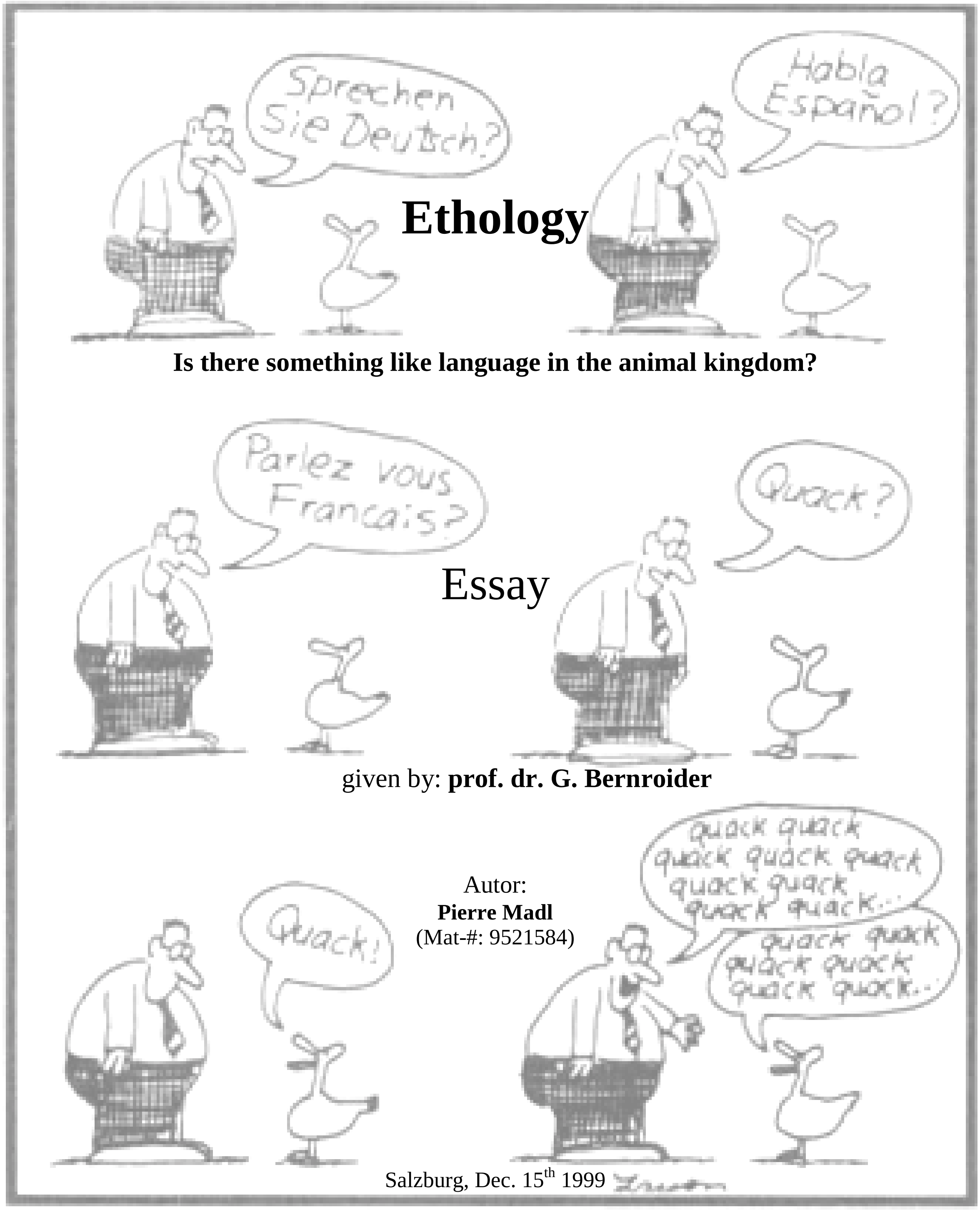

Ethology

Is there something like language in the animal kingdom?

Essay

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Abstract:

Whether language is uniquely human is a vigorously debated issue. Animals obviously communicate. Bees, for example communicate the location of food through an intricate dance. And several teams of psychologists have taught various species of apes to communicate with humans by signing or by pushing buttons wired to a computer. They string words together to express meaning and to make and follow requests. Skeptics point out important differences between apes' and humans' facilities with language, especially in their respective abilities to order words using proper syntax. Nevertheless, these studies reveal that apes have considerable cognitive ability.

Introduction:

Language is a cultural artifact rather than a basic property of human minds. Is it an invention that happened to take place in prehistoric times? A biologically predisposed capacity present to make us communicate by language? And are we the only species capable of using this sophisticated means of communication?

To philosophers such as Descartes, language was that function which most clearly distinguish between beasts and humans, and was "*the sole sign and only certain mark of thought hidden and wrapped up in the body*".
All languages used by humans convey thoughts by the same means: They all use words and sentences to organize ideas. In contrast animal communications often have something similar like words (for instance, a cat can purr happily and hiss angrily), but no serious reports so far have made claims that they can form complicated sentences (such *as I'm going to stop purring and start hissling unless you give me that catnip immediately*).
H. J. Jerison (1973), a psychologist, once wrote: "....we can think of language as being merely an expression of another neural contribution to mental imagery, analogous to the contribution of the encephalized sensory system and their association systems. We need language more to tell stories than to direct actions....the fact that language also resulted in improved communication should not be confused with the requirements for communication in troops of soldiers, monkeys or apes. The quality of communication in living troops of non-human primates is such that it could be stimulated with very little information-processing material, and it appears to be no more effective in the control of behavior than the vocal communication of other species; e.g. birds".
Once human language began to develop and be used, with all its implications, human encephalization presumably proceeded rapidly due to selective benefits accruing to those individuals best able to communicate and utilize this new medium efficiently.

What makes language so special?
There are five major properties of all human languages: Language is **creative**, is highly **structured** or patterned, is **meaningful**, is **referential** (i.e. it refers to and describes things and events in the real world), and is **inter-personal** (communicative; i.e. involving the thoughts of more than one person at a time).
Besides mental prerequisites, the use of language needs certain distinct anatomical features.

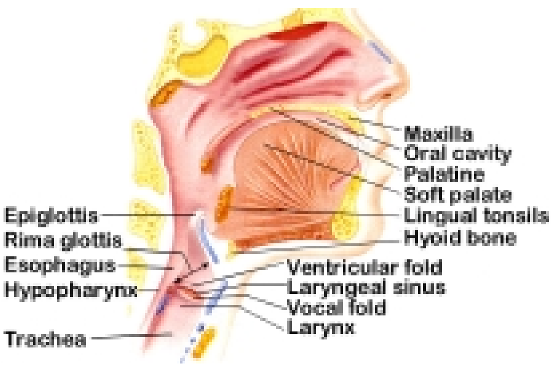


Fig.: Speech in humans is produced by the air flow from the lungs that passes through the larynx (voice box) containing the vocal cords and from there through the oral and nasal cavities which together make up the vocal tract. Different vowels are created by movements that temporarily obstruct the air flow through the vocal tract. For some consonants the air flow is stopped completely. Examples are *p*, where the stoppage is produced by bringing both lips together, and *t* where it is produced by bringing the tip of the tongue to the back of the upper teeth. Some other consonants are created by blocking the air flow only partially, for example the *th* (as thick), which is produced by bringing the tip of the tongue close to the upper teeth but without actually touching them.
Coordination of the such a complex structure as the voice box is brought about by neuronal structures present in every human being. Scientist have assigned certain areas of the cerebral cortex to language functions (in most right-handers, in the left hemisphere). These include Broca's area, whose damage produces deficits in speech production, especially of function words (expressive aphasia), and Wernicke's area, whose damage leads to deficits in comprehension of word meanings (receptive aphasia).

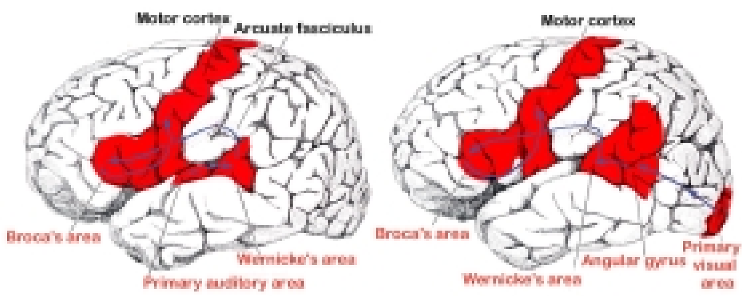


Fig.: The image shows the brain's pathways for perception of the <u>heard</u> word and then speaking the same word (left); whereas perception of the <u>written</u> word and then speaking the same word is shown on the right. The Motor cortex has to accomplish the complicated task of coordinating neuronal stimulation of vocal cords, motion of lips, mandible, and tongue.

Language structures in the neocortex:

There are two aspects to communication: First, the sensory aspect (language input), involving the ears and eyes, and second, the motor aspect (language output) involving vocalization and its control.

A major share of our sensory experience is converted into its language equivalent before being stored in the memory areas of the brain and before being processed for other intellectual purposes. For instance, when one reads a book, we do not store the visual images of the printed words but instead store the words themselves or their conveyed thoughts in language form. The sensory area of the dominant hemisphere for interpretation of language is Wernicke's area, which is closely associated with both the primary hearing areas and the secondary hearing areas of the temporal lobe.
The translation of speech or written word’s into thoughts involves both sensory and association areas, such as primary auditory, auditory association, primary visual, visual association, and gnostic areas. The **primary auditory area** (language comprehension or Wernicke's area) is located in the superior part of the temporal lobe near the lateral cerebral sulcus, it interprets the basic characteristics of sound such as pitch and rhythm.
Located in the occipital lobe, the **visual association area**, receives sensory impulses from the primary visual area and the thalamus. It relates present to past visual experiences and is essential for recognizing and evaluating what is seen. Posterior to the language comprehension area, laying mainly in the angular gyrus region of the occipital lobe is a visual association area that feeds the visual information conveyed by words read from a page into Wernicke's area. This angular gyrus area is needed to make meaning out of the visually perceived words. In its absence, a person can still have excellent language comprehension through hearing but not through reading.
The **gnostic area** is the common integrative area located among the somato-sensory, visual, and auditory association areas. The gnostic area receives nerve impulses from these areas, as well as from the taste and smell area, the thalamus, and portions of the brain stem. It integrates sensory interpretations from the association areas and impulses from other areas so that a common thought can be formed from the various sensory inputs. It then transmits signals to other parts of the brain to cause the appropriate response to the interpretation of the sensory signals.
In the most lateral portion of both anterior occipital lobe and the posterior temporal lobe is an area for naming objects. The names are learned mainly through auditory input, whereas the physical natures of the objects are learned mainly through visual input. In turn, the names are essential for language comprehension and intelligence, functions performed in Wernicke's area, located immediately superior to the names regions.
A special region in the frontal cortex, called Broca's area, provides the neural circuitry for word formation. It is located in the posterior lateral prefrontal cortex and partly in the premotor area. It is here that the plans and motor patterns for the expression of individual words or even short phrases are initiated and executed. From Broca's area, the **language area**, nerve impulses pass to the premotor regions that control the muscles of the larynx, pharynx, and mouth. The impulses from the premotor area to the muscles result in specific, coordinated contractions that enables one to speak. Simultaneously, impulses are sent from the motor speech area to the primary motor area. From here, impulses reach your breathing muscles to regulate the proper flow of air past the vocal cords. The coordinated contractions of one's speech and breathing muscle enables the pronunciation of thought.

Language skills in Wild kids:

There are some remarkable examples of children who lived removed from all human society. They wandered in the forest and survived, reared by bears or wolves. In 1920, indigenous villagers of northern Canada discovered a wolf mother in her den together with four cubs. Two were baby wolves, but the two others were human kids, subsequently named Kamala and Amala. No one knows how they got there and why the wolf adopted them.

Fig.: Kamala was about 8yrs old and Amala was only 1.5. They were thoroughly wolfish in appearance and behavior; hard callus had developed on their knees and palms from going on all fours. Their teeth were sharp edged. They moved their nostrils sniffing food. Eating and drinking were accomplished by lowering their mouths to the plate. They ate raw meat. At night they prowled and sometimes howled. They shunned other kids but followed the dog and cat. They slept rolled up together on the floor. Amala died within a year but Kamala lived to be eighteen. In time, Kamala learned to walk, to wear clothing, and even to speak a few words (Brown 1985, p100).

There were other children who have been raised under almost unimaginably inhumane conditions.
Isabelle was hidden away, apparently from early infancy, and given only the minimal attention necessary to sustain her life. Because her mother was deaf, no one spoke to her. Isabelle was six years old when discovered. Of course she had no language, and her cognitive development was below that of a normal 2-year-old. But within a year, this girl learned to speak.
Thus Isabelle at age 7, with one year of language practice, spoke as well as her peers in the second grade, all of whom had 7 years of practice.
Rehabilitation from isolation is not always so successful. A child "Genie", discovered in California about 20 years ago, was 14 when found. Apparently, she had lived tied to a chair, was frequently beaten, and never spoken to - but sometimes barked at. Psychologists and linguists tried hard to teach her. But Genie did not become a normal language user. Even though her semantic sophistication was far beyond children, Genie did not master syntactical skills that appear in mature English sentences, nor did she combine propositions together in elaborate sentences (Curtiss, 1977).

According to the **critical period hypothesis**, there is an especially sensitive period in early life when language acquisition is easy; i.e. some characteristics of the brain change as the critical period draws to its close, so that later learning becomes more difficult. Critical periods seem to govern the acquisition of a number of important behavior patterns in many animals. Another example is the attachment of the young of various animals to their mothers.

Communication in birds:

Juvenile birds learn songs by listening to adult males of their own species. But this exposure will only be affective if it occurs at a certain period in the bird's life.

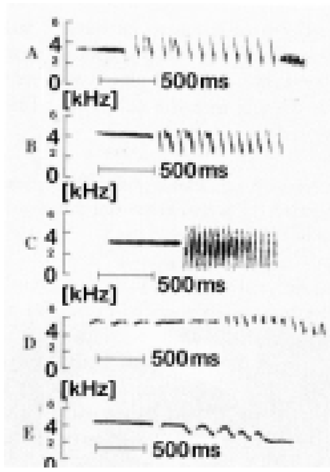


Fig. The sound spectrographs representation of the song of an adult, male white-crowned sparrow plots the frequency region of the bird's vocal output over time.
(A) shows a normal song beginning with a whistle or two, that continues with a series of thrills, and ends with a vibrato.
(B) The song of a bird raises in acoustic isolation but exposed to 4mins of normal singing between the ages of 35 and 56 days. His adult song was almost normal.
(C) The song of an isolated bird exposed to normal song between days 50-71. The adult song of this bird has some crude similarities to normal white-crowned sparrow songs.
(D) and (E) show the songs of birds whose exposure to normal song occurred very early in life (days 3-7) or very late (after 300 days of age)respectively. Training at either of these times had no effect (Marler, 1970).

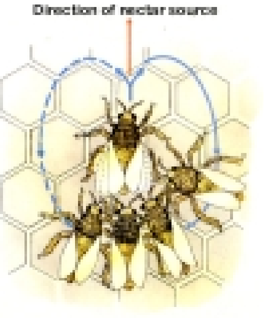
Talking Parrots....

Irene Pepperberg (1995) surprised many experts by training an African gray parrot named Alex, to use speech in what appeared to be highly complex ways. Alex was able to name more than 80 objects and events, frequently requested things he wanted ("I want shower"), and has been known to give directions to his human trainers. But does Alex understand the word he used? On one occasion Alex was given an apple for the 1st time. He immediately labeled it "banerry", and kept saying it even though the trainer tried hard to teach him "apple". Pepperbergs explanation: apples taste somewhat like bananas and look something like cherries, so Alex had chosen a word that from his perspective was quite appropriate.

....and laughing Dolphins:

As fascinating this might be, it still does not yield any answers whether animals are capable of grasping more complex features of language? Herman and his colleagues taught a female dolphin named Ake an artificial language in which sweeping hand gestures are the words. Each gesture symbolizes an object such as a "Frisbee", an action such as a "fetch", or a description of position such as "over" or "left". Ake has learned more than 50 of these gesture-words. To test whether Ake is capable of comprehending complex features of language, the researchers established a set of rules on word order and the grammatical function of each type of gesture. They discovered that Ake comprehended word order and syntax in sequences of up to 5 gestures; e.g. "right basket left Frisbee fetch" instructed Ake to take the Frisbee on her left to the basket on her right. More impressively, when familiar gestures are rearranged to form new command that Ake has never seen before, she continued to respond correctly. The use of anomalous sentences - grammatically incorrect with nonsense words or impossible requests, such as asking her to fetch immovable objects, resulted in refusal of the instructions given. It appeared as if Ake recognized that the requests were "silly"; a response often observed in children who are presented with anomalous sentences (Herman, Richards, Wolz 1993).

Dance of the Bees:



An even simpler way of communication, but extremely efficient has been shown by Karl von Frisch. He demonstrated that an explorer bee that has successfully located a nectar rich food source communicates with the other worker bees by means of an intricate dance. The direction and duration of the dance informs other bees of the direction and distance of the food source. The straight-line part of the dance point in the direction of a nectar source relative to the sun, and its duration indicates the distance. The other bees, who cannot see the dance in the dark hive, huddle close to feel what's going on.
Again, as impressive as they are, honeybees' dance hardly challenge the complexity, flexibility, and power of human language.

Primate Communication:

Although our nearest animal relative, the chimpanzee, does not come close to attaining human language even with the best of good will and the most strenuous educational procedures, we should not be too surprised of some rudiments of language-like skills can be made to grow in them.
Chimpanzees vocal tracts differ from our own, although, they are able to vocalize more than a few words, they cannot literally speak as we do. It appears that in the human child there exists a cognitive structure which employs and coordinates reference, cooperative giving, and joint orienting of attention in intraspecific behavioral interaction which precede language. It is not simply "words" or vocal speech that are absent in chimps, rather the entire complex structure which serves to orient, organize, and regulate cooperative behaviors between individuals (Gardner, et al. 1979).
However, apes can learn that objects have names, but only of they are taught beyond an object-label association. Several investigators overcame this obstacle by employing visual systems of various kinds. Some use artificial systems based on colored plastic chips or symbols on a computer screen, while others have adopted items from American Sign Language (ASL).
Chimps using visual systems can acquire a substantial number of "words". Chimpanzee Washoe was introduced by A. and B. Gardner (1969) to words at about age one year and treated just like a human child, with naps, diapers, and baths. She was taught ASL by having her hands physically molded onto the desired position; other signs were learned by imitation. In most cases, a candy or escape-from-threat functioned as motivators to learn a series of paired-associate responses. By comparison, a child makes a spontaneous transition from non-communicative to indicative pointing, that is, pointing for the purposes of directing other's attention. A chimp typically falls short at this point.

After her 2nd infant died, a depressed Washoe repeatedly asked "Baby?" and became withdrawn when told "Baby dead, baby gone, baby finished." After 2 weeks his trainer had better news for Washoe: "I have baby for you." Washoe reacted to the signed news with instant excitement, her hair on end, swaggering while signing over and again, "Baby, my baby." When Fouts then introduced the foster infant Loulis, it took several hours for them to warm up to each other, whereupon Washoe broke the ice by signing, "Come baby" and cuddling Loulis. Moreover, Washoe taought some of her human signs to the adopted baby, which is a very interesting case of "cultural transmission" by another species (Fouts, Hirsch, 1992).
Imitation learning, implies a major handicap. Apes taught to use ASL to communicate with the outside world, were trained to imitate their teachers, but were not challenged to comprehend and respond independently; that is, language as a functional operative skill, not just a series of hand movements to be made at the teacher's request.

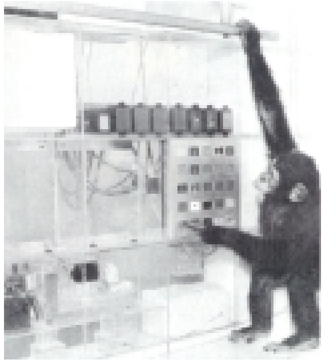
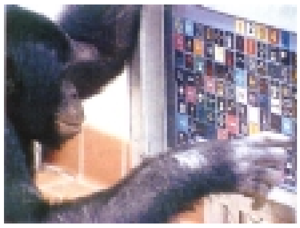
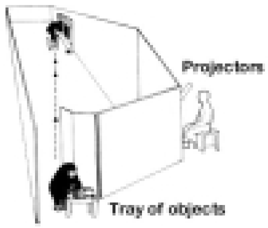


Fig.: Chimp Lana has learned to speak by punching logos on a computer keyboard. When she pressed a key, the symbol light up. By doing so she asked her trainer for an orange. Although, she had no word for orange, but she did know the color and the word for apple, so she improvised: "Tim give apple which is orange". Also impressing is the fact that when Lana was introduced to two other keyboard trained chimps, they started to ask one another for specific food or even for tools they can use to get food (Savage - Rumbaugh, 1986).

It is known that chimps have mental representations of various objects and events in the world.
But, do they have anything like a notion of what consequences what can have? Austin and Sherman, two fellow chimps of the Savage-Rumbaugh laboratory, were given a different approach. Symbol training emphasized the functional indicative aspect of symbols and receptive comprehension of symbols. They were taught to comprehend and respond to symbol usage by others (food and tool lexigrams) as well as to use symbols to affect behavior of others. One has to keep in mind that symbol production is not necessarily equivalent to symbolic encoding. Symbolic encoding does exist in chimps, and can be demonstrated, however, it is not a necessary concomitant of symbol-object pairing.



After having accomplished several representational usage of the lexigrams, Sherman and Austin began to take the naming games out of the teacher's hands. They began to initiate and structure exchanges. Instead of waiting for the teacher to ask that items be given or labeled, they began to name items and to show them to the teacher (either by pointing or by giving). They did not exhibit a stereotyped imitative version of the teacher's role; rather, they incorporated the function of the teacher's initiating and singling out role into their own behavior. Of considerable interest is the finding that these chimps indeed used their new acquisition in naturalistic interactions with their trainers, not just in laboratory tests, which goes far beyond true naming capacities.



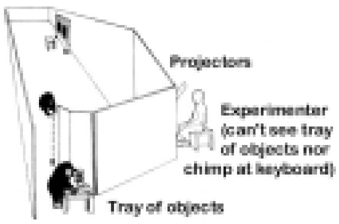


Fig.: The chimp looks at the tray of objects to decide which one he will take to the examiner (the objects on the tray change each trial). After deciding, the chimp goes to the keyboard and states which object he is going to select. The chimp returns to the tray and picks the one as stated at the keyboard.

Further evidence has come from Premack's studies on the concept of causation. He showed his animals pairs of objects. In each pair the 2nd object is the same as the 1st but had undergone some change; i.e. one pair consisted of a whole apple and a sliced apple, another pair showed a dry and a wet towel, and a yet further set showed a piece of paper with pencil marks.

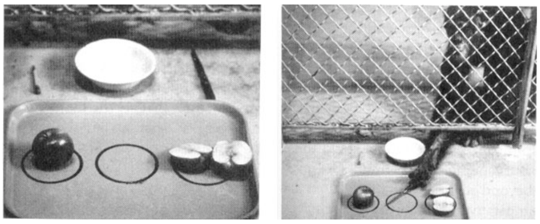


Fig.: The chimpanzee's tasks was to place one of several alternatives between the objects - a knife, a bowl of water, or a pencil. Sarah, the chimpanzee under trial performed correctly on 77% of the trials, far more than would be expected by chance. Thus propositional thought definitely is present in a rudimentary form.

Human speech is characterized by abstract syntax principles. Can chimpanzees do anything of this sort? Can they organize to form meaningful combinations (e.g. water-bird when observing a duck)? Washoe designated a swan as a water bird, and Koko, a gorilla trained by Francine Patterson (1978), reportedly described a long-nosed Pinocchio doll as an elephant baby. Pigmy chimps quite often come up with novel combinations of words. Their language knowledge in general is broader than in common chimps but this is currently subject to elaborate testing, thus cannot be further emphasized in this paper.

Apes can certainly use symbols meaningfully, but can they equal even a 3-year-old's ability to order words with proper syntax (to a child, "you tickle" and "tickle you" communicate different ideas)?

Recent studies done by Savage-Rumbaugh (1993) reveal that pygmy chimps can even learn to comprehend the semantic nuances of spoken English. Kanzi, one such chimp, was trained the informal way by speaking to him throughout the day, while simultaneously pointing to the corresponding symbols on portable language boards they carried with them. Quickly, he learned to combine the symbol-words to request snacks and preferred activities, such as watching Tarzan movies. Kanzi's progress in comprehending novel commands was comparable with the grammatical abilities of a 2.5-year-old. He even behaved intelligently when asked, "Can you show me the light?" or " Can you bring me the light (a flashlight)?" or "Can you turn on the light?".

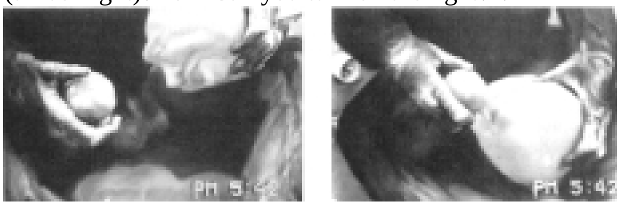


Fig.: Asked to "feed your ball some tomato", Kanzi picked up the tomato and a pumpkin-faced sponge-ball, then placed the tomato to the ball's mouth.

Conclusion:

Members of non-human species communicate with one another in many ways. Bees do a complex dance to indicate the distance to and direction of a food source; birds sing songs when seeking to attract a mate; seagoing mammals in the wild, such as whales, communicate with one another through complex patterns of sounds. But language?

Although there is evidence that chimps can learn words and show some propositional thought, there is little satisfactory proof that they can create or understand syntactic structures that are so characteristic to humans expression. It is true that people tend to see what they want to see; interpreting chimps signs as language may be little more than wishful thinking on the part of their trainers. It is also true that apes gain their limited vocabularies only with great difficulty. They are hardly like speaking or signing children, who effortless soak up dozens of new words a week. One might say that there is little qualitative difference in this regard between us and these primates and that these accomplishments are too sporadic and limited to be of much interest for understanding the minds of either chimps or humans (what's the difference of a dancing circus poodle trick and a trained primate?)

At a first glimpse such criticism is probably justified, because interspecific communication, cannot be done at this stage. But comparing a chimp that can make sings or push in sequences to get a reward like a pigeons pecking a sequence of keys to get a grain, seems rather naiv. The findings so far strongly suggest that there are precursors and prerequisites to our language capacities that are observable in trained primates.

For chimps as for humans, early life is a critical time for learning language. If raised without early exposure to speech or word symbols (critical period hypothesis), the chimps are unable to gain language competence. Even tough language skills in trained apes are modest by human standards, it is most likely that if apes had a vocal tract, they would most certainly be talking.

But rather than thinking of language as all or none, it is better to view it as a continuum of skills, some of which apes possess. Whether the chimps' accomplishments should be called language, then seems to depend on one's definition of that term. We can chose to say that trained chimpanzees use language. But in doing so, we have changed the technical meaning of the term so as to exclude the learning aspects of it (speech, comprehension, etc.).

The results of further studies will undoubtedly shed additional light on this controversial issue. One should keep in mind that those scientist try hard to squeeze some million years of evolution into a life span of a primate - and this fact alone does not make things easy at all.

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