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The Fully Conscious Ape

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The fact that language can both span time and yet create a reality of spoken space/time – when employed in a common way by a group of human beings – gives rise to the question of whether we are constructing language or language is constructing us.

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Every student of animal behavior or comparative psychology quickly learns that any tendency to explain the behavior of animals from a human perspective must be avoided. The error of anthropomorphism is made especially clear for students of primate behavior in the relatively new discipline called "primate cognition." Previously, work on this topic was done within the field of comparative psychology, or primate behavior. However, with the rise of computer programs and the ability to test primate skills through the use joysticks (Hopkins, Washburn, & Rumbaugh, 1989; Rumbaugh, Richardson, Washburn, Savage-Rumbaugh, & Hopkins, 1989), it became increasingly acceptable to refer to what nonhuman primates do as "thinking," or "cognating." The complexity of computer programs themselves went far beyond the stimulus-response framework of animal behavior and with the rise of AI programs that made real-time decisions and offered real-time answers to questions. They made it reasonable to attribute thinking and high-level cognition to animals. However, the question of whether or not either AI programs, or monkeys, are actually engaging in more than high-level correlational analytic processes remains open. On the other hand, the case for humans is clear. We can identify stop lights, motor bikes, and store fronts in a series of photos – a skill that, oddly enough, separates us from our computers.[1]

Do Nonhuman Primates Think?

The question of whether nonhuman primates are able to "think" in the way that human primates do was first brought to the forefront of the field by Rumbaugh (Rumbaugh, 1969; Rumbaugh & McQueeney, 1963; Rumbaugh & Pournell, 1966) with the *transfer index*, a paradigm developed from discrimination-reversal-learning and learning-set tasks. Later, with the discovery that apes could spontaneously use joysticks, Rumbaugh and Savage-Rumbaugh devised a *shaping task* for monkeys, which allowed them to master the use

[1] One hesitates to think of robotic cars that are unable to do this simple kind of discrimination, but, until computers become "representational" – which they are not at this point in time – new instances of simple things can confound their "perceptual systems." Robotic cars will become quite efficient if all cars are on an autopilot grid, but that is a very different kind of computation than the processes of representation. It is the ability to think and to communicate in a representational manner that places us in a special category of our own for now. Of course computers can be told that X represents b and remembers this at once, but being told something by a programmer and actually performing that "mental operation" are very different classes of affairs – a situation often overlooked as they out the newest AI abilities.

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of the joystick (Rumbaugh, Richardson, Washburn, Savage-Rumbaugh, & Hopkins, 1989; Rumbaugh, Washburn, Savage-Rumbaugh, & Hopkins, 1990). [2] Monkeys do not immediately understand the correspondence between what they are doing with their hands on a joystick and what takes place on a video screen. Rather, they can be taught to control the movement of a target on a screen through the use of a program that requires an increasingly fine orientation of their attention to this relationship. The difference in how apes and monkeys acquire this control is similar to the difference in how they come to learn to recognize themselves in mirrors (Changa, Zang, Poo, & Gong, 2017).

Whether monkeys are trained to touch a dot on their face as shown in a mirror or trained to control a joystick that is moving a cursor on a screen, the behavior must be carefully shaped, or the monkeys do not acquire the skill. Apes, by contrast, acquire both skills without shaping. Apes have no need for "attentional shaping" because they have sufficient control of their own attention to place it upon the relevant variables required to understand the relationship between joystick movement and cursor movement.[3] The role of shaping in both mirror recognition and joystick control is to focus their attention on a dot or circle while the location of either changes frequently. The monkeys must touch the dot, or they must control a cursor on a screen whose movement is determined by a joystick. In the mirror recognition task, the dot initially begins to appear on many locations on their own body and finally on their face (which is locked in place, facing a mirror, throughout the task in order to ensure that they must attend to their face in the mirror). In the video task, the curser initially produces a reward with any swipe of the joystick but eventually requires accurate control of the joystick, while monitoring the screen. Both tasks thus shape the monkey's attention to a specific relationship. The monkey acquires the pairing relatively easily once their attention is controlled.

The difference between the monkey and the chimpanzee (in such video tasks) thus reduces to the chimpanzee's ability to identify the main variables and to voluntarily place his or her attention on them. Then, through a cause-and-effect analysis, he or she determines how to solve the task – which the ape does of his or her own freewill (Haggard, Clark, & Kalogeras, 2002).[4] This a nontrivial difference. This is the same ability that allows an ape to form a concept of the "self" as a single entity existing across time and circumstance to reflect on the actions of that self and to acquire language.

This self-control of conscious behavior via self-conscious monitoring of one's own behavior, coupled with the ability to place one's self-directed attention upon the relevant variables of the task, is a rare skill among nonhuman animals. It requires the ability to alter behavior in rapidly changing situations by consciously monitoring both the incoming stimuli as well as what the "reflected self" or the "imagined self" is doing/thinking at the same time.[5] Real world examples of the inability of monkeys and baboons to self-direct their attention are provided below [6] to illustrate that this difference in the self-control of attention has real

[2] The apes did not require shaping. Once they observed humans with whom they identified employing a video game, they began to do the same.
[3] Personal observation of Sherman and Austin when first presented with a joystick. They enjoyed this task but did not attempt to get "really good" or compete against one another as human children would do. However, as they grew older, they did attempt to become very adept at some video tasks. The idea of competing for "points" in such tasks was not introduced to them.
[4] Some may object that the term "freewill" carries with it unwanted connotations. Others may argue that if every aspect of the history of these apes were known, we would see that they were compelled to want to learn video games for reasons not clear at the moment. Perhaps so, but the apes were able to monitor their own behavior vis-à-vis this task. Still others may object that even humans do not actually have "freewill," and that this term is wrongly applied to apes. This paper is not a venue for a philosophical treatment of the concept of "freewill." The term is being employed here to indicate that no one guided the apes' attention so that they became able to use a joy stick. No one rewarded them with food for this. Their interest and desire to engage the task appeared to come from within. They instantly understood that the joystick controlled the movement of the cursor on the screen. Thus, their behaviors had the appearance of "freewill" and the apes perceived themselves as doing this task of their freewill.
[5] It has been reported that Ham, the first chimpanzee in the space program, was taught to follow cues by avoidance of shocks. However, when the apparatus malfunctioned, and he had to land the space craft while receiving shocks for correct choices, he ignored the shocks and correctly landed the craft.
[6] YouTube: How to fool a baboon into showing you where to find water (https://youtu.be/CIRucMIxwM8)

world consequences of considerable significance. This presumed difference between monkeys and apes appears to be the result of the ability of the *Homo* (and presumably *Pan*) central nervous system (CNS) to apply "a specific neural mechanism to produce intentional binding of actions and their effects in conscious awareness." (Haggard et al., 2002, p. 382).[7]

The Homunculus

In humans, this ability has been termed the *homunculus,* or the person inside controlling the person on the outside. The homunculus is perceived as a nonexistent entity. Studies of neurological control reveal that human subjects exhibit neurological activation patterns commensurate with one response over another long before the subject becomes aware of what his/her actual choice will be. That it is to say, some part of the subject knows what it is going to do before it can report an awareness of what it is going to do (Haggard & Eimer, 1999). This raises the question not only of how this takes place, but also "who" it is that knows and makes the decision, if it is not the self-aware part of the subject? Thus, was the decision voluntary? Perhaps the decision with regard to how to respond to a rapid incoming stimulus itself was not voluntary, but the decision to place the attention on that incoming stimulus was voluntary if made by an ape or a person.

Attempts to locate a homunculus in the brain or a brain region responsible for this difference in awareness between great apes (including ourselves) and monkeys have repeatedly failed. It is as difficult to locate the *awareness of self-awareness* and as it is to locate consciousness. As Ramachandran and Hirstein (1998) have pointed out, we can even be aware of limbs we no longer have, and thus the awareness we experience is not limited to bodily perception. It exists as a creation of our mind. Often we cannot eliminate this creation even when we wish to do so. We are always aware of being aware. We are concomitantly aware of being unaware, or at least of having been unaware. We are not absolutely certain that any other living beings experience this odd state of affairs, because they cannot describe it, as do we. However, the bonobos, Kanzi and Panbanisha willingly assert that they aware of what others know, and don't know, in theory of mind tests (NHK Kanzi: An Ape of Genius, Part II, 2000). Thus, they have an awareness that they are aware of the various states of awareness of others, which would be impossible to do, without being aware of their own awareness. They are also aware of their own emotions, and therefore able to control them - through that state of awareness. They do not simply react, they act with decision, deliberation, intention and prediction.

In being aware of being aware, one possesses the ability to control that to which one elects to direct their attention. This remains true, even if we cannot identify the "who it is inside of us" that is doing the directing. By taking control of our own attention, we decide what we do, when we do it and how we do it. We are no longer the slave of environmental events around us.[8] Animals (apart from apes, whales and dolphins) do not normally take control of their own attention. When a sight, a sound, or an event of some sort occurs,

[7] The strong and consistent difference in the control over attentional awareness between monkeys and apes as described here does not reflect any attempt to equate the rearing conditions across species. Thus, it remains a possibility that early rearing intervention with monkeys could eliminate this otherwise profoundly significant gap.

[8] One of the video's referenced - footnote 5 - is of a bushman who is able to "trick" a baboon into doing things it would not otherwise do by manipulating the baboon's attention. The baboon's attention became so focused on one thing (the fact that is wanted some seeds) that it was unable to voluntarily "remove" its attention from this in order to think about what it should have done once its hand became caught attempting to retrieve the seeds. Another example is of wolves learning to attack baboons in trees. They learn that if they frighten baboons sleeping in trees, one baboon will produce an alarm call. One baboon becomes alarmed at the sight of wolves surrounding the tree. In response to its own state of fear, the baboon produces an alarm call. Normally, this call is given when a leopard has entered the tree, in which case the best thing to do is to rush to the ground. That response would result in immediate capture by wolves.

their attention goes to that event. Thus when we wish to control animals, we typically take charge of their attention. This is basically the function of Skinner box. It is not really to present lights and sounds – that could be done anywhere. It is to separate the pigeon from other pigeons, and all environmental stimuli so that the only stimulus which can compete for its attention is the one in the box, and that stimulus remains stable except as manipulated by the experimenter. Of course, any sort of generalization beyond the box becomes problematic, because beyond the box, there are literally millions of constantly changing stimuli competing for the pigeon's attention. What determines which one wins? Presumably something about the combined statistical history of all the incoming stimuli (Embrick & Poeppel, 2016).

The other tried and true method of working with animals is to simply overpower them so that they must attend to that which we desire. Animal trainers advise their students to "take charge of the animal," which simply means not allowing the animal to do anything that it wishes to do because its attention is drawn in first one direction or another. Thus the horse is to learn to go where the rider directs and not where it wishes. It must learn to inhibit its attention and tendencies and to follow, instead, only the direction of the rider. In traffic, we put blinders on the sides of its eyes. Dog training consists of essentially the same thing. The person becomes the stimulus for the dog, (the horse, the monkey, the elephants, the dolphin, etc.) and decides when and what it will be permitted to so.

However it is unwise to attempt to control animals by overpowering them, because the emotion that is generated through any use of force interferes with that which we wish them to learn. It is therefore easier to "shape" an animal through small steps into a routine set of actions. Again reward is not required, what is required is the repetitive execution of the routine itself. All comparative psychologists learn these things every early. But scientists in fields such as linguistics, primatology, anthropology and biology often do not, causing considerable confusion when cross-disciplinary fields begin to address such things as "intention" in primates, or "cognition" in dogs.

Humans cannot and do not "control" adult apes (or other adult humans) except by sedating them, overpowering them, or *by explaining things to them.* Of course "explaining" requires the presence of language. And the magic of language is that it can then be employed by the party who understand what has been said, to control their own behavior, if they accept the spoken words as true. And thus, within dialogue – truth becomes born - as doe's deceit. And one employ language to control another through fear, deception, truth or love.

Explaining (and/or demonstrating) are the only acceptable ways to alter the behavior of humans or apes. Success in language acquisition can be achieved through the provision of a rearing environment filled with love, safety, predictability and language (Russell, Lyn, Schaeffer, & Hopkins, 2011; Savage-Rumbaugh & Fields, 2013; Schiefflen, 1990). "Explaining" can be highly effective when an ape has acquired language, as all behavioral interactions then become subject to linguistic *negotiation* (Dubreuil & Savage-Rumbaugh, 2018; Savage-Rumbaugh, Shanker & Taylor, 1998; Segerdahl, Fields, & Savage-Rumbaugh, 2005). The capacity for language allows the ape to execute self-control through self-directed monitoring and speech. This linguistically emergent self-hood is inevitably accompanied by an insistence upon freewill by the ape. Captivity becomes an unacceptable state of existence once apes realize that humans are intentionally keeping them captive (Roffman, 2016).

This emergent awareness (Rumbaugh, 2013) necessarily effects how apes view human beings, especially those who are untrustworthy, unfair and/or who underestimate their intelligence. Their similarity to our conscious ways of organizing our social systems leads us toward an attraction to apes. But when we characterize apes as lesser, or shadow versions of ourselves, our attraction to them turns quickly to revulsion.

It then seems as if humans cannot distance ourselves sufficiently from apes. Historically we humans have bounced back and forth between admiring and detesting apes (Cheney & Seyfarth, 2008). But apes are not a lesser version of humanness, they are completely different form of *Homo*, a different 'flavor.' They represent a form of life whose culture has become adapted to following the ways of nature for the past 3 million years. During that same time span we have been busy adapting nature to our own ends. We have expanded material beingness and they have expanded nonmaterial beingness. They now arrive epigenetically equipped to listen to the wind. We arrive, epigenetically equipped to feed the fire. But either of us can change quickly, within 4 to 15 generations, should we elected to alter our cultural environment in basic way. And were we to attempt to do so we would find all kinds of bodily changes accompanying the behavioral changes, just as has been demonstrated with the "domestication" of the fox and other animals (Dugatkin & Trut, 2017; Christie, Marine, Fox, French, & Blouin, 2016).

Without understanding why, we "sense" in the behavior of apes, a deliberateness, an intentionality and an awareness of themselves as causal agents that is not present in "animals," but that defines every moment of our conscious existence. When this "sense" becomes objectified through the vehicle of language we instantly expect them to speak and act as we do, for we have never encountered beings with language except for humans. They have many of our competencies, but they deploy them quite differently and ways the ordinary person does not expect and often has great difficulty comprehending (see Segerdahl, 2014 for a description of this problem).

Through positive and constructive dialogue with apes, we can lose our fear of them. Once fear subsides, the realization slowly arises that apes possess a personhood, a sense of independence, and thoughtful self-reflective behaviors that can only be compared to that we ourselves experience arises (Roffman, 2016). Our kindred heritage becomes self-evident, and the thought of them as "animal" becomes overwhelmingly *anachronistic*. Apes are identical to us in the important tangible aspect of self-conscious moral action, and self-control. But their interpretations of moral social action can differ greatly from ours, depending upon their cultural heritage and their distinct perceptual skills which cause them to see, feel and hear things in manner somewhat different from us.

When one is treating apes as objects of observation (rather than potential interactants and/or rational sentient beings), the realization of their true consciousness never emerges. The true understanding of personhood, freewill, and awareness of self-awareness - as we know these behaviors in other humans – is promoted only through interaction, and dialogue, in the absence of fear. [9] These three things (loss of fear, interaction, dialogue) fundamentally alter ones' perception of apes, from the moment they take place, in a nonreversible manner. And no amount of description of this experience suffices to explain it to someone who has not encountered it. (But see Segerdahl (2014), for an excellent scholarly analysis of why it requires direct linguistic interaction to alter our misperception of apes.) Make no mistake, apes are distinctly different from monkeys with regard to the ability to control and direction their attention through an unknown inner source - one we share with them.

Can monkeys LEARN to do this? Indeed if this a skill that is acquired by humans and apes, can it also be acquired by other species? The answer to this question is unknown, but the data suggest that either this kind of awareness of awareness either exists or it does not (Rumbaugh, 2013).

[9] There are many reasons to believe that dolphins and elephants are also capable of this awareness of self-awareness. However, their anatomy is much different from our own. This prevents direct interaction in the same sense that is possible with apes. This uncanny similarity to ourselves makes apes attractive to some and yet repellent others. Many people harbor an unspoken fear that humans will "revert" to apeness through interaction or that apes will morph into humans and take over the planet, as in the movie, *Planet of the Apes*.

In the end, it is difficult to say whether a monkey who has been shaped to recognize itself in the mirror literally knows who it is (Changa, Zhang, Poo, & Gong, 2017). It is equally difficult to know whether the monkey controlling the joystick actually knows that the joystick is a tool that it moves the objects on the screen, or whether it has simply learned what to do to earn a reward. One would like to think that monkeys do become aware of themselves as causal agents. In both the mirror and joystick task, there is partial evidence that monkeys do learn and are intentionally doing each task with some self-awareness of their actions. For example, after being forced to recognize their face in the mirror and touch a laser dot on it, the monkeys employ the mirror to investigate other parts of their bodies. This raises a central question, has training actually brought forth the capacity to control one's own attention, the emergence of causal agency, and higher order consciousness? Has it developed a monkey version of the homunculus? *If this has occurred, not nearly enough attention has been dedicated to these findings* (Rumbaugh, 1971).

The raising of the homunculus issue leads directly to the next obvious question: When apes use a symbol to request an apple or to give information about an apple, do they know that they are employing a symbol? Or, are they merely aiming for a reward? Do they know what we humans know when we employ language – namely, that language is a system for representing the world (Deacon, 1997; Savage-Rumbaugh, Rumbaugh, Smith, & Lawson, 1980)? Knowing that there is a self and being able to "think about the self" apart from what the self is actually doing is a level of conscious awareness that apes and human share. But knowing that one is also representing ones' thoughts to others via symbols requires yet a higher level of consciousness awareness.[10]

All questions about what apes and monkeys know or do not know are difficult to answer. Science has very little "proof" that we humans "know" things apart from self-report, which has been the standard technique for assessing what humans know for most of the history of the psychological sciences. Yet, studies have shown that self-report it is not always accurate. As De Waal (2013) has pointed out, there now exists a vast literature demonstrating that human consciousness is a very narrow window, beneath which floats a vast array of behaviors/decisions and perceptions which determine our behavior even if we are unaware of them. Indeed, many great artists and scientists have spoken of the "self-within" as a force that produces behavior seemingly on its own.

But at least we can inquire of humans as to their perceived states of knowledge. Animals cannot be asked questions about what they know. This has left animal behaviorists with no choice but to employ methods of inferential logic. Those interested in knowing what monkeys and apes know – along with those interested in knowing what monkeys and apes know about what they know – have devised a veritable panoply of paradigms to address the question of whether monkeys have a "self-within" (Washburn, 2018). Do monkeys simply "do what feels right," including imitating other monkeys performing very complex tasks, or do they have an awareness of self – of intentionally guiding and directing their behavior (Washburn, 2018)? After several decades of study, we are not much closer to a clear answer to this question for monkeys (Washburn, 2018). Nor have the somewhat intermediate species, such as baboons, gibbons, or siamangs, even been studied with the multitude of techniques applied to monkeys.

[10] Of course, sometimes language is simply ritual behavior – as in ritualized greetings, ritualized reactions of political commentators, etc. – but, at other times, language provides absolutely new astonishing information about the state of the speaker and his or her knowledge of the world.

Rules – Hidden in Relationships across Trials

Duane Rumbaugh (Rumbaugh, Reisen, & Lee, 1970) was one of first "primatologists" to start the new discipline now called primatology. It was unique because its focus was the evolution of a biological order rather than a topic such as biology, psychology, or anthropology. Consequently, it became one of the first interdisciplinary academic organizations. Rumbaugh oriented the attention of those working with primates to the uniqueness of this particular order by directing a film entitled *Survey of the Primates.* The film introduced many members of the order Primates, while emphasizing that it contained living representatives of every evolutionary advancement made in the group of beings that led to the eventual emergence of humans. For this reason, Rumbaugh advocated the study of learning skills – as they advanced – within members of this order. The purpose was to reveal the path that learning ability took on the road to humanness. Rumbaugh was, at that time, the only primatologist to compare the learning abilities of a vast array of different primate species in a systematic way using a paradigm explicitly designed for that purpose, the *transfer index* (Arnold & Rumbaugh, 1971; Rumbaugh, 1969; Rumbaugh & Arnold, 1971; Rumbaugh & Steinmetz, 1971).

He was ever mindful of the need for careful experimental work and the need to sort out patiently the variables that account for each behavioral change. He was especially attentive to the effects of differential rearing and experience upon the development of mind, behavior, responsiveness, emotional reaction, sociality, etc. He became the first psychologist to systematically document major differences in the cognitive abilities of monkeys and apes. He also demonstrated that learning skills slowly advance as one moves upward in the order Primates (Rumbaugh, 1973). The scope of his work has yet to be matched by others interested in the evolution of intelligence. Both he and Robert Yerkes viewed most of the psychological tasks given to apes at Orange Park, Florida, as various measures of the intelligence of different primates. Robert Yerkes (Yerkes, 1943; Yerkes & Yerkes, 1929) frequently speculated that apes could surely acquire language. Eventually, Rumbaugh took up this challenge, expanding his interest from the evolution of intelligence per se to the evolution of intelligence through the behavior of language.

The issue of the differences between the intelligence of apes and monkeys, as defined by the transfer index, goes far deeper than one notices upon first read. The transfer index tells us that apes, unlike most animals, are able to recall and utilize information about whether they are right or wrong across a series of trials without any reinforcement for so doing. All they receive is information about the success or failure of their responses. Thus, more is going on than just "learning to learn," as takes place in the learning set research initiated by Harlow (1949).

Apes begin to infer that the task has inherent rules – rules that are neither a function of the stimuli themselves nor, in any direct manner, a function of the rewards the ape receives or does not receive. It is rather the consequence of summed responses, right or wrong, that provides the information the ape needs in order to infer the existence of the underlying rule. Terrace's failure to grasp the basic nature of the transfer index led to his erroneous critique of Lana (Terrace, 1980). The same failure also led to the Thompson and Church (1980) critique. Terrace followed in the tradition of Skinner (Holland & Skinner, 1961) and ignored the specifics of how learning occurred in order to focus upon the ways in which reinforcement acted to control behavior. Rumbaugh arose from the classical schools of learning, especially that of Clark Hull (1943), and focused on the specifics of learning per se. However, he fully understood behaviorism, associative learning, discrimination learning, imitation, and Skinner's schedules of behavior. He became especially intrigued with the differences between conditioned and non-conditioned behaviors and how novel, unconditioned, seemingly "reasoned" behaviors could arise from ritualistic behaviors maintained through external reinforcement.

The transfer index demonstrates that apes do not just learn to do tasks, they learn things "about" tasks, including consistencies discovered across long groups of trials. To them, the world is not merely a series of rewarded responses, it is a world of to-be-discerned relationships between events, living beings, goals, motivations, and negotiations. Apes are not reducible to mere "recipients" of the events around them. Neither are we. Apes, like ourselves, are always "thinking about things" and seeking ways to affect them. One chimpanzee at the Yerkes Center in Orange Park, Florida, clearly enjoyed the "test games," in which she viewed herself and the psychologist as "co-participants." When the researchers ran out of bananas, she would invert the task by giving a reward to the experimenter when she was correct (from a stack of bananas that she had previously stashed rather than consumed)![11] This illustrates how an ape is invariably responding to a simple task at multiple levels: the task, the rules, and the nature of the social exchange achieved through the mechanism of the task. The interaction with the researcher becomes a kind of game. One in which both play by a set of rules, and the focus of ordered interaction itself becomes more fascinating to both than the bananas are to either one. Thus, they play the game, trading the bananas back and forth at the appropriate junctures between trials. The bananas become merely a way of keeping track of the number of responses as a kind of contract of exchange between both participants. Thus, do apes mentally separate the world from what takes place in it and from judgements regarding other participants, not simply reactions to them?

Apes also have the ability to analyze the world in a causal way and perceive themselves as causal agents (Poti, Langer, Savage-Rumbaugh, & Brakke, 1999; Savage-Rumbaugh, 1990). Tasks which fail to allow them to do this (i.e., the traditional match-to-sample, serial learning, and paired associate learning tasks) inevitably produce monkey-like performance in apes, and they do not like them. Object presentation tasks, by contrast, inevitably provoke an investigative response. When presented with a new object, the first thing an ape does it to take it apart and try to see how it works. Digital cameras are particularly puzzling as they can see the picture and want to find out what causes it by looking inside. (They will tear up quite a few before they give up.) And, like humans, apes come to the eventual conclusion that they themselves are but one of many causal agents in a dynamic constantly-changing social landscape. Therefore, it becomes important to them to understand the sociobehavioral landscape, not just what happens to them as a member of it.

Deprivation Rearing

Apes are not born with the conscious potential for cause-and-effect agency-based ways of viewing the world. Like humans, they acquire this capacity as infants and toddlers. Deprivation rearing of ape infants during the first three years of life leads to severe and permanent cognitive and sociobehavioral damages with serious consequences (Davenport, Rogers, & Rumbaugh, 1973; Mason & Rushen, 2006). When deprived of proper maternal contact and empathy, they become aggressive, emotional, vindictive, and unpredictable. They behave just as do atypical, autistic, or so called "wild" children (Savage-Rumbaugh, 1990; Savage-Rumbaugh, Romski, Hopkins, & Sevcik, 1989). Especially important in preventing these tendencies in either species is the acquisition of sufficient language capacity to enable verbal reasoning to begin to act as force of self-management and self-control (Rumbaugh, Roffman, Pugh, & Rumbaugh, 2017). However, when the proper preverbal emotional bonding fails to take place, language cannot arise in apes.

[11] Personal communication, Emil Menzel. Menzel indicated that monkeys never did things like this at Orange Park, but apes constantly surprised any researcher who established an emotional bond with them. When such a bond develops, apes inevitably seek a way to push it beyond the experimental context if this option at all is availed to them. Most research protocols forbid this and thus prevent the ape from displaying the very intelligence for which the experimenters are looking.

Similar findings also exist for human children (Carson & Earls, 1997; O'Connor, Rutter, Beckett, Keaveny, Kreppner, & The English and Romanian Adoptees Study Team, 2000). The extreme importance of these first three years is overlooked today in most studies of apes. They even fail to mention the rearing histories of their subjects (see, for example, Barth, Call, & Tomasello, 2007).[12] Nursery reared apes are treated as "normal" subjects and compared to human children reared in families, as though similarly reared (Barth et al., 2007; Tomasello, 2006). Yet Tomasello is a developmental psychologist and well aware that even partial exposure to human enculturation changes the equation (Tomasello & Call, 2004; Tomasello, Savage-Rumbaugh & Kruger, 1993).

When the goal is to locate situations in which humans outperform apes, this is easy to do, especially with measures that biased toward humans. Were the goal to find tasks in which apes can outperform humans, this would also be easy to do, with task biased toward apes, especially tasks that focus on rapid information processing times. Such information would reveal little more than pitting two AI programs against one another that have been designed to do different tasks, and then trained on different tasks. Finding that the programs produce different results is a foregone conclusion and says nothing about AI itself, nor about the process by which AI has evolved to accomplish a range of different things.

In comparing the social skills of human and nonhuman apes in the midst of interaction, one notes that apes can do most everything they get good at faster than humans, including the exchange of complex subtle social signals – so subtle that most humans miss them entirely. These signals are difficult to observe because of the ape's quadrupedal stance, their brow ridges, and their dark sclera. All make their joint attention and glances, as well as their pointing gestures, less obvious. Apes with extremely sophisticated social skills and bicultural knowledge can make their signals very difficult for humans to discern. This allows for quiet intergroup communication while keeping the humans out of the loop. Additionally, apes employ their eyes in rapid pointing gestures to establish joint attention, so rapid that this cannot be seen by those on the other side of river of wire mesh. Being on the outside of a cage rather than in the midst of a social group makes it impossible to track the many complex social messages apes provide through glances. When masks are worn to shield the human's eyes from all substances, the glare from the masks increases the problem. Indeed, most humans standing outside cages are in the position of blind person. Being in the midst of social group of highly intelligent adult apes who are communicating will inevitably leave one with the impression that sophisticated information is being exchanged that humans are unable to comprehend.

In the wild, a great deal of ape joint referencing takes place with regard to locations and entities encountered in the forest while traveling. Apes do not tend to focus explicitly on objects as humans tend to do, though they can. Similarly, humans do not tend to focus explicitly on locations, though they can do so. Captive rearing greatly decreases the capacity of apes in all manner of nonverbal communication skills simply because the apes, as a group, are not traveling, locating food, nor feeling the pressure to co-ordinate and co-operate that automatically arises when one is responsible for one's own welfare. This captive deficit begins at birth and tends to increase through epigenetic effects across generations (Christie et al., 2016).

Many captive apes lack even the most elementary preverbal skills of children; they are not normal in any sense. They are akin to "wild children," and suffer the same kinds of cognitive and social communicative deficits. Yet nearly all of the current views of ape communication are based on such apes. Their cognitive deficits increase across generations as long as they remain in these culturally-deprived, language-less

[12] Tomasello argued that there are no reports of apes pointing. The following apes have been reported to point: Lucy, Lana, Sherman, Austin, Kanzi, Panbanisha, Panzee, Mulika, Nyota, Nathan, and Teco. An explanation of why and how bipedal carriage of an ape infant spontaneously leads to pointing is provided in Savage-Rumbaugh and Fields (2011).

conditions. These deficits have gone unrecognized because the lifespan of apes resembles that of the careers of most primatologists, leading them to take no note of the cross-generational decline of apes in zoos and especially biomedical facilities.

Language comes naturally to children reared in loving families (Lock, 1978; Savage-Rumbaugh, 1990). The same is true of infant apes, except that the onset of language is delayed until the period of constantly clinging to the mother subsides. The fact that scientists have failed to date to identify language in wild apes is not because they are unable to produce vowels. Instead, our brains are biased to process human speech and the rate at which humans produce consonant vowel transitions (Remez, 2005), and to classify all other consonant vowel transitions as noise (Remez, 2005).[13] But just as "junk" DNA has turned out to control many biological processes, it is probable that nonhuman primate vocalizations will become a rich source of understanding of their complex social behavior. In fact, the entrenched view that ape vocal communications contain only emotional information has been maintained not as a matter of established fact, but as matter of anthropocentric bias (Lameria, 2017). The more likely problem is that vocal expression is under the control of heavy predation. The larger group sizes of bonobo provide greater safety and this species vocalizes far more frequently.

The Language of Lana

Rumbaugh never stopped addressing the issue of whether monkeys and/or apes or any other animals think in the way that we do. There were hundreds and hundreds of experiments that approached these questions from different perspectives, both formal and wonderfully informal. Every time a ball was thrown to his dog Fruff, the behavior in response was an experiment of sorts. Every time his dog Nuggie wanted to go outdoors, an experiment of sorts took place in discerning Nuggie's understanding of the relationship between past and present behaviors, the use of learned or unlearned signals to indicate things, the ability to negotiate barriers, etc. Such topics never strayed from Rumbaugh's attention.

He understood that human behavior is often controlled by unconsciously conditioned events and that we humans have the capacity to rise out of those events, to think about them, and to construct our lives differently if we but become aware of our past conditioning. Indeed, this is the essence of humanness, but we do not know from where this skill suddenly appeared in the order Primates. Nor do we know why it does not seem to exist in monkeys. Indeed, monkeys have seemed to remain forever on the precipice of flowering, never really achieving the significance they seemingly portend. And yet, this special ability is there in apes; one can tangibly sense it, feel it, and experimentally measure it (Savage-Rumbaugh, 2016a, 2016b). It flows out of them in all manner of ways whenever an opening is given for it to do so (Savage-Rumbaugh, Shanker, & Taylor, 1998; Segerdahl, 2014).[14] Apes do not always employ it in a standard human fashion, but there is never any doubt they are employing it. Thus, the fact that deprivation can kill it and render the human child or ape unable to ever fully recover struck Rumbaugh as profound. How does a human being lose its ability to become a thinking, evaluating, reasoning, rule-generating, cause-and-effect learning being? And, if an ape can become

[13] This is similar to what takes place with figure-ground illusions, in which we are forced to see each component as a figure or a ground but not both. We are forced to parse sounds as speech or noise but not both. Therefore, we hear the sounds of nonhuman primates as noise regardless of whether it contains meaningful phonemic components or not.

[14] Apes are increasingly being denied this opportunity. New NIH regulations require that only "natural behaviors" be studied in apes. This requirement takes the extreme view – namely that apes are biological beings with genetically determined behaviors and that those behaviors alone are worth study. Given that apes share almost 99% of our DNA, the majority of their behaviors, like ours, have to be plastic and open to change; that is simply how DNA kinship works. Therefore, it is precisely this plasticity which needs to be understood. To rule that our closest living relatives can be used in biological research, but not in studies of language or other acquired high level behaviors, is simply a political mandate. It will prevent future generations of scientists from having the opportunity to discover the behavioral similarities between ourselves and apes, the cultural factors underlying our differences, and how these cultural factors are passed from one generation to the next.

like a human with enriched rearing and exposure to language, why cannot a monkey do the same, or at least approximate these behaviors? From a Darwinian viewpoint, the vast changes that are wrought through language, thought to exist only in our species, do not make sense. They stand out as a sort of sore thumb, challenging the theory at its very heart and promoting a vast array of explanations of the human exception (Boyd, 2018; Brandt & Eagleman, 2017; Everett, 2017; Harari, 2018; Herculano-Houzel, 2012, 2017; Pagel, 2012).

This illustrates the critical importance of what we call "rearing," an inferior occupation performed only by females for many years. What takes place during human rearing that has the power to turn each child into a being that is no longer under the control of the stimuli around them and their internal desires? Rumbaugh was raised the son of a Presbyterian minister, who carefully taught that humans are special, a fact he accepted until he began to test Albert, the gorilla, at the San Diego Zoo. After several sessions in which Albert became increasingly hesitant to "perform," he decided to let Rumbaugh know that he "got it" regarding the rules of the transfer index, but he did not approve. Albert did not think the task was "fair." He so indicated by leaving an indelible image of his fist on the one-inch thick plexiglass bins used to present objects in Rumbaugh's transfer index studies (Rumbaugh, 2013). The image traveled all the way through the plexiglass. In an act of reverence and deference, Rumbaugh "retired" Albert from the transfer index studies. He then published a picture of him in the San Diego Zoo News Magazine, walking in full bipedal gait while carrying his bedding material, straw.

Rumbaugh never elaborated on this picture, but it was a distinctly poignant comment on the evolutionary view that it was bipedalism that separated man and ape. This view has not been challenged even today; indeed, it is constantly noted that humans started the journey of separation from apes by becoming bipedal. But Albert or any other ape has the capacity to be bipedal. From that point forward, Rumbaugh continued his work as a psychologist seeking to understand learning while keeping his focus on the order Primates. His goal was to try to understand how we humans (and apes like Albert) become able to reason, to reflect, and to know about things rather than knowing "what to do when" in response to a stimulus.

Rumbaugh poured his vast knowledge of the topic of primate learning into the design of the *Language Analogue System* for Lana, the chimpanzee, at the suggestion of Dr. Geoffry Bourne, the director (and former double agent) who had brought him to the Yerkes Center (Rumbaugh et al., 1973a). This was a complex design intended to bring forth gestures, pointing, syntax, novel behaviors, emergent, and linguistic competency. And it worked far better than even he himself had dared to hope (Rumbaugh, Glaserfeld, Pisani, & Gill, 1974; Rumbaugh et al., 1973b).

There was never any doubt in Rumbaugh's mind, from Albert forward, that apes can think and behave as we do, with awareness, conscious choice, freewill, and attentional control. He also felt that they had a potential rational action if they could acquire language.[15] This was not simply opinion on Rumbaugh's part. It

[15] Recently, it has become politically correct to declare all apes "dangerous." Steve Ross of the Brookfield Zoo informs us in the pages of *National Geographic* (Hu, 2018) that "chimps just sit around and think of ways to kill people." Contrast that view with Rumbaugh explaining what took place when he became angry at baby chimpanzee Panzee for leaving teething marks on his jeep dashboard; she took his hand gently, placed a small flower in it, and looked him straight in the eye. Suddenly, all of Rumbaugh's anger vanished. If the Brookfield Zoo were to re-evaluate their rearing and standard operating procedures, they would find that their chimpanzees behave very differently. Chimpanzees prisoners, like human prisoners, can only be sitting around and thinking about ways to kill people because they do not like the people to whom they are exposed, or were exposed in the past. Keeping either human or nonhuman apes confined is not an easy task and our systems for doing so in both cases represent our limited understanding of how to alter behavior in constructive ways. Comparative psychology could can great insight into evolutionary cultural processes by taking on the responsibility of rehabilitating all chimpanzees into linguistically competent constructive beings though behavioral shaping in the context of constructing inter-individual cultural and linguistic norms. Most of the literature extant today on the evolution of the mind is being written from a biological perspective, as though the evolution of the body (or material goods created by the brain) have been the leading edge of change. The role of culturally instantiated linguistic patterns and acquired coded forms of interaction are only now being recognized (Thibault, 2017) and have not been studied in an experimental manner. When this new way of looking at what language actually is manifests - clinical psychology will become the

arose from the rigorous data-driven perspective, which was delivering results that sorely challenged his religious and ethical background and his early rearing. It was not his desire to reach this conclusion, and it sometimes sorely vexed him. But he stuck by the data.

In spite of his belief that apes could reason and acquire language, Rumbaugh felt that the early language data from Washoe were unconvincing. The Gardners' were neither recording everything they said nor everything that Washoe said. Thus, there was no way to determine whether Washoe's utterances represented trial-one novel constructions or associative learned connections between utterance and reward. Unless all utterances during training and testing were recorded on a computer, one could never determine the truth Rumbaugh argued. (What he did not even suspect at that time was that apes could learn language even without training.) Terrace raised similar questions, but, unlike Rumbaugh, Terrance ventured his conclusions in advance of his studies: Only humans were capable of language. Rumbaugh (2013) observed that:

> Both the Gardner's and Premack appeared to take the language capacity of the chimpanzee as a 'given.' I didn't, neither have my colleagues. Neither the Gardner's nor Premack attempted studies to determine the literal meaningfulness of "words" taught and used by their chimpanzees. [They failed to address the real question.] (Rumbaugh, 2013, p. 49)

Rumbaugh's computer-based system got off to a bit of rough start. For the first six months, Lana (chimpanzee) failed to learn anything. Rumbaugh decided that Tim Gill, his research assistant, should enter the room and try to demonstrate for her how the computer worked. Of course, Tim also played with, groomed, and comforted her. Eye contact was established, as was pointing and joint regard; within two months, Lana learned the first two stock sentences. She then took off rapidly, and, by the end of the next two months, she had acquired an additional nine sentences and was beginning to pick up the hierarchical nature of her Yerkish grammar. She also began to terminate sentences that included mistakes and to pay attention to things Tim said on his keyboard, when he was not in the room with her. She quickly understood the use of the question mark ("?"), and the errors in her stock sentences became nonexistent. She also started to read Tim's utterances on the projectors above her system and could determine the difference between a partial sentence with an error and a partial sentence without an error. She demonstrated this by completing the correct sentence and erasing the incorrect one.

Her progress was published in *Science* under the title "Reading and sentence completion by a chimpanzee" (Rumbaugh, Gill, & von Glaserfeld, 1973). Immediately, a raft of critics rushed to dismiss Lana's linguistic accomplishments. Terrace led the way by developing pigeon and monkey simulations intentionally designed to "mimic what Lana was doing. Yet, these "mock ups" differed from Lana's training in every major aspect (Terrace, 1987; Terrace, 2001).[16] They included no differential consequences, discriminations, hierarchy of responses, projectors, conversations, internal cues, or communicative engagement such as eye contact, pointing, joint regard, etc. Indeed, no experimenter was present and, thus, conversation or language

effective tool it has long sought to be, but it will need to take behaviorism, functional linguistics, learning theory, computer based techniques of focusing attention, and anthropolgy under its caring domain, to succeed.

[16] Lana learned all of her 60-some stock sentences within 10 mo. Without being trained to do so, she picked up on the "self-correction" capacity of the period to erase a sentence if it contained an error. This saved her from finishing a sentence she knew was incorrect. And the emergence of this ability revealed that, from the very beginning, Lana was closely self-monitoring and not simply performing a linear chain as Terrace charged. To self-monitor and self-correct, Lana had to be able to compare her intended sentence with the one she had typed Rumbaugh, von Glasersfeld, Warner, Pisani, & Gill, (1974). Humans do the same thing when they type a sentence and look at it before it is complete to see if what they have so far is correct. Of course, a certain degree of self-monitoring is required for a robot to walk or for a monkey to use a joystick. But this is a not an attentional-awareness-of-the-self issue, as motor routines are programmed to monitor posture, gait, and inflow of information. Attentional-awareness-of-the-self is a process that allows the modification of an "en route" acquired response to an internally generated goal, as when Lana terminated a wrong sequence midstream rather than completing it. Lana also understood that things had to be specified by symbols or names, and she began to ask for names she did not know (Rumbaugh & Gill, 1975).

was not even the goal. The pigeons responded only to an onset cue, which signaled that it was time to peck. The cue initiated a linear sequence, which required no decision points and no mapping of any sort to external events. To call this a limited replication of Lana's language task was an oxymoron. It was a study designed to deliberately ignore the detailed reports of the actual methods employed with Lana. Indeed, it represented a violation of everything students are taught to do when attempting to compare behavior across species. But it was highly successful in convincing behaviorists that Lana's language use was reducible to linear sequencing and thus required no comprehension syntax or semantics.

Little was understood about language at the time. And nothing was understood about the gestural precursors to language; they were not even acknowledged in the literature. While most of what Lana did stumped the scientific critics and sent them scurrying to present nonlanguage-based explanations, the system did not stump Lana herself (Rumbaugh, von Glasersfeld, Warner, Pisani, & Gill, 1974; Rumbaugh, Gill, von Glasersfeld, Warner, & Pisani, 1975) she used it effortlessly, much more rapidly and easily than Tim (https://youtu.be/pD9sgWuI_D4).

Behavioral psychologists concluded that Terrace's nonlanguage-based linear sequencing paradigm explained Lana's data without paying attention to the methodological details. Soon however, tests with pigeons revealed that they had failed to learn the basic sequential relationships between all items in the sequence. Each item selection merely served as a cue for the selection of the next item. Terrace (2001) therefore switched to monkeys, who were able to learn basic sequential relationships and longer sequences. It can easily be seen from Terrace's video footage that pigeons are not looking back and forth between stimuli, but monkeys appear to do so. Whether working with monkeys or pigeons, Terrace (1987, 2001) employed only one serial sequence at a time with go/no-go cued paradigm and nothing else. Thus, these training paradigms could not come close to providing a stimulus/response explanation of Lana's behavior.[17]

For pigeons and monkeys the *very* presentation of the sequence was the cue for its execution. For Lana, the constantly varying external conditions determined the hierarchical structures of Lana's utterances and formed the basis of her grammatical training (Terrace, 2004; von Glaserfeld, Warner, Pisani, Gill, & Bell, 1973). There was not a single "onset" stimulus for many things, such as requesting that the computer make the window open or show a movie. The only stimulus had to arise from within Lana herself. Additionally, there was absolutely no way that Lana could learn the additional 68 stock sentences she mastered without attending to the hierarchical concepts that undergirded them. To do this, she had to map the hierarchical syntactic structure to events in the real world. It must be noted that the hierarchical structure did not exist on the keyboard itself. It had to come into existence in Lana's brain through remembered information collected across trials regardless of reinforcement. It had to come into existence in Lana's brain as a representation of the information that her experiences were allowing her to self-construct.[18]

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[17] Lana's "sequences" were associated with a wide range of different conditions, which Lana quickly learned to discriminate and, with an equally wide range of consequences, quickly anticipated. Each of these required a different sequence with components that overlapped and branching side nodes related to differing subjects, verbs, adjectives, and nouns. Thus, it was essential that Lana mapped her sequences to real world events and that she attended to all required grammatical markers as she did so. The pigeons learned one sequence, prompted by light appearing on the display. This was symbol-to-world mapping that characterizes the essence of language, deliberately excluded from the pigeons (Rumbaugh & Gill, 1975).

[18] When AI programs "learn," they do so through feedback about the correctness (or incorrectness) of their output (or "responses"). Through learning algorithms, AI programs set up increasingly complex patterns of responses, which help them to appear to increasingly "make sense" of incoming stimuli. They make sense of such relationships between incoming stimuli (input) and responses (output) by adjusting weights between connection points within the program itself at different nodes. They then employ this information to establish mathematically defined spaces that help to organize and process this information in increasingly accurate ways. These mathematically defined spaces can be designed with the ability to interrelate to one another in a hierarchical manner. But these created hierarchical structures are neither true grammatical or semantic representations, in the sense that Lana self-constructed true syntactical and representational spaces. This limitation arises because computers currently work with mathematical representations. They have no means by which to "compute" or represent qualities or qualia. Each picture shown them is digitized in order to allow them to manipulate the image mathematically, not visually, as do our brains. Mathematics, by definition, is a way of quantifying already represented

Thus, if Lana saw and wanted an M&M, then she had to produce a sequence of symbols. If she saw and wanted a piece of bread, then she had to produce a similar sequence, which differed at only two nodes: the node at which the symbol for "piece of" had to be selected and the node at with the symbol for "bread" had to be selected. She had to make the correct selection at each of four such nodes from a variety of different choices. Her selection could neither be determined by a previous symbol in a linear manner nor to some form of "ordered relations" between stimuli in each sentence or a single external event that could "trigger" each sentence. The correct selection could only be made by mapping it to an external event that had taken place, an internal event that Lana desired to take place (such as receiving a piece of bread), or to a preceding utterance by Tim (or another communicative partner). Therefore, if Lana were to learn the 68 stock sentences (which she quickly did), she also had to acquire an internalized and hierarchically-organized systematic representation of the structural components of the Yerkish language. That internal organization itself would allow for the production of correct novel sentences. To the extent that Lana perceived novel events and mapped them onto her internally constructed hierarchical structure and semantic space, each such sentence would provide information about those spaces and, thus, about how Lana's mind constructed and utilized them.[19]

Terrace (2004) noted the criticality of such a hierarchical relationship when speaking about Lashley:

> Lashley argued that chaining theory could not account for knowledge of relationships between different items in serially organized behavior and presented two important examples to support his argument. First, he noted that all human languages assumed knowledge of relationships between words from different parts of sentence. For example, if someone told you that the girl wearing the blue uniform won the race, you would understand that it was the girl, not the uniform that won the race... Lashley's critique of chaining theory, and his proposal that the organization of language and skilled sequences is hierarchical, is often regarded as the heralding of the human 'cognitive revolution.' (p. 481)

Terrace was thus well informed. He did not overlook the necessity for a hierarchical training structure; he merely ignored it in his pigeon/monkey studies. He was well aware that Lana's grammar required both hierarchical relationships and mappings to external events, and he chose not to emulate this key feature in his work with pigeons. Yet, he critiqued the Lana studies as though neither methodological format nor hierarchical structure mattered. If pigeons could learn serial sequences, then, according to Terrace, Lana's behavior was reducible to conditioning and could not be symbolic or grammatical. This conclusion did not follow from Terrace's paradigm, but it was widely accepted.

Additionally, Terrace's mock-up ignored all instances of trial one data, which Rumbaugh presented for Lana. These data demonstrated that, with every single novel sentence, Lana's behavior could not be accounted for by conditioning. And they raised the question, what else could Lana be doing if not language? There were not simply a few errors Lana could make. There were hundreds of thousands of potentially incorrect sequences. Any new event required a novel sequence of a particular kind. The probability of any one sequence being correct by chance was .0000000013.

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things. It is not in and of itself a way of representing things. However, it can form ordered sets of relationships between things that are labeled as "same" for purposes of being members of given set. And, through monitoring devices, computers can take in real world stimuli directly as digital information. However, they do not yet direct their own attention but instead monitor incoming information as directed. Whether computers will gain a real capacity to direct their attention and/or compute truly representational relationships, as Lana did, remains to be seen.

Novel correct sequences have to be composed of chunks of other sequences, as grammar exists only within such chunks. Each new novel sentence also required a new and proper mapping to new external events or to new internal thoughts and/or desires. Mistakes could be made at the symbolic, syntactical, or conceptual level at any point in the sequence. Randomly generated sentences would be uninterpretable from the standpoint of meaning. For example, in the case of Tim putting the wrong food in the dispenser and then lying about his actions, if Lana were to type a random string such as "Out into movie move Tim," then the sequence would be nonresponsive to Tim's previous utterance and to Tim's previous behavior. It would make no sense to Tim, and it could not be parsed by the computer. The vast majority of things she could potentially type would similarly make no sense because any correct sentence had a probability of only .0000000013. But if Lana typed "Lana no want cabbage. You move cabbage out of dispenser," then the utterance would (a) be responsive to Tim's previous utterance, (b) resolve his incorrect behavior (by telling him to undo it), and (c) be syntactically correct. And Lana did respond with such an utterance, improbable though it was by random standards. And she did so again and again in different novel situations with different utterances. No other proof was needed nor could more powerful proof have been offered. And all utterances, by both Tim and Lana, were recorded in order the moment they took place.

Lana's meaning was always clear, if not exactly in the proscribed Yerkish syntax. This fact enabled Tim to respond appropriately and accept Lana's sentence if he understood it, or he required her to repeat it with slightly improved syntax. The option of interpreting what Lana was trying to say was often taken by Tim, just as it is often taken by most parents whose children are just learning to speak.[20] In so doing, the parents and Tim act to "make manifest" the child's (or Lana's) expressed intent even when if it is not fully and properly linguistically formed. This is a key aspect of language acquisition for young children. It is of major importance to utilize this scaffolding technique for any child that has language delays of any sort (Schieffelin, 1990; Vygotsky, 1934/1986). Scaffolding has no relevance to traditional psychological tasks that require associative learning, serial learning, discrimination learning, short memory, etc. These are tasks that are designed to test learning or to measure it, not to facilitate it. Tim's presence and his utterances assisted Lana in making her intent linguistically manifest. Without his intervention, she could not have acquired language, at least initially, because language is inherently fostered through dialogue, and dialogue requires a process of mutual understanding and cooperation. In a sense, dialogue can be said to "smear" language across the multiple minds engaged in dialogue.

The pigeons and monkeys utilized by Terrace were unable to produce even one conditioned mapping between real world conditions (such as seeing the experimenter entering the room with a Coke) and a sequence of keys they selected. They learned no stock sentences. Thus, in spite of Terrace's claims that serial learning could explain Lana's behavior at a nonlinguistic level, he offered no real data to this effect. He offered only argument by analogy – a fundamentally flawed analogy. Terrace sought to create intraresponse conditioning within a single organism. Rumbaugh sought to create symbolic/grammatical links between real world events, things and states. Terrace taught chaining with serially cued nonhierarchically organized response chains,

[19] It is noteworthy that today's AI programs do not construct novel sentences in the same way that Lana did and that the sentences, which they do construct do not inform us about their internal organization of data. That is, because their internal organization consists of a mathematically constructed manipulation of weights, frequencies, probabilities, and relationships that changes across trials (decisions). It is one, which deals with quantities, and not qualities, at its innermost level. However, it can map these mathematical relationships back to *qualities* that we human beings understand with sufficient accuracy to emulate our internal thought processes in many instances. Thus, it does not matter that machine thought processes differ in form, as long as they are sufficiently in output. After all, the much more mysterious processes that other brain employ to manipulate information is also hidden to us, as is much of what our own brain is doing. Thus, has society has accepted the fact that machines can do these things (even IF we are not quite sure exactly how that do them) and it now trusts its machines with it most critical data and tasks, even wondering if there will jobs for humans in the future as its humans have come to feel inferior to the machines they have created.

[20] However, Tim also often insisted on proper syntax, something that parents generally do not insist upon and something that can be very confusing for a child, unless parents model the correct sequence.

which shared no basic characteristics with the Lana project system and its hierarchically organized structure of Yerkish grammar (von Glaserfeld, 1975).

Thompson and Church

A slightly more sophisticated attack was leveled by Thompson and Church (1980). This attack attempted to dismiss Lana's data as a random series of symbols, not by analogy, but by designing a computer program that produced "six stock frames," which Thompson and Church maintained could account for all of Lana's sentences stock sentences. These frames were:

A) Machine give X….
B) Machine make X….
C) Person (give) or (move into room) X
D) Person (move behind room X…) OR person (put in machine X…)
E) Lana (want eat X…) OR Lana (want drink X…)
F) Person (V….)
Where X = foods 1-n, objects 1-n
V = actions 1-n

They maintained that Lana could have determined which of the above frames to utilize by assessing the following things, in an ordered manner, as did their computer program.

A) Is an object present?
B) Is the object a food?
C) Is the food in the machine?

They were allowed access to a significant portion of Lana's data (over 5000 utterances) through their model because Rumbaugh provided it upon request. They found that the vast majority of Lana's utterances (91%) were stock sentences. This was unsurprising because Lana was required to produce many such stock sentences each day in order to receive foods and drinks and to manipulate the various devices in her world (movies, slides, music, a window, etc.). Thompson and Church (1980) focused on sentences that were directed to a person, in which 44% of her utterances were novel. They reduced this number by subtracting from it all "nonreinforced utterances" (19%) which they regarded as errors and the partial utterances (6%), which left 19% of Lana's utterances for consideration. They conceded that 472 utterances could not be explained by their model and stated:

> [These utterances] showed many elements of the sequencing relations as the proto-typical stock sentences shown earlier and seem to represent extensions of it rather than departure from it. Presumably Lana produces these sequences when she has not been able to obtain an incentive in the usual way with a stock sentence. (p. 314)

But there were a number of problems with the Thompson and Church model. Sentence frame C, "Person move into room X" (e.g., "Tim move into room coke"), did not exist as one of Lana's stock sentences, and she did produce such utterances. Sentence frame D, "Person (move behind room X…)" or "Person (put in machine X…)" (e.g., "Tim move behind room chow" or "Tim put in machine chow"), also did not exist as one of Lana's stock sentences. The stock sentence "Tim move chow behind room," "Tim put chow in machine,"

and “Tim move coke into room” did exist. However, these stock sentences would not have been properly classified by the Thompson and Church computer model, and there were many such sentences in the data. Thus, either they presented their own model incorrectly in *Science* or the model was flawed and classified sentences that did not belong to frames C or D into those frames. The fact that *Science* published an article with such an obvious error raises significant questions about their review process with regard to the field of ape language.

Assuming that Thompson and Church (1980) could correct this error, would their model work? Pate and Rumbaugh (1983) decided to address this question using a later block of data, collected after Lana’s sentence length had been expanded to allow for up to nine symbols.[21] This data consisted of an experimental protocol that employed three stock sentence stems used to query Lana…

> …about the name of a food or drink, the container in which the food or drink was placed, and its location. After answering these questions correctly, Lana was asked whether she wanted the food or drink. Typically, she answered "yes" immediately. She was then required to ask that the food or drink be brought into her room if it was outside her room. Finally, she had to ask that the food or drink be given to her. Her responses to these questions are the data analyzed in this experiment. It should be noted that, since other experiments were being conducted and since her normal interchanges with the computer and humans continued to occur, Lana's responses constituted only a relatively small proportion of her productions on the days this experiment was con-ducted. (p. 135).

Pate and Rumbaugh (1983) recorded 881 utterances during this time period, 512 of which were syntactically well-formed. Based on the questions directed to Lana, her responses were determined to consist of one of three types of sentence *stems*: “Name this,” “Lana want,” and “Question you.”[22] Pate and Rumbaugh (1983) concluded that:

> Conservatively, it can be suggested that Lana was choosing among 69 different sentences, rather than among 6 as in the Thompson and Church (1980) study, with some of them having as many as 135 alternatives for various blanks in the "stock" sentence….In conclusion, it has been argued that Lana's language-like behavior, in later stages of training, is more than the selection of a "stock" sentence with blanks being filled by an appropriate choice of a paired associate. We do not hold that her behavior exhibits all of the characteristics of language, but the simple discrimination learning approach taken by Thompson and Church (1980) is not sufficient. Lana's productions were too complex for such a restricted model; they should be viewed as further along the behavioral continuum that ultimately supports the complexities of human language. Just where her productions should be marked on that continuum is not now clear. (p. 138)

Rumbaugh and Pate (1983) demonstrated that Lana quickly moved far beyond the kinds of utterances first analyzed by Thompson and Church (1980) and that, as she did so, the complexity of her utterances increased but remained well-formed, even though many new syntactical demands were made upon her by the increased sentence length. They argued that if Lana had initially employed conditioned discriminations and paired associations to guide her behavior, then the increasing number of alternatives (69 sentence types and 139 choices in this limited experimental study) made it far less likely that such a solution could continue to be

[21] The Pate and Rumbaugh paper also included an error, in that they reported that Thompson and Church found that 91% of Lana’s sentences could be accounted for by their model when a person was present. Thompson and Church actually stated that 91% of the Lana sentences could be accounted for by their model when a person was not present.

[22] During this time period (July and August of 1977), Lana was not often required to obtain her food and drink through the machine, which meant that nearly all her utterances occurred during conversations.

efficient. While this is likely the case, Rumbaugh and Pate (1983) left open the possibility that a nonlinguistic model could be devised to explain Lana's data.

The key element overlooked by both Thompson and Church (1980) and Pate and Rumbaugh (1983) was that Lana's novel utterances occurred in the midst of a dialogue about what she wanted to do or receive. It was not simply an external condition (i.e., the presence of absence of food), its container, or its location that preceded Lana's novel utterances; it was the prior utterance of the person in the dialogue to which Lana was responding. And the prior utterance could vary along many dimensions. Lana had reached the level of Skinner's "inter-verbals." She was answering questions and making comments in the course of conversations, and, thus, only a functional linguistic analysis of such dialogues could truly inform the questions that Rumbaugh, Terrace, Thompson, and Church were attempting to address (Savage-Rumbaugh, 2018).

Tim (and other caretakers) made decisions about many things and conveyed their decisions linguistically. Tim moved about in space with the food and decided whether to put food in a cup, a bowl, a machine, etc. He decided whether to go down the hall and get food or not. He decided whether he wanted to eat the food himself or not, etc. Apart from Tim's utterances, there was generally no particular external cue to reveal what Tim was going to decide to do. Lana thus began to "listen" to Tim[23] and to respond accordingly. As she did so, conversations materialized. Not only did these conversations contain novel utterances by Lana, they contained novel utterances by Tim that Lana needed to interpret.[24] Their conversations out-pictured the relationship that developed between them as Tim tried to teach Lana to understand language.

A dialogic analysis of the data from Tim Gill's dissertation demonstrated that the Thompson and Church model cannot explain Lana's data (Rumbaugh, 2018). This is true even if it were to be shown that a chimpanzee is capable of learning 69 stock sentences with 139 alternative choices. Indeed, it is true even if we assume that chimpanzees can acquire an essentially infinite number of conditioned discriminations and paired associations. This dialogue demonstrates that Lana was capable of producing appropriate novel utterances in response to Tim's novel utterances and novel situations and of simultaneously ignoring factors such as the presence or absence of objects and foods.[25] Therefore, the case for the conditioned cues/paired associations explanation is eliminated.

Gill (1977) presented Lana with a set of initial planned conditions (food present or absent, food offered appropriate or inappropriate to a particular time of day, Lana questioned as whether she want something to drink or something to eat, etc.), followed by a set of planned responses (putting the requested food item in the dispenser or substituting another item). These planned situations were selected specifically to determine if there was any evidence to suggest that Lana's utterances were determined by the Thompson and Church model or not.[26] In this setting, 34% of Lana's sentences were novel.[27] All novel sentences were correct. That is, they

[23] Here, "listen" means than Lana began to pay attention to Tim's utterances as projected above her keyboard, which appeared one word at a time as Tim spoke.

[24] Lana was given no specific training to comprehend Tim's novel utterances, yet she began, almost imperceptibly, to comprehend what Tim said. To date, no analysis of Lana's comprehension of Tim's novel utterances has been conducted. Yet comprehension of the novel utterances of others is as much a part of language proper, if not more so, as the production of novel utterances. It requires attention to both the contextual and linguistic surround and, thus, the ability to move back and forth between these two planes (Dubreuil & Savage-Rumbaugh, 2018).

[25] Lana typically did request foods when they were placed in her dispenser, but she was quite capable of stopping at any point to do other things or to engage in conversation. Thus, the presence of food in a dispenser did not simply grab Lana's attention and prevent her from uttering other kinds of sentences, as the Thompson and Church model predicts.

[26] This study was conducted after the Thompson and Church report and the collection of the Rumbaugh and Pate data set. Gill's data ruled out conditioned discriminations and paired associations.

[27] This number is slightly lower than the one produced by Thompson and Church. In this particular experiment, stock sentences and stock responses constituted, by design, a portion of the trials. This was done to contrast such situations with those in which Tim lied to Lana, something he never did during training.

were interpretable and context appropriate, not random lists of words produced because a "conditioned sentence" did not produced the intended result. A stock sentence sometimes did not produce the desire result, as this was part of the experimental design. When that happened Lana's responses did not degenerate into random utterances. She engaged in highly specific questions and actions to determine what had gone astray in the negotiated communications between herself and Tim. Lana wanted to know if Tim had broken the rules of purpose, if he knew what he was doing, and why he was doing what he was doing. The data not only dismissed the Thompson and Church model out of hand, they demonstrated that Lana was operating at a much higher cognitive level than had previously been recognized and that the language provided to her really did not offer the proper models for the kinds of things Lana was able to compute.

Lana produced novel sentences for the following purposes:

A) Asking Tim questions
B) Providing Tim with information that he apparently did not know
C) Attempting to assess what he did know
D) Attempting to assess whether he and she agreed upon the type of food in the dispenser
E) Stating what Tim had done
F) Trying to determine why Tim was behaving oddly in some test conditions (i.e. lying)[28]

All novel utterances derived from stock-sentences components but, much more importantly, they demonstrated that her acquired language – limited as it was both semantically and syntactically – allowed her to go places in terms of a social dialogue with Tim that she had never previously traversed. There was absolutely no possibility that any previous situations could have served as a cue for these novel utterances because Tim had never previously lied to Lana. This study consisted of 29 conversations with Lana. Each conversation was different. Many conversations reflected a knowledge, on Lana's part, of previous conversations in similar experimental conditions.

This dialogue analysis focused on those conversations in which Tim lied to Lana.[29] It revealed that Lana was not interested in repeating conversations about whether Tim did or did not put chow in the machine, once she realized that he was doing this on purpose. Repetition of past events was Tim's focus. Having experienced one such conversation, Lana attempted to cut the next one short. She sought instead to inquire as to Tim's motive for what was obviously incorrect behavior on his part. Tim's behavior was more likely to be repetitive than Lana's because he was trying to follow an experimental protocol.[30] Lana was simply trying to determine what was going on.

[28] It is noteworthy that these were all things that Tim had done in the past with Lana. That is, Tim had used language to ask her questions, to tell her things, and to try to figure out why she was making errors he could not understand. Thus, these pragmatic social functions had all been modeled for Lana but in different contexts and with different sentences. Lana's deployment of these same behaviors was logical, linguistic, and a clear demonstration that she was not exhibiting conditioned responses but that she was displaying reasoned thoughtful responses (Gill & Rumbaugh, 1974).
[29] The decision to lie to Lana was not part of the study's design. It was made "on the fly" while Tim was in the midst of a conversation with Lana in a response to her request for the correct food after he had made a substitution. In part, it reflected the normal way in which Tim made new decisions all the time during conversations with Lana, though he had never lied before. Tim's behavior reflected his tendency to treat Lana's utterances as language and to "take her at her word" during training sessions. In part, that had been done to show Lana what her world meant to Tim, but it was also done in an effort to keep a tight one-to-one between behavior and linguistic utterances and ensuing expectancies. Thus, if Lana asked Tim to move X into the room when she wanted Y, Tim typically complied and moved X in the room even if he suspected she wanted Y so as to demonstrate what her utterance meant to him.
[30] The experimental conditions of Tim's dissertation called for him to repeat certain situations for the purpose of gathering "reliable" data, data that would fit the mold of other animal studies. However, repetition is not the normal province of dialogue. Experimental standards reflect the prevailing assumption that the behavior of animals is repetitive.

As the analysis traces the history of Tim's lies across ensuing conversations, it can be seen that Lana's first inclination is simply to point out to Tim that he made a mistake. This is reasonable and would be the first assumption most humans would make. Next, Lana tries to determine why Tim made a mistake and to ask him if realizes that he made a mistake. Then she asks him to correct the mistake. When Tim refuses, Lana asks him if he wants his mistake to stay in place. When he says "no," she finally inquires as to whether Tim himself wants to eat food that he has been keeping from her. Each conversation in this series unique, new, and different because of what Tim did and said and because of what Lana said (See Appendix 1).

Much of the training prior to the dissertation had been repetitive, though Lana was always coming up with something new to test the limits of what could be said. During the dissertation, she did not hesitate to challenge or question Tim, her interlocutor, when he began to lie to her. She could stay on topic and she could switch topics if Tim appeared frustrated, as she was a keen judge of his mood. She clearly understood that a "sentence" was defined by the syntactic units that needed to go between a period and please. She understood what the punctuation mark "?" was intended to imply, and she switched easily back and forth between questions and comments. She understood and employed turn-taking, joint regard, joint attention, and joint reference, though no attempt to teach these skills had been made. These skills were not even recognized in the child language literature as relevant linguistic phenomena at that time. Lana constantly pointed. She not only realized that Tim had a mind, but she was mindful of what he thought; when he lied to her, she tried to figure out what his problem was, as he and she had always worked their way through to an agreement about the meanings of their utterances. There was always a reliable one-to-one correspondence between a symbol for each food and the food itself, as well as for symbols of objects, actions, locations, and events. That is, until suddenly the one-to-one correspondence was violated. Lana behaved much as Tim had behaved in the past when she made a mistake. That is, she strove to re-establish agreement with Tim between the intended meaning of his symbol usage and the real world as she perceived it to be. This was not the mark of "conditioned" mind, but rather the mark of an extraordinary intelligence, an intelligence somewhat different from our own but already extraordinary by the age of four.[31]

A small portion of this amazing ability of apes to do things we cannot do has been illustrated by Inoue and Matsuzawa (2007) and Matsuzawa (2009) in a study that required chimpanzees to look at a sequence of numbers from 1 to X, and then, when the numbers were replaced by squares, touch the squares in serial order from 1 to X (where X = 1 to 5). The chimpanzees required less than a second to view the numbers, with some apes requiring only 210 milliseconds. They were then able to recall the screen location of the numbers and select them the proper ordinal sequence without viewing the actual ordinal number as they recalled its location. Humans have difficulty even seeing all the numbers in the amount of time. Chimpanzees not only see them but store their spatial location. When humans are allowed four or five seconds to see the numbers, they still fail to be able sequence them once they are covered with a square. The task combines short-term memory with spatial memory, and apes are far more adept at this skill than humans. Even with practice, humans become only slightly more proficient. Because apes live and travel in a forest that must be mapped and constantly remapped visually, they seem to have evolved different ways of taking in and utilizing information of this sort. It is as though they have a snapshot memory of the screen on every trial. It is quite possible that Lana utilized a skill like a snapshot memory by rapidly memorizing every string of utterances that Tim produced on her projectors, almost effortlessly, and then utilized that information in later conversations, which Tim could not recall without looking at the written record. Of course, Tim conceived of Lana as a being who needed repeated

[31] The first author had the privilege of knowing Lana and working with her but, at that time, did not fully grasp exactly how to communicate properly with Lana. Only after studying Lana's data and contrasting it that of Sherman and Austin did the full force of the dialogic exchanges between Tim and Lana even begin to become clear to her. Then, after rearing Kanzi and Panbanisha and realizing how much language comprehension was possible for apes, did the author begin to understand that theirs is not a lessor form of intelligence in any sense but a different form of intelligence, with which they are constantly "making sense" of the world using another perceptual vantage point.

practice across many trials to remember even simple names. But names do not stand for points in space on a screen. The numerals stand for point in space across a screen, but these points change every trial and are depicted for less than a second. The chimpanzees' proficiency at the task clearly reveals that it would be no problem to switch the locations of keys on Lana's keyboard. She should be able to learn a new display pattern in just a few moments even if her keys changed location every trial. Additionally, dyadic and triadic reference between a symbol and an object took place in all conversations between Tim and Lana. They were built into the functional dynamics of the system itself (Rumbaugh, 1975; Savage & Rumbaugh, 1977) by the design of the rooms, the keyboards, and the projectors. Lana used language constantly to accomplish something, either in dialogue with Tim or by activating her computer-controlled devices.[32]

Had Lana been unable to understand and/or engage in human reference and cooperation – as Tomasello and Call (2018) opine of apes – she would also have been unable to learn to use the Yerkish system. Lana understood her system extremely well, and her utterances were more deeply enmeshed in the Yerkes syntax than those of Tim, who was constantly mixing Yerkish and English syntax (as any new second language learner does). She also knew the personalities and preferences of Tim and the other experimenters working with her and treated each one differently. Gestural communication accompanied nearly everything that was done at the keyboard, except when it was actively ruled out to give a "blind test." Had Lana's first one and half years of life not been with her wild-reared mother, Cookie, Lana also would never have succeeded. But Rumbaugh knew that chimpanzees deprived of their mothers become cognitively compromised for life. He also knew that chimpanzee infants whose mothers had been wild-reared were much more likely to try to communicate. He therefore requested Lana because of her mother.

Lana was honored and loved and treated far better than the other apes at Yerkes. However, she was not treated as a child. She was not cuddled, cared for, kept from fear, and she did not always have a trusted companion to protect her once she was separated from her mother. Tim left when he obtained his degree and no other student stepped forward to take his place in Lana's world. It was not an easy task to try to work with Lana because of the tensions promoted by the critics and the reaction against stock sentences. It was difficult to understand the intricacies of the conversational web that Tim and Lana had created together. To replace Tim meant studying the entire database in depth, without the aid of video, a daunting task because, while it contained all the utterances, there was no information regarding the context.[33]

In adulthood, Lana was housed with Sherman and Austin. She was able to raise a son and to live with other chimpanzees, but she was always in her own world following Tim's departure. He was the only being (aside from her mother and her son) with whom she formed a strong social bond. She greatly missed her computer when it could no longer be made available to her because of the lack of funding and the desire of students to pursue other goals. It was not the fault of any single individual that Lana's life did not continue as it had become. It was rather the ignorance of many, who failed to realize the secrets hidden in her data. Amongst all the repeated trials and stock sentences, there lay an intelligence that had the ability to shine through when given a chance. Rumbaugh always understood this and he saved the original printouts of Lana's data, which are stored today at the Language Research Center in Atlanta, Georgia. In the wake of the harsh critiques hurled

[32] Washoe and Sarah, by contrast, spent much of their time answering questions (who, what, and where questions) or, in Sarah's case, making match-to-sample choices. Answering questions is not dialogue in the traditional sense. It is a simple rehearsal of known signs. Sarah and Washoe's dialogue-poor settings produced a communicatively, semantically and syntactically deficient ape in Sarah's case and a a syntactically language deficient ape in Washoe's case. These deficiencies were not considered to be "methodologically based" but rather species based. Yet method is queen in pscychology and method plus rearing should have been first logical place to turn to find explanations of the reasons for the differences in result between approaches.

[33] The Sarah, Lana, and Washoe efforts began before portable video cameras were available, so there is very little video documentation of what took place.

at Lana, Rumbaugh turned to focus on single word acquisition and spontaneous combinations in two younger chimpanzee, Sherman and Austin.

AI, Siri, and Other Computer Models of Language

With the advent of AI, Siri, and other new methods to analyze large chunks of language input (Christian & Charter, 2016), it is now clear that the brain can chunk and process input at a level that does not require an innermost grammatical processor, as these methods are capable of producing a syntactical parser from the quasi-regularities of language (Christian & Charter, 2016). This means that the attention of a novice speaker (as Lana was) can be focused on discerning "meaning." Discerning meaning is a far more complex task than acquiring grammar, and it requires both verbal and nonverbal data points. While participating in dialogue, a task that requires a capacity for representation and reference, the quasi-regularities of grammar can be, and are, acquired at a nonconscious level without a grammar nugget. What arises instead, out of the maize of language input, is a complex "meaning nugget" laced with personal memories that begin to assume a personhood of their own and define one's life.

Christian and Charter (2016) noted:

> . . .quasi-regularities in language arise in the same way that a particular pattern of tracks are laid down across a forest, through overlaid trances of endless agents who find the path of local least resistance. Continuing with this analogy, just as a well-trodden forest path becomes more strongly established, so a more frequently used chunk becomes more entrenched, resulting in easier access and faster processing. With sufficiently frequent use, adjacent tracks may blend together, creating somewhat wider paths. For example, the frequent processing of simple transitive sentences, pressed individually as multi-word chunks, such as "I want milk," "I want candy," might lead first to a wider track involving the item-based template, "I want X". Repeated use of this template, along with others (e.g., I like X, I see X), might eventually give rise to a more abstract transitive generalization along the lines of NVN (a veritable highway, in terms of our track analogy). Similar proposals for the emergence of basic word-order patterns have been proposed for both within emergentist (e.g., O'Grady, 2005; Tomasello, 2003) and generative perspectives (e.g., Townsend & Never, 2001). However, just as with generalizations in perception and motor skills, the grammatical abstractions are not represented explicitly but result from the merging of item-based procedures for chunking. Thus, there is not a representation of grammatical structure separate from processing. (p. 243)

These findings, written essentially 50 years after Rumbaugh designed the LANA system, provide a concise description of what Rumbaugh thought language consisted of at that time and which he deliberately designed into the system to inculcate language into Lana. Lana's stock sentences became a path into language. A replication is merited with today's technology.

If the Lana system were to appear today, the ape's behaviors could be analyzed easily to determine the degree to which the system produces chunks such as "I want milk" and then links these to veritable highways through the process of dialogue. Lana's language was a mini-language with a mini-grammar, specifically designed to promote mini-dialogues in a mini-world with a range of mini-options, while inculcating reference and syntax. Within that small world, it offered Lana free-will and the ability to say and do what she would to affect her world. Yerkish crystalline structure is easy to learn, but it is not as flexible as English.

Lana's success represented a true triumph for the goals and methods of experimental psychology, learning theory, linguistic theory, and computer-controlled devices and recording. It is remarkable that Rumbaugh was able to bring these things together in the way that he did. Within a few short years, Lana demonstrated the capacity to grasp all major linguistic and cognitive challenges that would be set forward to apes for the next 50 years.

For this accomplishment, both Rumbaugh and Lana were attacked by scientists uninterested in abiding by the normal rules of scientific critique. Ape language infringed too closely upon the human claim of uniqueness and thus drew an emotional as opposed to an intellectual response. Their goal was simple: to convince the scientific world to ban the study of ape language per se and to cast the scientists who undertook serious study of apes as foolish, careless, and swayed by their subjects' supposed "charms."

Rumbaugh played by the rules and gave Lana's data to those who wished only to shut down the field of ape language. He never wavered from a polite and generous response to all ostensibly legitimate scientific critiques, in public or in private. However, he studied Lana's daily data from day one until all funding for Lana was removed, along with Lana herself. Lana was sent to the Great Ape Wing of the Yerkes facility. Rumbaugh continued to believe in Lana's capacity and returned her to the project when a new building was erected for her at Georgia State University.[34] At that point, Rumbaugh began investigations into her counting ability as another way of looking at Lana's sequencing abilities. Interestingly, Lana achieved the capacity to count to 5, linking ordination and enumeration into a single concept, but had trouble going beyond 5, just as she had experienced difficulty keeping track of word order when her sentence length was expanded from 5 to 9. The methods Rumbaugh introduced to Lana were soon filmed by NKH and then transferred, via film to, who constructed a similar task for the chimpanzee Ai (Matsuzawa, 2001, 2003, 2009).[35]

The linguistic and technical sophistication of Lana's training paradigm and the computer-based system itself went far beyond the simplistic critiques of Terrace, Thompson, and Church. These critics failed to even try to take into account what Lana was actually doing or actually saying, much less considering the dialogues between Lana and others. They sought to reduce all data to far too simplistic nonlinguistic paradigms, presumably to avoid dealing with the actual complexity and sophistication of the data. At that time, the mere idea that a computer or a pigeon could be trained to do something that appeared to overlap with Lana's actual behavior was enough for people to set Lana aside. Rather than focusing on Lana's further progress, it became necessary for Rumbaugh to backtrack and repeatedly explain to those unfamiliar with apes, grammar, and the transfer index how meaning and reference came into being.

In the 1980s, an understanding and analysis of dialogue began (Halliday, 2004). No one recognized the obvious, namely, that it was dialogue that generated representation, meaning, and reference between speakers. No one thought of language as an interindividual process shared by at least two brains and often millions of brains even though the studies with two chimpanzees who began to employ symbols to communicate with one another pointed in this direction (Dubreuil, 2015; Locke, 1978, 1980; Savage-Rumbaugh, 1986; Savage-Rumbaugh, Rumbaugh, & Boysen, 1978; Shotter, 1990, 1993; Thibault, 2017).

Rumbaugh, unlike others in the field, incorporated dialogue in every training paradigm employed with Lana once she mastered the first 10 stock sentences. He had designed a training method that moved between

[34] This building was named the Lanson building in honor Lana and her son, Mercury, who was born there and cared for by Lana throughout her life.
[35] Matsuzawa then introduced the counting task to the chimpanzee Ai but dropped the requirement that she link numbers to objects, turning it into a simple sequencing task. Ai quickly learned to sequence many numbers, going far higher than Terrace's monkeys (up to nine). Matsuzawa then discovered that if he hid the numbers immediately after they were displayed, Ai's ability to recall the numbers and their location on the screen far exceeded that of humans.

request-based training, name-based training, and syntax-based training. He was far ahead of his time in predicting how language actually "got done" by the brain. The egocentric view of humans (i.e., contrasting themselves with apes) was steeped in centuries of man/beast dichotomies, which makes it difficult to see apes as they truly are. It is as though scientists are forced to study apes with ear muffs and horse blinders, through the telescopic lens of politically correct methodology. Should the scientists hear, see, or feel something that follows language, they must subject apes to a series of tests not unlike those to which African tribes subject chicken oracles. The findings with regard to language have been needlessly complicated with the inevitable tendency to think of apes as brutish, dumb, and cognitively inept. Apes are none of these things, though, like us, they can become any of them in the wrong environment.

Nim Chimsky

Terrace not only trained pigeons, he eventually obtained a chimpanzee, Nim, whom he reared for the first few years of life in an apartment by a family in New York.[36] When Nim was two, he was moved to Delafield where he stayed with graduate students when not in his one-on-one "signing class" at Columbia University. Nim's teachers dedicated their signing sessions to asking Nim to imitate what they said to him, encourage him to make long serial sequences of signs, or do MTS tasks ("Nimshortclip," at https://youtu.be/B51mFD_kCSA).

Terrace (1979) stated that he was unaware Nim was imitating his students until he studied video tapes of their sessions.[37] He then learned that Nim was actually not making sentences. Instead, he was either imitating his teachers or randomly putting together a number of signs he knew and throwing in "wild cards" that were more or less always appropriate, such as his own name. Some strings were 17 signs long, with many signs repeated over and over. Terrace concluded that Nim did not have the slightest idea of how to construct a syntactic utterance. He then located a small segment of film in which Washoe imitated her teachers at times. He used to state (in a major article in *Science*) that apes have no ability to form a sentence, unless they are imitating their teachers. Whatever the faults of the Gardners' work, Washoe's and Lana's teachers did not encourage imitation. Nim's teachers insisted upon imitation.

With a single article, Terrace dismissed the Gardners' effort as a fool's mission. Terrace claimed that the Gardners, "like himself," had been "tricked." He also claimed that he had been "saved by video tape," and that only through tedious video analysis of each sign was it possible to really determine what apes were doing. In addition to himself, Terrace claimed that his students were fooled. Given that Terrace's students were saying to Nim over and over to "Sign with me," it is difficult to accept Terrace's claim that neither him nor his students were aware that Nim was imitating. Imitation was the modus operandi by design.

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[36] Terrace obtained Nim from the first author's faculty advisor at the University of Oklahoma, William Lemmon. Nim was separated from his mother, Carolyn, who had twins and was having trouble taking care of both them. The first author was given Nim (named Onan at the time) and asked to care for him in her graduate student apartment full time, which she did while Lemmon and Terrace negotiated the sale of Nim. When Terrace arrived to take Nim away, the first author was there and met him along with Stephanie Lafarge, who immediately tried to breastfeed Nim. The first author learned at that time that Terrace had previously taken another chimpanzee, Bruno, and had him raised with a Swedish nursemaid before returning him to the University of Oklahoma chimpanzee colony because he (Terrace) was not ready to proceed with a signing study at that point. As a student, she did not quite know what to conclude, especially since Bruno had now been returned and was learning signs from Fouts. She did decide at that point not to own any chimpanzees herself. She did not want to be forced to make such serious decisions about their lives nor to take them away from other chimpanzees at any time. She had come to understand the truly immense power of early rearing. She did not pretend to know what was best for them, as, at that time, she had seen no evidence that any of them, except for Lucy, Ally, and Paucho, had acquired sufficient language to come under their own self-control, and she was trying to figure out why this was case. What stopped them from going much further? Why did Washoe have to have a collar on all the time, but Lucy did not? (https://youtu.be/MjR8hSSL5cc)

[37] One has to wonder what he was doing with the video tapes if not watching them. Why were the students always insisting that Nim imitate them if they were not told to do so?

In hindsight, it appears that the Nim project was cleverly designed not to determine what Nim could learn, but to enable Terrace to claim that all of Washoe's behavior was the result of imitation or random signs with wild cards tossed in. This critique of Washoe was unprofessional. Terrace also noted that Gardners had not recorded the precise order of Washoe's signs and thus treated "me hug" or "hug me" as the same utterance (with the agent being the unexpressed "you" in both cases).[38] However, the Gardners were not looking for a specific order in Washoe's early signs, but rather the occurrence of any and all combinations. Combinations were of interest to them specifically because they were not teaching combinations nor asking Washoe to imitate their combinations, as Terrace's students were doing with Nim. To the Gardners, "me hug" and "hug me" meant the same thing and the order was not, at such an early point in training, something that needed to be accurately recorded. The vastly more important finding (in their view) was that Washoe was expressing things with any combinations because Vickie had not achieved this.

While Washoe can sometimes be seen making the same sign as her tutor in the movie, there were also times when she was not doing so. No one at *Science* raised the question of whether Terrace's analysis of one very short movie made of Washoe was representative of her behavior. Having known Washoe personally, the first author observed her produce signs without imitating others on most occasions. Washoe's difficulty was not imitation. It was rather that she produced few spontaneous utterances unless asked "What this, What that, Who this, etc."[39] Like Nim, Lana, Sarah, Gua, etc., Washoe's language was the direct product of the training paradigm employed with her. Behavioral psychology would predict exactly that.

Terrace adopted the singular agenda of tearing down and terminating the study of ape language, rather than that of the responsible scientist and critic. He used Nim to demonstrate that as an "ape," Nim was merely "aping" his teachers. He then collaborated with Sebeok and Rosenthal (1981) to host a New York Academy of Sciences conference for the purpose of debunking the field of ape language itself as groundless and its practitioners as charlatans easily deluded by apes. At the conference, Terrace announced that Lana could not possibly have understood what she said. Then Randy, a magician, backed the calls for an end to ape language studies, explaining how easily people can be fooled by magicians into seeing things that are not there. Everyone was repeatedly reminded of Clever Hans and other "experimenter effects" shown to affect studies with human beings. The message was that if a horse can convince people that it can count, imagine what an ape – with its much larger brain – can do.

Terrace again employed the tactic of innuendo, arguing that if "simpler" animals could do any part of what apes appeared to be doing by nonlinguistic means, then apes, with their bigger brains, were simply doing more of the same. He maintained that it was so easy for apes to do this that the entire field needed to be shut down. He claimed it as little more than an entertaining form of pseudoscience, needlessly fooling the public. Serious scientists who were well aware of cueing, imitation, and paired associate learning were compared with chimp trainers who worked in the entertainment business.

The New York Academy of Sciences allowed itself to be used to stage political theater with a single agenda: End all funding for ape language studies. The Gardners heard of the agenda and refused to attend. Rumbaugh and the first author attended as the sole participants to speak on behalf of the validity of the scientific approach and the intelligence of great apes. Had they not attended, the other attendees would have

[38] Video tape was not available at the time Washoe was raised, so the Gardners were unable to provide a video record to counter Terrance's claims. Of course, Washoe could also indicate the agent by simply looking directly at them or by pointing, in which case there was no need to produce the sign.
[39] To be fair to Washoe, she was simply doing what her teachers expected her to do. Could she have done more, quite possibly she could have. To be fair to her teachers, they were doing what the field of comparative psychology and their site visitors expected of them.

had no foil.[40] Why did Terrace set out to single-handedly stop all inquiries into ape language? Why did he raise a chimpanzee only to declare that he had been "fooled," when he knew that his students were instructed to teach Nim to imitate their signs? Why did he lead such a conference? Behaviorism – as a discipline – was being rapidly eroded by the new era of computers and cognitive science. Today, it exists mainly as treatment for humans with cognitive and behavioral deficits, acknowledging their cognitive capacities but treating their behavioral, socioemotional, and cognitive deficits with rewards, punishment, time outs, interval schedules, and sensitivities to their behavioral histories. Behaviorism has succeeded in the marketplace of therapy but lost considerable ground in the market place of intellectual ideas.

Skinner and Terrace did not appreciate the intellectual decline of behaviorism, led by E. O. Wilson (1975) through his masterpiece, *Sociobiology*, a work that announced the takeover of psychology by biology. Wilson argued that social behavior, including the social behavior of humans, was the product of a lengthy history of social evolution and that most of the things we, and other social animals, did would eventually be explained by biological investigations, not behavioral investigations. In brief, we were products, in every way of our past, not our present and not our behaviors in this lifetime, no matter how important such behaviors appeared to be in our daily lives. We had become a sociopolitical animal with remarkable intelligence, but the interactions between us were not the seeming products of our rational minds. Rather, they were the products of our genetic history. The "ego" itself, so long touted by Freudian psychologists as the homunculus of sorts that "tied" our personalities together in however shaky a form, was but an illusion created by our intellectual capacity. The real behavioral forces driving us, at every level, were genetic forces – they were mindless and interested only in reproductive fitness. Skinner responded, not with a book of his own, but by commenting to Wilson, "You left me out." What followed was series of discussions between Wilson and Skinner (Naour, 2009) which remain valid, but widely unread, today.

The linguistic behavior of apes, if truly valid, transcended all claims of behaviorism with regard to animals and seriously impinged upon Skinner's account of language in the book *Verbal Behavior*. By imposing upon Skinner's analysis of verbal behavior, they also threatened the thin line of connection between animal studies and human behavior that Skinner had drawn. To Terrace, this was unthinkable. To linguists, such as Chomsky, it was also completely unthinkable but for a very different reason, the "grammar nugget," a construct as elusive as the homunculus. In rearing a chimpanzee, and naming that chimpanzee, *Nim Chimsky*, Terrace set out to prove both the Gardners and the linguists wrong and behaviorism correct. His efforts did not go as planned. He knew far too little about chimpanzees, children, child development, or social behavior to possibly have succeeded. Serial training, outside the extreme confines he imposed upon his pigeons and his monkeys, simply did not work. When such organisms are allowed to attend to other things in a real world, they do so. Terrace's studies succeeded only because he constructed restricted rearing and testing environments designed to control the attention of his subjects. These studies, along with many other similar studies by behaviorally oriented scientists, came under attack by animal rightists, and labs closed down around the country. As the laboratories closed, studies of learning per se dropped off, replaced by the rise of computers, devices that could learn much more rapidly than animals and which ostensibly could model human learning far better.

[40] Many decades later, after learning of Kanzi, reviewing video tapes of him and listening to the Rumbaughs speak of him, Sebeok approached and offered his regrets and apologies. He had truly believed that Han's and his go/no go paradigm explained all of ape language. Ultimately, Sebeok could see that the variety in Kanzi's behavior could not be explained by conditioning, and he expressed sincere regret for his opposition. Rumbaugh, far more than anyone could possibly imagine, had been sensitive to the effects of training and cueing and had designed studies to avoid these effects for many years at the San Diego Zoo. According to all standards of science, the controls that he and the first author put in place to avoid such cueing deserved more respect than Sebeok, a semiotician, accorded them when he came to realize this, especially when confronted with the behavior of Kanzi.

The question of whether or not apes could acquire language slowly transformed into the question, "Why do we have language?" A multitude of new books arose to explain the seeming puzzle of why we are the only creatures - across all of evolutionary - time that have developed language. And, how, from the use of language, we found our way to modern society, crispr, the gut biome, the connetome, Siri, Alexa and the trans-human (Muller, Wrangham, & Pilbeam, 2017; Pagel, 2012; Wrangham, 2019; Wrangham & Peterson, 1997). The eventual machine/human interface to arise from this change will supposedly wipe out billions of years of evolutionary history. It will solve all of our ego-based problems with new inventions that combine computers and living tissues in unimaginable ways, as long as we can avoid mutually assured destruction for just a bit longer, and/or the combined intended economic hegemony of China and Russia.

If we accurately understand the abilities of apes, it would eliminate this seemingly unbridgeable gap between humanity and the rest of the animal kingdom. It would position us to better understand a new perspective of who we are and how we came to be; a perspective uncontaminated and not infatuated with the recent advances in gene editing and the AI simulations of great intelligence. It is these two things – the seeming loss of biological integrity coupled with the seeming loss of our intellectual and ethical self-hood – that is causing humanity to start to feel "unmoored," as Harari (2018) puts it.

To return us to the proper understanding of who we actually are and the path we actually traveled, we require the *proper* connection to our last real living relatives on the planet. We do not need such fanciful concoctions as the *Planet of the Apes* series. In remnant populations, here and there, the great apes continue to lead the life we led until just a blink of an eye ago in evolutionary time. We no longer understand our previous life, and, in losing touch with it, we have lost touch with our origins. We perceive them as brittle, ugly and terrible and suspect there is something deeply sinister within us, a force that must be kept at bay. And we attribute this sinister from to apes and seek to keep them at bay as well (Wrangham, 1997; 2017).

The fact that our biology is now easily edited and many of our intellectual accomplishments easily achieved by machines leaves humans looking for somewhere to turn and someone to blame for what we feel we have lost. However, this is a completely unnecessary state of affairs and one distinctly of our own making. It is a function of our view that it is the body that evolves over time rather than behavior and our fascination with the object-based world we have created. We did not begin this way; we elected this cultural path, and we can elect any future cultural path we choose.

Language Theory Now (and Then)

Language is the single critical tool that enables us to go far beyond our processing capacities because it can so easily be chunked into patterns, and each new set of patterns allows us to process more diverse arrays of information. In 2018, the immediacy and importance of syntax and symbols continue to exist but no longer as properties external to language per se. They are instead becoming understood as a byproduct of usage patterns, a necessary outcome of the need to rapidly process auditory information (Christianson & Charter, 2016; Savage-Rumbaugh, 1994). Meaning arises from usage patterns, but it is not located "inside" such patterns because they are forever being recycled, through dialogue, to create new meanings. Thus, meaning can only lie somewhere beyond syntax and symbols. It is now understood as existing within an endless series of co-constructed representational "intellectual spaces," or spaces formed between speakers and listeners, as well as between writers and readers, through dialogues which create their own existence and our raison d'etre (Dubreuil, 2015; Dubreuil & Savage-Rumbaugh, 2018).

A confirmation of these facts comes from the work of Artetxe, Labaka, Agirre, and Cho (2018). Their approach builds on "deep" AI translations between two languages. Previously, this was accomplished with databases of many parallel sentences in each language. Humans generated those parallel sentences for the computer to search. Artetxe et al. (2018) upended this method of machine translation with a program which "completely removes the need of parallel data and propose(s) a novel method to train a NMT system in a completely unsupervised manner, relying on nothing but monolingual corpora and a dictionary" (p. 1). Thus, without training on syntax, semantics, context, meaning, or any other aspect of language, an AI program is able to learn to translate from English to German or German to English. This process is labeled NMT (neural machine translation), and the main requirement is simply a very large nonparallel corpus in each language. The model uses the same encoder and decoder for both languages. It makes use of word embeddings, in which the structural nature of each language is carried. It assigns a space (the same space for both languages) to groups of words that are common.

The spaces that the program assigns for both languages are semantic in nature. Thus, it becomes possible to train a general machine translation system "without any form of supervision whatsoever" (Lample, Conneau, Denoyer, & Ranzato, 2018, p. 2). Humans do not need to provide feedback to inform the program of whether or not it has made proper translation. The computer is able to generate its own feedback by equating the evaluation of sentences in different languages with the problem of translating sentences in a given language, which must be correctly recognized even if distorted by noisy signals mixed in with the actual signal. Thus, the problem of different languages reduces to the same problem as that of a noisy signal. One cannot help but reflect upon the virtual cacophony of human languages around the world and as being something akin to a "noisy" signal and the legend of the Tower of Babel:
https://en.wikipedia.org/w/index.php?title=Tower_of_Babel&oldid=866095619

The only requirement for the Artetxe et al. (2018) translation program is the existence of a monolingual corpus on each language. Lample et al. (2018) observed:

> The key to this kind of translation is to build a common latent space between the two languages (or domains) and to learn to translate by reconstructing in both domains according to two principles: (i) the model has to be able to reconstruct a sentence in a given language from a noisy version of it, as in standard denoising auto-encoders (Vincent et al., 2008). (ii) The model also learns to reconstruct any source sentence given a noisy translation of the same sentence in the target domain, and vice versa. For (ii), the translated sentence is obtained by using a back-translation procedure (Sennrich et al., 2015a), i.e., by using the learned model to translate the source sentence to the target domain. In addition to these reconstruction objectives, we constrain the source and target sentence latent representations to have the same distribution using an adversarial regularization term, whereby the model tries to fool a discriminator which is simultaneously trained to identify the language of a given latent sentence representation (Ganin et al., 2016). This procedure is then iteratively repeated, giving rise to translation models of increasing quality. To keep our approach fully unsupervised, we initialize our algorithm by using a naive unsupervised translation model based on a word by word translation of sentences with a bilingual lexicon derived from the same monolingual data (Conneau et al., 2017). As a result, and by only using monolingual data, we can encode sentences of both languages into the same feature space, and from there, we can also decode/translate in any of these languages; see Figure 1 for an illustration (Lample et al., 2018, p. 2).

Thus it is now possible to perceive clearly, that which was suspected all along: The embedding of so called "words" in patterns of speech results in a kind tight weave between syntax and semantics, and that

syntax is a derived and clarified function of this pattern, not the ultimate cause of it. The so called "grammar nugget" lies not in the brain but in the patterns of language use themselves. Therefore, this nugget is a piece of software that lies open to other species. Lana demonstrated a basic ability to acquire that software. Now, AI programs have done the same thing. This has finally resulted in the capacity of computers to translate from one language to another without the need for human feedback once the model itself is constructed. Each language employs a somewhat different structure to say the same things, but because these are mapped to a common space within the program through frequency patterns, the program is able to learn to translate by treating unrecognized patterns as noise. By referring similar patterns back to a noisy signal detector, it can begin to find patterns of usage that correspond to one another across languages. For example, the patterns of denoting selfness (through words such as "I" and "me") share a commonality across languages because humans have a common perception of selfness and thus speak, reference, and actuate it through language in similar ways. The use of the word "me" is more likely to be associated with pattern in which the word is paired with other words that correspond to the linguistic designation of a being as a recipient of an action rather than the agent of an action. Of course, the program itself is not searching for or categorizing recipients or agents. It is simply searching for patterned regularities across languages. But these patterned regularities exist precisely because they themselves have evolved as regularities by which we can differentiate actor from agent. The computer need not care about whether someone is an actor or an agent. It need only look at patterns, but we do need to care about this distinction. [41]

This is a way of determining whether or not machine training is picking up sufficient grammatical processes from the encoder for each language. Within the decoder, the computer is able to work toward creating common translations from "chunks" lodged into common photo "syntactic/semantic-like" spaces.[42] Both this approach and that of Christianson and Charter (2017) lay bare the fact that linguistic processing is, at heart, chunks or phrases, each of which have parts that can be recombined with parts of other chunks or phrases. These common ways of chunking things are also easily processed by wet neural nets that need to store and match patterns. These chunks and phrases leave "trails" in the networks of real neurons. The trails left by an oral language also engage a certain rhythmic pattern and are uttered as a unit, with no pauses or breaths between them. When these patterns include rhymed chucks and/or metered phrases, they are much more easily recalled as each pattern, through similarity to the other in yet another dimension (rhyme and meter), each evokes the other.

[41] This is the reason that while the way in which AI programs can identify patterns is extremely helpful to us, it is also a reminder that it can be inherently dangerous to rely only on AI programs for things that matter to us as human beings. AI employs our patterns of behavior to make sense of many things that we do, but it has not embodied those patterns and thus the reason for any such pattern has no inherent possibility to a computer. We could, of course, model the embodiment experience, complete with memory, but such a solution is not ideal simply because memory is a shared experience between embodied entities.

[42] The term "syntactic/semantic-like" is utilized here because these spaces do not form based on meaning but merely on pattern. However, they are "semantic-like" because when speaking of something like Mother Nature, for example, many items such as wind, water, trees, animals, etc., will be found to co-occur. Similarly, when speaking of animals, many items such as food, cattle, sheep, vegetable, egg, etc., will co-occur. When speaking of day, night will often co-occur; when speaking of hot, cold will often co-occur. These spaces will have fuzzy edges, and they will overlap, making them multi-dimensional. There will be sufficient mathematical overlap between these "semantic-like" spaces to enable one language to become equated with another by dropping out the noise that separates them. Much of this noise is embedded in small grammatical differences in languages with a common origin. In languages with very different origins, such as tonal languages, these issues are not yet resolved by AI programs, which currently deal only with text, but there is no inherent reason why they could not be expanded to such languages and to audio data as opposed to textual data. In these spaces, objects and actions are always surrounded by linguistic markers of some sort because they co-occur together in language. Thus, objects and actions are not freed from and can never be entirely freed from the meaning they carry as encoded by these markers which specify the intended relationships between various chunked textual units. The concept that Deacon (1979) attempted to express in his book, *The Symbolic Species*, also finds its functional manifestation in this program, which translates from one human language to another without human assistance. The program is to identify this concept from the features of multiple language use patterns, but it neither "knows" the concept nor does it intentionally set out to map this concept. Both Deacon and the program draw their conclusions from usage patterns observed across languages but do so through different processes. Deacon has the advantage of understanding and experiencing what it is "to mean," but the computer does not.

If we set aside written languages, there is no need to consider these chunks as anything other than a unit even though they may contain multiple so called "words." The interesting thing is thus not the "word," but the "units" of varying length that map the "syntactic/semantic space" or, more precisely, the "production structures" for the translation of one language onto another (Christiansen & Charter, 2016).

The linguistic idea that humanity requires an innate "grammar nugget" to enable our brains to decode language has now been shattered by both computers and by apes, who easily solve this problem without a grammar nugget (but see Bolhuis, Tattersall, Chomsky, & Berwick, 2014 below). True language structures do not need to map to the ones that linguists employ. Linguists work from the top down, inferring structure from a written language. Machines, like Lana, are forced to work from the bottom up. Lana had to reliably map enough regularities across chunks or phrases at various nodes in her language onto regularities in her world to cause the emergence of representation and reference, two qualities that computer mapping does not require. Lana accomplished this through stock sentences. Most human children accomplish this by listening to how language is used around them and how this usage corresponds to events that they experienced in common with the speaker. The fewer the number of common linguistic and behavioral experiences, the longer it will presumably require to begin to understand the sound-to-thing-to-event match that is constantly taking place through language. But they do not need to speak – as did Lana – in order to map these regularities, as their parents are doing this around them and for them all the time.[43]

This sound-to-event mapping is fundamentally what the human brain is doing as it learns a language, but the child need not be aware of this for it to happen.[44] As the child begins to speak, the brain turns its attention toward dialogue and interverbal-meaning mappings begin to emerge, taking the process beyond the here and now. In order to translate text, the current AI program requires 10,000 hours of text in two or more languages. Unlike a child, it does not require real world experience or dialogue. It is only constructing a mapping between languages, not a language to meaning map. The fact that the vector spaces created for each language are sufficiently similar to allow translation reveals that humans are using language for many of the same things and in many of same ways across different languages. While a given structure, such as the past tense, may differ between languages to a considerable degree, it does not matter because the "action of talking about the past" is present in both languages and is done in sufficiently similar ways across language for translation to emerge. It still must be stressed, however, that what emerges is not a model of the past tense or even a category of past tense but simply something constructed from how the past tense is deployed within language.

Admittedly, there is something a bit unsettling about a language model that translates across languages easily without knowing the grammar or the meaning of either sentence. Essentially, we are faced with a program that knows how to manipulate meaning but not how to instill or understand meaning. Any "meaning" derived from a machine translation originates from the intent of the speaker and/or the interpretation of the listener, not the computer program per se. An "interpretation" – unlike a translation – is not merely a rephrasing; it is an understanding of how to go from utterance to action. Indeed, the regularities that arise in the computer system's analysis seem to be designed to make language easier to employ, just as Lana's stock sentences made it easier for her to construct new sentences; whether or not "meaning" existed in her sentences was a different question. 'Meaning" can only be addressed through an elucidation of the context and the dialogue.

[43] It is also possible that mirror neurons become activated as parent and child co-engage in language and many other activities, and that groups of co-activated mirror neurons could then seemingly behave as a "grammar nugget" would, thereby further enabling language acquisition in the normal child (Rizzolatti, Cattaneo, Fabbri-Destro, & Rozzi, 2014).

[44] This is why grammar lessons are so boring to the brain. Rather than memorize rules, the brain may function best by listening to language in some kind of context that links the utterances to life in meaningful ways, preferably in dialogic settings.

In one sense, it can be said that a computer programmed in English can "speak" to a computer programmed in German, and the German computer will "know what to do." Yet, this is an odd state of affairs. Two computers could be programmed to carry on a conversation all day. However, without a person present on either end to interpret the translations, nothing would take place unless the utterances were translated into a computer execution code of some sort. Certainly, a computer programmer can enable the computers to act — by translating language into computer code.[45] But in that case, someone somewhere would be waiting to "interpret the output," as meaning does not yet exist "within" the machine no matter how closely it approaches human behavior.[46]

It would be helpful if there was a simpler task that enabled us to compare the abilities of humans and apes, one that was relevant to language but did not require syntax, semantics, meaning, or the capacity to track referential topics across sentences. Chase's (1983) data suggest that the search for an unassailable species difference would be toward Miller's (1956) assessment of continuous processing capacity. Human's continuous processing capacity is 7 plus or minus 2, that of monkeys, 5 plus or minus 2, and that of pigeons, 3 plus or minus 2 (Chase, 1983; Miller, 1956). If that of apes were to be 6 plus or minus 2, this would account for the fact that apes can do many of things we do but not with the same degree of proficiency hat we possess (Shiffrin & Nosofsky, 1994). It would seem that practice on the task should provide for increased memory and/or processing capacity, but it does not. Only if the same stimulus pairings are repeated over and over, allowing them to be chunked and thus processed as a unit rather than as independent items, does one find improvement. Thus, we can find a way around our inherent processing limitations but only at the expense of losing awareness of some of the information to be processed by bundling it into packets we do not seek to open (Christisan, 2016). As long as leaving these packets closed allows us to succeed in our daily activities, this becomes a functional and efficient way to operate. It is clear that such chunking helps us (and AI programs) deal with the complexities and the "messiness" of human language.

The Matsuzawa (2009) task differs from Miller's processing capacity task in that in does not require a judgement of sort, merely an execution of a well-learned sequence mapped onto a constantly changing spatial array. However, it does require a nearly instantaneous recognition of the serial ordering task onto the spatial display. The ability to rapidly map spatial display after spatial display with ease was first noticed by scientists at the Yerkes facility in Orange Park, Florida, in the early 1920s. At the very least, Matsuzawa's results inform us that Lana could map any spatial sequence she executed on her keyboard much more rapidly than Tim could. Additionally, she may have been far better able to recall any such sequence than Tim could. By attaching "meaning" to those sequences, she could far outpace Tim as long as the meaning she attached was correct. What was perceived at the time – following a spatial sequence of keystrokes – as a difficult task was probably trivial for Lana. Like Ai, Lana was so proficient at spatial sequencing that changing the locations of the keys did not matter. She could recall a sequence of symbols and map it to any new location easily. Most likely, she was not only free of spatial cues, she was master of spatial displays in ways that Rumbaugh and Gill (1975)

[45] As an example, our society is now creating many programmers who themselves do not appreciate going through the cumbersome process of human communication. Unless one speaks to them in clear interpretable "stock sentences" – the way one might speak to Siri – they do not wish to carry on a conversation. If one listens to the conversations such persons have between themselves, one senses intellect but a dampening of feeling and an avoidance of any topic that cannot be parsed readily through a tree of choices. It is bit concerning to consider that via its interaction with machines and as a function of their internal architecture, the human species might begin to lose the true value of its language, as well as its feel, its rapid metaphorical quality, its poetry, and all the other things about language that reflect humanness. The age of asking "what it means to human" might be moving toward an age of nonhuman humans: Not cyborgs, but human minds that learn only computer speak from birth forward and thus fail to entertain concepts beyond that of hierarchically organized trees with "if/then," "either/or," "and," "match-to-sample," "paired associate" and weighted connections paths between them. Indeed, we are finding that it does not matter if Siri or Alexa really do comprehend language because people are learning to alter their language to be able to speak to a computer device that cannot not process their language.

[46] In a similar sense, one could raise the existential question of whether meaning actually exists "within" human beings or rather between them in dialogue.

could not have imagined.

While continuous simultaneous processing may seem similar to short-term memory, it is not. Miller's task requires memory only in the sense that one is making a judgement from a range of colors or other things, which must be kept in mind at the time of the task. There is not anything to memorize in Miller's task, but a number of comparisons must always be kept in working memory. In the case of language, reference to previous sentences often requires moving back in the dialogue while keeping the current sentence in mind. The chunking aspects of phonemes and sentences may allow us to pack in more information but at the cost of being unable to decode the chunks.

However, it is not only the processing capacity that matters but how this capacity is employed as well. It is evident that humans employed their processing capacity in the service of language, tool-use, and social behavior (in that order) for at least the past two million years. It is possible that apes have employed their rather different processing capacity in the service of social behavior, language, and tool-use (in that order). The current differences between us in form, function, and control of the physical world derive directly from these different processing choices. Certainly, the task of keeping a fire going focuses on objects, the relationship between objects, and a kind of continuous monitoring. One of the oral histories at Wamba, Congo, is that humans and bonobos stopped living together when humans insisted on keeping their fires going while bonobos allowed theirs to extinguish and travelled on.[47] It is quite a lot to simultaneously monitor cooking, wood gathering, what is taking place around one, potential forest dangers and sounds while properly feeding the fire. The bonobos at the Language Research Center had the same problem once they learned to make fire, suggesting that the number of things a species is able to monitor simultaneously may account for the species differences between ourselves and apes. Without constant attention, the fire will go out or grow too large, and one must be able to predict when and where to add more wood. Each fire is different when made on the spot in the forest and there is no way to standardize how to keep a fire just right for cooking other than by constantly and carefully adjusting the source of fuel.

Searching for the "Peculiarly Human" in Language: Bolhuis, Tattersall, Chomsky, and Berwick (2014)

Bolhuis, Tattersall, Chomsky, and Berwick (2014) addressed the challenges to Chomsky's earlier "grammar nugget" with something now called "merge."[48] "Merge" is an attempt to blend semantics and syntax into a single concept, rendering them indivisible, so to speak. The argument is such that the basic element of language is neither something that can be captured or expressed by an ape nor by a translation program based only upon probabilities. For example, they argue that "apple" and "the apple" constitute two different fundamental forms of reference. The symbol "apple" can be uttered when one is hungry or sees an apple. Similarly, "yikes" can be uttered when one is nervous or sees a snake. In such cases, neither "apple" nor "yikes" need be referential; both can be utterances provoked by the onset of external stimuli. Moreover, neither needs to be the "same as" the stimulus that evoked them nor represent them in particular manner. "Yikes" is an

[47] The oral histories of the region where many bonobos are found date the separation of bonobo and human to the invention of fire and the human fascination with fire. Long ignored as trivial by primatologists and anthropologists alike, a new respect and regard for these stories has emerged as many geological events reported in such oral histories have now become scientifically documented (Nunn, 2018). The oral histories also suggest that the separation between bonobo and human (which, in the oral history, is not associated with bodily form but rather with lifestyle) took place before both species migrated from North Africa to Central Africa. According to these legends, bonobos and humans were created as brothers, but humans came to the creation event first and thus received the more beautiful faces and bodies.

[48] The "grammar nugget" was thought to be an innate "translating code" that resided in every human brain and allowed the young children to begin to make sense of language. It was postulated to exist because parents did not appear to be teaching children grammatical rules, but the child was learning them nonetheless. Computer AI programs do not have a "grammar nugget" any more than a pigeon has a "grammar nugget."

expression, which occurs in the flow of events. Importantly, while its production may cause others to look for its cause once it is heard, it need not "mean" snake; it could be a hot wire that provokes "yikes." The reaction of "yikes" arises so rapidly that there need be no conscious intention undergirding it, such as to warn others. Indeed, even when a speaker is alone and there is no one to warn, such an expression will arise upon the sudden sight of a snake or some other dangerous entity. A person does not need to have learned to pair "yikes" and snake in the past, as it can refer to a general state of alarm, not a specific cause of alarm.

If one changes "yikes" to "the yikes", then one has created something very different; something not the same at all. No one would ever utter "the yikes" upon nearly stepping on a snake. "The yikes" is something that someone might say in a report about an event, as in "the yikes yell alerted others." Thus, simply by merging an article and a noun the meaning of "yikes" changes from the act of expressing "yikes" to something about such an act. By contrast, if one translated Nim's signs "want apple" to "I want the apple," Nim's meaning is not affected because he is simply asking for apple, not a specific apple per se, just the one that is there. Adding these other words makes no difference to Nim as long as they are generally "appropriate." Nim does not have the "merge" function under this line of reasoning because he is not trying to construct a sentence. He was merely trying to obtain an apple and linking signs together to the effect of transitioning the apple into his possession. Thus, teaching Nim the sign for "the" would not have mattered, and it was not attempted because Nim could not have known how to utilize it, being that he was chimpanzee, and, therefore, by definition, congenitally unable to produce language.

Under this view, apes are unable to merge words together (via the use of syntactic structures) to produce entirely new meanings because they lack the ability to blend syntactical structures with semantic structures. Furthermore, when an AI program chunks "the apple" into one unit, it is working with something that has already been blended by the human who produced the utterance, and the same thing would be true of any other chunks that the programed formed as well as the patterns of usage among such merged chunks. Therefore, the program is simply replicating the linguistic structure which already exists, not replacing it. This structure is, in and of itself, computational, according to Bolhuis et al. (2014).

An AI program's ability to do this and to locate patterns of usage in a multidimensional mathematical space is itself dependent on the "merge" function of things like "the" and "apple" as well as other hierarchical "merges" performed with language, all of which affect a "merge" between syntactical structures and meaning structures producing unique combinations that inherently become more than the sum of their parts. This is similarly why providing a computer with a representational linear hierarchy does not allow it to translate language. A computer does not operate as a representational entity. It operates upon data or specific instructions that tell it exactly what steps to perform. When the data have a pattern hidden within them that is inherently there because of the mind that generated usage patterns that can be grouped together and analyzed, the program itself is simply acting on the data. It is not creating something new, nor does it claim to be, even as the mathematical spaces that the computer generates appear to be new in some non-hierarchical sense. The hierarchical structures generated by the linguistic concept of "merge" do not arise directly from data; they represent the kinds of things that word units are able to do in combination with one another because of the syntactic structures with which they merge. The linguistic hierarchical structures that emerge, while sensitive to data patterns, go beyond them to become representative of them at a higher level of organization.

By stepping back to the simplest "act of reference," Bolhuis et al. (2014) were trying to address the essential nature of language, which is how meaning arises differently when we use words as behavior versus using words to talk about a behavior or an utterance. Thus, linguistic responses can be conditioned responses as noted by Skinner (1957) in his explanation of interverbals, but they can also be something that are not

conditioned and instead are referential and representational. When humans begin talking about behaviors or about words or about language itself, this process of "aboutness" per se moves everything to another level, a level that is connected to the here and now but not in the here and now. At this new level, we become able to jointly recreate events and refer to them in absentia. Simply in so doing, a kind of aboutness emerges because we are not using words in the midst of things, we are using words to discuss things that we are not doing at that moment. Along with this movement out of the here and now, we find that "the" apple is also becoming a special kind of apple, one that has properties apart from the eating of an apple, the tossing of an apple, etc. Thus, an apple can now be an imaginary apple, or very special apple, such as an apple logo.[49] Is an ape able conjure up an imaginary? Most assuredly, and apes can also pretend to engage in the imaginary eating of imaginary apples by as early as three years of age. Can a dog or a monkey conjure up an imaginary bone? To date, there is no such report.[50]

Bolhuis et al. (2014) "maintain that language is a computational cognitive mechanism that has a hierarchical syntactic structure at its core" (p. e1001934). Rumbaugh drew essentially the same conclusion in 1970 when he conceived of the Lana project. Only Rumbaugh extended this conclusion as he refused to accept (on the basis of no evidence) the idea that the structure of a language per se emerged from an innate computational structure. He felt that it had to emerge from some form of systematic interaction with the world through basic learning processes, such as associative pairings (either classical or reinforcement-based), discriminations, serial responses, learning to learn, learning sets, etc., within the context of actual language use. In essence, this inner structure was built anew within each context through producing language, listening to language, and engaging in bilateral dialogue. The culture of those who possessed language guided its transmission to the next generation. Thus, by arranging Lana's training in a hierarchical manner and providing her with a communicative partner, he sought to move her beyond the domain of simple associations and into the interindividual domain of representation and reference. Lana's achievement does not in any way dispute Bolhuis et al.'s (2014) conclusions – it simply extends them to apes.[51] But, to be very clear, Lana's achievements do not in any way extend to monkeys. These achievements suggest instead that the dividing line Bolhuis, Terrace, and many others were attempting to draw between the human way of processing incoming information and the animal way of processing the same incoming stimuli is in fact valid but that this line between human and animal has been drawn at the wrong place.

Beyond the Sentence

When a group of words are uttered, if they are independent units, the relationship between those words must be made clear. This can be accomplished by intonation, order, and grammatical indicators. However, relationships between words are not limited to the relationships within sentences; they travel across sentences. Language is in fact almost always drawing relationships to utterances from past sentences, both recent and distant. This relationship, which both speaker and listener (or reader) must jointly construct and understand,

[49] Are apes able to understand logos? Yes. Sherman and Austin were tested for this specific capacity and were able to identify logos for such foods as M&M, Welch's grape juice, etc., with no specific training to employ logos as symbols in a simple communication task (Savage-Rumbaugh, 1986).
[50] Dogs, apes, and humans can all suffer from a kind of psychosis in which reality breaks down and things that are absent are seen, as in a dream. But such is not the conscious act of pretending or deliberately imagining something; it is the mind attempting to provide a faithful picture of reality but creating something that it takes for reality, which does not exist other than in that individual's mind.
[51] So far, in spite of Rumbaugh's urging, no one has tried to replicate the Lana paradigm with monkeys. Other work with monkeys suggests that they would remain tied to immediate conditions, but their ability to employ joysticks and recognize themselves in mirrors with training begs the question of whether they could become representational if required to express then inner preferences though a hierarchical system like the one presented to Lana. Such a model could also be employed by computer programmers to attempt to create "representation" in a computer, except that computers do not experience internal desires in the way a monkey does. Writing a program to mimic the rise and fall of desires might result in a system that appears to mimic a real animal, but the next step, the one that leads to representation, remains mysterious.

allows each listener to follow the meaning of each speaker (or writer). The better we know a given speaker (or writer) and the more conversations we have had with them, the more elliptical this process becomes. Functional linguistics addresses this issue, but Bolhuis et al. (2014) did not. The AI translation program also does not address this issue, as it handles one sentence at a time.

But Bolhuis et al. (2014) implied such a function when they discussed "merge" as relating to the apple. For example, in the sentence "Where is the apple," *the* apple refers to a specific apple that has been jointly referenced previously, either in an earlier sentence or perhaps by a pointing gesture. In any case, the recipient knows which apple "*the* apple" is by something that took place beyond the bounds of this sentence. "The" and "apple" become merged in this sentence to refer to something that only another sentence (or gestural act of reference) can define. Thus, this sentence itself is embedded in a larger context of reference. In a similar way, the use of a single word, such as "it," poses a similar problem, even though it is not merged with an article. For example, in the sentences "Don't do it!" or "Do it later," the listener requires some external reference to know what the "it" is that should not take place now or that should take place later. Otherwise, "it" could not mean anything.

"It" might be a very special activity that was known only to both speaker and listener (such as kissing), which was never expressed in words, but was commonly understood as the referent of "it" in that moment of time. This is the level at which language, real world events, and subjective experience actually "merge." The linguistic level is merely a way of expressing reality at a level once removed from the actual behavior. The linguistic level requires a "merge" function because the reality of co-experience generates it, and language must then map at a level once removed when the speaker and the listener wish to talk about "it." (Or at level twice removed, if a lengthy text, such as this one, wishes to reference "it.")

The ease with which young children, as well the apes (Lana, Sherman, Austin, Kanzi, Panbanisha, Mulika, Panzee, Nyota, Nathan, Teco), become able to engage in and understand joint unspoken reference to past events implies that the context surrounding those commonly shared events must activate brain structures in a similar manner. Joint memories are thus created, and situational knowledge can then become conjoined with linguistic expression. This joint experience and joint memory allow anything that is commonly understood to be dropped from expression between such parties, as long as the method by which this removal takes place is commonly understood. The excitation of a common knowledge state appears to be a fundamental property of the mirror neuron system. Far too little is known about its precise function at this time to attribute joint linguistic perceptions to it, but the speed and the ease with which joint perception and joint recall take place, both at the behavioral level and the linguistic level, indicate that something more than our ordinarily linear way of looking at behavior must be taking place (Rizzolatti et al., 2013; Savage-Rumbaugh, Fields & Taglialatela, 2001). Thus, at the linguistic level, sentences, such as "No, we aren't going to do this now," "I like that, let's do it," and "We don't want it we want a different one," are readily understood by apes like Kanzi, who began to comprehend English language on their own. However, in these kinds of sentences there is not one word that is easily tested or identifiable by a photograph. These kinds of sentences characterize the true language of early interaction far more than the nouns and verbs that were taught to Lana. When sentences like "We did that yesterday" and "We have done this before*"* occur, it is because the joint memories of speaker and listener are becoming coexpanded across time, and reference to time (such as yesterday) is entering into the child or ape's conscious understanding of time. Even if the child or ape cannot define yesterday, both individuals have a sense of comemory removed in time, and they understand what the parent is saying. Indeed, being the recipient of such sentences allows an individual to infer what "yesterday" does mean in an experiential manner. Children begin to enjoy listening to stories that are read from books, which describe the experiences of others (not those of themselves) only through words. At this point, language comes into its own,

allowing the reader and the listener to be transported in time and space to another world. Movies do the same kind of thing, but they employ images as well as words for their desired effect. Can apes who understand language listen to stories, watch movies, and understand them? Yes, they most definitely can. Demonstrations of this took place daily at the Language Research Center and the Great Ape Trust.[52]

Thus, at the most basic level, reference – with representation – is the linguistic essential. Syntax itself depends on this ability, and it arises from reference and representation as means of clarifying the relationship between sequences of such acts. And of course, contrary to the assertion of Bolhuis et al. (2014), apes can employ markers to indicate aboutness (see Rumbaugh, 1977; Savage-Rumbaugh et al., 1993). If they could not, their "language" would reduce to paired associates. But that has not happened with any ape who has been said to have components of language except for Sarah and Ai, both of whom were trained by the "match-to-sample" method only. Nim, it seems, acquired some language, quite probably because he began to understand some language while reared in the home of Stefanie Lafarge and her children. But his Columbia University tutoring sessions reduced him to match-to-sample and serial learning sessions, with no realization that he might be beginning to understand spoken English. At "home," his teachers signed (but did not speak) to him in more natural circumstances. This study, like every other ape language study (except for Koko), was terminated.[53]

Lana demonstrated her ability to recall and reference past actions and past utterances when she asked Tim to put milk in her milk dispenser. He put water there instead and then told her that he put milk there. Lana asked Tim, "? You want water in the machine." Lana discerned the mismatch between his statements about his actions and his true actions. She can only conclude that something is wrong and thus addresses Tim's mental state with a question about his desire. Lana received no training to employ the verb "want" for individuals other than herself, yet she was able to deduce that individuals other than herself also possessed desires and that their desires could differ from her own. Lana was able to linguistically query them about their desires in a manner similar to that which Tim used to inquire about her desires. This is quite remarkable given the limited vocabulary and syntax provided to Lana. Lana was still a young chimpanzee at this point (4 years old), but she had already formed the concept that Tim had a mind and that the thoughts within his mind and her own may or may not be the same. Thus, when Tim's behavior made no sense, she immediately concluded that he might be doing something seemingly odd (that is, not fulfilling her desires as he always done heretofore) but reasons of his own desires.

In ordinary dialogue, there are often complex referential links made between sentences. This is the reason that language "interpretation" is not easily accomplished by machines. A machine can read "things" and take note of them, file them into lists, categories, and probabilities, and sort them into many kinds of frequency relationships to other "things" it has read. But unless "told the answer," computers are merely going on probabilities and weighted functions. They do not know what a "thing" is nor can they operate with a general definition of a "thing" or "things" or "its" when it comes to interpreting what a person means. Simply stated,

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[52] Research projects were in the midst of documenting this ability in 2013, after having been previously prevented from doing so in 2008. In 2013, the project was terminated due to a hostile takeover of the facility by investigators brought to Iowa to collaborate with the authors.

[53] The Koko research program survived until her passing in 2018 because it was the only study fully privately funded. Thus it was fiscally immune to Terrace's critiques. *It was also immune to changes in government funding policies which took place in direct response to the discoveries produced by ape language. Government policies limited the study of apes to "species specific behaviors" and defined language as not among those behaviors simply because the langauge of apes is not yet undertsood.* Patterson achieved the capacity for private funding early on, due to the attention of *National Geographic*, as did Jane Goodall and her studies of wild chimpanzees. Goodall did not believe that wild chimpanzees were capable of language or even of many of the higher cognitive processes that belong to human beings, though she felt that their emotional lives were extraordinarily similar to our own. And in the end, *National Geographic* adopted her view, stopped publishing articles about Koko, and recently even began to criticize her. Not long thereafter, Koko passed away. At that time, it was widely announced that ape language had ended. It has not ended. Kanzi, Nyota, Teco, Elykia, and Maisha continue to reside together in Iowa, but language has not been studied there since 2013, when the facility was taken over by Jared Taglialatela and Bill Hopkins, with funding from Yerkes Regional Primate Research Center.

it is very difficult to tell a computer what a "thing" is because "a thing" is one thing one moment and another thing the next moment, depending of human acts of reference and representation.

Searching for the "Peculiarly Human" a la Pre-Verbal Behavior with Tomasello

Tomasello and Call (2018) tried to address the "peculiarity of human behavior" through studies of prelinguistic reference. According to Tomasello and Call (2018), even before the complex referential action of merge begins to take place between sentences and events, a precursor of it is already happening between individuals at the pre-verbal level exists. Tomasello has tried to take Bolhuis et al.'s (2014) argument back to the most basic level, one that predates the link between grammar and reference.

Tomasello and Call (2018) broke gestures and glances down into three types of cognitive states:

A) Those that lack intent,
B) Those that have intent but lack co-ordination and co-operation, and
C) Those that are intentional and designed to solicit coordination/co-operation through clear acts of triadic and dyadic reference.

After 30 years of studying preverbal communication in apes, he concluded:

> It is… a mistake, … to assimilate great ape gestures to human gestures by claiming that they are used referentially and declaratively in a human-like manner, as apes.' A "pointing" gesture has many limitations and they [apes] do not gesture iconically. Great ape gestures constitute a unique form of primate communication with their own unique qualities. (p. 1)

Tomasello and Call became adamant that apes are not like humans with regard to their basic preverbal referential abilities, but that they are also not like monkeys (or most other animals).[54]

If we take Tomasello and Call's (2018) above conclusions seriously, they require that apes be placed in their own genus because apes "constitute a unique form of primate communication with their own unique qualities" (p. 1). Tomasello and Call find this vexing conclusion problematic, but they feel forced to assert that essentially there are three types of living, communicating, moving things: ourselves, animals, and apes. The human/animal distinction, which has served others so well for so long, simply does not work for them.[55]

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[54] Apes may be like more like whales, dolphins, and elephants, but Tomasello is not a comparative psychologist as was Rumbaugh; he is a developmental psychologist, one who is interested in developmental processes, but not in how or whether differential rearing conditions affect developmental processes. He believes that developmental processes are species-specific and designed to unfold under a wide variety of conditions; therefore, the differential environments (and even ages) of the apes and children he compares have been of very little consequence to him. Unlike Rumbaugh, who also studied elephants and dolphins, Tomasello has no interest in any species other than apes and humans. His own work was dedicated to defining the differences between ourselves and our closest living relatives. When monkeys are mentioned for purposes of contrast, Tomasello relies on the work of others. And when chimpanzee are mentioned, he relies on students for data collection and analysis. No doubt he actually observed chimpanzees at some point, but he is disinterested in observation of free ongoing behavior as a method of consequence. He prefers tightly designed experiments. They are, of course, necessary and valuable but should always be informed by a thorough knowledge of one's subjects, especially when attempting to analyze some of the most complex and varied behaviors that have manifested on Earth.

[55] This distinction does not work for the authors of this paper because, in our view, apes belong in *Homo* on the basis of their DNA, level of consciousness, behavior, anatomy, tool production, nonverbal gestures, joint regard that elicit cooperation and coordination, and the capacity to comprehend articles.

For Tomasello and Call, apes are their own thing – intermediate between us and the rest of the animal kingdom. They were compelled to invent an entirely new category, one that allows for intentionality, but not joint referential regard or cooperation and coordination. Monkeys, on the other hand, clearly lack intentionality and reference as indicated by Tomasello and Call (2018). Apes may be evolving cognitively but have not made it to the stage that permits them to employ acts of reference – to refer to objects, as well as to past, present, future, and desired acts of coordination and cooperation with others as oriented toward objects, persons, places, events, and things.

At first glance, it may appear that that Tomasello and Call's work has little to do with the attempt by Bolhuis et al. (2014) to locate the basic grammatical primitive. But it actually has everything to do with it. Bolhuis and his colleagues moved downward from complex form of language to the very simplest behaviors of which they can conceive that are still clearly language to them. Tomasello and Call moved upward from the behaviors of nonhumans such as monkeys to apes and then to children. Both parties desired to demonstrate that apes have no conscious intent behind their seemingly linguist utterances.

But Tomasello and Call (2018) become trapped by their own proof that apes do display communicative intentions, and thus they have some kind of knowledge of what they wish to communicate and some level of selfhood that extends beyond that of monkeys. They are thus forced to go to great pains to show that apes cannot and do not coordinate their gestures and glances with each other, as do human children. This fact, they asserts, prevents them from achieving cooperation through the means of reference available to our species. Apes, upon this view (currently a very popular one), are caught in a kind of Neverland where they seek referential linguistic relationships but fall backward into a raft of conditioned interactions. In something akin to the fall of man, apes are prevented by this cognitive inadequacy from ever rising out the jungle toward civilization. *Homo sapiens* have made this leap. They were able to do so, according to Tomasello and Call (2018), because, at the nonverbal level, humans acquired the innate capacity to link gestures to glances together in dyadic and triadic reference and then to spoken words and linguistically mediated cooperation and coordination.

Tomasello, like Rumbaugh, maintains that behavior matters more than biology when it comes to how we categorize living, moving beings. No matter how much DNA we share, we are human and not ape. We are human because we are able to make reference to things in intentional ways and coordinate and cooperate around these intentional referential communications. These basic differences in our communicative capacities are expressed linguistically within a hierarchical system that allow words to function in many different ways through changes in their relationships to one another. This is the quintessential message of Tomasello and Call (2018), Bolhuis et al. (2014), Deacon (1997), and Savage-Rumbaugh et al. (1980).

But studies of wild children and apes reared with human caretakers reveal again and again that the differences Tomasello, Bolhuis, Skinner, Deacon, Harari, and many other argue for cannot be species-specific differences; they are culturally instantiated in children, and bonobos can adopt them as well (Savage-Rumbaugh, & Hopkins, 1986). Children reared by animals that do not engage in the forms of preverbal also fail to achieve this capacity. For an example of the deep damage such rearing can cause, see *Wild Child: The Story of Feral Children* (https://youtu.be/cymZq1VblU0).

Similarly, deep damage takes place in apes, but our attunement to what is human prevents us from seeing how severely the behaviors of ape offspring are altered. Apes reared in zoos and biomedical facilities become the "wild children" of their species because these environments provide no cultural moorings. These apes then pass these environmentally induced behavioral problems to the next generation quite possibly

through epigenetic markers (Adkins, Rasmussen, & Docherty, 2018).[56] Tomasello's results are based on populations of apes who have been reared in seas of cultural, social, and kinship deprivation. It is unfair to compare them to children reared with families in middle-class homes and a strong cultural heritage.[57]

Tomasello observes that he began his work 30 years ago with the view that apes were, cognitively speaking, large monkeys (Tomasello & Call, 2018). His views on this topic are presented below in detail (Tomasello & Call, 2018) for readers who may be unfamiliar with what has now become the politically correct (but totally erroneous) perspective in the field of primatology.[58] From Tomasello and Call:

> The great discovery of Seyfarth et al. (1980) was that some forms of primate vocal communication (e.g., vervet monkey alarm calls) *seem* to operate representationally: *Different calls are used systematically in association with specific classes of referents*. The implications of this discovery for the evolution of human linguistic communication were immediately obvious. But further research soon documented limitations in individuals' ability to use such representational vocalizations to communicate flexibly with different recipients, in various psychological states, in a range of social circumstances (see, e.g., Cheney & Seyfarth 1990). Indeed, the caller seemed to have very little intentional control over the production of the vocalization at all: '*Listeners acquire information from signalers who do not, in the human sense, intend to provide it*.' (Seyfarth & Cheney 2003, p. 168); "Nonhuman primates vocalize in response to important events, irrespective of how potential recipients may view the situation" (Zuberbühler, 2005, p. 126, but see Schel et al., 2013; Crockford et al., 2017).
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> In addition, it was perhaps noteworthy that great apes, as humans' closest primate relatives, did not seem to have these same kinds of referentially specific calls, at least not to the same extent as various

[56] Epigenetics are thought not to alter basic Darwinian processes because these markers can be passed on from one generation in what is said to be the "classical Darwinian manner." And they can also be lost and no longer transmitted in some cases. But precisely because they are inherited and thus cause some physical and behavioral characteristics to increase, decrease and/or be preferentially acquired more rapidly in succeeding generations, they can affect the relative balance of different genomic characteristics within a population, even if the markers should no longer be inherited. Indeed, they may well be a way of transmitting behavioral and acquired characteristics that are reversible for period time during which they affect only a limited number of the population, but as larger numbers are affected, and the genome frequencies changed, some markers may no longer be needed. What is clear is that events within a given lifetime can cause changes to the epigenome, these changes can be passed to the next generation and they can affect the offspring. This means that selection can be greatly speeded up and it can be based on experience. While the epigenetic markers may eventually be removed, the experiences can continue to effect the sensititivity of the genome as they become more instantiated in the population.

[57] Tomasello's prolific and detailed contrasts of apes with children are based on normal children and what Tomasello has characterized as "normal chimpanzees." These are chimpanzees reared either at the Yerkes Primate Research Center or at the zoological gardens associated with the Max Planck Institute. These chimpanzees are often separated from their parents at birth and reared in "nurseries" for a variety of different reasons. Should infants be left with their mothers, it is probable that the mothers themselves were wild-caught and reared in a similar nursery setting. Most such nurseries are composed of small cages. They vary in the amount of time the infants experience in bodily contact with a human from none to a few hours per day. They vary in the amount of time infants have with one another. Although the first years of a human or ape life, under "natural conditions," normally require essentially constant bodily contact with the mother or other family member. The immense psychological impact of changes in that requirement have become only partially understood for modern humans and are often over looked entirely with regard to apes.

[58] The apes Tomasello has studied were mostly been reared in conditions completely antithetical to the development of the very skills whose emergence he was attempting to discern. In addition, most of the ape populations in the wild have been studied under conditions of stress due to poaching, increasing habitat incursion, etc. Their behaviors thus may be severely altered. The subtleties of pointing, gesture, glance, and language production found among wild apes have not yet been well studied. It is difficult to track the apes and to be sufficiently close to them over the developmental time spans required for such work. Apes are quadrupedal, live in lush forests, are not readily identifiable, and travel in "groups," the members of which may not see each other for days. These means that many components of their nonverbal interaction will not be transparent to observers and often not even noted. The high degree genetic similarity between apes and humans reveals that most aspects of human social behavior must exist in apes but in a form not easily discerned. Ape behavior, like human behavior, is highly plastic and culturally determined. Apes surely have some form of language, or all the prelanguage skills they have would not be present. To locate language from the 'outside' – without an interpreter, is a nearly impossible task unless one is essentially constantly with a group, sans any breaks, for multiple generations. This is because language is, at heart, a vehicle for transmitting plans and relevant events. Those plans and events unfold over time spans distantly separated from the dynamics of the utterances per se.

species of monkeys (and prairie dogs and chickens). It is in this context, in the 1980s, that we began our studies of great ape gestural communication. The focus from the beginning was on gestures as social action aimed at influencing others, taking as a starting point the many insightful observations of field ethologists on the communicative actions and displays of species ranging from fish to birds to dogs. Specifically, our initial study was prompted by two ethological papers in the volume Action, Gesture, and Symbol: Emergence of Language (Locke, 1978). In one of these, Plooij (1978) reported and discussed an ethogram of chimpanzee gestures, based on observations of the infants and juveniles in the Gombe (Kasakela) community. What was remarkable was that these gestures did not seem to be the kind of fixed action patterns characteristic of the phylogenetically ritualized communicative signals of the ethologists (e.g., bird mating displays). They seemed to be much more under the intentional control of the individual for flexible use as needed in particular social circumstances. In the other paper, Locke (1978) reported some ethological observations of human infants requesting to be picked up, most often using the well-known gesture of "arms up" toward the adult. This gesture was not like the most studied gestures in child development, namely pointing and the use of iconic signs, and it certainly was not conventional linguistic communication. Instead, it seemed to be a kind of learned "intention-movement" (Tinbergen, 1951, 1952): The baby was using a reaching-up movement not to actually crawl up into the adult's arms but rather to prompt the adult to effect that end for her. On the surface, at least, there seemed to be a remarkable similarity to some of the chimpanzee gestures Plooij was reporting.

And so we went to watch the Yerkes chimpanzees. We went armed with three basic questions: (1) Did chimpanzees use at least some of their gestures flexibly and under their own intentional control?; (2) how did they learn their gestures, if indeed they learned them at all?; and (3) how did they understand what they were doing (i.e., what underlying processes of social cognition were involved)? In the background was perhaps the somewhat larger question of how chimpanzees' gestural communication related to the evolution and development of human language. What ensued was a series of four observational studies (Tomasello et al., 1985, 1989, 1994, 1997), carried out on two groups of captive chimpanzees at the Yerkes Primate Center, comprising one to two dozen individuals each. Later, after we arrived at the Max Planck Institute in Leipzig in 1998, we and our colleagues (especially Katja Liebal and Simone Pika) expanded both the ape species studied and the questions asked. We summarized much of this work in an edited volume (Call & Tomasello, 2007) and further developed some theoretical implications in a book on the evolution of human communication (Tomasello, 2008).

In the past decade or so a number of other researchers have also begun to investigate great ape gestural communication, including importantly in its natural habitats in the wild. Many of their observations and interpretations are broadly consistent with ours, but some disagreements have arisen as well. Our goal in this paper, after a brief account of the most important areas of agreement, is to address the most important of the outstanding disagreements. In general, we will defend the view that much (not all) of great ape gestural communication is intentional and learned, *but at the same time it differs from human gestural and linguistic communication in being fundamentally individualistic rather than cooperative*. Great ape gestural communication is a sophisticated form of individual intentionality, not human-like shared intentionality (Tomasello, 2014).

Similarly, the first author began her studies of apes in 1970 at the University of Oklahoma Primate Research Center. The chimpanzee Washoe, the Gardners, and Roger Fouts had just relocated there from Reno,

Nevada.[59] The first author also began studies of gestural behavior and nonverbal communication in chimpanzees and assisted Fouts with the sign language training of four young chimpanzees, Booee, Bruno, Thelma, and Cindy.[60] The first author began comparing and contrasting what was taking place at the gestural level with chimpanzees that were acquiring signs and those that were not.

The chimpanzees of the Oklahoma Primate Research Center (both those in signing studies and those that were not) had immensely varied backgrounds. Some were mother reared, some were reared in human homes from birth, some were peer-reared, some were zoo reared, some were captive born, some were imported from Africa – all were very different. Some pointed all the time, others never did; some understood spoken English, some did not; some liked people immensely, others hated people immensely; some were dangerous as adults, others were not dangerous at all as adults; some plotted to escape, other stayed in the cage even if the door was open; some explored the forest if given a chance, others had no interest; some could imitate extremely complex behaviors on trial one (such as changing the tire on a car), others did not imitate much of anything a human did; some were very quiet, others very noisy; but all of them communicated intentionally and referentially with one another about many things (Savage, 1975).

Those who had been reared in human homes from birth did not know what another chimpanzee was when they saw it. They had no innate behaviors at their disposal to allow them to interact with it, except those they had acquired from human culture. They liked playing with chimpanzees, but they did not wish to be left with them. In brief, the 30 chimpanzees at the University of Oklahoma Primate Center were all very different, and those differences could be traced to their rearing conditions. The more positive social experiences they had encountered with humans, the more humanlike their behavior. This is to clearly say that becoming more human-like did not depend upon the amount of time with humans, it depended upon the degree of positive social experiences with those humans. In spite of all these differences, except for the ones who had never seen another chimpanzee from birth, they could all be mixed and matched in different social groups with relative ease and they formulated and developed a system of gestures and vocalizations that worked for them (Savage, 1975).

The first author spent five years studying this varied population of chimpanzees as a graduate student. Unlike Tomasello, her experiences included daily first-hand direct interaction with chimpanzees from a variety of backgrounds described above. William Lemmon, director of the Oklahoma Primate Research Institute, was involved in a research program to determine whether or not maternal behavior was innate in chimpanzees. Thus, chimpanzees were placed in human families from the day of birth, and they were to be reared as human children. In many regards, their rearing experiences were not unlike those of Washoe, but all were captive born and all were separated from their mothers at a much earlier age. In every case, this early separation and human

[59] The first author immediately recognized the existance of wide variations amongst the chimpanzees at the University of Oklahoma Primate facility - in their abilities to imitate humans, to point, to engage in dyadic and triadic reference, to acquire ASL signs, and to co-ordinate and co-operate with human one another. It was clear that some (as adults) could do none of the above. Some were completely unpredictable and unmanageable and very dangerous. Others were completely at ease with most humans, and while they did not appreciate being "managed" and could strongly resist, they were certainly highly co-operative when kindly treated. They were not aggressive unless provoked. The more language they understood the more co-operation they extended. All of the chimpanzees at the University of Oklahoma (except those being reared in a mother-infant group at that time) had experienced some form of human rearing, be it in a circus, a rodeo, as a pet, as a member of human family, or by William Lemmon and his wife in their family. Thus the differences were therefore not attributeable in any simplistic manner to human rearing or human enculturation per se, but rather to the explicit experiences they received during human rearing. Those that were being reared in the mother-infant group experience no human rearing, other than accepting food through the wire. Yet when they were introduced to humans they treated them in a kindly manner and interacted, played and groomed with them readily, as though they were another form of chimpanzee. They also displayed no aggression toward humans unless provoked.

[60] Thelma and Cindy were females wild caught at the relatively late age of 2 or 3. Booee and Bruno were captive and each had previously served as a research subject and was consquently "hand-reared" by a human nursemaid. In Booee's case, he was part of study to sever the corpus collosum. In Bruno's case, he was part of study to determine if apes could acquire language and was also reared by a nursemaid.

rearing resulted in apes with lithe bodies, fluid movements, less dense musculature, great attention to human beings, ease of object manipulation, tendency toward bipedal stance, and, in males, a reduction in the tendency to display. It also resulted in apes who seemed to comprehend human language from time-to-time. These apes also moved more slowly and with much greater bodily control and deliberation. Lemmon was interested in having them learn to sign and thus the University of Oklahoma offered Roger Founts a position and housing for Washoe. The Gardners were happy to send Washoe there as she had outgrown their trailer and was starting to become interested in leaving the yard. The goal was for Washoe to have a baby and for their students and Roger Fouts to determine if language was passed to the infant by Washoe.

The directional two-way interaction with a wide variety of chimpanzees, each with a somewhat different rearing background, left no doubt that chimpanzees produced intentional gestures, monitored the recipient, modified their gestures, engaged in dyadic and triadic referential glances, and responded to such gesture and glances. Not only did they do so, but they did so with a speed and alacrity that was far beyond that of human children. Hundreds of hours were spent traveling and foraging with various chimpanzees in the Oklahoma forest surrounding the primate research center. Some of the chimpanzees, even as adults, did not require a lead. They not only cooperated and coordinated at high levels with the first author, they imitated complex tasks and acquired gestural signs rapidly. They rode in her car as adults without any restraint, cooperating perfectly, never attempting to leave the car unless allowed to do so. The first author was able to visit the local drive-ins and order food to go with them, to go fishing with them, to explore new habitats, to be around children without difficulty, to change a car tire when needed, and many other normal human activities. The degree to which such actives were possible was a direct function of the amount of time they had spent as a member of a human family as a child. Many were still in human families. The wild-born adults were dangerous and aggressive and could not be taken out of the cage. The circus and rodeo reared chimpanzees were even more dangerous and attacked humans by stealth whenever possible.[61] These activities were not engaged in for fun or to show off the chimps. They were part and parcel of the daily lives of the chimpanzees being reared in human homes as part of Lemmon's research program. Part of a graduate student's duties included spending time in such settings with these chimpanzees to assist their human family members.

The Oklahoma Primate Research Institute also housed *Macaca nemistrina, Macaca archtoides*, baboons, gibbons, and siamangs. It was not necessary to read the work of Seyfarth and Cheney to conclude that vast differences in communicative intentionality and ability existed between monkeys and all species and apes. The gibbons and the siamangs lay somewhere in between, just as Tomasello described for apes. But apes were clearly not in between. While some may view direct interaction with any primate as something that should be avoided at all costs, if one has questions regarding the intentionality of their communication and whether it can be shared as can human intentionality, interacting with them is the quickest and most direct route to deterring whether this capacity is there or not.

If apes that had been human reared were not only willing to interact, but eager to do so, it was easy to coordinate with them. In such situations, one was able to reference by glance, by gesture, by facial expression, by body posture, or by any other means employed by humans. These apes understood gestural and visual coordination and easily coordinated during joint travel and in tasks, such as cleaning up the kitchen, taking care of a kitten, and hunting chickens.[62] Wild-reared chimpanzees demonstrated great sensitivity to glance and coordinated with each other but rarely with humans. Monkeys did not have this capacity. They observed

[61] The first author lost part of her left index finger to a circus-reared chimpanzee and part of the function of her right index finger to a rodeo-reared chimpanzee.

[62] Of course, at that time, Tomasello had not begun his work. Had he had the opportunity to spend time at the Oklahoma Primate Research Center instead of the Yerkes Primate Research Center, his research would surely have been very different. Communication is basically an inter-individual phenomenon, and it carries with it an inherent component of subjectivity.

humans closely and reacted to them immediately. If one turned their head and/or their body suddenly to look at something, monkeys did the same. But this is not the kind of joint intentional reference utilized by apes and humans. Only siamangs and the gibbons behaved in the fundamentally individualistic manner described by Tomasello and Call (2018). They are also classified as a separate genus and thought to represent a transitional form from monkeys to apes. They have a certain degree of awareness of self that is different from monkeys, but it seems to flit in and out. With apes, it is always there. We are both always thinking, as well as acting, and we are aware that other members of our species are doing the same thing. Thus, there arises the conscious option for a symbolic plane to emerge (Dubreuil, 2015).

The first author moved to the Yerkes Primate Regional Research Center and began a postdoctoral position under Rumbaugh. The difference between the two primate facilities was shocking. While the first author was aware of the great range of behavioral differences to be found among chimpanzees, she was not prepared for the Yerkes Center. It was a place where nearly every ape exhibited some kind of stereotypy. Many of the apes were too deeply disturbed to be able to engage in nonverbal gestures, glances, joint reference, signs, or any kind of prelinguistic or linguistic behavior.

It was not that they lacked the basic cognitive ability to do so, they lacked instead any awareness of a reason to do so. They were asocial with each other and with the humans who cared for them. They easily retreated into their own mental worlds even when one tried to interact and offered food. After an aggressive display or attempted attack, they behaved much as do severely autistic humans. The degree to which the colony of apes at the main center were socially inept was staggering. They certainly lacked human-like shared intentionality. Even the chimpanzees who had been reared in circuses and rodeos in Oklahoma were nothing like the chimpanzees of the Yerkes facility.[63]

The first author continued investigations into chimpanzee and bonobo communication at the Yerkes Primate Center, armed with the questions below. Did chimpanzees and bonobos differ in their nonverbal gesture, eye contact, and directional gaze? Could chimpanzees reared in the Yerkes nursery be rehabilitated sufficiently to enable them to begin to communicate both gesturally and symbolically with one another in an intentional manner? Would they learn to use gestures between them without rewards for so doing? Would they be able to understand the truly representational and referential nature of symbolic processes at the nonverbal level and at the symbolic level? Would they be able to coordinate and cooperate with one another at the gestural and symbolic level and appropriately intermix these two modes of behavior? The description of their path from nursery reared apes who were essentially in their own world and who had spent a year trying to acquire Yerkish symbols without success is documented in *Ape Language: From Conditioned Response to Symbol* (1986).

Not only did Sherman and Austin provide a positive answer to the questions above, they went beyond them. They were able to tell one another the kinds of foods hidden in containers and the kinds of tools they needed to solve a task, to make statements about future intended actions, and to demonstrate that their symbols served a referential function. They developed an extremely high-level tight dyadic and triadic intentional cooperative, coordinated gestural communication system. This capacity is illustrated in the following video in which they take-turns requesting, providing, and sharing food. The speed and fluidness of the coordination between them could not have been shaped, either deliberately through reward or through joint practice. It emerged from their social and cognitive relationship and was applied to the task at hand quite spontaneously (https://youtu.be/zImRAPk7oco, Sherman and Austin 6).

[63] The Yerkes chimpanzees had not always been like this. Films taken of the colony in Orange Park Florida, before the move to join Emory Medical, show that the Orange Park the chimpanzee colony was very similar to the Oklahoma Primate Research Center, which was, in fact, modeled after the Orange Park Facility.

Data from 28 bouts such as those illustrated in the video revealed the occurrence of 72 interindividual gestures, coordinated with eye contact and visual reference to the food tray or the keyboard (Savage-Rumbaugh, 1986). Each gesture was different and conveyed something relevant to the food exchange at the moment in time when it occurred. In addition to gestures, Sherman and Austin synchronized many of their movements and nearly all of their actual requests made at the keyboard.

They easily moved into and out of synchronized coordinated states linked to communicative moments. The video leaves no doubt that chimpanzees have the capacity for humanlike shared intentionality (Savage-Rumbaugh, 1986). When Terrace visited the facility and observed this behavior in these apes, after having reared Nim, his first question was, "How did you get them to sit still?" His second questions was, "How did you get them to coordinate with one another?" A brief look at one of his training sessions conducted with Nim revealed why Terrace asked these questions. He was unable to get Nim to do either of things on his own, yet they seemed to come readily to Sherman and Austin. In the Nim video (https://youtu.be/B51mFD_kCSA), he is being forced to sit still. The teacher is trying to teach him to look at her, to co-ordinate with her, and to sign with her. He is not cooperating. He is not interested in the task. It is not communicative, and he clearly did not wish to participate in, or repeat over and over, the things he was being asked to do.

Sherman and Austin were clearly interested in their task, they enjoyed doing it together, they liked to repeat it, and no one needed to force them to sit still or to attend. These behaviors arose from them because their environment was designed around social interactions and tasks that interested them. This environment allowed cooperation and coordination to emerge between them, guided. It is also the case that use of the keyboard itself with its dispensers encourages apes to attend and to sit still. This skill is required to perform the simplest of tasks, and they do not need to be taught specifically. Just as apes learned to employ joy sticks quite on their own, they learned to use Rumbaugh's keyboard on their own. When they began to employ language they understood what was common knowledge and what needed to be shared through symbolic expression (Greenfield & Savage-Rumbaugh, 1984). Thus the speaker left unsaid what did not need to stated, and made manifest, that which was not known to the listener.

Having encountered firsthand the capabilities of ASL home-reared chimpanzees such as Lucy at the Oklahoma Primate Research Facility, there was never any reason for the first author to question the ultimate potential of apes (Temerlin, 1975). Chimpanzees quickly teach everyone that forced restraint and forced practice does not result in progress unless the restraint and the conditioning program are extreme, as was the case with Ham in the space program. When forced restraint is applied early on, learning can be very rapid and extensive in both apes and monkeys; however, it is incompatible with the normal process of socialization between mother and infant. The fact that human infants are slow to develop and must be carried is a kind of natural forced restraint that allows for a much longer period of observational learning – with the burden of remaining with the group becoming removed from the infant and placed on the parents, siblings, etc. This means that the hands are free to gesture very early and indicative communication is needed because the human infant is not able to reach the things it wishes to have. When infant apes are carried by human beings, they begin to point spontaneously and quite early (Savage-Rumbaugh & Fields, 2011, 2013).[64] (The behavior of

[64] Because of the close relationship formed between Matata and the first and fourth authors, Kanzi was often carried by them, with the full agreement of Matata. As an infant, he transferred often between Matata and these authors of his own freewill. This cultural tradition was continued across generations and was even extended to Teco, whose mother, Elykia, had been carried only by Matata. Elykia, like Matata, sought the human assistance of the author's in rearing Teco. In the wild, both bonobo females and males share in infant carriage. Initally, infants are handed back and forth, but soon they initiate this on their own, just as do human infants who become old enough to reach out to the other parent or relative. In this way, the first and third authors became relatives of the infants from birth, and it was this cultural behavior of the sharing of infants that made it possible for the authors to participate very early in the co-rearing of bonobo infants and thus to create a true *Pan/Homo* culture. This has not taken place in any of the other ape language studies, as they were oriented toward making the apes human. The bonobo study was directed toward integrating the first and third

Genie, a contemporary "wild child" who was tied to a toilet and punished frequently, revealed severe disturbances in all normal preverbal and nonverbal behaviors (Curtis & Whitaker, 2014). Genie failed to acquire normal social behavior or adequate language (https://youtu.be/VjZolHCrC8E, Genie Wiley - TLC Documentary).

The computer keyboard allowed for quick symbolic utterances, and they could use it together. It served as a focus for joint attention and joint regard just as had taken place between Lana and Tim. Perhaps most important of all is that as language beings to function at the representational level, it allows the user to gain increasing self-control. Thus, it became possible to teach rules – such as food sharing – to Sherman and Austin. Once they understood the rules for how things are done, when presented with a tray of foods, they followed these rules, adjusting them with their own elaborations and redactions.

However, it was the rules inherent in this task that led their ability to sit quietly, pay attention, etc., plus the fact that, like humans, chimpanzees have voluntary control over their attention. The rules however were not about such things as sitting still or paying attention. The rules required three things: a) to use symbols of some form (vocal, gestural, lexical), b) to take-turns, and c) to share.

The behaviors which Terrace questioned were not part of these rules, but they emerged between Sherman and Austin as they began to communicate with one another. The rules were always about the need to collaborate and share but not about the methods of so doing. Human children are also taught such rules. Thus, there is reason to believe that the humanlike shared intentionality was conveyed to the children just as we conveyed it to Sherman and Austin.[65] They were expected to adopt these cultural customs just as parents expect their children to adopt such cultural customs. The expectancies were accepted when a bond of trust and affiliation developed between the adult and the pupil. There is no need to teach such things as sitting still or paying attention if a being is capable of directing its own attention through its own freewill. The being will do so and will follow the rules and expectations of the task or set of events at hand.[66]

Increasing Self-Conscious Control of Attention, Orientation Toward Future Events – Monkeys, Apes and Man

The relationship between monkeys, apes, and humans has long puzzled humanity. And it has altered between assigning them godlike status (for example, Hanuman) to pronouncing them as the worst of beasts. Legends of monkeys and apes living with humans and speaking to each other exist around the world. Oral histories of Mali and Congo describe bonobos and chimpanzees as having lived sympatrically with humans until humans discovered fire. With the use of fire, humans stopped traveling through the forest to obtain food because they needed to protect their fires from rain and keep them going. Keeping a fire going is difficult in the middle of the rain forest and starting one there is even more difficult. Humans began to construct upside

authors into the ways of bonobo culture. Thus, from the beginning, efforts to understand the gestural and vocal cultures of bonobos were ever present (Savage, Wilkerson, & Bakman, 1977).

[65] And there is reason to believe that rules regarding sharing and "deep coordination" are also taught to bonobo and chimpanzee infants (Savage, Wilkerson, & Bakman, 1977) but that captivity precludes the passing on of these important cultural values.

[66] Apes are capable of directing their own attention. Sherman even turned Austin's head toward the keyboard to get him to pay attention when he seemed to be wavering. Since holding the head of chimpanzee and directing its attention toward the keyboard was not something the researchers did, it appeared that Sherman understood that Austin needed to look at the keyboard if he was going to select a symbol. If Austin was not cooperating, Sherman took matters into his own hands. He not only understood that Austin's state of mind was not in accord with his at that moment, he also understood that what he needed to do was to direct Austin's attention, not guide or direct Austin's hand. This is really quite remarkable since most humans have tended to guide hands of the apes to get them to produce sign language symbols (e.g., Fouts, Terrace, Miles, and Patterson).

down nests on the ground around their fires to keep the rain from drenching them, and then they brought some food to eat around their fires, which inevitably led to cooking.

It is said that the bonobos also learned to make fires but elected (by their choice) to allow theirs to go out and to follow the natural rhythms of the forest.[67] At that time, the bonobos and the humans were considered brothers but not one species. They lived together in the forest, and they shared a language (Hopkins & Savage-Rumbaugh, 1991). Some of those words are still present in the language of the humans today. Oral histories also record instances of bonobos deciding to live with humans in human village habitats and to make fire in those cases. It is important to note that in such instances, the bonobos are not viewed as pets nor are they treated as pets. In fact, marriages between humans and bonobos have taken place. These oral histories correspond to the incomplete lineage separation data currently being produced by genomic sequencing studies (Rogers & Gibbs, 2014). Thus, while lineage division may have begun 5 to 12 million years ago, interbreeding continued for millions of years. Today, the lineage separation remains incomplete and interbreeding could theoretically occur.

It is clear that Egyptians employed baboons in many occupations. Some hieroglyphics even comment on the ability of baboons to understand words (Cheney & Seyfarth, 2008). Baboons are often depicted as being kept on leashes. It seems that their attention wandered otherwise; however, they were reported to participate with humans in many professions.[68] Today, baboons have become attracted to human villages, and many humans are attracted to the baboons. There are cases of friendships being made between humans and baboons which entail no food. Contact seems to be made simply because both species enjoy the company of the other.

Across time, the *ape-monkey* moved from a position of demi-god to that of scapegoat and trickster in Western and European Cultures. According to Jewish legend, when humans whose languages were intentionally befuddled due to the construction of the Tower of Babel, ape-monkeys (who were also speaking and helping to build the tower) lost their language entirely and were banished to the forest. The "see no evil, hear no evil, speak no evil" principle represents what monkeys cannot do – as opposed to humans who continue to employ language in these ways and thus to deceive one another. With the rise of Christianity, Western theologians began to use monkeys and apes as living examples of what man would become if he turned away from God and gave way to his baser instincts (Cheney & Seyfarth, 2008, p. 21).

Unlike apes, baboons experience difficulty in directing their attention toward something that is unrelated to immediate aspects of social organization or food. They have difficulty recognizing themselves in mirrors, solving transfer index problems, using tools, solving object manipulation tasks without trial and error, and learning to use a joystick. Their calls sometimes appear to be under stimulus control as well. This can lead to instant death when they become frightened by wolves who have surrounded their sleeping tree as noted above.

Cheney and Seyfarth (2008) initially argued from a behaviorist perspective that there was no reason to assume that the calls of vervet monkeys represented a snake, leopard, or eagle, even though given under those conditions. The important thing for the monkey was simply to pair a particular call with a particular

[67] Support for this view is the fact that some bonobos, quite on their own, decided to learn to make campfires in the forests of Georgia and to cook food. However, they also showed no interest in keeping the fires going, and some even became adament about putting them out (See NHK documentary film, Kanzi I - https://youtu.be/dBUHWoFnuB4, Kanzi – An Ape of Genisu -Part 1.m4v) there are three parts to this documentary).

[68] Unless trained, as service dogs can be trained, to ignore all stimuli other than the tasks commanded by the owner. In such a case, the "owner's attention" takes charge of the animal's behavior in much the same way as the attention of a hypnotist takes charge of a person's attention. When this takes place, the person does very little until the hypnotist requests an action. The same is true of well-trained service dogs. Dogs cannot be hynotized however, as they don't have the capacity for divided attentional direction which humans possess.

predator avoidance response. But later, after investigating the far more complex vocal repertoire of baboons, they concluded that the ability to recognize social relationships in the context of more than 80 graded calls required at least some representational understanding of the calls, who made them, and the hierarchically organized familial relationships in which the calls took place. In a large troop of a hundred or more individuals, the number of different responses that would be required to a given call was simply too large to process without being able to construct a representation of the relationships between the different callers (Cheney & Seyfarth, 2008).

The difference between the capacity to treat a sound as meaning "eagle is present" versus "run to the bush" represents the essential entry point into language. If a sound does more than announce "eagle," or, in other words, if the sound becomes associated with things about an eagle (where eagles nest, how high the eagler is flying, etc.), then it begins to "mean" eagle – apart from any singular reaction to the word "eagle."

Cheney and Seyfarth (2008) stopped short of assigning "meaning" even to the complex vocal system of baboons. The separation they make between "meaning" and representation is difficult for most humans to grasp because meaning and reference inevitably co-occur in human language. Cheney and Seyfarth attempted to forge a separation based on the intent of the caller by concluding that baboons are able to form and to hear a sound and to employ a representational image – without either the speaker or the listener intending to do so, or at least without intending to do so in the human sense of intentional communication. The only counterparts we have in humans in communication are earlier cries of babies, and while these can differ before the baby becomes intentional, there are certainly not 80 different kinds of infant cries, and it is not assumed that the baby forms a mental representation of the cry.[69]

In observing the behavior of wild baboons recently exposed to city life in South Africa, one can see a vast array of new "non-baboon" behaviors emerging in a relatively short amount of time. These emerging behaviors attest emphatically to the views on emergents espoused by Rumbaugh and Washburn in their book *Intelligence of Apes, and other Rational Beings* (2003). But in spite of the raft of complex new behaviors in such baboons (including things such as suddenly figuring out how to remove sliding glass doors from their frames and how to enter windows with many different lock systems), there is no indication that processes other than trial and error learning coupled with observational learning – as assisted by the mirror neuron system – are taking place.

But the attention of humans and apes, even before six months of age, is not bound to immediate time and space. They can ignore or attend to stimuli. And they will certainly take into account circumstances that precede and follow any call. This is why apes are not long fooled by speakers playing calls of other chimpanzees. They quickly learn that the call is coming from a speaker and not a chimpanzee. Baboons and monkeys, it seems, can be continually fooled by the speaker. Monkeys habituate to the sound but then are fooled again the next time, as they do not attribute the sound to the speaker hidden in the forest.

The chimpanzees Sherman and Austin readily learned on their own to differentiate between live video and taped video. They could not be fooled because they constantly tested the signal to see if it responded as a real-time signal or not. They could even correct for rotations in the angle of the video signal without training

[69] The work of Tomasello and Call (2018) with apes is designed to take this distinction one step further. That is, they found that the data forced them to accept that apes must not only have mental representations but that they must also have intentions when they produce gestures. They distinguished human and ape gestures at the level of "deep cooperation," suggesting that apes are not capable of really coordinating and working together in the fluid manner that characterizes human society – except, that is, when it does not characterize human society and when human skills are employed in the construction of weapons, to terminate other groups of humans, etc. Indeed, the singular thing which reliably seperates humans and apes is the increasing sophistication of the construction of weapons of war to annihilate other human groups.

to do so (Menzel, Savage-Rumbaugh, & Lawson, 1985). There is no suggestion in the literature that any species (beyond humans) is able to perform such a comparison between a live and delayed signal, nor that another species could possibly wish to do so – on its own accord – for the sole purpose of determining whether it is watching tape or live signal. The consequences of ignoring a live signal are much different from that of ignoring a taped signal and thus the temporal origin of a signal does matter. When one can understand these facts, the differences between such signals should be intentionally discerned.[70]

The ability to focus one's own attention at will is not characteristic of animals other than humans and nonhuman apes.[71] To place one's attention simultaneously on what is in one's own field of vision and interest and at the same time recognize that something quite different can occupy the attention and interest of a conspecific who has another set of experiences or a different vantange point requires the capacity to both control one's attention and to deliberately shift it back and forth between various perspectives. Again, this has only been demonstrated in apes that have acquired a human lexical language. (Kanzi I, NKH documentary, https://youtu.be/dBUHWoFnuB4).

Behaviorism has long attempted to circumvent species differences by employing a paucity of stimuli. This allows for the relating of responses to a very few stimuli by making these stimuli artificially salient in the organism's world. This is the value of the "Skinner box" and was part of the intial design of Lana's world, a world in which the only salient things were her lexigram keyboard and Tim Gill. It is much more difficult to explain the behavior of organisms in their natural environment where stimuli abound. This has led ethologists to resort to explaining species differences by innate processes, or those that appear cannalized and not susceptible to various outside stimuli. Neither approach works when one is attempting to explain and/or control the behaviors of higher nonhuman primates such as macaques or baboons. Even the work of Rumbaugh and Washburn (2003) with monkeys resorted to video screens with simple displays and very small cages. Rumbaugh, King, Beran, Washburn, & Gould, (2007) attempted to account for the role of stimuli in determining the behavior of human and nonhuman primates through "salience theory," noting that:

> In accordance with what we here view as the constructive biases of species' brains stimuli are differentially organized into amalgrams that reflect an exchanged of salience and response ellicting properties of ompoenent units which are then integreated to form a basis of knowledge about the organism and its ecological niche…species may create emergent behaviors with no history of specific training and even new capacities, to service adaptation to both familiar and novel challenges. (p. 973)

While this theory recognizes that the organism's history of interacting with the environment in various ways leads it to be able to form completely new concepts, it does not specifically address how apes and humans

[70] In one case, Sherman (a chimpanzee) was watching a live signal from Kanzi (a bonobo) which he thought was video tape, as he was often shown video tapes of Kanzi and the other bonobos. This was the first time that a live video feed had been attempted between the buildings. Kanzi kept trying to convey to Sherman that there was a live video connection between their buildings, but Sherman failed to understand his bonobo message over the video. Kanzi understood that the video feed was live because this was explained to him in English and with the lexigram keyboard. Finally, Kanzi gave up trying to get Sherman's attention to the video feed and produced a very loud and very clear chimpanzee utterance, a true chimpanzee pant-hoot toward the outdoors – which he had never done before and no one knew was even possible for him to do. The pant-hoot was sufficiently loud that Sherman could hear from the other building as well as over the video signal, and apparently it conveyed information to Sherman about the video signal. Sherman understood immedately that this signal was live and began to gesture to Kanzi over the video. He also answered immediately with a pant-hoot of his own which also traveled between the buildings, and he proceeded to watch the live feed with Kanzi very carefully. Communication between them ensured in ways that the human observer could only note was taking place but could not decode. The fact that Kanzi was able to produce what sounded to human ears to be an exact rendition of a chimpanzee pant-hoot was startling. It illustrated that Kanzi was well aware of the kinds of communication required with Sherman though he did not employee it himself. In a similar manner, Bow, a chimpanzee who understands both spoken and printed Hebrew and English, is able to comprehend and translate bonobo utterances produced by Kanzi, if Kanzi is attempting to speak English rather than bonobo. He is also willing to translate Kanzi's utterances (personal communication, Aya Katz).

[71] And perhaps dolphins and elephants – though they have not yet been shown to be capable of theory-of-mind competencies.

become able to monitor and control their attentional processes. When attentional processes are brought under control by the self – or by other means – new abilities can be acquired and then transferred to novel contexts. This is most clearly illustrated by the recent success in proving that monkeys can recognize their mirror image. This was accomplished after many decades by imposing far greater constraints than are normally used with monkeys in such tasks (Changa et al., 2017). The monkeys were strapped into restraint chairs, and their heads were positioned so that they not avoid looking at their faces in the mirror, while a laser dot was projected onto various locations nearby. By controlling the monkeys' visual attention in this manner, mirror recognition, which had eluded other investigators since the 1970s, was rapidly achieved. This suggests that things which have been percieved as cognitive difficulties in monkeys are more likely the result of deficits in self-organized intentional attention control.

And the cognitive improvement we observe taking place, as we move up the phylogenetic tree from monkey, to ape, human is actually a reflection of an increase in the conscious capacity for self-control of one's own attention. In other words, within the order Primates, beings are becoming increasingly able to consciously control their attention and thus their conscious activities and creativity through greater degrees of conscious control over their own attention. The ability to do so naturally requires monitoring of increasing number of channels of simultaneous input and eventually allows a "constructed ego based self" to be monitored while the body is acting based on its set of experience. Thus what we have equated with intelligence *per se*, or the ability to process information in a logical, reasonable manner, is not so much about "information" *per se*,

Of Human Apes and Language

The key capacity of nonhuman and human apes lies in their ability to put the world "off line" so to speak, or to encode it into a visual-spatial-symbol mode. This enables thought about the future or the past and one's intentions about the future, and/or the justification of the past to take place. It also enables intentional deception to take place. In order to achieve this ability, both human and nonhuman apes must be reared in a cultural environment that already displays this capacity, and in a situation of relative safety. Any traumatic events during the rearing period can seriously impair the acquistion of this "off line" world, and lead to autistic behavior in both species.

Once this world is culturally instantiated in a population, it is the population itself that carries it across time through a process Lock (1980) has termed "the guided reinvention of language." All events become actuated in and through language – not "language as behavior" but language that is about behavior - that is, shared language about their thoughts, goals, intentions, beliefs, etc, as described by Thibault (2017). Languaging (as a process, not a form) requires the ultimate removal of the attention from the here and now. Eventually, as Skinner's "inter-verbals" become traded back and forth, and written, this process begins to redefine the entire existance of the speakers and listeners. It builds up a new world around them composed of the *products of language and its material and nonmaterial cultural instantiations*. Thus, we are endowed with the ablity to "remake ourselves" anew through the process of language and the invention of material and nonmaterial cultural practices. However, the web of culture ties us together so tightly that we become bound by the constructive as well as the selfish practices that are embedded with the memes of the culture. It requires consicious intent to move beyond culture.

This ability to create a mentally co-constructed world (Dubeuil & Savage-Rumbaugh, 2018) appears in the games of imagination engaged by younger children and continues into adulthood with games such as "Second Life". It reaches its pinnacle in the various religious activities, theologies, rituals, and traditions

around the world – especially those typified by the great cosmologies of gods and demigods whose actions have been believed, in ever age, to the Earth and to whom one's attention and supplication is to be directed, if one wishes for success in the temporal world according to many religious tradtions. To attend to the world beyond this world requires the ultimate control over attention and thus is often practiced in monasteries and remote locations where attention can be more easily focused. Science has striven to set mankind free from these practices and to replace them with knowledge of more practical sort. One the geatest surpises of Savage-Rumbaugh, Roffma and Pugh, in working apes has been the degree to which they are receptive to mythical narratives. This is not new to Lingomo though, as it is common knowledge in the Iyondje area of the Congo that bonobos engage in spiritual practices.

It is the removal of attention from the here and now, coupled with the power of imagination, that has always made human creativity possible. However, it is the domain of language to bind together that creativity into common ways of addressing the physical world, interpreting that world, determining moral action in that world, and assigning blame and punishment for noncompliance within the standards of that coconstructed cultural world – that defines each distinct culture and the larger nature of humanness.

When full blown human language is permitted to develop (as was the case with the bonobo group led by Matata who was wild caught at puberty), it leads inexorably to a consideration of the nature of humanness itself. In the case of these bonobos (Dubreuil & Savage-Rumbaugh, 2018) it led to them perceiving themselves as existing on the continum of "humaness." They demonstrated this by electing to sort their own photos into the pile of humans while sorting those of chimpanzees they knew well into the pile of animals (Savage-Rumbaugh, Segerdahl, & Fields, 2005). A similar test was given the chimpanzee Vickie, who likewise sorted herself with humans as opposed to animals (Hayes & Hayes, 1951). However, Vicki was reared alone and did not know other apes. Kanzi and Panbanisha were living with other bonobos and have been reared by Matata, a bonobo born and reared in the the Congo. The also regularly interacted with the chimpanzees, Lana, Sherma, Austin, Panzee, and Mercury at the time of this test. This does not mean that they thought they were human or "like us." It means that they recognized the overlap between their conscious capacities to become intentional causal linguistic agents and those we possesed. They knew that they had freedoms and abilities that the chimpanzees in the same facility lacked. They also knew that they were expected to treat these freedoms in a responsible manner…and while they made mistakes now and then, they grew steadily in this ability and in language comprehension just as do children. The degree of self-control the bonobos came to possess would have enabled them to live outside of cages, had society so permitted. But they are by the fiat of definiton "wild animals" and must be so treated.

Through the vehicle of high-level language comprehension and their ability to answer complex questions, they indicated that they understood the reasons for captivity at some level, but wished for freedom. They also understood the danger of escaping. When security guards, workmen or staff deliberately left cages open to the area beyond their outside enclosures, they refused to leave. In addition they indicated that they understood the danger inherent in trusting all human beings (Roffman & Nevo, 2010), and they began to refuse to display their understanding of language to human beings who treated them as animals.

The capacity to develop a symbolic world as discussed in *Dialogues on the The Human Ape* (Dubreuil & Savage-Rumbaugh, 2018) is a capacity of the great ape brain, but *human* language *pe se* a property of *human* culture. Regardless of the complexity of any bonobo language in the wild (and it may be extremely complex), it will lack those properties of language and culture that are peculiarly human. These human properties include tool manufacture, shelter construction, deception, and writing. The bonobos who acquired our human language

did not foresake what their bonobo mother Matata passed onto them. They incorporated both into a bicultural existance, with "bonobo" being their first language and their first culture.

This research revealed that while physical development is necessary; it is not a sufficient variable to enable humanness. Language, properly acquired in a matrix of social-gestural-visual communication, does provide what we humans experience as humanness. But it is a form of humanness that is carried in our living breathing cultures anew into each generation (Lock, 1980). Our culture, with its embedded language practices, tells us "how to be," and "how to suceed" in the world around us. It derives its validity from the fact that it produces parents who give us life. However it has also historically urged cultural groups to compete against one another.

When captive apes are deprived of the opportunity to acquire language and live in social groups with symbolically constructed worlds, their suffering is not unlike the suffering of wild children reared in isolation from human culture (Malson, 1972). This suffering can be ameliorated with great investment of time and sufficient social bonding to produce the kind of triadic communication that Tomasello and Call (2018) asserted to be absent in chimpanzees – as a species deficit. As the videos of Sherma and Austin clearly reveal, they entered into what Tomasello and Call (2018) have described as deeply cooperative behavior. But, being reared in the Yerkes nursery, they initially lacked this skill. They displayed many autistic behaviors and were resistant to all symbolic training paradigms initially employed with them. The subjects of Tomasello and Call (2018) also lacked these communicative skills and were similarly deprived. These apes not rehabitated and thus remained social deficient.

One Sherman and Austin bonded to humans, they began to respond to affective symbolic interaction. In fact, until affective bonding to a specific individual was put in place, as an explicit experimental variable, no forms of deeply cooperative behavior or symbolic behavior appeared. Yet following the emergene of an understanding of the role of gestures and glances in communiation, Sherman and Austin employed both gestures and glances between them in highly cooperative ways. They were innovative beyond the human context in which they acquired, and they achieved a speed more rapid than humans utilize in their interindividual exchange of gestural and facial.

These inter-individual gestures and glances appeared in novel circumstances and began to be accompanied by vocalizations. This high level of communication, coordination, and sharing remained with them throughout their adult lives. Chimpanzees in the wild do not lack these abilities. Indeed, close study of video of the behavior of wild chimpanzess reveals high levels of coordination and cooperation. However, because of their quadrupedal stance, their black sclera, and the dense vegetation – these behaviors are displayed in ways that are not readily discerned by humans.[72] It is quite probable that Sherma and Austin were employing their vocalizations symbolically, thought this was not recognized at the time. They did have some voluntary control over their vocalizations and this capacity increased as they approached adulthood.

Thus, the most probable reason for the seeming lack of linguistic continuity between ourselves apes is the a) inhibition of their vocalizations are maintained due to predation pressures and b) we are unable to process their sounds a speech. Because of the need to quickly process each sound as speech or nonspeech, our brain makes a categorical decsion (between speech and nonspeech) before we are aware that it has done so. This

[72] Humans invariably have an anthropocentric bias that causes them to see and hear language only if it displays itself in human ways. Without effort to rid onself completely from one's bias, even primatologists simply cannot "see" much of what takes place between apes unless the video footage is shown to them in slow motion, with explications at every step.

serves to form a species barrier. Most primate and avian species barriers are formed by changes in vocalizations as step one. This means that the human inability to hear some form of speech is not a reliable indication that they lack speech.

There is no doubt that chimpanzee and bonobo field researchers often sense that complex communication is occurring; however the only method they currently employ with voclizations is to link them to immedate external events. For example, a typical conclusion for apes is as follows:

> Both vocalizations and gestures contain audible information about the signaller, for example that they are in the presence of food (Schel et al., 2013b) or that they desire to be groomed, to threaten, or to travel" (Hobaiter & Byrne, 2014). (Hobaiter, Bryne, & Zublerbuhler, 2017, p. 71)

Yet a moment's attention to human vocalizations reveals that they are rarely about 'the present." And any who attempte to understand their meaning in that highly temporal manner linked to context would fail. The earliest use of human language reflects the communication of internal states, then of the direction of attention of others and soon the co-ordination of mental events. Symbolic linguistic communications are not about the here and now. Even with infants, orangutan mothers are utilizing vocal information that is not linked to the here and now. Presumably, they would not be doing this if they did not expect the infant to be able to comprehend words/sentences about things displaced in time and space (Tomasello & Call, 2018).

As the video of Sherman and Austin illustrates, even at 4 and 5 years of age, they were capable of symbolically encoding information about food types in multiple ways. They can also symbolically encode information about tool type (Savage-Rumbuagh, Rumbaugh, & Boysen, 1978) and about intended actions (Savage-Rumbaugh, Pate, Smith, & Rosenblum, 1983). And it was easy for the bonobos to code information about specific locations in the forest and specific travel plans at a very young age, both with indicative gestures and symbols (Menzel, Savage-Rumbaugh, & Menzel, 2002; Savage-Rumbaugh, 1984).

Given that these considerable abilities exist in very young apes, it is clear that adult apes under free-living conditions are likely to communincate about intended future travel plans, intended feeding locations, needed objects, etc., and many other possible future events. When living in groups, they will need to agree about such things in order to act in co-ordination. Apes are simply too large-bodied to wander an area in search of food as a troop. They must either know when food ripens and where, so that they can arrive at an optimal time or send out scouts (Savage-Rumbaugh & Fields, 2013; Savage-Rumbaugh, Williams, Furuichi, & Kano, 1996). But observers cannot see "deep in time" toward the future behavior of free-living chimpanzees.

A Call for a New Way of Thinking about Apes

Studies of captive apes who have acquired language not only reveal the limiting nature of past, they reveal that apes, like humans, are constructing highly complex symbolic worlds (Dubreuil & Savage-Rumbaugh, 2018; Greenfield & Savage-Rumbaugh, 1984). Indeed, the present + future world becomes so complex that *linguistic participation in it is required to understand it*. In previous ape language research, such participation never took place because (a) there was no wild caught participant simlar to Matat that possessed language, (b) no kinship groups were allowed to form and exist across time, and (c) no humans participated in symbolic communication with an adult group of apes. To participate in such a group enables consolidation of information and experience across space and time that begins to serve as the basis for a bi-species culture to emerge.

The only reason a more detailed explanation of the mentally co-constructed worlds achieved by these methods has not emerged, has been the great difficulty in achieving success in communicating far simpler things such as the ability *to provide information*. The main reason this difficulty has been encountered is clear from the literature to dae. The bi-cultural rearing of these particular apes has made possible competencies that so far surpass those of other apes, that other researchers are hesitant to accept the data. They do not see these ablities in their apes, but neither would they see them in their own children if they were to rear their children in the same manner that their ape subjects have been reared.

It was unfortunate that the sophistication of the bonobo culture was severely constrained in 2007, following a publication the first publication to speak about the capacities of these apes to understand their own situation. The article the implications for ape management in captivity and listed the bonobos as co-authors (Savage-Rumbaugh, Wamba, Wamba, & Wamba, 2007). Then in 2013, the research program was completely terminated by former colleagues invited to assist with research. Upon arrival, they announced that they had accepted new funding which required the permenant absence of Dr. Rumbaugh, the first author and all others associated with the original research trajectory and termination of the language effort.[73] All associated staff and research personel were removed from the facility. The Bonobo Hope Board of Scientists continues to co-owns the bonobos and remains legally charged with the oversight of the research program and the welfare of the bonobos. These scientists continue to oppose the termination of the research program, and to seek conditions that will further self-expression by the bonobos.

The fact that funding tied explicitly to the termination of the language program came quickly forward, stand as a quiet testimony to the success and effectiveness of the research itself. Had the work between 1972 and 2013 not created world-wide attention and interest, it would not have attracted funding with a vested interest in terminating the program. It also stands as a testimony to the politics of science and the use of public funds to prevent the acquistion of knowledge about apes. Finally, the fact that DeWaal, Tomasello, and Matsuzawa elected not to replicate the methodology employed with Lana, Sherman, Austin, or Kanzi – raises questions regarding reliablity of their negative conclusions about the capaticy of apes for language. The postive conclusions set forth by Rumbaugh (2013) and the authors of this article will not be found wanting should others elect to invest the time and effort to replicate the research. However, a much better solution awaits. It would be much more cost efficient for these bonobos, who already have these abilities, to be linked via the internet to other apes who also comprehend English through the internet. With the proper introduction to this media, coupled with the internet, many situations fostering linguistic communication between the groups could be undertaken and documentation and exploration of language production and comprehension could be faciltiated. Kanzi and the other bonbos began employing video technology for communication with child in Japan in the late 90's, and understand this media (see this supplemental video, https://youtu.be/0Myl142PvH8).

In the wake of ACCI's (Ape Cognition and Conservation) action, Tomasello (2017) announced that ape language had "come and gone." He justified this action by providing a list of items he claimed Kanzi - and other apes – were unable to do. Many of them were things that Lana, Sherman and Austin had already done as noted in this pape. These included the abiltity to make informative statements (Savage-Rumbaugh, Pate, Lawson, Smith, & Rosenbaum, 1983) and/or to take the information known to the listener into account (Greenfield & Savage-Rumbaugh, 1984). Tomasello's (2017) main concern arose from his conviction that apes are unable to coordinate in the kind of sophisticated manner, he attributes to humans noting that "humans communicate - not only to get others to do things, but to inform them" (p. 102). The human ability to co-ordinate through the trade of material goods, all based around the concept of "object ownership" surely exceeds that of apes. However the full extent of the ability of apes to co-ordinate in other ways remains to be understood.

[73] Video visits and phone calls are prohibited for all participants in the original research program, as are most public requests.

Every recall test of these lexically competent apes has shown that they retaim their symbolic understanding (Beran, Pate, Richardson, & Rumbaugh, 2000). If language were not a valuable skill to them, the lexigrams would not be retained.

The bonobos constantly communicated to inform the first, second and fourth authors of this article, as did Sherman, Austin and Lana (See Appendix One). For example, they told us when a pack of dogs was approaching the facility, when and where a fire had occurred in the facility, when and how P-suke had died, when and how certain parties had harmed them with the hose, etc. They told us when others made incorrect statements about them and when others lied about their own actions. The information they provided was inevitably timely, accurate and verifiable. They would also inform Matata of many things. However the fact that the information provided impinged upon the motives of other human persons in facility made this a difficult topic to pursue. What apes do not do, is state the obvious, because they take into account the knowledge base of he listener (Greenfield & Savage-Rumbaugh, 1984). Tomasello's (2017) conclusions are not based on the literature. Where he elects to cite the literature, he refers to Kanzi at 5 years of age or younger. The adult Kanzi is a very different being. Ape language has not come and gone as an area of inquiry because apes are unable to co-ordinate, or lack linguistic talents. It has been deliberately blocked by funding sources who do not wish the inquiry to continue.

National Public Radio followed up with an announcement that ape language was no longer viable and that data to support it either never existed or was unsatisfactory. They produced a video especially to address this topic (https://youtu.be/uYWSXRUGxDQ). This video quotes Robert Sapolsky and the lectures he presented during his class, as evidence of the *truth* of their position. Sapolsky has never worked with apes, nor in the field of langage, nor has he been a major critique of the research. Sapolsky's position is also cited in a recent *New York Times* article which addresses the survival of the Mountain Gorillas. Sapolsky posits that human uniqueness resutls from the ability to hold two contradictory ideas at once, while finding a way forward.. As an example, he speaks of Sister Helen Prejean, *who advocated that the more unforgivable the sin, the more it must be forgiven.*

Humanity, in its desire to declare itself unique, has committed atrocity after artocity against apes and it does not appear ready to stop. The most unfair tactic has been the continual mischaracterization of their true nature and abilities. Funded by organizations who seek to employ apes as biomedical subjects and, more recently, to develop transgenic ape models for the study of human brain malfunctions (Belmonte et al., 2015), ape language became, for them, an inconvenient truth. The human ability to hold two positions at the same time and find a third way forward has employed to decieve others humans. And deception is also within the capacity of apes (Savage-Rumbaugh & McDonald, 1988).

The fact that we share the capacity for language stems in part from the fact that the lineage separation between ourselves the African apes remains incomplete. This should strike all as significant and remind us that the psychological worlds constructed by humans and apes have the potential to overlap…as we not completely separate. It should give us pause when we consider transgenic research with beings that have the potential to become capable of fully understanding what is being done to them and why. We could, of course, continue to rear them as "wild and deficient" ape-children," but knowing now - that the behaviors they display in captive conditions are caused by inadequate rearing and cultural environments insufficient to allow the transmission of complex information, it is immoral to cause them severe mental anguish (Kellogg & Kellogg, 1933). Apes who have been the recipients of deprivation should permitted to establish linguistic encounters with other apes. Science need not continue to confine them to outdated and predetermined

categories while caliming that our "bad side" arose from within them (Wrangham & Peterson, 1996). It did not. It arose from cultural norms that we can alter, as can they.

It is neither good science nor ethically correct to prevent the *only* adult group-living kinship-based linguistically competent group of apes from continuing their bicultural trajectory. This group began in 1975 with the importation of Bosondjo, Lokelema, and Matata to the Yerkes Center on a lend-lease agreement to determine if they were a distinct species. These bonobos were biculturally reared from 1975 to 2013 and are in their third generation. They should be premitted to communicate with other bonobos and chimpanzees by electronic means and with free-living bonobos in the Congo via the same means. They should be allowed to participate, in a fully informed manner, in their own future. (Fields, Segerdahl, and Savage-Rumbaugh, 2005). (Lyn, Savage-Rumbaugh, & Rumbaugh, 1998; Savage-Rumbaugh, Wilkerson, & Bakeman, 1977; Savage-Rumbaugh & Fields, 1998; Savage-Rumbaugh, Fields, Segerdahl, & Rumbaugh, 2005). Preventing them from doing so while stating that they no real linguistic ability - while creating daily living conditions impede linguistic competency is morally wrong. Any research with the bonobos should be regared as circuspect and driven by political agenda, rather than pure scientific inquiry.

The bonobos who acquired lexical symbols without training have demonstrated the highest levels of interspecies linguistic competency of all living apes (Dubreuil & Savage-Rumbaugh, 2018; Rumbaugh et al., 2017; Savage-Rumbaugh, 1997, 1999; Savage-Rumbaugh, 2016a,b; Segerdahl, Fields, & Savage-Rumbaugh, 2005). These abilities still exist though they, according to Iowa Public Radio, only Kanzi knows and/or employs lexigrams. During the single visit accorded to the first author, all bonobos were blocked from any access to the keyboard, except Matata – who normally does not employ the keyboard – she speaks bonobos instead. Matata hurried to the keyboard and began to talk to the first author. Immeidately her keyboard was electronically disabled.

Research amongst wild bonobos began in the 80's by Kano (1992). While research has continued steadily, very few new facts have emerged. With language an entirely new door opens into the world of our living kin. Without it, we will remain in the darkness of ignorance about ourselves, our history, and our living relatives (Segerdahl, 2014; Segerdahl, Fields, & Savage-Rumbaugh, 2005). There is no need to do so.

This infringement upon the daily lives and the language capacity of these bonobos has taken place without any professional or ethical oversight that takes into account their unique life histories and/or their capacities to express themselves, as the IACUC composed of scientists knowledgeable about these individuals was disbanded without notice in 2013. The scientists of Bonobo Hope, a nonprofit board in whom the oversite and ownership was vested in 2013, is calling for bonobos and chimpanzees to be classified as *Homo*, and for these bonobos to be given the freedom they have earned and deserve (Roffman, Savage-Rumbaugh, Ronen, Fontaine, & Nevo, in press; Rumbaugh, Roffman, Pugh, & Rumbaugh, 2017).

They are no longer allowed to speak freely, nor is any person who was a part of their bicultural environemet allowed to visit, or speak with them even by phone or video. The authors call for this to be reversed as per the statement made by Duane Rumbaugh on April 14, 2014. This statement was written in response to the misuse of the bonobos at that time.

GUIDING SCIENTIFIC PRINCIPLES AND STATEMENT

1. The bonobos are of great interest because they are of a rare and endangered species that only infrequently is available for research. The particular bonobos, housed in Des Moines, IA, are of

special interest because of their rearing. Their language competence, learning, and social behaviors have been well documented and will continue to be of great interest for research.

2. Scientists who have documented histories of rearing and researching the bonobos of Des Moines have certain intellectual property rights with the bonobos that are to be respected. In my view, these rights are neither assignable nor subject to separation from the scientists who hold them. They are not products to be bought or sold. They are founded in academic, not commercial value systems.

3. Neither ACC nor BHI will seek or accept funds from any party or agency that is known not to respect the scientists who hold documented academic/intellectual property rights because of their research of the bonobos of reference, research that embellishes their attractiveness for continued research.

4. No biomedical research procedure will be used with even one of these bonobos without at least one faculty-level scientist of the proposed program serving as the first subject in every protocol that is to be implemented with the bonobos.

5. Funds might be sought separately for the bonobos and for the chimpanzees that might find sanctuary in the Des Moines laboratory.

6. Care will be taken to ensure that the apes' facilities for their maintenance and research will be sound and always humane. In addition, the facilities must ensure them protection, in so far as possible, from natural disasters and unreliable function.

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I wish to acknowledge, with deepest respect and eternal gratitude, all that Duane Rumbaugh taught me about learning, cognition, language, consciousness and how to do excellent and responsible science throughout his life. He was the finest scientist and human being I have ever known and every moment with him was a gift and a treasure.

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Supplemental Material

1. Lucy video - https://youtu.be/MjR8hSSL5cc
2. Lana video - https://youtu.be/pD9sgWuI_D4
3. Nimshortclip - https://youtu.be/B51mFD_kCSA.
4. Sherman and Austin 6 - https://youtu.be/zImRAPk7oco
5. NHK Video Documentary Kanzi III - https://youtu.be/0Myl142PvH8

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