

Culture Prefigures Cognition in *Pan/Homo* Bonobos

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ABSTRACT: This article questions traditional experimental approaches to the study of primate cognition. Because of a widespread assumption that cognition in non-human primates is genetically encoded and “natural,” these approaches neglect how profoundly apes’ cultural rearing experiences affect test results. We describe how three advanced cognitive abilities – imitation, theory of mind and language – emerged in bonobos maturing in a bi-species *Pan/Homo* culture, and how individual rearing differences led to individual forms of these abilities. These descriptions are taken from a rich ethnographic material, and we argue for the scientific superiority of participant-based ethnographic studies of primate cognition in shared *Pan/Homo* cultures.

Key words: primate cognition, imitation, theory of mind, language, culture, ethnography

Introduction

In this paper we further develop our investigations into the ways in which *Pan/Homo* cultural living alters the development of the cognitive capacities of great apes. At this juncture we focus our analysis on the following three arenas:

- (i) imitation
- (ii) theory of mind
- (iii) language.¹

1. Animal culture

Culture has often been viewed as that which distinguishes humans from animals (Povinelli, 2000, Tomasello, 1999, 2003). This view is more common among humanists than among biologists (Boesch, 1999: Savage-Rumbaugh, Williams, Furuichi, and Kano, 1996). Many psychologists, for instance, assume that while humans live meaningfully in shared cultures developed and maintained in collaboration, animals move instinctively and alone in environments. As such they cannot interpret in causal or mental terms; this is also held to be true for the highly social and intelligent great apes (Donald 2001, Povinelli 2000), though some psychologists have steadfastly disagreed (Rumbaugh, 2003). While cultural psychologists such as Bruner (1990) consider human cognition as a capacity formed by culture in early childhood, they perceive chimpanzee cognition as determined by genetic factors with limited ability for cultural influence (Tomasello 1999).

¹ Due to the limited space available for the papers on this collection, the rich material contained in the footnotes of this paper have been deleted: more than 2,000 words. Yet they can be found among the stuff available in the Great Ape Trust website: GreatApeTrust.com.



In the past decades, however, animal culture has become a subject of empirical biological research (for an overview, see Bonner 1980, de Waal 2001). Biologists now study how animals learn from each other, and how ways of life are transmitted culturally and not just genetically (see Boesch 1991, Guinet & Bouvier 1995, Whiten et al. 1999). Rather than discovering animal-like traits in humans, as early sociobiologists did (e.g., Wilson 1978), biologists now reveal humanlike traits in animals.

In this paper, we offer a new view on this opposition between psychologists and biologists. Our view is not the classic one of studying what is 'out there' according to one or another disciplinary perspective. Rather our view has been hewn out of our own study of how human culture changes cognition in great apes, specifically, a group of eight bonobos who have been subjects of our cultural and linguistic investigations since 1975 (Savage-Rumbaugh, Bakeman and Wilkerson, 1977; Segerdahl, Fields, and Savage-Rumbaugh, 2005).

Traditionally, scientists have attempted to explicate ape cognition through systematic experiments designed to determine if apes are able to exhibit, and/or can be trained to produce, various skills thought to be indicative of particular levels of psychological functioning. A fundamental epistemological flaw mars this work. It is a well known fact that 'normal' psychological functioning in human individuals results from a lengthy rearing and enculturation process which involves parents, relatives, peers, and formal educational experiences. Without the benefit of such experiences, human children do not thrive, nor do they perform well on tests of psychological functioning. Implicit in tests of ape cognition lies an unstated and unproven assumption: namely that ape cognition differs from human cognition in that it will remain inherently limited regardless of the ape's cultural rearing environment. This implicit assumption leads scientists to conclude that tests of different apes from widely different backgrounds should produce similar findings as long as the apes are relatively 'normal' (meaning they are not obviously mentally demented). However, it remains the case that most of the individual apes on which psychologists base their conclusions have been raised in groups of wild-caught orphaned apes, or born in captivity and reared in nurseries and other environments lacking a cultural web.

By contrast, we argue that different *Pan/Homo* cultures should produce predictably different results. Moreover, imitation should occur spontaneously if the group contains adult members of both cultures who are salient entities and whose skills could be emulated out of a desire to be like 'individual X.' Researchers living within this milieu experience the culture first hand as recipients of culturally instantiated actions, agreements, norms and processes across significant dimensions of time as well as across those important cultural perturbations which result from each birth, each death, each instance of serious injury and each significant socio-political realignment. Participant observers, through the embodiment of such experiences, become enabled to describe them in a manner traditionally employed by ethnologists to describe the foreign cultures that they have adopted.

Through the living of a joined life, one learns about shared emotions, shared intentions, shared goals, shared perceptions of time, shared ethical norms, shared health

and shared illness, and shared mythologies, among many other culturally instantiated ways of being. These shared perceptions of reality serve as sort of clay from which the events of daily living become co-molded and co-interpreted. Experiential knowledge of these events becomes verifiable through simple daily acts of joint living and joint engagement. This happens as it does because if perceptions emerge that prove to be inaccurate, nearly all attempted joint actions will fail. *Thus there exists an inherent 'cultural correction device' which acts as an automatic constraint preventing incorrect perceptions from compounding themselves.* This 'cultural correction device' insures that the interpretations given the actions of others inevitably contain a high degree of validity.

Life in a shared culture avoids the pitfalls inherent in trying to determine whether or not captive apes reared in zoos and research labs lacking operational kinship groups, do or do not have certain abilities. Upon becoming an accepted member of an activated *Pan/Homo* culture, one gains insight into the emotional, cognitive and mythical percepts that under gird a functioning culture. Even as one experiences these processes, detailed data gathering, classification, and constant hypothesis testing is necessary in order to provide some organizational schemas of the nearly overwhelming wealth of sensory and symbolic information that impinges upon and overloads ones senses day and night.

Cultural forces operate on the novice initiate at many levels, from the trappings of clothing and prized objects, to the functionality of language and symbol systems, to the mythological forces that coalesce the motivations and intentions of the group, to the actual cellular embodiment of the constant sensory bombardment. But having made the transition to 'group member' – which is a very difficult process in itself -- bestows upon the successful initiate certain abilities, rights and privileges. One can comment on the abilities, foibles and beliefs of others in the group because one now knows about their social constructions through joint engagement, not through second-hand report or arbitrary artificial testing procedures.

In the accounts that follow we present snapshots drawn from a large compilation of ethnographic data that has been systematically knitted together across a period of seven years (Fields, in preparation). Each of the categories discussed herein is exemplified by examples drawn from this larger corpus, none stands as an isolated instance. Whilst the charge of 'anecdotalism' may be attempted in order to discredit the validity of the experience of living in a *Pan/Homo* world, such charges will inevitably melt as the number of documented novel instances mounts. Additionally, thick description, accompanied by video verification as journals move toward on line video explication of behavioral processes will place charges of 'anecdotalism' squarely out of bounds. For an example of the power of video explication of linguistic processes, see Savage-Rumbaugh, Fields, and Spricu, 2005.

2. *The Pan/Homo Culture: An Ethnographic Snapshot*

A notable difference between our work and that of more traditional ethnographers is that our *Pan/Homo* culture has been formed in collaboration with our research subjects. Moreover, we employ the terms *Pan* and *Homo* loosely. They refer to a particular

culture found among wild bonobos and to a particular culture found among humans. It happens that these different cultures currently coalesce with different anatomical forms, but we do not take this situation to be immutable. Both *Pan* and *Homo* biologies are capable of instantiating many cultural forms other than those we are investigating. Our work does not speak to the biologies, but rather to the processes whereby cultures interweave themselves into biologies.

For more than three decades a group of bonobos has been intentionally initiated into aspects of human culture by humans who live, eat, sleep, travel, speak and interact with them during continuous and direct physical inter-action in an environment as free from cages as law will permit. These interactions are not that those typify most human/ape encounters. Thus these individuals are not treated in accordance with the common view of 'ape as a creature less than human' but rather as entities whose potential is vast and unrecognized by our current limited views. Equally central is the fact that, by experiment choice, human culture has not been one-sidedly imposed. Rather, an intermediary culture with both *Pan* and *Homo* features has emerged by design in the interplay between apes and humans. This culture has operated upon, and changed both species, moving them toward a new norm.

These interactions take place within a matrix of travel. Movement through space as a group is critical to nearly all animal species and certainly to nonhuman primates. Even though *Homo* has evolved home basis, travel remains a central part of the lives of even modern humans many of whom have no need to travel in order to survive. Shared journeys, shared companions, shared sleeping arrangements and shared food are essential ingredients of our *Pan/Homo*. To the extent we are prevented from sharing these basic actions of social living, we function less as a common culture and more as a set of independent beings, each with their own agenda and views. The shared perception of potential danger, novelty and surprise during travel is also an important component of group cohesion, and a means of establishing a shared history and common perspective on that history. In our environment, canine species also play an important role. They establish particular bonds with different bonobos and behave protectively toward the bonobos by moving ahead in the forest and keeping watch for snakes, foxes, bears and panthers and wild dogs that occasionally are seen there.

These bonobos share a common vocal information system that is not innate, but culturally acquired (Tagliatela, 2004) and a written system, also culturally acquired. Their skills in these domains vary according to age and length of time in the *Pan/Homo* cultural world. All humans in the environment share common vocal and writing systems and to some extent humans have become able to interpret aspects of the bonobo vocal system. The degree to which either species can acquire the vocal system of the other appears to vary with initial age of exposure, length of exposure and type of exposure (Tagliatela, Savage-Rumbaugh, Baker, 2003; Tagliatela, 2004). Vocal communication between bonobos is extensive and ranges from specific information about the environment (for example, someone is on a telephone pole outside, visitors are here, chow is being brought to the building) to laughter and screaming (Savage-Rumbaugh, Fields, and Spircu, 2004).

All bonobos in this environment are treated as sentient entities with varying degrees of human linguistic abilities and varying degrees of bonobo linguistic abilities. All were born at the Language Research Center (LRC) except for Matata and P-Suke who were wild caught in the late 1970's and 80's. Matata was captured just prior to puberty, thus unlike most captive wild-caught bonobos who are infants, Matata was able to learn nearly all aspects of her bonobo ways of life before coming to the United States. P-Suke, like many captive apes, was taken as an infant, and raised in a human home and later alone in a zoo for many years. Kanzi, Panbanisha, Nyota, Nathan, Maisha, and Elykia are the children and grandchildren of Matata.

The LRC is a beautiful and natural place consisting of a variety of venues nestled within in a 55-acre forest located on the periphery of a 300-acre riverine preserve where the South River flows. Culturally, each bonobo's interpretation of the world reflects his or her rearing circumstances. Bonobo Matata and human Sue represent the bipolar matriarchy that has created the dynamic of the *Pan/Homo* continuum. Based upon each bonobo's post natal ontogeny and cultural expression, we place these bonobos thusly:

<u>Wild Bonobo</u>	<-> <u>Pan/Homo</u>	<-> <u>Pan/Homo</u>	<-> <u>Pan/Homo</u>	<-> <u>Human</u>
Matata	Elykia	Kanzi	Panbanisha, Nyota*	Sue
Maisha	Nathan*	Nathan*		Bill
(Bosondjo)	P-Suke*			Liz
				Dan, etc.

Matata represents a version of wild bonobo culture as Sue represents Midwestern North American human culture. Kanzi was bi-species mothered. Panbanisha grew up with a human mother within a functional bi-species group, Nyota is growing up with two human parents within an extended bonobo family; and Maisha was mothered by Matata. Elykia was mothered by Matata, with intermittent human mothering, Nathan is being raised by Panbanisha and a human mother (Both P-Suke and Kanzi play a fatherly role with all of the children.) Bosondjo is the father of Kanzi and Panbanisha. He was part of the initial group for several years, but was later relocated to Florida at the direction of the Yerkes Primate Center and the American Zoological Association.

These rearing differentials significantly inform the manner in which each individual learns, knows, believes, hopes, intends, and thinks, yet there are striking differences in how they learn and to the degree to which what they know can be linguistically modified. The power of language lies in our ability to employ it to attract the attention of others to our perception of reality. The degree to which language functions in this manner among the bonobos varies in association with the extent and form of exposure to human culture early in life.

3. Imitation

An important cognitive capacity emerging in apes who are enculturated in humanlike but bi-species cultural environments is the ability to imitate human intentional actions.

According to Tomasello (Tomasello, Savage-Rumbaugh and Kruger, 1993), the early experience of human pedagogic practices transfers the uniquely human ability to see others as intentional agents to young bonobos (Tomasello, Savage-Rumbaugh & Kruger 1993). As a consequence, the LRC bonobos have developed the ability to imitate actions as means/goal schemas (1999: 35). However, Tomasello also states that imitation is not defined as a cultural ability but is rather a cognitive prerequisite for the existence of culture. One may ask if Tomasello's definition is consistent with his own assessment that LRC bonobos learned to imitate through their emersion in the *Pan/Homo* culture.

Our hypothesis is that in order to recognize what a human experimenter is doing and to desire to imitate his or her actions, it is necessary that the bonobo share essential aspects of culture with the individual to be emulated.

Kanzi began to flake stone after observing Dr. Nicholas Toth

Kanzi's ability to flake and fashion stone tools is well documented by NHK of Japan (see *Kanzi II*, 2000, video documentary.) Kanzi makes fine Oldwan type cutting knives from a variety of stone materials. He learned to do this by observing the archeologist Dr. Nicholas Toth. Nick showed Kanzi what to do in a single encounter and after a few brief demonstrations, Kanzi began to utilize a rock as cutting edge. He tested different flakes for sharpness and easily chose the best one. He attempted to knap without success. But he continued to attempt what he had seen Nick do, long after Nick left. Kanzi's first flake was not produced for several months and a number of years were required before he was able to perfect his technique. Similar amounts of time have been required for some adult human subjects to become equally adept.

P-Suke's inability to flake stone

We have tried to teach P-Suke how to make rock tools on many occasions. Yet P-Suke will only hold the rocks, he will not even attempt to percuss. P-Suke's lack of willingness to participate in the use of cultural artifacts extends not only to rock tools, but to many simpler things. For example, the bonobos enter and exit the building by pressing a button to operate an automatic door. P-Suke refuses to press this button. He certainly can see what the button does, and he wants to open the door, but he will not do so. The other bonobos must open the door for him and they always do so, unless they are upset with him.

On the other hand, some artifacts of human culture are readily adopted by P-suke. He has, after a single demonstration, adopted the wearing of a mask and employed it in pretend games of scare and chase with youngsters. He has also noted the kinds of salves that are used for wounds and after a single demonstration has self-medicated his own injuries. He knows how cars work and like Kanzi and Panbanisha, he happily bounds into one to take a ride, while no amount of coxing can induce Matata into a large metal vehicle that moves.

When P-Suke arrived at the laboratory he was essentially silent except for nonlinguistic sounds, such as screams and laughs. Across the past eight years, he has ac-

quired nearly the full bonobo vocal stream of communication, including emulations of English-like phrases employed by Kanzi. He is able to emulate Kanzi so well, that at times it becomes difficult to tell which one is vocalizing if they are both out of sight.

Five year old Nyota spontaneously explicates his knowledge about flaking stone

One day, after about two hours of attempting to encourage P-Suke to learn to flake stone, we let Nyota join P-suke. Nyota had been observing all from the back room. Five year old Nyota ran out to the tool making area, picked up two pieces of flint, knocked them together, and then simulated a small piece of flint flying in the air to represent a liberated chip. While Nyota was much too young to have the strength to actually make a stone tool, he knew the rules and he was anxious to demonstrate them for us on P-Suke's behalf. In Nyota's case, no one has ever tried to formally teach him about stone tool making. He acquired what he knows through watching Kanzi, Panbanisha, Bill and Sue make stone tools. As early as six months of age, when Nyota was watching Panbanisha make stone tools, he would emulate her actions by making a flailing motion in the air with his right arm while closely watching his mother as she flaked.

4. Theory of mind

Povinelli, maintains that when evolution installed theory of mind in *Homo*, humans began interpreting other animal species as if they too had theory of mind (Povinelli & Vonk 2003). According to this view humans are biologically determined to over-interpret the cognitive capacities of non-human primates. Humans and chimpanzees share much behaviour, e.g., gaze following: if an experimenter looks up in the sky, the chimpanzee typically does so too. Because humans are equipped biologically with theory of mind, Povinelli reasons, even scientifically trained experimenters instinctively over-interpret the chimpanzee's looking reaction as though it were caused by awareness that the human is 'seeing something.' According to Povinelli, (2000), interpretations such as these are imbued with problems, as the concept of mind is an *a priori* category in humans. We apply the concept automatically, even when we are acting scientists who wish to test to determine if chimpanzees have theory of mind. Therefore, Povinelli concludes most scientists (other than himself) are likely to be incapable of seeing that apes are not like human beings with regard to even their most basic cognitive schemas.

Povinelli's view is supported by laboratory tests which demonstrate that chimpanzees lack the capacity for theory of mind. Normal human children pass these same tests at about four years of age (Povinelli 2000, Call and Tomasello 1999). However, we found that our human-enculturated bonobos pass linguistically mediated theory-of-mind tests (Savage-Rumbaugh, Fields & Taglialatela 2001) with alacrity, utilizing linguistically encoded information.

ToM in natural dialogue

One day, Bill found fresh blueberries in the refrigerator and gave the entire package to Kanzi. Nyota knew that Kanzi ate all the fresh Blueberries yesterday and that Bill did

not give him any. He also knew that Bill knew this and he expressed it by stating “BLUEBERRIES YESTERDAY” while looking toward Kanzi, then looking expectantly at Bill and stating “BLUEBERRIES GRAPES TODAY?” Nyota knew that Bill generally shares the blueberries, especially with himself and Panbanisha, as blueberries are Nyota’s most favorite fruit. All Nyota has to do to emphasize that he was not treated as fairly as he should have been yesterday is to express himself at the keyboard and Bill will quickly grasp the problem. Only Nyota employs the terms ‘yesterday’ and ‘today’, but Kanzi and Panbanisha readily grasp their meaning.

Nyota can be even more explicit when he knows he knows something that Bill does not know. For example, Bill’s solution to Nyota’s request for “BLUEBERRIES TODAY” was to look in the freezer and offer frozen blueberries, Nyota responded with an emphatic, “NO ICE.” Bill was perplexed because he didn’t have any fresh blueberries and told Nyota, “I’m sorry but I don’t have any fresh blueberries. They are all gone.” Nyota responded, “CHILDSIDE CHILDSIDE, CHILDSIDE CHILDSIDE.” –another location within the building, where bonobos are not permitted to go. Bill was sure there were no blueberries on Childside because earlier he had come from Childside. It was Saturday, and he was the only one at the lab. Nyota responded “SUE.” “Sue’s on Childside?” “TALK TALK TALK SUE NOW.” You want me to call Sue on the telephone. “Peep-yes.” At that point Bill called Sue, and she indicated that she had asked someone to go to the store and get fresh blueberries and that she didn’t know if this person was back yet. Bill walked around to the Childside and found that someone had just gotten back from the store and was unloading the car. On the table in the childside grouproom was five pints of fresh blueberries. Later Sue explained that she had spent the night with Nyota had he had asked for blueberries so she had ordered them for him.

Kanzi expresses displeasure when a promise is overlooked

The first time this level of skill became unambiguously clear was when a video was made of Sue promising to bring Kanzi something for his seventh birthday when she returned to the lab the following day or ‘tomorrow’ as she emphasized to Kanzi. The tape was then shown to Kanzi. Upon entering the lab the following day, Sue at first forgot her promise. Kanzi began to display at her over and over and would not stop, a most singular event. Every attempt to calm Kanzi down and asked him was wrong only provoked him further. Every question about why he was being ‘bad’ resulted in more vigorous and aggressive displays. Finally Sue left the room.

Away from Kanzi and able to reflect, Sue suddenly recalled her promise of the previous day. She called out to Kanzi who was in the other room: “Are you mad because I forgot your birthday?” Kanzi immediately respond with a cascade of vigorously agreeing vocal explosions. As soon as Sue apologized and told Kanzi she would not forget and that she would bring his presents, he immediately burst into joy and not another display was seen. There could be little doubt that Kanzi remembered what had been promised to him the day before on the video. No attempt to cover this fact, no offer of preferred food, no offer of kindness, no stern words, nothing could erase this fact from his knowledge. Only recognition of the error and profession of eager-

ness to correct the problem changed this situation. These and other similar events become the self-imposed ‘experiments’ defined through daily living within the *Pan/Homo* culture.

One might ask, why did Kanzi not simply remind Sue of her promise. Certainly Kanzi has done exactly this on many occasions. On this day it appeared that Kanzi thought Sue’s action was deliberate.

Panbanisha reminds Bill his glasses are on the washing machine because he cannot see the keyboard

In another instance, Bill was fixing lunch and Panbanisha was using an old non-talking keyboard to tell him something. Bill feeling rushed and busy responded, “Panbanisha, I can’t see what your saying. Please use the talking keyboard.” Panbanisha knocked on the glass and signaled for him to come over to her. As Bill approached, she held the keyboard out so Bill could see it clearly and uttered “GRAB” and then pointed to his glasses on the washing machine. The clear implication is, of course, you cannot see because you don’t have your glasses on. Then Panbanisha uttered “KEYBOARD.” Bill could immediately see he had not turned the keyboard on so that it would talk.

Panbanisha helps Bill remember what he has forgotten to do

One night Bill was putting the bonobos to bed. At that time, a very special orangutan Mari, shared the *Pan/Homo* culture as a peripheral member. Mari loved to be outside and when nightfall came she insisted on sleeping outdoors; however, generally she would come inside briefly to have supper with the bonobos. On this night she did not come in and the bonobos had supper without her. Bill was giving the bonobos their blankets when Panbanisha interrupted and uttered, “MARI BLANKETS JUICE.” Bill had completely forgotten about Mari because she was outside. Fortunately, Panbanisha reminded him. He immediately went outside and took Mari some blankets and juice.

5. Language

In contrast to the chimpanzee Nim, who was language-tutored in a specifically designed classroom five days a week for five to six hours a day (Terrace 1979: 46-50, 56), the LRC bonobos acquired language freely in an unbound fashion lacking intentional tutoring of any sort. This fact corresponds well with observations emphasized by Chomsky (1959, 2000), namely, that children acquire language without systematic linguistic instruction or correction: but effortlessly and spontaneously as an aspect of maturation. Chomsky and others interpret these observations as evidence for an innate and uniquely human language faculty (Hauser, Chomsky & Fitch 2002). However, the LRC bonobos cause us to conclude that these central observations are not so much evidence for an innate and uniquely human universal grammar, as they are indications that cultural dimensions of language, often downplayed as extra-linguistic or contextual features, are the central pathway into language proper.

A new concept of language is mandated by these findings. Consequently we have revised Charles Hockett’s (1963) classical catalogue of the design features of language to incorporate the cultural dimensions of daily exchange in which the LRC bonobos’

language emerged. The focus of the new catalogue is upon how language becomes stimulated to function in daily interplay between humans and bonobos in *Pan/Homo*-life situations. The catalogue tabulates twelve design features: (i) spontaneity, (ii) boundlessness, (iii) immanence, (iv) cultural creativity and generality, (v) placement, (vi) gestures and tools, (vii) culture-sustained vocal speech and other media, (viii) cultural unity, (ix) non-arbitrariness, (x) reflexivity, (xi) flexible interface of primate reactions, and (xii) the moral and personal dimension of language. In contrast to other studies that look at language from cultural perspectives (e.g., Duranti 2001, Tomasello 2003), *our hypothesis is that language is as an integral aspect of cultural practices; interlaced within the substrate of certain basic traits of human culture (cf. the language-game analogy, Wittgenstein 1953).*

Matata's language

The fact that Matata and Maisha have some linguistic abilities, even though they are not yet self-evident to *Homo* beings, is evidenced by the tendency of Kanzi and Panbanisha to translate for Matata when she cannot make her wishes known. Panbanisha regularly tells Sue which foods Matata wants to eat and which doors Matata is asking to have opened. Kanzi makes clear P-suke's needs, and when Kanzi does not succeed in getting them across P-suke displays, at everyone. Nyota often speaks for Nathan and Elykia.

Sometimes Matata provides very specific information to Kanzi and Panbanisha. For example, one day when everyone was quiet Matata, who was located 200 yards away in another building, began to vocalize. Kanzi did not answer her by looked toward her direction. Sue asked "What is Matata talking about?" Kanzi answered "CHOW." Sue thought maybe Kanzi was mistaken however she phoned the building where Matata was located to ask what was happening she was told that someone was just walking in the door with a bag of chow.

On another occasion, Matata's vocalization from far away suddenly set Kanzi to climbing as high as could inside the building to look out of the monitors in a specific direction. When Sue sent someone to find out what was there, they found a man up in a telephone pole.

We find it difficult not to suspect that Matata came to the United States equipped with a language of some form, though it is not the same kind of language that Kanzi and Panbanisha and Nyota have acquired. Matata is able to express needs, wants and events of general interest (for example, there is a man on the telephone pole), but she does not appear to engage in self-reflection. It is a though she speaks a language lacking the personal pronouns I, he, she, it, they, we etc, and a language lacking past tense.

Kanzi and Panbanisha appear to be cognizant of this discrepancy for there are many things they will, upon our request to "Tell Matata X," quickly translate for Matata. These include things such as "Visitors are coming, Chow is here, The gorilla is in the forest, Someone is getting in trouble, We are doing good, We are coming to see you, Kanzi did a good job, We are having bananas, Panbanisha is happy, etc." Likewise there are many things that they understand but refuse to translate upon request. These include things like "It is raining outdoors, Sue thinks that you should tell Mai-

sha to be good, If you go into the middle test room and let Sue shut the door, she can move Kanzi into the third cage. You need to let us lock you outdoors because the repair man is coming. This ball is red. The bottle of juice is big. Sue is taller than Liz. Liz is going to go to the childside to talk to Bill about her schedule. Holly will wash the dishes later. We saw a panther last here last week, etc.

Kanzi, Panbanisha, and Nyota are able to talk about things present, in the past, and of the future. As far as we can detect, Matata, Maisha and Elikya do not do this, or at least they do not do so with humans. Matata is able to communicate about things present to Kanzi and Panbanisha. For example, on one occasion, Matata was very upset as she called out in usual sounds. Sue and Panbanisha were in another building where they could hear Matata calling and Kanzi answering. Sue asked Panbanisha, "What are Matata and Kanzi talking about?" Panbanisha responded "DOGS." Sue inquired further, "What dogs?" And Panbanisha replied, "BAD DOGS CRIS CROSS CORNERS." A staff member was sent into the woods to determine if this was so. It was, there were five to six wild dogs at Lookout Point, a location very close to Crisscross Corners. Wild dogs seasonally come and go as they move up the river hunting for deer.

Beliefs about Good and Bad

Let us take for purposes of example, a piece of knowledge and belief about good and bad that exists in the *Pan/Homo* culture. Kanzi and his family have grown up with the mythical characters Bunny and Gorilla. Bunny is a kind entity who protects the bonobos. Bunny never does anything bad and always brings wonderful surprises for the bonobos. Gorilla lives on the edge of our forest and has a reputation for stealing food and prized objects. Kanzi is quite afraid of Gorilla and this invented boogiemans has served us well in limiting how far Kanzi is willing to venture into the forest. Kanzi believes that if he goes too far, such as over the fence into the subdivision, Gorilla will be waiting. Bunny and Gorilla are costumes which the lab employees put on and perform the mythological moment. When Kanzi became an adult, Sue introduced Gorilla as a costume to Kanzi. She let him try on the Gorilla costume. Then Sue put on the costume. Kanzi knew Sue was in the costume, but there were limits to how far his beliefs could be modified. While Kanzi would tolerate Sue in the Gorilla costume, it was clear that in Kanzi's mind, he was not sure to what degree the costume would affect Sue's behavior towards him.

As long as Sue does not wear the costume too long, she will be treated as 'Sue,' but if she continues to wear it and to behave as the gorilla, she begins (in Kanzi's perception) to lose her role and status as a member of the *Pan/Homo* culture and to become an outsider. This is dangerous to Sue for outsiders can be subject to serious attack without cause, whereas as accepted members of the culture are subject to serious attack only if they intentionally and deliberately violate cultural conventions.

Unlike Kanzi, Panbanisha believes that Sue will always be Sue regardless of the gorilla costume and she is not afraid at all. She knows that the donning of the costume is a game and she will often initiate a request for this game and specify who is to be 'scared' by the gorilla, how the gorilla is to go about accomplishing this action, and where

where to gorilla is to go. Lab employees such as the secretary enjoy participating in the game and pretend to be scared. Panbanisha is always watching them very closely to try and determine whether or not they are really frightened.

Nyota offers a very interesting surprise in his behavior. Nyota views the gorilla costume as “NO PRETEND.” Nyota cannot imagine the gorilla costume would scare anybody because it is plastic and fake. He believes if you want to scare a person, human or nonhuman, get a real snake and chase them with it.

An example of the way in which these differences in belief and knowledge operate could be seen the first time a nearly unimaginable event happened. The ‘gorilla’ (Sue in costume) approached the laboratory carrying Nyota! Never had the gorilla actually touched a bonobo before. Panbanisha watched, intrigued at this event, but not the least upset. Kanzi, hair standing out all over his body, ran to keyboard to announced to Bill, ”NYOTA GORILLA!!!” He then gestured for Bill to go out and do something about the fact that the gorilla had stolen Nyota.

A Pan/Homo debate: Sue and Panbanisha disagree

A second example of cultural cognition deals with hope, expectation, and planning. While we have evidence that all bonobos plan and possess expectations, such situations are much more difficult to document with Matata than with Panbanisha, Kanzi or Nyota. Indeed Panbanisha is able to provide us with examples of planning, expectation, and hope essentially everyday. One example, documented on video, occurred as the sun was going down, and NHK was filming the bonobos. Sue was trying to facilitate an event where Panbanisha would go to spend some time with her bonobo mother Matata who was staying in other building about 200 yards away (the ‘P-Suke’ building). Panbanisha has been inside all day long and wanted instead to go walking in the woods with Sue, regardless of the fact that it was late and almost dark. Sue began to discuss her plan with Panbanisha. It was clear Panbanisha did not want to go see Matata. She suggested that she and Sue go to Sue’s Gate, Scrubby Pine Nook, or Lookout Point, anyplace but to see Matata. Sue insisted they go see Matata. Both Sue and Panbanisha maintained their views and a human/nonhuman argument was explicated upon the lexigram keyboard before the camera that lasted thirty minutes. Sue was exasperated. Panbanisha was not willing to cooperate. Finally Sue said, “Panbanisha, this is serious. You have two choices. You can either go to the P-Suke building to see Matata or you can go back to the colony room with Kanzi.” Panbanisha thought for a very long moment and then with a stern look on her face turned and walked back to the colony room. Clearly, she had comprehended Sue’s linguistically expressed plan and offered Sue many alternatives, but when Sue would not accept any of them, she likewise would not accept Sue’s plan.

Bill talks to Panbanisha about her feelings after arguing with Sue

After the discussion noted above between Sue and Panbanisha Bill asked Panbanisha how she was feeling about not going out with Sue and she responded, “MAD.” Bill told her he was sorry and that perhaps tomorrow they might go to Camper Cabin and Midway. Panbanisha responded, “CAMPER CABIN LATER.” Bill said, “Yes, later.”

Bill did not see Panbanisha the next day. About a week later, Panbanisha reminded him, "CAMPER CABIN LATER." Bill said, "Oh Panbanisha, I'm so sorry, I forgot. Let me go talk to Sue." Panbanisha stopped him and also uttered "EGGS LATER." Eggs are the traditional food associated with Camper Cabin. Panbanisha was making sure that if she got to go out, that Bill would have the forest baited with food. And if she didn't go, that Bill would arrange for the bonobos to have eggs that night. As it turned out, no one was able to go out that day because it rained, but Bill got the eggs for dinner. That night Panbanisha remembered and asked for the eggs and all the bonobos had some. Then Bill asked Panbanisha how she felt and she responded, "TV-TAPE, BLANKETS, BANANA." Bill understood that Panbanisha was ignoring his question and that she wanted him to get a videotape and put it in the television, find some more blankets, and some bananas before he left. But Bill wanted to know how Panbanisha felt. He persisted by asking, "Are you still my friend?" She responded "GOOD" and pressed up against Bill. Being very happy that he was forgiven for forgetting his promise, Bill provided Panbanisha her requests and said goodnight.

6. Conclusion

Kanzi, Panbanisha, and Nyota are significantly changed by the ontogeny of their human enculturation. P-Suke seems to be as well, but this is only emerging in his case, as he arrived at the laboratory with knowledge of Japanese, but no English, lexical or bonobo comprehension skills. With each new generation after Matata, the *Pan* babies of human cultural bias begin to gaze, think, gesture and behave in nonverbal ways that increasingly diverge from Matata. Yet they remain fully capable of socializing normally with other members of *Pan*.

Lacking a language of self-reflection, but possessing a language of ideation and co-construction of dialogic representation, Matata lives in world that is both within bounds and yet out of bounds to Kanzi and Panbanisha and the other members of the *Pan/Homo* culture. The contrasts between Matata and Kanzi stands as a striking example of the fact that tests such as those offered by Premack (2002), Tomasello (1999, 2001) and Povinelli (2000) tap culturally instantiated realities, not biological limitations.

Other investigators interested ape cognition retain the option to act as observer-recorders and/or presenters of test materials. Through such techniques, they assume the luxury of engaging in interpretations that may or may not prove valid. By contrast the cultural actions of participants are real and have real consequences, some of which can be and have been dangerous. Our actions within the culture stand as part and parcel of the set of discernable facts.

In light of the data presented here and elsewhere since 1975, it is becoming increasingly clear that those scientists who wish to develop theoretical perspectives regarding the limits of ape cognition -- while remaining outside the circle of insights that arise upon authentic cultural engagement -- must now justify the means by which they may assert such intellectual privilege.

As other researchers move to replicate the *Pan/Homo* culture of the LRC bonobos, they should be cognizant of the critical role played by Matata (and initially by Bosondjo). The *Pan/Homo* culture began with Sue spending years integrating herself into the bonobo culture of Matata, Lokelema and Bosondjo within the first few months of their importation to the United States in 1975. Experience in integrating herself for five years into a group of chimpanzees prepared her for this venture. It was with Kanzi's birth that the human influence began. If Sue had not integrated herself fully into the bonobo culture she would not have been permitted to assist Matata with Kanzi's care and rearing. The polarity that emerged between Matata's rearing patterns and Sue's manifest itself initially in the fact that Sue carried Kanzi bipedally and Matata carried him quadrupedally. When Sue held Kanzi she supported his weight. When he rode with Matata on their long walks in the forest, he had to support himself. Thus with Sue he was free to look ahead and to manipulate all manner of things with his hands as he walked. With Matata, he had to attend to clinging and saw only the rushing canopy of green as they traversed the forest. This simple difference experienced by Kanzi as he rode first with Sue and then with Matata (whichever he chose) set the stage for the cultural bifurcation and polar tension that has created the *Pan/Homo* culture. This tension itself serves as creative and positive force. Without it, Kanzi would have experienced only "human rearing" and we suspect, would not have been stimulated sufficiently to develop many aspect of cognitive competence that he now manifests.

Are there limitations to great ape cognition that are not culturally based? Is brain size and/or brain wiring a basic constraint in some yet unexplained way? We know that human children who suffer hemispherectomies at an early age still acquire language and human culture. Apart from difficulties in locomotion and some minor cognitive deficits these individual do not differ appreciably from normal children, even though their brains are half the normal size and clearly must become differently wired. These simple facts point us in a new direction of self-understanding and awareness. They emphasize the strength of cultural realities, cultural bias and the myopic focus of the current theoretical constructions of mind. Minds do not arrive preformed and minds do not emerge in precise stages. Minds are bended and folded by culture forces that are operating at a level that we are only beginning to understand.

Certainly the coordination of gestures and glances among parents and offspring that arise in the matrix of dialogic reality co-construction, play a role in the development of mind, but these events, which typically operate 'off-line' as non-conscious nonverbal co-coordinators in the dance of behavioral interchange (King, Shanker and King, Greenspan and Shanker) are not the driving forces of dialogic competency. They are too intricate, too rapid and too unconscious to begin to be the carriers of conscious reality. They are its manifestations, but not its structural units. The plasticity of the nervous system is the matrix upon which culture forces operate and propagate themselves. They control its shape and its potential through physical dynamics yet to be explicated.

Though we do not yet fully understand how cultures transmit knowledge, what we have acquired from the LRC bonobos has far reaching implications for our understanding of the relation between human biology and culture. We are forced to acknowledge that skills we have assumed to be fundamental to all aspects of human cognition (i.e. language, imitation and ‘theory of mind’) are not innate. They emerge within a cultural environment that has been constructed of whole cloth across millennia of social weaving. Whether we approve or not, we are products of the very cultures we ourselves have, in co-constructed dialogic exchanges, brought into being. These cultural forces act anew on each generation, perpetuating themselves with regularity so profound that we have assumed our rational thought processes to be innate. The LRC bonobos reveal that our species, like these bonobos themselves, must possess a vast and unrecognized potential to alter the most fundamental aspects of our cognitions.

To conclude that the bonobos would not have gained their competencies without human input is foolish. Even Kanzi’s own experiences in becoming an excellent knapper suggest that the changes are hewn from the fabric of engagement. Kanzi’s affair with stone has changed the structure of his musculature and wiring of his brain, for it takes two hands, operating simultaneously but nonsymmetrically, to produce stone flakes. Kanzi did not change simply by watching us. He changed through the physicality of knapping. P-Suke lacks Kanzi’s physical and mental knapping anatomy as he has not changed through the physicality of a knapping engagement.

What happens in the engagement of physicality with stone technology is intriguing and set *Homo* on a unique course. However what can happen in the far more dynamic realm of the physicality of social interchange is as yet unknown, but fundamental change at this level as the potential to lead to completely new behavioral worlds, social worlds that we have not previously constructed through any extant culture.

TABLE 1

Individual	Sex	Age	Place of Birth	Cultural Mothering
Matata	F	>35	Congo, Africa	Wild Bonobo/taken at puberty
P-Suke	M	>30	Congo, Africa	Wild Bonobo/taken as infant reared in human family as an ‘ape’ -- language comprehension and enculturation is Japanese
Elikya	F	8	Decatur, Georgia	Wild Caught Captive Bonobo Mother
Maisha	M	3	Decatur, Georgia	Wild Caught Captive Bonobo Mother
Kanzi	M	25	Yerkes	Wild Caught Bonobo Mother and Human Mothers
Panbanisha	F	19	Decatur, Georgia	Human Mother
Nyota	M	6	Decatur, Georgia	Human Mother and Human Father and Human Enculturated Bonobo Mother
Nathan	M	3	Decatur, Georgia	Human Enculturated Bonobo Mother And Human Mother

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