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Ape Consciousness–Human Consciousness: A Perspective Informed by Language and Culture[1]

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SYNOPSIS. **Animal consciousness has long been assumed to be a nonviable arena of investigation. At best, it was thought that any indications of such consciousness, should it exist, would not be interpretable by our species. Recent work in the field of language competencies with bonobos has laid this conception open to serious challenge. This paper reviews this work and the case it makes for our impending capacity to tap the consciousness of a uniquely enculturated group of bonobos who are capable of comprehending human speech and employing a lexical communication system.**

WHAT IS CONSCIOUSNESS?

Investigations into the domain of consciousness face many conundrums. In a recent internet dialogue on the topic, sponsored by the Consciousness Studies program at the University of Arizona, the central issues were 1) What is consciousness and 2) How should it be studied?

Even though these issues are still being addressed, studies of great apes have demonstrated a capacity to comprehend spoken English, at the level of phonemes, morphemes, and novel syntactical constructions; events which one associates with consciousness. While questions swirl around whether what apes have is "really language," whether they have a true understanding of "theory of mind" and whether they are "conscious"—we see the critical issues as those of forming practical assumptions about theory and methodology that empower us to proceed with research informing our understanding of other minds and other species. In so doing, we adopt a theoretical position at a level of social science description borrowing from quantum theory, space-time sub-neural explanations of consciousness.

According to John Searle, "consciousness refers to the state of sentience or awareness that typically begins when we wake from a dreamless sleep and then continues through the day until we fall asleep again, die, go into a coma, or otherwise become unconscious. Dreams are also a form of consciousness, though in many respects they are quite unlike normal waking states" (Searle, 1998). We accept Searle's description of consciousness and agree with the view that subjective experience must be taken seriously as an object of study. Moreover, we would observe that "consciousness cannot be understood unless it is accurately described and that reductive approaches are inherently inappropriate to this descriptive task" (Velmans, 1998). For the time being, we believe that it is useful to assume that "consciousness may be an irreducible fundamental property of the universe in the same category as space and time or mass and electric charge. However, we take exception to Chalmers's idea that "we know in fact that brain processes cause consciousness" (1998). Our position is a simple assumption: consciousness is a property (Searle, 1992) which the brain manipulates in ways we might conceive of as bending, folding, focusing, or magnifying. Such contouring of consciousness is a function of the brain's typology, which we assert has been fashioned by culture. We suggest that reality is a construction of consciousness molded by forces of the brain shaped by culture.

We use the term culture in the anthropological sense, a variation of Leslie

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White's famous definition of culture. That is, culture is a force that has emerged which allows adaptation by the species to the environment at a rate which biology alone would not allow. We further argue that culture, language, and tools ride upon a common neural substrate. As forces, language and tools are subsets of culture.

We suggest that consciousness is quite general among animal species. The differences in what we as humans might interpret as degrees of consciousness are dependent upon the power (size) of the neural substrate to fold or bend consciousness into the appropriate reality. Thus, culture and consciousness co-construct the driving force in the evolutionary mechanism acting upon the highly plastic matter of biological life. Our position supports Hameroff's explanation that purposeful intelligent behavior may accelerate evolution and explain the Cambrian explosion (Hameroff, 1998). We believe that culture, as a force, is the unifying agent of consciousness within a species, such that, culture constructs the structure of our consciousness so that we (and other species) are able to share experience.

Given this co-interactive framework, it is only reasonable to suspect that the culture in which an ape is reared will significantly affect the form of consciousness it develops, as well as its communicative expression of that consciousness. If reared in a human culture, ape consciousness will be molded according to a form that human beings can recognize more easily as similar to their own and thus understandable by them. Such cross-cultural rearing studies can be understood as experiments in the grafting of cultural consciousness across biological platforms. Moreover, the expectations of the human participants in such studies will, unwittingly, affect the outcome. This is because the extent to which they extend their activities of "humanness" to permit the incorporation of alternative biological platforms into their group cultural consciousness, will affect the capacity of the developing organism. Thus studies of ape competence on "human tasks" can never be pure measures of ape capacity. The expectancies and culture of the measurer will inevitably affect them. Nonetheless, they inform us with regard to ourselves, the role of our expectancies and the plasticity of apes.

Ape language—Insights into human bias and cultural expectation

Ape language work at Georgia State University's Language Research Center has repeatedly produced important advances in the understanding of apes and their potential for linguistic processes since the first keyboard was presented to the chimpanzee Lana in 1972. At that time, little was known about the perceptual and cognitive capacities of great apes and it was considered unlikely that they would be capable of discriminating the small 2 dimensional printed patterns ("lexigrams") intended to serve as words. (Rumbaugh, 1977*a*, *b*) It seemed less probable that apes would respond to lexigram-words in a meaningful semantic manner or put them together in any fashion that incorporated even one or two of the rule bound parameters inherent within a transformational grammar.

When the "Lana Project" began, the chimpanzee Washoe had learned some signs, and serious questions were beginning to surface regarding the amount of imitation that underlay her actions (Terrace *et al.*, 1979). Moreover, her signs were often inarticulate and difficult to decipher for all but those who lived and interacted with her on a daily basis. Another chimpanzee, Sara, had also begun to respond to complex conceptual questions posed through the use of plastic tokens (Premack, 1986). However the token system was not designed for communication of needs or ideas, but rather as a test or probe of the apes' capacities in conceptual arenas thought to be unique to language. The lexical keyboard system proposed by Duane Rumbaugh, provided a potential means of propelling apes beyond the limitations posed by these other methodologies. In addition, it offered a more accurate means of data collection as it was linked to a computer, which recorded all utterances of experimenter and ape. The computer system could be programmed to require that Lana produce complete syntactically ordered strings of lexigrams arranged according to certain simple combinatorial rules. The first studies left no doubt that Lana could discriminate lexigrams visually, and that she could learn the simple ordering rules sufficiently well to apply them to novel sequences. Lana could also associate different symbols with various real world people, places, and things (Rumbaugh, 1977*b*) and the computer-collected data demonstrated that imitation was not the basis of her performance.

Like many other novel findings in science, the work with Lana raised more questions then it answered. It was not clear that Lana *always* understood what was said to her through lexigrams, particularly if the requests were somewhat unusual. It was also not clear why she sometimes made what seemed to be incomprehensible errors and formed nonsensical strings. What was clear was that she expected certain things to happen in response to her utterances. When told she was wrong, Lana would begin to cycle through a variety of incorrect but appropriate, as well non-syntactical and semantically inappropriate alternatives. These "alternate responses" were often unlike the errors produced by human children just gaining linguistic competency. They were more like "word salad" with mixed dressing for the ordering rules. Children's errors may be characterized as "cute" but they are eminently interpretable by all who hear them. By contrast, Lana's errors were more appropriately characterized as "puzzling" and it was often difficult to figure out what Lana was trying to say.

Lana rarely communicated unless she wanted something. Consequently, to "build" conversations with Lana, experimenters posed intentional "problems" such as hiding food, locating it in the wrong vending device etc. Through such means, discussions about a given topic could be maintained for a longer period of time. It might be thought that the need to "build conversations" should be taken as an indication that Lana's use of symbols was somehow not humanlike. However similar hurdles are encountered in working with autistic children. Often such children pass through a stage of very limited communication, where they fail to elaborate unless pushed. Repeated pressure to expand utterances however, is often the key to the emergence of a breakthrough capacity to generate more typical interactive language exchanges (Greenspan and Benderly, 1997).

The second generation of language studies with the lexical-keyboard system attempted to compensate for some of the perceived inadequacies in Lana's semantic performance. Her errors had revealed that while she grasped the combinatorial rules of her syntax, she often did not consistently apply semantic content. That is, the semantic loading of some vocabulary items was weak. Indeed, it often seemed that Lana knew more about how to use words, than she knew about their actual meanings. Thus, when presented with a problem in which she saw food in a green box outside her room, Lana would switch between sequences such as those listed below in an effort to produce a correct sentence.

"You put box which is black in room"
"Tim move bowl which is green in machine."
"Machine move bowl which is black"

It could take 5 to 15 attempts to produce the correct sentence "You move box, which is green into room." Errors included such phrases as "You move into Tim. . . " that is things that had no possible real world component. The fact that Lana simultaneously changed many elements of the sentences in response to being told that she was incorrect indicated the absence of a systematic elimination of incorrect responses.

Lana also lacked the capacity to employ or comprehend words used in nonsituationally familiar ways. In Lana's lexical world, the lexigram "bowl" was selected when Lana was shown a bowl or a photo of a bowl. But if someone said "There are no bowls" or "Put it in the bowl" or "We are looking for something that is in a bowl" or "Fill the bowl with water" or "Which bowl do you like"—usages of a sort that never occurred within Lana's experiential world—she had no means of relating to them. Yet such usages, along with metaphor, regularly inform our human use of language.

Consequently the ensuing effort, with

two young male chimpanzees (Sherman and Austin) was directed toward the careful inculcation of single words and a more objective analysis of both semantic and pragmatic word functions as contrasted with lexical "assignment". The "meaning" of words came under intense focus, and *receptive understanding,* along with object labeling became an important component of the linguistic instruction. The social aspect of language and culture was also enriched far beyond what had been the case for Lana. And lastly, in place of working with a single subject, efforts were concentrated upon communications between two co-reared apes, Austin and Sherman (Savage-Rumbaugh, 1986).

This simple change had profound theoretical implications that are still not widely understood. *It meant that, for the first time in the field of animal language, the experimenter was removed as half of every subject-experimenter interaction.* Such a change fundamentally altered the traditional experimental psychological paradigm in which every action of an animal subject is both preceded by a structured event, (usually termed the "stimulus") and followed by a structured event (usually termed the "reinforcer").

Previous animal work with apes, dolphins, and parrots followed the experimental control paradigm. These paradigms are insufficient for either the inculcation or analysis of functional linguistic phenomena. *Linguistic communication necessarily takes place between individuals in a multiplicity of exchanges that cannot be controlled from the outside either by intentionally setting the stage of the preceding stimulus or effecting a particular reinforcing event.* If there can be said to be a "reinforcing event" for the speaker during normal conversation, it can only be that of the comprehension of the listener. If there can be said to be a stimulus event that prompts the verbal selections of the speaker, it can only be the prior utterances of the listener, which are themselves a reflection of the listener's prior comprehension.

In attempting to analyze linguistic exchanges, one inevitably comes to focus upon the exchange of meaning between participants, in a situation where "meaning" is not controlled either at the level of input, output or reward by any experimentally manipulatable variable. Consequently, as one moves from the experimenter-subject paradigm to the study of communications between two or more participants, the boundaries of the traditional approach to the study of animal behavior are pressed beyond normal limits. Finally, once the exchange of meaning is the focus of investigation, it quickly becomes apparent that what we call "meaning" cannot exist outside of a socio-cultural context. What one party's utterances "mean" to another can only be determined within a socio-culture framework that permits utterances to assume certain inter-individual expectancies and obligations. This leap into the social dynamics of language took the work beyond the "can they talk" phase into something far more complex, and began to open up the issue of what talking is all about as well as how it is that social contracts are constructed. It required new skills on the part of Sherman and Austin, skills that had been missing in Lana, and for which little, if any, behavioral evidence existed.

The work with Sherman and Austin revealed that symbolic communication of a high level, with the use of an abstract code and with mutual understanding and cooperation, was possible between non-human creatures (See Fig. 1). It also revealed that the semantic processing of the symbolic components of the communicative system was not just lexically based and dependent upon stimulus-response associative phenomena. It was instead, semantically grounded and functionally abstract. Finally, it illustrated, for the first time in the field of animal language, the critical components of listener comprehension and listener cooperation (See Fig. 2).

Prior to this work, the functional components of animal language had been little discussed. But the difficulties which Sherman and Austin encountered, and had to overcome, clearly demonstrated that without these fundamental components of the language endeavor, the phenomena, which we call linguistic communication, could not take place. Inevitably, this work also raised

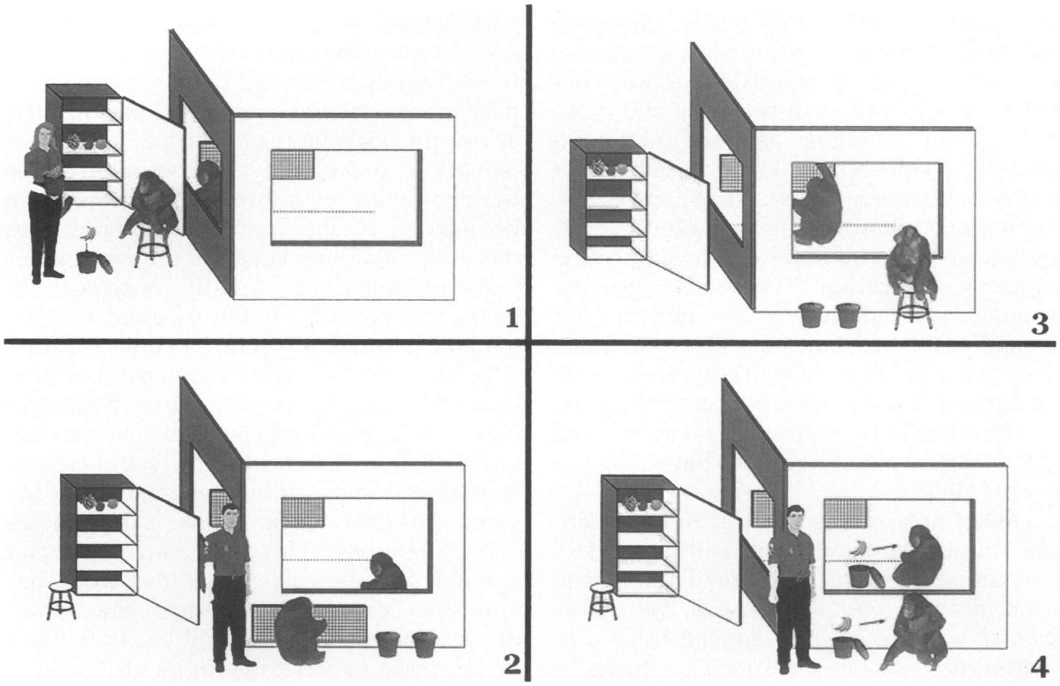

FIG. 1. 1. Austin (seated on stool) watches as experimenter A goes to the refrigerator and selects one of many different foods to hide in a container. Sherman (in test room) can see that Austin is watching the experimenter but he cannot see which food is selected and placed in the container. (His vision of this action is blocked by the open door of the refrigerator.) 2. Austin, with experimenter B, uses his keyboard to tell Sherman which food has been hidden. 3. Sherman uses his keyboard to request the food, which Austin has said was in the container. 4. If Sherman is correct, both chimpanzees share the food in the containers. On ensuing trials the roles are reversed.

The nonverbal contextual situation was critical to the competent execution of these communications. Both chimpanzees understood, from the way in which the procedure was conducted, that one had information which the other did not and that there was a need to share this information. If the same task were carried out as a simple match-to-sample problem, in which chimpanzee A was asked to match chimpanzee B's utterance in order to receive a mutual reward, they both failed. The emergence of semantic symbol use occurred only in a meaningful communicative situation that was commonly understood by both parties.

the question of whether or not Lana, as well as other "language trained" apes, birds, and dolphins were engaging in complex experimenter-subject interaction chains, rather than functional semantically based communication with a pragmatic component. Regardless of how semantically or syntactically complex the question, *i.e.*, "How many green hide?" or "Take the hoop to the window"—no repetitive response based drill has the essential ingredients to produce the sort of pragmatic functional communication that we associate with every human linguistic exchange. Like many autistic children, were other animals giving the right answers in a detached noncommunicative way? Did they simply appear "smart" to us because the things they said seemed so unusual for animals? Had Alex and Lana, and Ake been human, would we have readily recognized that they did not really relate to language in a spontaneous and interactive social exchange of meaning?

Before the truly communicative interchanges achieved by Sherman and Austin, the emphasis within the field of animal language was upon syntax as extant apart from communication. This focus derived from the assumption of some theoreticians regarding the universality of syntactical structure and the implications of understanding the fundamental nature of that universality for opening the key to thought processes

FIG. 2. Left upper panel. Sherman (seated left) looks at the kinds of foods on the tray in front of him and decides which item he would like to eat first. Left lower panel. He then selects the symbol on the keyboard to represent that food as Austin observes. Right upper panel. Austin picks up the food that Sherman has indicated and gives him a bite. Right lower panel. Austin then takes a bite of the same food for himself. These communicative behaviors were carried on between Austin and Sherman with no experimenter present in the room. They occurred because sharing and turn-taking were part of the everyday cultural tradition in the laboratory. These behaviors were not programmed or shaped, but rather modeled as the proper decorum surrounding food.

assumed to be uniquely human (Pinker, 1994; Chomsky, 1965). Without negating that stance, the work with Sherman and Austin came to show that such a position, regardless of its "correctness" could never, in the end, serve as an explanatory mechanism for the endeavor of human language. Language was not reducible to its internal structure alone. It required two participants able to mean and to intend, locked into a social context of communicative exchange.

The next phase of work pressed the boundaries of scientific method in a different way. The findings with Sherman and Austin brought forth a sensitivity to the process of comprehension as an invisible phenomenon, in the process of language acquisition. Consequently, when research efforts with Kanzi, a young bonobo, began, the emphasis was not on production but comprehension. There is no way to reward comprehension, because, in its initial stages, there is no overt behavioral indication of what is taking place. This made it essential to move away from any type of training. The results of this change in approach to the inculcation of language in a nonhuman being are taking considerable time to be incorporated into the philosophical body of thought regarding language skills in human and non-human creatures.

Since the appearance of modern scientific paradigms, and probably before, it has been assumed that any animal that learned even a small portion of human language would have to receive this knowledge through explicit instruction. The arguments against the "realness" of language in apes, dolphins and parrots have centered on the methods by which the language is acquired. Human language has often been felt to be more real than animal language as it appears seemingly without effort (Pinker, 1994; Pinker and Bloom, 1990). Moreover, many have assumed that there exists some innate degree of language capacity in the human species that permits us to understand the intentions of others (Searle, 1998). Animals, by contrast, are said to learn many correct responses, but these responses are assumed to differ in kind from what occurs in our own species (Bickerton, 1984; Calvin and Bickerton, 2001).

The bonobo's capacity to acquire high level linguistic skills in essentially the same manner as a child, albeit more slowly, revealed that the burden of linguistic development was carried by comprehension not production (Savage-Rumbaugh *et al.*, 1986). It is especially important that comprehension emerged in contextually meaningful situations, with many variables, not in repetitive training sessions with only a few variables characteristic.

Language competency appeared in Kanzi through an osmotic process in which caretakers passed on their linguistic culture without awareness or intent. These findings raised, for the first time, the serious possibility that bonobos possessed a sentience similar in kind, if not degree, to our own. It also followed logically that this sentience had gone unrecognized in field studies simply because we could not easily grasp the highly abstract and symbolic nature of their communications in the wild. (Savage-Rumbaugh *et al.*, 1996*b*).

Because Kanzi's mode of acquisition was very different from that of other linguistically tutored animals, his linguistic output was dramatically changed as well. Analysis of his utterance corpus revealed a basic comprehension of syntactical ordering rules as well as a comprehension of grammatical classes Greenfield and Savage-Rumbaugh (1991). But more than this, his understanding encompassed all manner of novel events and even of metaphor. His understanding of language informed his interpretation of real world events and his broadened capacity to interpret and appropriately classify real world events informed his linguistic comprehension in a boot strapping effect. An example of this was the ease with which Kanzi learned to flake stone tools given a modicum of both visual and verbal instruction. Similar attempts by other apes required long and arduous conditioning and shaping regimens (Toth *et al.*, 1993).

Because Kanzi's achievements went far beyond the accomplishments of Lana, Sherman and Austin; it became essential to determine the degree to which these remarkable capacities were a function of Kanzi's species versus a function of the unique rearing circumstances surrounding his development. Kanzi's rearing had taken place in a free-form captive environment modeled upon the type of existence a young bonobo might experience in the wild. This contrasted with the formal training regimens encountered by Sherman, Austin and Lana. Kanzi's linguistic accomplishments raised two possibilities. The first was that bonobos and human beings somehow shared a peculiar and unique genetic heritage for linguistic competency, and that studies of wild bonobos had simply failed to reveal the true abstract nature of their communication system. The other possibility was that something about the unstructured socio-cultural approach—with its absence of training and its focus upon comprehension—facilitated language in a manner that classical learning approaches did not and could not.

Kanzi's culture was characterized by many objects and by a variety of participants, including human beings who served as caretakers, but also by many others. There were repairmen who cleaned the lab, fixed the cages, and repaired the bridges in the field. There were visitors who wanted to meet Kanzi, dogs who guarded the lab at night, wild animals encountered in the forest, maintenance crews with their large machines, garbage truck drivers, telephone linesmen and many others. But Kanzi's world was not solely a human one; it was also "peopled" by Matata who was raised as a wild bonobo in the Congo. Across time, as Matata produced more offspring, Kanzi's world grew to include many nonlinguistically competent siblings who multiplied in number and began to form a bonobo community.

Kanzi thus developed as a being within

a *Pan paniscus/Homo sapiens* socio-cultural world. That is, as a bicultural entity who learned multiple of ways of relating to and communicating with others in both his bonobo and human cultures. His linguistic acts were fully, intimately and irrevocably embedded within both these cultures. Moreover, his behavior indicated an awareness that his biological mother could not fully relate to, or trust, many of his human caretakers. The same was true of the majority of his human caretakers; they could not completely understand or adequately relate to the culture and ways his bonobo mother. Kanzi served, and continues to serve, as something of liaison between these two cultures in ways that remain to be adequately documented. He will, for example, often employ the keyboard to request food for his mother and siblings who do not know the lexigrams.

Because Kanzi's language development was enmeshed within a culture, his life and communications evidenced a richness and depth that transcended the symbolic communications of Sherman, Austin and Lana. Kanzi became able to "mean" in a variety of ways. He also appeared to understand that symbolic meaning is something that can be constructed between individuals in the act of social engagement. He seemed to recognize as well that the "meanings" constructed through joint action develop a history, expectancies and even a certain necessity of being, once undertaken in a legitimate fashion. But Kanzi's very existence made it necessary to determine the relative effects that biology and environment had played in his development.

Consequently, the ensuing research project sought to separate the species variable from the environmental variable by co-rearing a bonobo (Panbanisha) and a chimpanzee (Panzee) in an environment that was essentially the same as that encountered by Kanzi. However, unlike Kanzi, these two apes were always together and therefore always inevitably exerting some indeterminable degree of influence over the development of the other. By introducing two additional apes to the environment built around Kanzi, the cultural aspects of the work expanded greatly. In addition, Kanzi himself provided a model for the behavioral and linguistic development that was very different from the one that Matata had provided for him. He could use the keyboard—she could not. Thus it was not really possible to precisely replicate Kanzi's experiences with additional apes. What we did do was to attempt to avoid the structured training, the emphasis upon production and the failure to ground the language within a rich socio-cultural environment that had characterized earlier work with Lana, Sherman and Austin. We concentrated upon comprehension in cultural context, we continued to make natural spoken English the main route of linguistic input and we spent as much time as possible in the natural forest setting.

Like Kanzi, Panbanisha and Panzee experienced a social environment within which keyboard usage was a daily affair by human caretakers. Because Kanzi was already lexically competent, the keyboard, which had begun with only 1 lexigram in his case, had grown to a board of 256 symbols. Thus the keyboard could not grow with Panbanisha and Panzee, as it did with Kanzi. If Kanzi was to be a part of their linguistic world, his 256 symbols had to be present as well. Consequently, Panbanisha and Panzee were exposed to 256 lexigrams utilized in complex communications from the first week of life. Perhaps for this reason, their acquisition of these symbols was much more rapid than Kanzi's. Similarly, their combinations appeared far earlier and Panbanisha composed more complex utterances of greater duration than Kanzi, although Panzee did not. Nonetheless, Panzee, though delayed relative to Panbanisha, followed essentially the same developmental trajectory (Brakke and Savage-Rumbaugh, 1995, 1996). She acquired the lexigram-words without any specific training and began to produce novel ordered combinations at about the same age as Kanzi and Panbanisha (Greenfield, Lyn, and Savage-Rumbaugh, in press). Like Kanzi, she also developed the capacity to understand and properly respond to spoken English words and sentences. She is not as accurate in her comprehension of completely novel sentences as are Kanzi and Panbanisha, nor does she recognize as many individual spoken words. She also has a greater degree of difficulty in differentiating words that sound similar, such as bowl and ball. Nonetheless, in mapping onto all the major capacities that were observed in Kanzi, but previously absent in Lana, Sherman and Austin, Panzee clearly demonstrated that Kanzi's skill was not limited to bonobos. Instead, it was a function of his early exposure to the bicultural social environment.

The process by which Kanzi, Panbanisha and Panzee acquired their lexicons include components of rapid mapping of sound to referent, similar to those utilized by human children (Lyn and Savage-Rumabugh, 2000; Lyn *et al.*, 1998). In addition, it has been found that no interaction with the ape itself is required, it is sufficient to speak to other individuals about a novel object in front of the ape. New words are learned and understood even when the apes appear to be disinterested in the conversation (Lyn and Savage-Rumabugh, in press; Lyn *et al.*, 1998). The cognitive and social processes that were found in Kanzi's proto grammatical utterances also characterized those of Panbanisha and Panzee, suggesting that there exist, within the genus *Pan,* basic cognitive processes that permit language acquisition in a human culture (Greenfield *et al.*, in press). Work with wild bonobos supports this position through the finding that bonobos employ intentional alteration of vegetation in a symbolic fashion to communicate to other bonobos who are following them (Savage-Rumbaugh *et al.*, 1996*a*). These findings are the first to indicate learned non-human intra-species symbolic communication across the domain of time.

Like Kanzi, Panbanisha and Panzee also attempted to produce human-like vocal sounds. Panzee gained far more voluntary motor control over the ability to produce low frequency sounds than either Kanzi or Panbanisha, suggesting that something about the vocal tract of *Pan troglodytes* is more amenable to the lower registrar than the bonobo vocal tract. Recent work has shown that Panbanisha has the ability to decode some sounds produced by Kanzi and to translate them to us.

It was not only the linguistic aspects of the *Pan Paniscus/Homo sapiens* culture that were passed on to Panbanisha and Panzee. They acquired many tool-use skills as well. For example, Panbanisha acquired the capacity to flake stone by observing Kanzi. But unlike Kanzi she began, with precision, to employ the technique of bi-manual percussion. Even though Kanzi had observed his human models demonstrate this technique, and even though he had attempted to emulate the bimanual technique, he did not become proficient in that skill without passing through a number of phases which entailed 1) non-precision stone slamming, 2) aimed throwing on a second stone, 3) precision bi-manual percussion with lack of sensitivity to edge geometry and 4) finally bi-manual percussion with sensitivity to edge geometry, as evidenced by rotation of the hammer and core prior to the delivery of glancing blows directed to the proper edges of the core. Whereas Kanzi developed this skill over a 2-yr period, Panbanisha's bimanual technique was oriented toward the edges of the stone almost from the beginning. It may be that observation of a bonobo model provided the needed input to permit Panbanisha to propel rapidly into direct aimed bi-manual percussion. A bonobo model may be more valuable to another bonobo, particularly during the execution of manual tasks that must be done somewhat differently as the fingers are longer, the thumb is shorter, and the wrists are less flexible. Kanzi's human model was certainly a more competent tool flaker, but nonetheless was limited to illustrating how a human hand would perform the task.

The fact that a competent bonobo model existed for many aspects of Panbanisha's development, coupled with the observation that in nearly every aspect of language and tool use, Panbanisha made more rapid progress than Kanzi, may be attributable to the modeling he provided. However, it should be noted, that Panbanisha did not appear to be motivated to watch Kanzi or to attempt to do things she observed him do in any sort of imitative manner. She preferred to spend her time with human female caretakers and with her bonobo mother Matata and seemed more prone to actively observe and emulate their actions. Panbanisha also demonstrated understanding of the intentionality of other agents in a bonobo version of the Sally Ann theory of mind paradigm which substituted a "bug" for the toy used in the traditional task. Panzee has also shown "Theory of Mind" skills in a paradigm adapted from earlier failed studies of this process in apes (Whiten, 1991, 1997, 1998). All three apes that are linguistically competent (Kanzi, Panbanisha, and Panzee) have also been shown to exhibit complex skills in planning travel routes (Menzel, in preparation).

PET scans done to compare Lana's linguistic capacity with that of Panzee revealed that Panzee's information processing skills were more highly elaborated and much more human-like than those of Lana. These findings regarding cortical function correspond tightly to the rearing and behavioral differences encountered between Lana and Panzee. They also reveal that the question of "do apes have language" is far too simple. Both Lana and Panzee "have" language to a certain degree, but their functional competencies vary greatly, as does the neurological processing of verbal material.

In sum, the work with Panzee and Panbanisha demonstrated that the powerful variable was that of rearing, not species. In an environment that did not require training, Panzee learned language faster than Sherman, Austin or Lana. She also comprehended spoken English while they did not. She produced more novel combinations and far more spontaneous utterances. Unlike them, she learned lexigrams independently of keyboard position.

The issue is no longer one of data, the adequacy of data, of potential cueing or experimenter effects, or of conditioning. In addition the issue is no longer that of "apes" in the general sense, but rather that one that must take into account, in detail, the socio-cultural experience of *each* ape, in determining how its performance on the continuum of linguistic competency is to be evaluated. The paradigms of the past, in which animal cognition is viewed as riding upon a different substrate than human cognition, are breaking down and the research at LRC has been a component of this change (Tomasello and Call, 1997). It has done so by investigating the issues of intentionality, inter-subjectivity, semantic meaning, observational learning, and tool use from a new perspective—one that incorporates the historical and social-affective development of the subject into the assessment process. In essence the "experimenter" becomes a part of the world of the "subject" in order to ascertain the competencies of the other. The importance of the research to date is not only that it offers the basic outline of new paradigm for understanding the mind of the other, but also in addition it provides techniques and data to support the approach.

The long standing philosophical issue of how meaning emerges has been significantly informed by work with apes, in a manner that could never have occurred, if all language studies were limited to *Homo sapiens* (Savage-Rumbaugh, 1990, 1991; Savage-Rumbaugh *et al.*, 1993). This work has clarified the Quinean problem and laid open the road for new insights into that which we give the name of "language." It is beginning to reveal that "meaning" can be packed into any gesture, glance, lexicon, or printed symbol. The packing of "meaning" requires inter-subjectivity—the mutual attribution of intentionality and a joint history, informed by mutually shared affective experiences. These components of communication are not limited to *Homo sapiens,* nor are they a peculiarity of the human capacity for reason.

Embracing both qualitative and objective systems of knowledge, the work discussed herein has recognized that empirical science is informative on a limited domain. It has employed qualitative methodologies to supplement empiricism when empiricism's limits of meaning have emerged as non-informing.

Moreover, we are cognizant of the problems of meaning inherent in the reflexive nature of language. Further, we strive for diligence recognizing that "epistemic objective knowledge contains domains that are ontologically subjective" (Searle, 1998).

Consciousness in other minds

Detecting consciousness: We agree with Searles's principle of connection between consciousness and the intrinsic intentionality that underpins linguistic meaning. The time has come to break away from views which hold that meaning, reference, and intentionality are not measurable phenomena and hence are closed to scientific investigation. Intentionality is systematically observable. While we do not ignore needs, wants, and desires as matters of intentionality, our current research with great apes emphasizes first the "measurable sequence[s] of complex monitoring responses in which the [person]: (a) checks to see that a listener is present before emitting a communicative signal, (b) engages the attention of the listener before emitting this signal, (c) emits a signal that requires a specific behavioral or verbal response on the part of the listener, [and] (d) monitors the listener's response visually and auditorially. . . " (Savage-Rumbaugh, 1986). More importantly, we recognize that intentionality has a dynamic quality when intentional processes emerge between speaker and listener. With respect to our research, we do engage dialogs, *i.e.*, intentional processes between listeners and speakers in which both are human and nonhuman primates.

Qualitative approaches, such as those described by Bernard (1994), increasingly serve our investigations informatively. We find that it is becoming critical to place special emphasis upon the development of nonprint data attended by "thick description" (Geertz, 1973) (See Table 6). Critical to our approach is the belief that ". . . there is an observable inter-individual sequence of events that must exist before the term intentionality is applied. . . " (Savage-Rumbaugh, 1986). The "processes of before" is necessarily historical and therefore introduces objectifying elements into the process, which helps tease out, in meaningful ways, the subjective content of the process.

Regarding the concept of "degree of consciousness" as stated, we reject this notion. We believe that the metaphors of bending and folding that we have applied to consciousness are a process that the neural substrate performs in the creation of reality. We reiterate our introductory remark, culture controls the typology of the neural substrate and therefore we believe culture is driving speciation. If we are correct, the brain of a nonhuman primate like Kanzi, reared in a *Pan/Homo* culture, capable of understanding spoken English and uttering lexical English counterparts, should possess a brain which is morphologically different than a brain of a feral bonobo or a bonobo reared without human language, culture and tools.

Our experience with great apes convinces us that they in fact possess consciousness, for they have first "person" accounts to offer of their lives. As a matter critical to the survival of scientific methodology, "We accept the[se] first person accounts and . . . the irreducible nature of experience, while at the same time refusing both a dualistic concession and a pessimistic surrender" to the debate regarding consciousness issues (Varela, 1998) or animal language research. We emphasize the power of cultural forces upon the neural substrate of biology and the significant role of culture as a force in evolution.

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