Grapes, banana, juice, and yes: Elements of language in non-human primates

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Bu makale insan olmayan primatlardaki dil öğelerini araştıran çalışmaları özetlemektedir. Kitap ve makaleler beş ana başlık altında toplanmıştır: sembol kullanma ve gönderi becerileri, dil anlama, dil üretimi ve türe özgü bir yetenek olarak dil. Alanda yapılmış çalışmaların incelenmesinin ardından bu çalışmalara yöneltilen eleştiriler ve eleştirilere verilen cevaplar kısaca özetlenmiştir. Dil yeteneklerinin sadece insanlara özgü olmadığı ve temellerinin değişik hayvan türlerinde bulunduğu sonucuna varılmıştır. Primatların dil becerilerinin çocuklarınkine benzediği, fakat dilbilgisi gelişiminin primatlarda çocuklara kıyasla daha yavaş ve kısıtlı olduğu bulunmuştur. Ek olarak, primatların dil anlama ve üretme becerileri iki yaşındaki çocuklarınkinden ileri gidememektedir. Primatlardaki dil öğelerini araştıran çalışmalar içerdikleri çeşitli sınırlama ve eksiklere rağmen dilin edinimi, gelişimi, ve çevreyle olan ilişkisini irdeleyebilmek için önemli modeller sunmaktadır.

Introduction

For years researchers have tried to teach primates language. Although seemingly very successful at first, early investigations of primates' linguistic abilities have generated much controversy and, in a way, disappointment. As syntax was thought to be the most unique component of human language, research naturally focused on the complexity of apes' symbolic utterances. Yet, when analyzed deeply, in many cases the apes' utterances turned out to be the repetitions of those of the researchers'. The consequent research on primates abandoned syntax and explored the referential skills, language comprehension and language production.

Studies on the referential skills and symbol use of apes provided evidence that apes did have true referential skills and that they could use symbols when communicating with each other. The symbol processing of apes resembled that of humans, particularly that of chimpanzees exhibited both hemispheric specialization and long-term memory for symbols. Language comprehension studies revealed that bonobos could understand speech as well as two-year-old children. Also, to an extent, comprehension skills proved to be species specific. The language production of apes was still another important topic investigated over the recent years. Researchers found that the symbolic utterances of bonobos had proto-grammatical

rules and that their language system contained elements of syntax. In the following sections, each of the main investigation topics is reviewed. It has to be emphasized that this review *does not* inquire whether non-human primates *have* language but which elements of language they might have.

Referential skills and symbol use

One of the earliest studies on referential skills and symbol use by apes was conducted in the early 1970s. The sign-language-trained chimpanzees, participating in the studies, could combine symbols in the *sentences* to request objects or activities but they failed to recognize the same symbols when a human made a request. Soon it became apparent that they did not possess full linguistic referential abilities and unless they learned to use symbols referentially, their potential for having language capacities could not be studied (Savage-Rumbaugh & Lewin, 1994). Accordingly, the studies that followed focused rather on symbols (words) than syntax (sentences) and the ability of chimpanzees to use symbols referentially with each other in a way that resembled human communication.

The referential skills of apes were studied in detail on two male chimpanzees (Sherman and Austin). The chimpanzees received structured, reward-based training and learned lexigrams that were arbitrary geometric symbols. The lexigrams could be produced as visual displays by pressing keys on a computer keyboard. Through extensive training, Sherman and Austin were able to use about 100 lexigrams that symbolized foods, locations, people, tools, and other objects. Similarly, after being taught each step in many trials, they developed communicative skills (Savage-Rumbaugh, 1986, as cited in Cranfield, 1995). Their symbol production skills, however, did not generalize to symbol comprehension. Furthermore, their symbol comprehension never led to comprehension of human speech. Still, despite all these limitations, Sherman and Austin demonstrated unexpected components of communication that resembled basic human communication. 'Once these [the keys elements of communication- requesting, naming and comprehension- were in place, the other aspects of communication emerged spontaneously. The chimps began to pay close attention to each other's communications; they engaged each other before delivering their message; they gestured to emphasize or clarify messages; they took turns. None of these behaviors, all of which enhance communication, was taught by us. Sherman and Austin developed them spontaneously' (Savage-Rumbaugh & Lewin, 1994). Most importantly, the apes spontaneously displayed the ability to announce their future actions. As typical examples, one can cite Austin pressing the *funny face* lexigram and making it or Sherman announcing *Go sink* and walking to the kitchen where he played at the counter (Savage-Rumbaugh, 1986, cited in Cranfield, 1995). The work with Austin and Sherman proved that apes are not only capable of using symbols referentially but they can also use symbols to

communicate with their conspecifics (Savage-Rumbaugh et al., 1993).

Hemispheric specialization in language functions has been hypothesized to be unique to humans. To test this, Hopkins et al. (1992) examined hemispheric asymmetries of language-trained chimpanzees by using a warning stimulus, which specifically activated each hemisphere. The warning stimulus could be a meaningful (food or tool lexigrams) or a nonmeaningful (familiar lexigrams with no associated meaning) symbol. Priming of the left hemisphere occurred only by meaningful symbols. Thus, the results indicate that hemispheric asymmetries for processing communicative symbols exist in language-trained chimpanzees and the chimpanzees' perception of meaningful symbols is similar to humans' perception of words.

The findings of Hopkins *et al.* are consistent with the study that has shown that Broca's area in the brain of the great apes (chimpanzees, bonobos and gorillas) is larger in the left hemisphere (Cantalupo & Hopkins, 2001). Linked to the language and speech, this asymmetry was previously thought to be unique to humans and taking into consideration the primitive vocalization skills of the apes', it is a rather unexpected finding. On the other hand, Broca's area might have been specialized for gestural communication long before it evolved to play a crucial role in human speech. Manual gestures of untrained chimpanzees also showed a left hemisphere bias (Hopkins & Leavens, 1998). The gestures were both intentional and referential, and were done predominantly by the right hand, which was controlled by the left hemisphere. The right-hand preference became more prominent when the chimpanzees simultaneously vocalized and gestured. These results suggest that communicative behaviors are lateralized to the left hemisphere in chimpanzees.

Beran et al. (2000) investigated whether a language-trained chimpanzee could have a long-term memory for symbols similar to humans. They examined the long-term retention of lexigrams of a female language-trained chimpanzee (Lana). Lana was presented with various objects, foods and colors, and asked to label them by choosing the correct lexigram. After not having encountered some lexigrams for 20 years, she was still able to recognize them consistently. Lana's long-term memory was similar to humans' ability to remember information for variable lengths of time.

Language comprehension

Language-trained chimpanzees seem to resemble humans in the way they use and process symbols. Yet, there is a crucial difference between them: the chimpanzees require extensive training to acquire linguistic abilities whereas humans do not have to be trained to learn language. This point was challenged by the later studies with a male bonobo (Kanzi). Kanzi was indirectly exposed to lexigrams and spoken language in infancy when Savage-Rumbaugh and her colleagues were trying unsuccessfully to train his mother. After being separated

from his mother, Kanzi started to use lexigrams spontaneously and it became apparent that he had learned to use lexigrams through observation. Afterwards, his language-learning environment involved participation in daily laboratory activities with researchers. Whenever the researchers talked to Kanzi, they also showed him the lexigrams that corresponded to the words they used. Although he was not required to produce lexigrams in return for food or other rewards, he watched as others utilized the lexigram board.

Interactions with Kanzi revealed that his ability to comprehend speech was related to his lexigram use. Similar to human children, his comprehension of new lexigrams or spoken words preceded his lexigram production (Savage-Rumbaugh et al., 1993). His speech comprehension skills were examined in comparison to a two-year-old female child's in an experiment. Kanzi and the child (Alia) were independently exposed to sentences that were uttered by an experimenter hidden behind a one-way mirror and had to carry out the requests that they heard. The requests involved such activities as putting an object in or on another one, taking an object to another location, doing an action on another person, etc. The stimuli sentences were designed to be quite unusual in order to prevent the subjects from understanding the request by a logical inference from the meaning of the words. After listening to more than 250 such statements, the rates of correct response for Kanzi and the child were 74% and 65%, respectively. Although there was no substantial difference between their comprehension of the semantic and syntactic structure of spoken sentences, they differed in some aspects of sentence processing. Alia performed better than Kanzi in the comprehension of phrasal compounds. On the other hand, Kanzi performed better than Alia in following correctly the word order in sentence reversals such as 'Can you put the ball on the pine needles' and 'Can you put the pine needles in the ball'. Bates concluded that '... this complex pattern of quantitative and qualitative variation between species cannot be explained by postulating a language organ that is present in Alia and absent in Kanzi... The Berlin Wall is down and so is the wall that separates man from chimpanzee' (1993, pp. 239, 240).

Kanzi's language skills were also analyzed for elements of syntax (Kako, 1991). The core elements of syntax were defined as discrete combinatorics, category-based rules, argument structure, and closed-class items. It was concluded that Kanzi's comprehension of spoken language provided evidence that his language system had the first three elements. He possessed discrete combinatorics because he seemed to discern that the meanings of sentences were formed by combining the meanings of words rather than blending them. His ability to understand English, particularly unusual sentences as 'Put the money in the mushrooms', suggested that Kanzi had category-based rules. He understood the categories of action word, object word, location word etc.; otherwise his performance on novel word orderings would have greatly suffered. His correct performance on reversed sentences - sentence pairs

formed by the same objects and locations arranged in different positions - demonstrated that he understood the relations between syntactic position and thematic role. Thus, he had knowledge of argument structure although it was not clear whether he knew about the number of arguments of verbs. Finally, he did not have closed-class items in his language system because he was not taught them.

Critics have asserted that apes participating in language studies gather information from the overall context and what appears to be language comprehension may, in fact, be an artifact of contextual comprehension. To test this claim, the comprehension skills of language-competent and of language-naïve bonobos were measured by comparing their responses to the sentences they heard (Williams, Brakke, & Savage-Rumbaugh, 1997). The language-competent bonobo was clearly better in comprehension (correct response to 77% of sentences) compared to its nonlanguage-trained conspecific (correct response to 6% of sentences). Although the language-naïve bonobo was good in following eye and hand movements of researchers and attending to their postural changes, these abilities did not provide it with sufficient contextual information to comprehend speech.

Language production

In another study, Kanzi's language production skills were examined by analyzing the way he combined lexigrams (Greenfield & Savage-Rumbaugh, 1990). These were two-element and three-element combinations of different lexigrams, or lexigrams with gestures. It was found that Kanzi started to use the action-object ordering of lexigrams after learning it from humans who used the word order of English. His choice of action-object order (*Hide Ball*; *Grab Austin* etc.) was consistent and applied to different categories of symbols. Kanzi also invented a rule that reversed the "agent before action" word order used by his caregivers. His rule was the combination of an action lexigram and an agent that was singled out with a gesture. The action lexigram was placed before the agent: the reverse order of English. Greenfield and Savage-Rumbaugh (1990) reported that this was an example of creative productivity on Kanzi's part because he used the rule regularly and it was not based on environmental learning. Additionally, Kanzi developed a second rule of his own where he combined two action sequences by preferentially placing one action before the other. This tendency to place some actions to the first and others to the second position was statistically significant. The researchers concluded that Kanzi's system was action based and that his symbolic utterances could contain grammatical rules.

In the past, language trained capacities of apes have been scorned upon as mere repetitions of humans' utterances and it has been argued that these very repetitions set chimpanzees apart from human children in their ability to learn language

(Terrace et al., 1979). Addressing this issue, Greenfield and Savage-Rumbaugh (1993) compared the repetition patterns in the speech of children with those of chimpanzees using the lexigram system. Their results showed that the repetitions of children and chimpanzees were not mere imitations but served discourse-related functions such as confirmation, requesting, promising or choosing an alternative. The repetitions were helpful in forming joint attention and maintaining the conversation. The main differences between children and chimpanzees lay in their motivation to continue the conversation and the length of their repetitive utterances. Children, unlike the chimpanzees, employed repetition as a tool for maintaining the conversation. Children as well produced repetitions that were longer than the chimpanzees' repetitions. The authors suggested that these might result from differences in the brain size and memory of humans and chimpanzees.

Language skills as a species-specific ability

Kanzi developed better language skills than Sherman and Austin. Kanzi was implicitly exposed to language in infancy, whereas Sherman and Austin started later and were explicitly trained to learn language. Furthermore, Kanzi was bonobo and Sherman and Austin were chimpanzees. Were the differences in their language skills a result of belonging to a particular species or an effect of the differences in their rearing and training? Differing in all aspects, Kanzi, Sherman, and Austin could not provide a satisfying answer.

In order to investigate the origins of the difference in language skills, a bonobo and a chimpanzee were raised together, in an environment where they were engaged in various routine activities and were constantly immersed in both speech and lexigram use (Brakke & Savage-Rumbaugh, 1995). For four years, an extensive record of both subjects' instances of symbol/speech comprehension and symbol production was kept. Measurement of the subjects' comprehension skills revealed that the bonobo's receptive skills for both lexigrams and speech were greater than the chimpanzee's and akin to the skills of a two-year-old child. The bonobo's successful performance was not affected by grammatical form or utterance length. The chimpanzee, on the other hand, had a more varied performance. It responded well to two-term sentences (action-recipient; action-location etc.) but had difficulty with three-term utterances (action-object-location; action-recipient-location etc.). Its performance indicated that as linguistic information grew more complicated it had problems in remembering the components of the utterance. Despite all these, the speech comprehension skills of the chimpanzee were extraordinary (though inferior to those of the bonobo) and unobserved, till then, in any other chimpanzee. In summary, although a species difference in language capabilities seems to exist, rearing technique made a great difference on language learning. Both the bonobo and the chimpanzee were able to develop elementary language comprehension by

living in an environment surrounded by language, similar to that of a child. In comparison to the bonobo, the language skills of the chimpanzee were possibly handicapped by a reduced attention span and difficulties in processing of sequential information.

The bonobo and chimpanzee study also provided some insight on species-specific differences in language production skills. Comparing the development of productive vocabularies of lexigrams, Brakke and Savage-Rumbaugh (1996) found that the chimpanzee started to produce symbols later, learned fewer symbols, and appeared to use them in a more constrained way compared to the bonobo. Yet, the production skills of the chimpanzee greatly surpassed those of other conspecifics, who received explicit and structured language training.

In summary, even as there are species-specific differences within primates in language acquisition, the differences do not originate from a domain specific 'all-or-none' capability in comprehension or production that is present in one species and absent in another.

Criticism and replies

Despite experimental evidence, linguists and cognitive scientists keep rejecting the claims attributing linguistic skills to non-human primates. Critics of the Ape Language Research (ALR) insist that no ape has ever developed any true linguistic skills and, at best, Kanzi's and the other apes' skills can be termed as *performative* and *effective* but certainly not *linguistic*. Pinker, for example, says that Kanzi just 'learned to bang on visual symbols on a portable tablet' (1994, p.341). According to Pinker, to understand a sentence, one's brain has to 'parse' it first (p. 196). Parsing is thought to be possible only if one possesses an 'internalized generative grammar'. In accordance to this perspective, and because Kanzi and the other apes do not have a mental grammar, it is virtually impossible for them to understand a sentence. It has to be stressed that such differences in opinion stem from the fact that ALR researchers and their critics use different definitions of language. Unlike their critics, ALR researchers do not consider having an 'internalized generative grammar' as a must for having linguistic skills.

In a critical attempt, it has been argued that although Kanzi appeared to understand what was said, his behavioral responses cannot be analyzed as understanding of the semantic content of the sentences but as the result of contextual information, cuing, training, etc. '[T]he testing of Kanzi's sentence comprehension (...) demonstrates that he is able to put together the object or objects and the action mentioned in the way that is appropriate given the properties of the objects involved, what he typically does with them, or both. His performance provides no evidence, however, that he was attending to even so simple a syntactic feature as word order' (Wallman 1992, p. 104, as cited in Savage-Rumbaugh et al., 1998). Wallman

concludes that even as Kanzi is competent in 'collateral' cognitive or social skills, he does not have a language faculty.

Kanzi's language skills have been criticized on the grounds that they are artifacts of various factors such as contextual information and cuing. In response to such criticisms, Kanzi's comprehension skills were measured under controlled laboratory conditions where the aforementioned factors could not affect his performance. Even in such controlled conditions, it was found that Kanzi's performance in communicational skills did not differ from a two-and-a-half-year-old child.

Greenfield and Savage-Rumbaugh (1990) have argued that it is rather pointless to ask whether an ape *has* language as much as it is pointless to ask *when exactly* a child has language- at one, five or ten years. Again, it is more worthwhile to ask *which* elements of language are present and *which* are absent at a particular developmental point. Since apes have not developed language in the wild, they can only have a potential to acquire the simplest forms of human language. These might be the prerequisite to complex adult grammar and might resemble what Bickerton (1990, 1996) calls 'protolanguage'. Bickerton suggests that protolanguage was the precursor to 'modern' language and that it can still be observed in the utterances of pidgin speakers, children under two and 'language-trained' apes. It has to be noted that substantial differences exist between language and protolanguage. Speakers of protolanguage can only have short utterances that rarely contain inflection or closed-class words, and they might leave out some words or not use the usual word order (Calvin & Bickerton, 2000). Nevertheless, possessing protolanguage is a state that closes the gap between an alingual state and the state of having full human language, and it may account for the findings of ALR.

Conclusions

Although language skills of bonobos and chimpanzees are similar to those of children, important differences do exist in grammatical development. The grammatical progress of an ape seems to be about three times slower than that of a child (Greenfield & Savage-Rumbaugh, 1990). Apes also have a substantially smaller portion of indicatives and statements. Furthermore, even if the apes have been combining lexigrams for several years, utterance length rarely exceeds three lexigrams and lexical combinations comprise a small part of all utterances (Brakke & Savage-Rumbaugh, 1996). Most importantly, the comprehension and the production skills of a two-year-old child seem to represent the uttermost levels for the apes.

In humans, the development of linguistic skills seems to depend mainly on exposure, in infancy, to linguistic environment and models. Since early exposure to language is nearly universal in the human species, primate models are valuable in extending our understanding of the relationship between language and environment.

Here, the ALR findings provide evidence for the idea that early exposure to a language-rich environment is essential for acquiring language skills (Brakke & Savage-Rumbaugh, 1995, 1996).

The core of language research in animals has concentrated on chimpanzees and bonobos, given their evolutionary proximity to humans. This point was stressed repeatedly by ape language researchers, who argued that the extent of shared genetic material is an important factor in shared language skills (Savage-Rumbaugh & Lewin, 1994; Williams et al., 1997). It has to be noted, however, that other animals, such as bottle-nosed dolphins (Herman, & Uyemama, 1999) and African gray parrots (Pepperberg, 1999) have also developed remarkable linguistic skills. As these animals exhibit language skills not unlike those of non-human primates, general cognitive abilities seem to be much more universal.

Research into the language abilities of non-human animals proved that language (or more precisely, elements of language) did not appear suddenly and exclusively in the human species and is not only the birthright of humans. Rudiments of language can be found in animals that are very distant from humans, mostly because language builds up on general cognitive and perceptual abilities rather than on the language-specific modules that have been proposed by Pinker (1994).

In the January 2003 issue of New Scientist, Ananthaswamy reported that Kanzi had started to talk. Analyzing the gentle noises he made during interactions with humans, researchers identified four sounds that held meaning across different situations. With these four *words* Kanzi said: GRAPES, BANANA, JUICE, and YES.

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