



## Is There Any Intermediate Stage Between Animal Communication and Language?

MARIA UJHELYI

*Semmelweis University of Medicine, Institute of Behavioural Sciences, 1089 Budapest, VIII.  
Nagyvárad tér 4., Hungary*

*(Received on 8 November 1995, Accepted on 25 January 1996)*

Animal communication and human language have fundamental differences in their structures and functions. Furthermore, there is no living species demonstrating an intermediate stage of language evolution. Thus, we have difficulty in finding characteristics attributable to a communication system which can already be considered as a starting point for linguistic evolution. However, some findings coming from neurolinguistic research give us the opportunity to suppose that varying and arranging linguistic elements can be detached from other grammatical functions. Further information in this direction comes from apes' language-teaching experiments; namely bonobos (*Pan paniscus*) are able to understand and produce differences in meaning by varying word arrangements. Based on these results one can suppose that an acoustic signal system, which possesses discrete units for variable use, might be very ancient and might exist independent and prior to a more advanced language state. In the natural setting, acoustic territorial marking behaviour is exposed to selection pressure to elaborate sign systems built up from discrete, variable units. In addition to the well-known territorial bird songs, some monkey species and all species of lesser apes have territorial songs fitting these criteria. The analyses of the so-called long calls in chimpanzees and bonobos make it likely that the group-living great apes preserved the ability to create syntactically different calls, which would be developed by requirements of social life. A call repertoire emerged in these species, which contained a large number of call variants at group level available for each group member via social learning. This type of animal call is different from ordinary animal communication; it shows some features of human language. It can represent an intermediate stage between animal communication and language, and communication systems similar to this one can be considered as a starting point or first stage of language evolution.

© 1996 Academic Press Limited

### Introduction

We are faced with a very great dilemma concerning origins of language. There are no living species possessing a less evolved language than the present-day human languages. Also, the gap between animal communication systems and human language seems too large to be bridged.

Human language is a complex, multi-dimensional communication system, in which the messages from one participant to another are mediated by descriptions of objects and their relations in the outer world. That is, language is a representational system, which makes it possible to communicate about any topic independent of the given communicative situation.

This function works via the possibility to form unlimited variations from a limited set of elements. Language is built up from sounds and words as elements, where the compositions of elements are governed by special rules. Finally, such a system cannot be transmitted genetically through generations, it must be acquired by learning.

There are no animal species in which a communication system similar to human language can be found. The majority of animal communications differ from language in each of the above-mentioned aspects. Their signals essentially express the animal's emotional states, which can serve as motivation for actions of others in given circumstances. There seem to be several exceptions, for example, the existence of

different vocal signs for different predators in vervet monkeys (Cheney & Seyfarth, 1990), but the exact meaning of these signs (referring to objects instead of suggesting the way of escape) remains to be proved. Furthermore, in animal communication a rather limited set of messages can be transmitted, which are in general, genetically fixed.

Impressed by these sharp differences, many authors claim that human language is unique (Lieberman, 1994), and we can't find any evolutionary precursors for it, particularly not at a subhuman level (e.g. Bickerton, 1990; Burling, 1993; Davidson, 1991).

However, just because of the complex nature of human language, it is very hard to imagine that it could have arisen suddenly, without antecedents. It seems to be quite impossible that a single genetic change could result in a fully developed apparatus for speech, as scholars in Chomskian tradition state, and it is also impossible that the relevant changes took place in a short time. On the contrary, it seems to be more plausible to suppose that the emergence of language, as of other complex functions, required a long time and several evolutionary stages (see Maynard Smith & Szathmari, 1995).

Although from the viewpoint of a functioning system, the existence of previous stages with absent or with modified forms of any subsystems, might appear unrealistic because of their given mutual dependencies, just one of the cardinal results of evolutionary processes is to establish a network of mutual dependencies and mutual preconditionality, which means that a system could and had to function earlier without the parts necessary for later functioning. Naturally, however, the function would not be the same. So, we are encouraged to seek possible evolutionary precursors to human language.

Some neurolinguistical findings suggest that the neural processing that arranges and varies linguistic elements can be detached from other grammatical functions. In addition, one of the main results of the apes' language teaching experiments shows that the bonobo can use different word orders, discovering the differences in meaning between them. Consequently, having discrete linguistic elements, and being able to produce variable sound lines from them, might be ancient and might exist prior to and without a fully developed language ability.

If we can find an animal communication system, or at least part of such a system, fitting the above-mentioned criteria, it could be considered a minimal language, which already differs from the

animal communication as a whole and forms a possible starting point for further language evolution.

### Syntax and Morphology

In present-day language, the grammatical function is realized via two types of operations. We can use the available linguistic elements (sounds or words) in different arrangements, and can link them with other elements (inflections, function words, prepositions, etc.). These two operations are dependent on each other (although not in the same manner in different languages) and mutually determine the domains of their occurrences. In human language, arranging and linking elements form an integrated function. That is, in present-day languages, syntax cannot appear independently from morphology. (We use the term "syntax" here for the sake of simplicity to mean the arrangement of elements; the term "morphology" is used to mean all the linking operations). Despite this fact, a dissociation phenomenon between syntax and morphology comes into sight when studying the normal language acquisition process and some language impairments.

In the course of language acquisition, infants normally begin to combine words when they know only a few. Production of morphological inflections and function words (prepositions, modal verbs etc.) appears when the vocabulary moves beyond 100–200 words. There is a dissociation in time between the beginning of the use of syntax and that of morphology. Interestingly, if a child produces a high proportion of grammatical function words at an early stage (at 20 months), he/she will actually be less efficient in the use of those terms later. A high proportion of this class of words may be characteristic to children who are relatively late learning the language, as Bates observed (Bates *et al.*, 1988).

The cortical localization of these two layers of grammar, as well as the timing of acquisition, seems to be different. As Friderici and her co-workers report, measurements of event-related potentials (ERP) as a reaction to syntactical and morphological stimuli show that the processing of syntactical problems proceeds at the left anterior part (Broca's area), but that of morphology at the posterior (Wernicke's) site (Friderici *et al.*, 1994).

Furthermore, there is some information concerning Broca's aphasics that is in agreement with this dissociation phenomenon. Some patients show difficulty in utilizing word order information to analyse a sentence, particularly when the word order produces an interpretation that is in conflict with

semantically more typical combinations of the same content words (Schwartz *et al.*, 1980).

Perhaps the most important finding in this context is the existence of grammatical impairment, possibly depending on genetical error. A family has been described, in which members of three generations are unable to acquire the inflections needed to use the regular past tense and plurals. Their deficit does not disturb the production of proper word order (Gopnik & Crago, 1990).

These findings and especially the existence of a specific genetic background for the ability to acquire morphology which does not concern syntax, strongly suggest their different evolutionary origins, although we do not yet know the precise nature of the genetical determination of grammatical ability.

One can suppose that the ability to vary the arrangement of the elements, and with this to produce meaning differences, may be very old. From the language teaching experiments we know that the great apes understand and also produce differences in meaning arising from different word orders. Premack reported some years ago that Sarah, a female common chimpanzee who was thought to use plastic symbols for words, could differentiate between the meaning of sentences such as "X gives Y something" or "Y gives X something" (Premack, 1985). While the common chimpanzee couldn't understand the general rule, but had to learn each case, the bonobo (Kanzi) can make generalizations and without further training can give proper responses to several hundreds of utterance pairs (Savage-Rumbaugh, *et al.*, 1993, pp 91–97).

Naturally, Kanzi's performance has a relevance regarding the origins of syntax if we can find naturally occurring characteristics corresponding to the laboratory results. The question is, whether apes have developed in a natural setting a communication system based on specific sound lines divisible into elements with variable use, which contain some meaning differences arising from different arrangements of elements.

### Naturally Occurring Syntax

It has been known for some years that there are some monkey species which produce long calls built up from smaller units. These species are the titi monkeys (Robinson, 1979), the tamarin (Masataka, 1987), the indris (Thalmann *et al.*, 1993) and the gibbons (e.g. Marshall & Marshall, 1976; Raemaekers *et al.*, 1984). These long calls or "songs"—according to Haimoff's definition (Haimoff, 1986)—are displayed without any overt external stimulus and have

some musicality in nature. The songs of different species represent different degrees of complexity. While the calls of tamarin seem to be relatively simple vocalizations repeating the same elements many times, the songs of gibbons are highly elaborated ones.

Recently Mitani & Marler (Mitani & Marler, 1989) gave a phonological analysis of male gibbon songs. According to this analysis, the gibbon song may be divided into distinct vocal elements termed "notes". Based on seven variables (duration, maximum frequency, minimum frequency, frequency range, start frequency, end frequency and number of frequency inflections) 13 basic note types can be distinguished. The songs are built up from these notes.

The songs can be varied using different type, number and positions of elements, segments or notes. Hence, the song repertoire of an individual male may be rather large.

Although the investigations of the great apes' vocalizations in natural habitats started only a few years ago, it is already clear that both the common chimpanzees and bonobos have long calls, which can be divided into some acoustically distinct segments, similar to gibbon songs (Mitani, 1992; Clark & Wrangham, 1993; Hohmann & Fruth, 1994).

In all the above-mentioned cases there are possibilities to create different call types by alternative application of available elements, which result in intra, and inter-individual differences in calls. In tamarins, for example, the different numbers of elements used distinguish between male and female calls.

In gibbons, however, the significantly larger song repertoire makes it possible to differentiate more finely. The singing displays convey information not only about the owner's presence and location, but also describe its sex, rank, and marital condition (Cowlshaw, 1992). For example, the songs of males and females are very different, and Raemaekers observed that unmated males sing in different ways to the mated ones (Raemaekers & Haimoff, 1984). Furthermore, inter-individual differences arise not only according to social status. Mitani & Marler emphasize that gibbon males compose different note orders and even use different sets of available note types. The note preference and song construction seem to be characteristic of a given male (Mitani & Marler, 1989).

Based on these findings it can be said that the listed call types at least partly fit the criteria of a minimal language. First, it can be shown that a given call is built up from a limited number of elements, which

form complex, acoustically different sound lines. Second, the call variants resulting from combination of available elements express not only the actual emotional states of an animal, but contain some representational meaning by signalling individual identity.

### Territoriality

All the primate species—excluding African apes—producing long, variable calls share a common feature in their social behaviour, namely monogamous territoriality. This type of social organization is rather rare among monkeys. Most monkey species live in groups, possess group territory, and defend it as a group or group member. In contrast, the indris, the gibbons and the other above-mentioned species mark and defend individual territory by acoustic signs, unlike other territorial mammals.

It seems that it is just this territorial behaviour which first established the linguistic capacity. Labelling one's own territory requires variable signs. If the labelling channel is an acoustic one, and the primary sounds are genetically fixed, then only by varying the elementary sounds can sign differences be achieved. Consequently, those individuals who are capable of linking, repeating, and combining these elements get selective advantages.

It can be shown that some of the notes of gibbon song occur independently of song, in another context, e.g. reaction to encounters (Mitani & Marler, 1989). These simple elements function in ordinary communicative situations. The combination of available elements resulted in a variable set of songs, which became suitable for territorial marking.

In summary, territorial singing behaviour contains some essential language characteristics, and consequently it might serve as a starting point for the evolution of a more complex vocal communication.

Territorial monogamy as a closed social unit seems to be a very ancient and simple form of social organization in the ape lineage, which was replaced by more advanced and more complex group structures.

In the great apes, including the ancestor of man, monogamy broke down, and with this, individual territorial behaviour ceased to exist. However, the capacity established earlier continued to exist, but with transformed functions.

Both the continuity and the discontinuity between the communication systems of lesser and great apes may be illustrated by a further specificity of the territorial song performance, namely by duetting.

### Duetting

A duet is defined as long calls or songs in which both sexes of a monogamous pair produce their loud sounds in an interactive manner, performing a mutually cooperative and coordinated display (Haimoff, 1986). Reviewing the duet songs of primate species. Haimoff concludes that "there have been no observations of any stable monogamous and territorial primate species in which duetting does not occur, or any polygynous primate species in which duetting does occur" (Haimoff, 1986). The function of duetting may be the maintenance and reinforcement of the pair bond.

Despite the strong correlation between the duet performance and monogamy, coordinated call display does exist in great apes. The common chimpanzee males often call together, while in bonobos a male-female pair duet occurs. Differences in partner preferences are due to differences in group structures between the two chimpanzee species. As de Waal (1988) observed, bonobos show a high degree of synchronization between vocalization of different individuals which has a gibbon-like nature. So the capacity of duet performance might be a heritage of the earlier monogamous stage. However, it is maintained by the actual way of life, changing the original function and structure of the duet song.

In gibbons (and in other non-hominoid monogamous species too), the duet songs are displayed at a given time of the day, in the early morning hours, and even only in a given time of the year if a breeding season exists, as in indris. In both chimpanzee species, duetting can be heard all day in relation to different activities, to achieve the assembly of a large number of community members.

In gibbon duets, the contribution of males and females to song display show a rather rigid and uniform pattern. Although there are some instances in which song transfer may occur—for example, when a female becomes widowed, she may adopt and perform the male song and so produce a pseudo duet (Geismann, 1983)—the strong sexual differences in song structure are likely to be genetically programmed. Although in bonobos' duetting there are also sex specific differences of spectral distribution when they vocalize together, both sexes are able to produce calls in essentially the same frequency range, and when they call alone the differences are hardly distinguishable (Hohmann & Fruth, 1994).

Mitani & Brandt found a similar trend to weaken the strong inter-individual differences between individual song repertoires. They observed that chimpanzee males attempt to match the acoustic

characteristics of each other's vocalizations when calling together. Single males appear to alter the acoustic structure of their calls when chorusing with different partners (Mitani & Brandt, 1994). This tendency results in large variability in call types on the one hand, but homogenization in call repertoire of the group on the other hand. That is, the call repertoire being acquired by a single male may contain a large number of variants mostly acquired via social learning, while the call repertoire itself is not exclusive to a specific individual. This is just the precondition for linguistic functioning.

### Conclusion

Human speech comprehension and production have some sub-systems processing different constituents of speech. It seems that these sub-systems represent different evolutionary stages in language evolution. Some of them might have appeared recently, for example, speaking with the help of word-linking elements, that is the emergence of true grammar; some may have appeared earlier in the course of hominid evolution, perhaps the finer phonological analysis; and in all probability, some already at the sub-human level, in apes.

In the light of these perspectives it may be useful to introduce a third term, which is narrower than animal communication in general, but broader than the present-day human language. This minimal language already contains some language characteristics, first of all in having variable elements at least on one level, with some sort of representation and learnability implied by syntax.

It seems that it is just the territorial signing vocalization that provides the basic preconditions for language to arise. A minimal language system can develop on this basis, although the territoriality itself does not exist, but a complex social network does. It seems that both preconditions are necessary, because neither monogamous species, nor group-living species without monogamous traditions, could achieve the level that can be found in great apes. Language possessed by great apes (more exactly, the two chimpanzee species) has a large set of syntactically different calls at the group level, having some objective referents. The calls also show some degree of learnability and of voluntary control. So, the natural apes' language fits the criteria of a minimal language and differs qualitatively from lower level animal communication systems.

However, the minimal language of the great apes also differs radically from human language.

While the variable use of discrete elements is a basic characteristic of all languages, human language has a unique feature in containing a set of elements (morphemes, words), functioning exclusively to link other words. This layer of language does not exist at the sub-human level. But the uniqueness of human language is of a much wider scope than just having morphology or "true grammar". Using linking elements between the so-called content words results in a radical reorganization of the language that existed before. Complicated rules are elaborated, which determine and limit the possible order of terms. In the present day languages, syntax cannot appear independently from morphology.

Furthermore, the existence and functioning of grammar also influences the meaning of the terms. It can be shown that the possibility of more complex and more abstract meanings arising was generated in the history of natural language by the means of a grammatical system.

The linguistic reorganization results in a language having qualitative differences from the earlier stages. Precursors to human language, or intermediate stages between lower animal communication and human language, cannot be merely rudimentary forms of this latter as is stated by the continuity theory (Gibson, 1994); they must also contain qualitative differences as a consequence of structural reorganization resulting in an integrated system. Therefore, language may be unique to humans but could have evolutionary precursors even at a sub-human level, representing a continuous evolutionary process.

A main question that remains open is the cortical representation of the apes' language. Deacon (1992), reviewing the investigations about monkey brains in relation to communication, points out that call production in monkeys appears almost entirely under the control of subcortical structures. However, it must be emphasized that while there are extensive data about monkey brains, data concerning apes are hardly available, and investigations of neurological events underlying song production are also missing. The only investigation about ape brain in this respect was carried out by Apfelbach (1972), who tried to elicit vocalization by electrical stimuli in gibbons. According to his results, the elementary sounds were elicitable, but not the song itself as a complex sound line.

Therefore, since there are radical differences between monkeys and apes in group structures, in behaviour, in intelligence, and as we have seen, in communication structures, differences must also exist in their cortical representation.

This work was supported by a FEFA grant making it possible to elaborate the text at the University of Sussex. I am very grateful to John Maynard Smith, Eors Szathmary, Eva Jablonka, Martin Stenning, David Harper and Pal Buk for critical and helpful comments.

## REFERENCES

- APFELBACH, R. (1972). Electrically elicited vocalizations in the gibbon *Hylobates lar* (Hylobatidae), and their behavior significance. *Z. Tierpsychol* **30**, 420–430.
- BATES, E., BRETHERTON, I. & SNYDER, L. (1988). *From First Words to Grammar: Individual Differences and Dissociable Mechanisms*. New York: Cambridge University Press.
- BICKERTON, D. (1990). *Language & Species*. Chicago: University of Chicago Press.
- BURLING, R. (1993). Primate calls, human language, and nonverbal communication. *Current Anthropol* **34**, 25–53.
- CHENEY, D. L. & SEYFARTH, R. M. (1990). *How Monkeys See the World: Inside the Mind of Another Species*. Chicago: University of Chicago Press.
- CLARK, A. P. & WRANGHAM, R. W. (1993). Acoustic analysis of wild chimpanzee pant hoots: Do Kibale Forest chimpanzees have an acoustically distinct food arrival pant hoot? *Amer. J. Primatology* **31**, 99–109.
- COWLISHAW, G. (1992). Song function in gibbons. *Behaviour* **121**, 131–153.
- DAVIDSON, I. (1991). The archeology of language origins—a review. *Antiquity* **65**, 39–48.
- DEACON, T. W. (1992). The neural circuitry underlying primate calls and human language. In: *Language Origin: A Multidisciplinary Approach* (Wind, J., Chiarelli, B., Bichakjian, B., Nocentini, A. & Jonker, A. eds) pp. 121–162. Netherlands: Kluwer Academic Publishers.
- DE WAAL, F. B. M. (1988). The communicative repertoire of captive bonobos (*Pan paniscus*) compared to that of chimpanzees. *Behaviour* **106**, 183–251.
- FRIEDERICI, A. D., PFEIFER, E. & HAHNE, A. (1994). Event-related brain potentials during natural speech processing: effects of semantic, morphological and syntactic violations. *Cognitive Brain Res.* **1**, 183–192.
- GEISMANN, T. (1983). Female capped gibbon sings male song. *J. Hum. Evol.* **12**, 667–671.
- GIBSON, K. R. (1994). Continuity theories of human language origins versus the Lieberman model. *Language & Communication* **14**, 97–114.
- GOPNIK, M. & CRAGO, M. B. (1990). Familial aggregation of a developmental language disorder. *Cognition* **39**, 1–50.
- HAIMOFF, E. H. (1986). Convergence in the duetting of monogamous old world Primates. *J. Hum. Evol.* **15**, 51–59.
- HOHMANN, G. & FRUTH, B. (1994). Structure and use of distance calls in wild bonobos (*Pan paniscus*). *Internat. J. Primatol.* **15**, 767–782.
- LIEBERMAN, PH. (1994). Human language and human uniqueness. *Language & Communication* **14**, 87–95.
- MASATAKA, N. (1987). The perception of sex-specificity in long calls of the tamarin (*Saguinus labiatus labiatus*). *Ethology* **76**, 56–64.
- MARSHALL, J. T. JR. & MARSHALL, E. R. (1976). Gibbons and their territorial songs. *Science* **193**, 235–237.
- MAYNARD SMITH, J. & SZATHMARY, E. (1995). *The Major Transitions in Evolution*. Oxford: Freeman.
- MITANI, J. C. & MARLER, P. (1989). A phonological analysis of male gibbon singing behavior. *Behaviour* **106**, 20–45.
- MITANI, J. C., HASEGAWA, T., GROS-LOUIS, J. & MARLER, P. (1992). Dialects in wild chimpanzees? *Amer. J. Primat.* **27**, 233–243.
- MITANI, J. C. & BRANDT, K. L. (1994). Social factors influence the acoustic variability in the long-distance calls of male chimpanzee. *Ethology* **96**, 233–252.
- PREMACK, D. (1985). “Gavagai!” or the future history of the animal language controversy. *Cognition* **19**, 207–296.
- REAMAEEKERS, J. J., RAEMAEEKERS, P. M. & HAIMOFF, E. H. (1984). Loud calls of the gibbons (*Hylobates lar*): repertoire, organization and context. *Behaviour* **91**, 146–189.
- ROBINSON, J. G. (1979). An analysis of the organization of vocal communication in the titi monkey *Callicebus moloch*. *Z. Tierpsychol.* **49**, 381–405.
- SAVAGE-RUMBAUGH, E. S., MURPHY, J., SEVIK, R. A., BRAKKE, K. E., WILLIAMS, S. L. & RUMBAUGH, D. M. (1993). Language comprehension in ape and child. *Monographs of the Society for Research in Child Development* **58**.
- SCHWARTZ, M. F., SAFFRAN, E. M. & MARIN, O. S. M. (1980). The word order problem in agrammatism. *Brain and Language* **10**, 249–262.
- THALMANN, U., GEISMANN, T., SIMONA, A. & MUTSCHLER, T. (1993). The indris of Anjanaharibe-Sud, northeastern Madagascar. *Internat. J. Primatol.* **14**, 357–381.