studies of gesture in zoo gorillas have been done, Kubie is probably not unique. Zura, his play partner, had an extensive range of gestures of her own, some of which were shared in her and Kubie's repertoires. Gorilla interaction recorded (by JET) at the Río Grande Zoo in Albuquerque, New Mexico, includes gestural communication which appears similar in quality to the observations of Kubie and Zura. This interaction took place in a similar social milieu, when a very young male attempted a sneak mating with an older female, meeting her in a moat and avoiding an older male's attention (Tanner 1993).

Gesturing for Kubie appeared almost exclusively in play situations, which often included attempts to get

the female to assume positions appropriate for vaginal inspection and/or mating. Even in this restricted context, however, several functions seemed to be served: getting visual attention, promoting future body contact, indicating directional whole-body motion, indicating play location, indicating readiness for engagement in play, drawing attention to a specific subsequent gesture, requesting a particular action, and drawing attention to the recipient as agent of activity.

We discern the same differing functional classes of gesture that Tomasello did for young captive chimpanzees: (1) audible "attention-getters" and (2) silent limb gestures requiring visual attention (Tomasello et al. 1985; Tomasello, Gust, and Frost 1989; Tomasello et al. 1994). However, we also find tactile-close gestures which do not regularly require visual attention. (Tomasello does not discuss the chimpanzees' gestures in terms of iconicity.) Attention-getter gestures for Tomasello's chmpanzees drew attention to playfaces or pout faces; Kubie's high-visual-attention gestures were not always accompanied by or followed by playfaces. Gestures, with or without playfaces, were used by Kubie when Zura was sitting passively, actively backing away from him, or resisting him; the use of a gesture enhanced the probability that contact would soon follow. For Kubie a playface alone, in contrast, was nearly always a *response* to Zura's actual approach to him. The playface was not a "play signal" but rather an apparent *recognition* that what was occurring or about to occur was play.

We have shown that these gestures were not intention movements; some gestures, however, may have been ontogenetically derived *from* literal enactments, a process that Tomasello et al. (1985) have described as "conventionalization" or, more recently, "ontogenetic ritualization," by analogy with the ritualization process believed to underlie the evolutionary origin of many species-typical displays. Kubie's depictions of activity desired from his play partners may thus have developed from force or whole-body motion into abstractions of arm motion or head motion. Signals learned by conventionalization are "shaped" by the responses of the recipient: for instance, initially, Kubie may have forcefully moved Zura in the direction he desired; when cooperative, Zura would soon have learned to make the appropriate movement before much force was applied; eventually only the gentle touches of tactile-close gestures would have been required. Similarly, tap other may have been derived from actual grabbing or pushing of the body; likewise plausible scenarios can be constructed for other of Kubie's gestures. A similar process can be seen in a study with a young gorilla, Muni, as subject. The gorilla first used a human companion as a physical object to climb upon or manipulate in reaching a goal, then later began communicating intent, through gaze and gesture, to the human in order to influence him to collaborate in reaching the goal (Gomez 1990).

For Kubie, unlike the chimpanzees studied by Tomasello and colleagues (1989, 1994), there was continuity in gestural repertoire across time and partners (Tanner 1993). Of the study set of nine of Kubie's gestures, seven types were used with three different female partners during different time periods. Thus, rather than dropping items from his repertoire over time, as reported for the chimpanzees, Kubie as a young adult (between ages 8 and 13 years) maintained and expanded his repertoire. Tomasello's chimpanzees, however, were observed from infancy to the beginning of young adulthood, so the results may not be comparable. We are unable to say whether Kubie had had an earlier repertoire of infantile gestures that he no longer used.

Kubie's similar gestural repertoire with the three females implies that if conventionalization was the process by which his gestures were established, he went through a similar process three different times with three different individuals. Was the whole conventionalization process repeated, or was observational learning involved? Zura was not in the group when Kubie originally developed his gestures, though as a youngster she perhaps had opportunity to observe Kubie using gestures with the older female Pogo. A simpler explanation might be that *comprehension* of the motion depicted in gestures is biologically encoded for the great apes, thus eliminating the need for conventionalization on the receiver's side of the interchange (Perrett et al. 1989). Unfortunately, we do not have developmental data that can address these questions.

Though we have no evidence that gorillas or other apes (without specific teaching from humans) can understand directly that manual gestures can stand for actions and objects without undergoing a "conventionalization" process such as we have described, Kubie's creation and use of a unique repertoire of gestures still gives us a window into the developmental process and environmental pressures which might eventually lead to further refinement of iconic communication and true mimetic understanding. Human children use a few words as referents before they leap to a general understanding that all objects have names, at which point rate of word acquisition increases discontinuously and there is an onset of "What's that?" questions. For apes, such an understanding of symbols and referents can apparently result either through the evolutionary process over many thousands of years (as it has in *Homo*) or, for an individual ape, over only a few years when human intervention takes place at a critical period of development (as we see in language-trained apes).

CONCLUSION

The use of iconic gestures is described here for an untaught gorilla and has been observed for both species of chimpanzees; it therefore seems probable that the ability to depict action iconically has existed for at least the past 7–8 million years and was found in the common ancestor of all extant African great apes, including humans. If we assume that orangutan ability to imitate has similar cognitive underpinnings (Russon and Galdikas 1993, Miles and Harper 1994), this would be extended back to 10 million years ago; certainly, all four great ape

species are able to utilize human sign languages when instructed, a related ability. What factors common to hominoids promote gestural depiction? Ape brachiation requires a three-dimensional understanding of space probably more complex than that for monkey locomotion, and space is the medium in which descriptive gestures act (Chevalier-Skolnikoff, Galdikas, and Skolnikoff 1982, Povinelli and Cant 1992). The complete rotational movement of the joints essential for locomotion by brachiation also makes possible subtle gestures of the hands and limbs (Morbeck 1994).

In most scenarios for the origins of language, iconic depiction has an important role in the early stages. Manual gestures are an integral element of human language, inseparable from ordinary speech; language itself is closely tied to gesture in humans (Hewes 1973, 1976; McNeill 1992; Armstrong, Stokoe, and Wilcox 1995; and, for a neuroanatomical discussion, Preuss 1994). However, the intentional use of gesture is not routine and abundant in the great apes as it is in humans. Perhaps great apes have the potential to develop a full understanding of how gestures and mimes can represent actions and objects but do not do so under ordinary conditions. This possibility would be in accord with recent findings that "enculturated" great apes develop the ability to imitate goal-directed actions, use referential pointing, and show perspective-taking skills whereas other individuals of the same species do not; apparently the characteristic human pattern of parent and child sharing their interaction with objects serves to teach great apes skills that depend on understanding the intentions of other agents, skills that would otherwise remain latent (Tomasello, Savage-Rumbaugh, and Kruger 1993, Gomez 1994, Povinelli 1994, Patterson and Cohn 1994, Rumbaugh, Savage-Rumbaugh, and Sevcik 1994, Call and Tomasello 1994). Gestures developed by individual apes like Kubie may illustrate the beginnings of an understanding of how another individual's attention can be directed, even if the shared object of attention is only a gesturing limb or a specific part of the gesturer's body. Such elaborated means of communication, which achieve increased success for the individual in social and, ultimately, sexual relations, would certainly have had selective value and over many generations would have resulted in such communicative behavior's becoming increasingly frequent and complex.

References Cited

ARMSTRONG, D. F., W. C. STOKOE, AND S. E. WILCOX. 1995. *Gesture and the nature of language.* Cambridge: Cambridge University Press.

BRETHERTON, I., AND E. BATES. 1979. "The emergence of intentional communication," in *Social interactions and communication during infancy.* Edited by I. C. Uzgiris, pp. 81–100. San Francisco: Jossey-Bass.

CALL, J., AND M. TOMASELLO. 1994. Production and comprehension of referential pointing by orangutans (*Pongo pygmaeus*). *Journal of Comparative Psychology* 108:307-17.

CHEVALIER-SKOLNIKOFF, S., B. GALDIKAS, AND A. Z. SKOLNIKOFF. 1982. The adaptive significance of higher intelligence in wild orangutans: A preliminary report. *Journal of Human Evolution* 11:639–52.

FOSSEY, D. 1983. *Gorillas in the mist.* Boston: Houghton-Mifflin.

GOLDIN-MEADOW, S., AND C. MYLANDER. 1984. *Gestural communication in deaf children: The effects and noneffects of parental input on early language development.* Monographs of the Society for Research in Child Development 207(49), nos. 3–4.

GOMEZ, J. 1990. "The emergence of intentional communication as a problem-solving strategy in the gorilla," in *"Language" and intelligence in monkeys and apes.* Edited by S. T. Parker and K. R. Gibson, pp. 333–55. Cambridge: Cambridge University Press.

———. 1991. "Visual behavior as a window for reading the mind of others in primates," in *Natural theories of mind.* Edited by A. Whiten, pp. 194–207. Oxford: Basil Blackwell.

———. 1994. "Mutual awareness in primate communication: A Gricean approach," in *Self-awareness in animals and humans.* Edited by S. T. Parker, R. W. Mitchell, and M. L. Boccia, pp. 61–80. Cambridge: Cambridge University Press.

HEWES, G. W. 1973. Primate communication and the gestural origin of language. CURRENT ANTHROPOLOGY 14:5–24.

———. 1976. "The current status of the gestural theory of language origin," in *Origins and evolution of language and speech.* Edited by S. E. Harnad, H. D. Steklis, and J. Lancaster, pp. 482–504. Annals of the New York Academy of Sciences 280.

KERR, M. 1993. The captive management and social dynamics of a two silverback gorilla group. Master's thesis, San Francisco State University, San Francisco, Calif.

KOHLER, W. 1925. *The mentality of apes.* London: Routledge and Kegan Paul.

MCNEILL, D. 1992. *Hand and mind: What gestures reveal about thought.* Chicago: University of Chicago Press.

MILES, H. L., AND S. HARPER. 1994. "'Ape language' and human language origins," in *Hominid culture in primate perspective.* Edited by D. Quiatt and J. Itani, pp. 253–78. Niwot: University Press of Colorado.

MORBECK, M. E. 1994. "Object manipulation, gestures, posture, and locomotion," in *Hominid culture in primate perspective.* Edited by D. Quiatt and J. Itani, pp. 117–35. Niwot: University Press of Colorado.

OGDEN, J., AND D. SCHILDKRAUT. Editors; 1991. *Compilation of gorilla ethograms.* Atlanta: Gorilla Behavior Advisory Group.

PARKER, S. 1993. The ontogeny of social play in an infant gorilla: A comparative cognitive perspective. Paper presented at the Animal Behavior Society Meeting, University of California at Davis, Davis, Calif., July.

PATTERSON, F. G., AND R. H. COHN. 1994. "Self-recognition and self-awareness in lowland gorillas," in *Self-awareness in animals and humans.* Edited by S. T. Parker, R. W. Mitchell, and M. L. Boccia, pp. 273–290. Cambridge: Cambridge University Press.

PERRETT, D. I., M. H. HARRIES, R. BEVAN, S. THOMAS, P. J. BENSON, A. J. MISTLIN, A. J. CHITTY, J. K. HIETANEN, AND J. E. ORTEGA. 1989. Frameworks of analysis for the neural representations of animate objects and actions. *Journal of Experimental Biology* 146:87–113.

POVINELLI, D. J. 1994. "How to create self-recognizing gorillas (but don't try it on macaques)," in *Self-awareness in animals and humans.* Edited by S. T. Parker, R. W. Mitchell, and M. L. Boccia, pp. 291–300. Cambridge: Cambridge University Press.

POVINELLI, D. J., AND J. G. CANT. 1992. "Orangutan clambering and the evolutionary origins of self-conception." *14th Congress of the International Primatological Society, 16–21 August, Strasbourg, France.*

PREUSS, T. 1994. "The argument from animals to humans in cognitive neuroscience," in *The cognitive neurosciences.* Edited by M. Gazzaniga, pp. 1227–41. Boston: MIT Press.

REDSHAW, M., AND K. LOCKE. 1976. The development of play and social behaviour in two lowland gorilla infants. *Dodo: The Journal of the Jersey Wildlife Preservation Trust, 13th Annual Report,* pp. 71–86.

RUMBAUGH, D. M., E. S. SAVAGE-RUMBAUGH, AND R. A.

SEVCIK. 1994. "Biobehavioral roots of language: A comparative perspective of chimpanzee, child, and culture," in *Chimpanzee cultures*. Edited by R. W. Wrangham, W. C. McGrew, F. de Waal, and P. G. Heltne, pp. 319–34. Cambridge: Harvard University Press.

RUSSON, A., AND B. GALDIKAS. 1993. Imitation in free-ranging rehabilitant orangutans (*Pongo pygmaeus*). *Journal of Comparative Psychology* 107:147–61.

SAVAGE-RUMBAUGH, E. S., B. WILKERSON, AND R. BAKEMAN. 1977. "Spontaneous gestural communication among conspecifics in the pygmy chimpanzee (*Pan paniscus*)," in *Progress in ape research*. Edited by G. Bourne, pp. 97–116. New York: Academic Press.

SAVAGE, E. S., AND D. M. RUMBAUGH. 1977. "Communication, language, and Lana: A perspective," in *Language learning by a chimpanzee*. Edited by D. M. Rumbaugh, pp. 287–309. New York: Academic Press.

SCHALLER, G. B. 1976 (1963). *The mountain gorilla: Ecology and behavior*. Chicago: University of Chicago Press.

TANNER, J. 1993. First-year Ph.D. report. MS, University of St. Andrews, St. Andrews, Scotland.

TANNER, J., AND R. W. BYRNE. 1993. Concealing facial evidence of mood: Perspective-taking in a captive gorilla? *Primates* 34:451–57.

TOMASELLO, M., B. L. GEORGE, A. C. KRUGER, M. J. FARRAR, AND A. EVANS. 1985. The development of gestural communication in young chimpanzees. *Journal of Human Evolution* 14:175–86.

TOMASELLO, M., D. GUST, AND G. T. FROST. 1989. A longitudinal investigation of gestural communication in young chimpanzees. *Primates* 30:35–50.

TOMASELLO, M., E. S. SAVAGE-RUMBAUGH, AND A. C. KRUGER. 1993. Imitative learning of actions by children, chimpanzees, and enculturated chimpanzees. *Child Development* 64: 1688–1705.

TOMASELLO, M., J. CALL, K. NAGELL, R. OLGUIN, AND M. CARPENTER. 1994. The learning and use of gestural signals by young chimpanzees: A transgenerational study. *Primates* 35:137–154.

VAN HOOFF, J. 1973. "A structural analysis of the social behavior of a semi-captive group of chimpanzees," in *Expressive movement and non-verbal communication*. Edited by M. von Cranach and I. Vine, pp. 75–162. London: Academic Press.

WHITEN, A., AND R. W. BYRNE. 1991. "The emergence of metarepresentation in human ontogeny and primate phylogeny," in *Natural theories of mind: Evolution, development, and simulation of everyday mindreading*. Edited by A. Whiten, pp. 267–81. Oxford: Basil Blackwell.