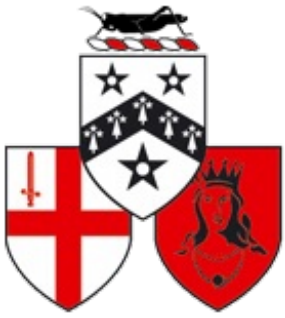

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Talking with Beasts: Human and animal languages
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Talking with Beasts:

Human and Animal Languages

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In most of my first series of lectures I described remarkable similarities and even superior abilities of other species to us in key areas of behaviour such as sex, parenting, detecting sensory cues from the environment and social recognition. However, in my last lecture I showed that when it comes to higher mental capacities such as consciousness, self-awareness and the ability to attribute mental states to others (the so called "theory or mind") it is very difficult to find clear experimental evidence for other animal species displaying anything other than rather rudimentary forms of these. I also indicated that the main reason for the huge advance in these mental attributes in humans might be due to the development of one faculty, the ability to comprehend and use language. While Voltaire has so aptly put it,

"Language is very difficult to put into words"

this has not stopped science from trying to do just this, although it is fair to agree with Voltaire that we still have a long way to go in understanding all aspects of human language.

Many have argued that it was our need for advanced social structures, tool use and co-operative hunting strategies to survive that drove the genus "homo" to evolve more sophisticated methods for communication involving symbols and syntactic structures that could convey information not only about things that were proximal to both communicator and receiver but also about objects and events that were distant in either space or time. The ability to represent objects and events in this way for communicating to others also opened up the possibility for any individual to call up this information purely for their own use either for strategic planning, artistic representation or self-reflection. This development of language could then conveniently be postulated as being responsible for driving both our significant increase in brain size (three times larger than that of our nearest current relatives the chimpanzees and bonobos) and with it all the other higher mental faculties where humans are so predominant over other animal species.

If such an evolutionary scenario is correct then the ability to comprehend and use language would, unlike other traits, have to be unique to humans. Indeed, such a view has received strong support from a number of eminent individuals one of the most notable being the linguistics expert, Noam Chomsky (Chomsky, 1988) and others such as Stephen Pinker (Pinker 1995,1999). This view has also been echoed in the past by many other influential scientists,

"No one is more strongly convinced than I am of the vastness of the gulf between…man and the brutes…for

he alone possesses the marvellous endowment of intelligible and rational speech [and]…stands raised upon it as on a mountain top, far above the level of his humble fellows, and transfigured from his grosser nature by reflecting here and there, a ray from the infinite source of truth." (Thomas Henry Huxley 1900 "Evidence as to Man's Place in Nature and Other Anthropological Essays" p155-6. New York Appleton).

although not, as one might expect, by Darwin :

"That which distinguishes man from the lower animals is not the understanding of articulate sounds, for as everyone knows, dogs understand many words and sentences" (Charles Darwin "Descent of Man" 1871).

So is the Dr Doolittle dream of talking with other animals in the same way as we talk to each other, or even the idea that other animals can really comprehend human language, simply an impossible anthropomorphic delusion? Is the use of symbolic and syntactical language the key unique human faculty that separates us from other beasts?

The main purpose of this lecture will be to examine all the different ways that we and other animals communicate with each other and why we use them. It will then consider whether human language is simply an evolutionary progression from other forms of communication and if, indeed, language is a unique human adaptation as many claim.

So how do we and other animals communicate and why?

If we consider human face-to-face communication it has been shown that only 7-10% is through the words we actually speak. The main mode of communication is through different aspects of body language (60-70%) and even vocal communication is primarily through non-verbal (or to be more accurate non-word) means (20-30% through the emotional content of speech, gestures or involuntary emotional expressions i.e. surprise, pain, fear, sorrow and amusement).

We have no trouble accepting that other animals have similar abilities to communicate and understand body language and have often quite extensive vocal repertoires. Indeed, many have argued that our use of speech has made us far less sensitive to these other forms of communication and that, as such, other species may be much better than us simply because they do not have any alternative. It is also important to realise that these modes of communication are primarily restricted to signalling our current emotions, desires and intentions and not to provide information about past or future events – however there are, as we will see, some exceptions to this.

Non-verbal communication

While it is tempting to speculate that other animals without language are more in tune with other more subtle forms of communication, this certainly does not extend to everything. Perhaps the most stunning example of our sophisticated use of body language is one of the simplest things that many of us have to deal with everyday – avoiding crashing into other people rushing along with us to get to work or negotiating a supermarket trolley around a busy shop. We may not have quite the level of problems encountered by huge flocks of migratory birds or shoals of fish or herds of wildebeests, but at least the latter mainly move in a co-ordinated way in the same direction. In fact if you are all travelling as a group in the same direction research

has shown that co-ordinated movement patterns can be achieved just by detecting the movement of your nearest neighbour!

Humans do seem to be peculiarly blessed with a sense of individual purpose that often leads to us travelling in different directions and speeds to one another at the same time and in the same restricted space. Just like everything else we have to acquire these avoidance skills and we all know that young children and businessmen in supermarkets have not yet quite mastered the required art. What we are actually doing in these situations is detecting subtle body cues that can tell us what direction another individual is going to take in relation to ourselves and how fast they are going. We do, of course, occasionally get it wrong and end up with the embarrassing farce of misreading the signals and both moving in the same rather than different directions. However, thankfully this does not happen that often. Indeed, in circumstances where people resort to speech to try to achieve the same objective of making their way through a crowd this often causes more confusion and collisions than relying on other people being able to read your direction of movement using body language.

Any Psychology textbook on “Interpersonal skills” will tell you that your body language makes a lasting impression on any new person you meet within a matter of seconds, and without you having even opened your mouth. Even when you do open your mouth, how you say things may make more of an impression than what words you actually use (as long as the words are comprehensible that is!). Hanging your head, avoidance of eye contact, walking with a stoop and looking at the ground, yawning, scratching, picking your nose, or just being short, fat and ugly can all do significant damage to making a positive impression. On the other hand, the positive communication advantages of simply being attractive are well established and this goes back to my lecture on sexual attraction and the importance of features such as facial symmetry as indicators of good genes. While we may indeed have evolved our sexual attraction to good physical features as an effective DNA test for good genes in a partner, this general trait also influences the way we look at any other individual even in general social contexts.

The study of human non-verbal communication has classified a large number of different modes that operate pretty much the same way for any other animal species although the relative importance of each can vary considerably.

Different ways we can use our bodies to communicate

- *Appearance* I have already touched on this by saying that the physical attractiveness of those we meet speaks volumes. The same would seem to be the case for other animals since similar principles of being socially and sexually attracted to “genetically fit” individuals apply (see my lectures on Hormones, Sex and Animal Passion – October 2002 and Sexual Conflict – November 2002 –www.gresham.ac.uk/lectureWinReal.asp?vid_ID=59). The intensity of physical scanning of another individual, particularly the first time they are encountered, is impressive in any animal species. For many animals this scanning procedure may be rather unsubtle, with a good deal of sniffing of sexual organs, mouths, secretory and excretory glands. However, for humans the same process goes on with an automatic scanning of the other person’s general body appearance ending up with a detailed analysis of their face and particularly their face expressions.

With other animals, drawing on examples of pampered perfumed pooches compared with scruffy smelly strays, one might tentatively conclude that appearance does not seem to be that important. However, it clearly is since many species exhibit individual preferences based on physical appearance although it is fair to conclude that they home in on relevant biological signals rather than paying attention to artificial perfumes, smart clothes or other forms of artificial adornment. Having said that, for horned species sporting a set of larger horns alone could drastically alter the impression your appearance makes on other members of both sexes!

- *Occulesics* is the study of what can be communicated by the eyes. We have all heard the saying that the "eyes are the window of the soul" and all animals that rely strongly on their visual sense to interact with their environment pay close attention to them. Perception of eye-gaze and whether another individual is prepared to meet your gaze gives a lot of information about their character and if they may be lying to you. They are, of course, also a major source of attraction as well as a good guide to an individual's emotional state. This is much the same for other mammals with marked changes occurring in the apparent size of the eyes (through lid opening and bulging of the eye), pupil size and the amount of white (sclera) that is exposed

Facial expressions are highly relevant communication channels in humans and great apes and are even used to some extent by non-primates (particularly in the context of aggression although smiling displays seem to also be quite common). The subtleties of these face expression displays can make them difficult to detect in other species but we have recently found that sheep can detect differences in the appearance of a stressed compared with a calm version of the same face (they prefer the latter). Even more impressive is that these animals also prefer the same human face when it is smiling as opposed to angry – so when we communicate our emotions through facial expressions, these signals can also be interpreted correctly by our animals! It would seem very likely that many companion animals with constant exposure to humans would also be able to interpret our facial expressions (even though we might not be so good at interpreting theirs).

- *Touch (Haptics)* Here we are mainly considering deliberate rather than accidental physical contact between individuals. While touch communication may not normally convey that much information it is arguably one of the most important for normal social and psychological development. One of the most intriguing findings from animal research in the last decade is that rat offspring produced by more "touchy-feely" Mums grow up to have lower anxiety levels and are more social than those produced by Mums who are not. The fact that this is a response to touch stimulation rather than to general quality of mothering is shown by the finding that extensive handling of rat pups by humans produced the same effect. As humans we all know that the way someone touches you speaks volumes about their intentions and also that there are large individual variations in peoples' tolerance of being touched. It is no accident that we use the phrase " being touched by someone's words". This is sometimes a very

accurate description of the physical experience we receive from the content and tone of what is conveyed to us by others using speech. Indeed, words and music can often evoke a sensation of touch.

The ability to communicate information through the sense of touch is of course well established in the blind through the use of Braille. Communication between humans and other animals can also make extensive use of this modality (communication between riders and horses being a prime example). The different types of touching used are mainly those experienced during both nutritive and comforting interactions with a parent. In humans this is mainly through oral and caressing stimulation. A good example of this in animals is licking by dogs and cats. In both of these species mothers lick their offspring either to clean or comfort them or to encourage them to suckle. It is perhaps not that surprising therefore to see them using the same behaviour towards humans, or other animals, either to comfort them or in response to being comforted. They can also be used in states of excitement to encourage further interactions in the same way that a mother encourages suckling.

It has often puzzled me why a number of social mammals clearly do not react to being touched by others in a particularly positive way. Sheep are a good example of this. Because sheep are born fully developed they experience less physical contact from their mothers than species where offspring are born precocial (like humans, dogs and cats) and are totally guided by the highly tactile physical guidance of their parents. Also sheep, unlike many other mammals, do not groom themselves or others and grooming may be an important reinforcer for the importance of the tactile stimulation received as an infant. In monkeys receipt of grooming seems to increase chemicals in the brain, like endorphins, which stimulate both pleasure and social bonding. With experience of a large amount of tactile stimulation even sheep can develop a highly tactile character and so it seems likely that the importance of touch as a mode of social communication is learned both through life experience and a genetic predisposition toward grooming.

- *Smell (Olfactics)* As I have discussed in my previous lectures on sensory and social recognition abilities of other species in comparison with us (Animal senses – January 2003), smell figures more prominently for many other animals than it does for us. Some dogs may have up to 1 million times more sensitivity than us for detecting some odours. So whereas we may rely more heavily on face or voice cues to detect signals communicating emotional, health or reproductive states in others, many other mammals can get all of this and more from smell. However, we are also sensitive to odour signals and our concern with both being clean and exuding pleasant smells is clear confirmation that we know this is important for us to be attractive to others so that we can communicate more easily with them. It is tempting to say that we do this as much for ourselves as for others, but since we quickly habituate to what we smell like personally (a characteristic of all our sensory systems) this means that we are less aware of what we smell like than others are!

- *Space (Spatial relationships or proxemics)* The proximity in which we and other animals place ourselves in relation to another individual communicates intention in itself and can affect perception of

communication using other modalities. For humans the concept of personal space was first coined by E.T. Hall only in 1963 and there are now fairly well defined parameters for the sizes of our “personal bubbles” that determine the nature of intended communication (6-18 inches for embracing and whispering, 1.5-4 feet for conversations with good friends, 4-12 feet for acquaintances and 12 feet or more for public speaking). Although there are considerable species and individual variations in personal space parameters there is little doubt that they also operate in other animals and are influenced by social familiarity. Failure to comply with these parameters will impede normal communication and lead to evasive or aggressive reactions.

- *Territoriality* This differs from personal space in that you don’t carry it around with you. It is space that is considered by others to be yours even when you are not immediately present in it or able to defend it. With humans this may simply be enforced by tradition (i.e. knowledge passed on to others) and even with other animals knowledge of the ranges of predators or rivals can quickly be learned. However, other animals do not rely entirely on tradition and do the equivalent of placing a personalised reserved sign on their territorial boundaries using the biological communication equivalents of “I’m Killroy”, “I was here yesterday and last week” and “Trespassers will join my hareem or be eaten”. As with most forms of communication you need to be a member of the same species to read them (since they are specifically addressed to you) and there is only one type of signal that can communicate all of this in your absence, (if you are unable to write that is) a sample of your bodily secretions. Urine, faeces or scent gland marks can say who you are, when you were last there, how often you visit and even potentially what kind of macho specimen you might be. Try doing the same thing using a single word!

- *Time (Chronemics)* This has to do with how you can communicate with others through your use and perception of time. With humans, punctuality or being fashionably late are examples that spring to mind. I will deal in a later lecture with the precise abilities of other species to perceive time although I can safely say at this point that they probably can. However, perhaps of more general relevance is “timing” in communicating signals to others. For example, there is no point in male or female of any species trying to call up a potential mate outside of the breeding season or asking another animal to play or groom you when they are having sex with or fighting with someone else. In every sense, success in communicating with others is as much to do with when you communicate as with what it is you are actually saying.

- *Movement (Kinesics)* I have already illustrated the importance of perception of body movements in communicating both emotional state and where you are going to move to next. They are also used extensively to convey sexual and aggressive intent either alone or in the context of vocalisations. However, another essential aspect of communication by movement is the use of specific voluntary

gestures to convey specific information to others. Many animals use specific gestures to provide information as to what they want. Such gestures can become quite elaborate and esoteric if they are shaped through progressive associations of such movements with a successful reward outcome. Many of us will have seen this in companion animals using a variety of esoteric methods to indicate that they want to play, be stroked/groomed, go for a walk or be fed etc. The same kind of thing can be seen in all mammals to varying degrees in order to get another individual to provide something that they want. These gestures are often a combination of direct physical coercion and more subtle elements and often with a defined escalation series to counter the less receptive observer.

For the most part, gestures have a direct “iconic” element in that they have an integral component that directly illustrates the desired object or activity (the dog scratching at a door or running up with its lead in its mouth or an infant monkey leaping onto its mother and then bounding away exhibiting a series of play moves). Examples of human “iconic” gestures are beckoning with a finger or pointing, and putting a finger to your lips to indicate that you want someone to stop speaking or to be quieter. Indeed, incorporating an iconic component to a gesture is highly likely to get it accepted into common usage faster and to make sure it has the strongest possible impact. Our graphic usage of finger gestures to indicate being annoyed with another individual or that another individual is sexually attractive are classic examples of this (even though many of us quite happily use these gestures without really contemplating what action and body part our fingers are actually representing!).

Of particular interest in considering whether other animals can comprehend and use a symbolic language in situations where the gestures used are clearly not “iconic” but “symbolic”, that is, like words and numbers, they are abstract representations of an object or action. However, it has to be said that apart from our development of “sign language” systems, to compensate mainly for speech dysfunction, even we as humans don’t normally make extensive use of truly symbolic gestures. The same would appear to be true of other animals, even our nearest living relatives the great apes. There have been claims that forms of natural sign language are used by some of the great apes and this has been documented in Gorillas, for example. As we will see later however, serious attempts have been made to teach chimpanzees, bonobos and gorillas human sign language systems.

This is not to say that the animal kingdom is devoid of examples of the use of symbolic non-vocal gestures to convey information to others. However, perhaps the most impressive example comes from the most unlikely quarter – the humble bee and does rely on acoustic cues generated by wing movements (i.e. a combination of movement and sound). Stingless and honey bees in their dances in front of their colleagues can acoustically encode the distance and height of food sources in a symbolic way. *Melipona panamica* foragers produce a series of pulsed sounds when unloading food to other bees and when they begin to make clockwise and anti-clockwise dance movements. During this phase they produce longer pulse sounds for a food source on the canopy floor than for one 40 metres up in the canopy. The sound pulse duration is positively correlated with increasing distance of the food from the nest (Nieh, 1999).

- *Voice (Vocalics or paralanguage)* this refers to non-verbal cues in a speaker’s voice. As humans we all

know that how words are spoken is often far more important than what is actually said in conveying a speaker's meaning. Paralanguage is tone, pitch, volume, regional and national accents, emphasis, sarcasm, emotion, truthfulness or deceit, confidence etc. Paralanguage is a major source of "spin" as far as making words convey a particular message is concerned. It can be so powerful that the actual meaning of the words uttered is lost:

"I understand a fury in your words, But not the words" - Shakespeare, Othello Act 4 scene 2

This type of communication also covers the important category of non-verbal vocalisations – crying, laughing, screaming in pain, yawning and exclamations used to get attention or warn of danger. Some aspects of paralanguage can impact on these basic vocal communications but since their production is often less under voluntary control than the production of speech there is limited flexibility for altering meaning in this way.

Both of these aspects of voice communication are used widely by mammals with sometimes as many as 20-30 different calls being distinguishable in a particular species. However, one important aspect of these calls is that they seem to be strongly genetically pre-programmed. Both my own work with sheep and goats (Kendrick et al., 1998), and that by other groups with macaque monkeys, has shown that when these animals are reared by another species whereas their parent can influence wide aspects of social and sexual behaviour, vocalisation patterns seem completely immune to the influence of experience.

The main animal species, which do have more extensive call repertoires that are clearly influenced by experience, are, of course, songbirds. Not only are their song repertoires and complexity influenced by experience but there is also a clear developmental time course for learning songs that makes the process very similar to human language. Here the simple analogy stops however because the songs, no matter how elaborate, are mainly about advertising for a mate and are certainly not for communicating complex information. Similar arguments apply to the songs of whales.

Why do we and other animals communicate our feelings, desires and intentions?

While we easily accept the utility of us and other animals being able to send and receive information about personal intentions, emotional states or perceived danger it is worth considering for a moment why such forms of communication have evolved. This may be easy for signals informing a member of the opposite sex that you are sexually attracted to them since this has a clear potential reproductive advantage. Similarly, communicating aggressive intent towards others often serves the important function of allowing the adversary to escape, thereby avoiding an unnecessary fight that might lead to injury. Informing others that you are intending to go off and look for food or that a predator is approaching has obvious advantages where activity as a group is likely to enhance positive foraging or survival outcomes compared with doing everything on your own. The cries for help used by infants who are totally dependent on the nurturing and protective skills of their parents are also easy to understand in a survival context.

But what is the point of any animal telling the world at large that it is in pain, afraid, agitated, depressed, or even feeling contented? True, in some cases receipt of these signals by others could provide them with

valuable information to help avoid or take part in external situations that may have caused the individual to produce them. You can then make the argument that this trait could help promote species survival. However, as I have discussed previously in the context of mate selection it is hard to give credit to any notion that an individual of any species normally goes around making conscious decisions to help produce better babies any more than it does to postulate that they are purely altruistically motivated to help others.

Life is first and foremost about self-preservation and so we need to look for answers that support this priority. Communicating your intentions and emotional states to others should therefore be self-motivated. As I have already discussed the vocal and body-language cues which are used to convey different emotional states are largely involuntary and, particularly in the case of vocalisations, seem to have a strong innate element (suggesting relatively inflexible elements of genetic programming). The main survival advantage of using these signals is to summon up parental care and one could therefore simply take the view that such signals continue to be used by adults because their importance to survival as neonates has meant that they had to be pre-programmed and adults do not have the flexibility to abandon them.

The idea that involuntary communication of emotional states is inescapable because of their importance for survival as a baby has some attraction. However, this is unlikely to be the full story for why we continue to broadcast our emotions to the world throughout our lives. Indeed, a curious twist to the story is that the same signals that attract the attentions of parents during the period of nurturing often do precisely the opposite to all other individuals. As I have shown in my previous lectures there is little evidence in the animal kingdom for genuine empathic responses to the suffering of others, although many social mammals, notably elephants, will protect injured or aged individuals by not abandoning them and even by warding off predators. Thus, while there is some advantage to be had in communicating to others that you are suffering so that they will help protect you, this will often not be an effective strategy. Indeed, these signals are actually more likely to attract predators than helpers!

A more radical way of looking at the purpose of this involuntary communication of personal emotional state is that it has less to do with informing the world than in helping an individual to cope better with a situation or actually to heighten an experience of pleasure. Viewed in this way the vocalisations and postures we use to communicate negative emotions serve the purpose of reducing the level of negative affect we are experiencing. Conversely, communication of positive emotions serves to enhance positive affect. If you think about this in a human context then we all know that crying out when you are in pain helps to cope with it and that laughing and smiling when you are happy accentuates your feelings of pleasure. Sometimes it is almost as if they help release a pressure cooker of emotional experience.

So in a very real sense while it has been very useful for us and other animals to detect and even respond to many body language and vocal signals produced by others, many of these signals may be regarded more as coping and self-stimulation strategies than as intended to be received by others. This is not to say however that we and other animals can’t actually use them to communicate with others on purpose! The major difference however is that when we, and presumably other animals, deliberately adopt these same postures or produce vocalisations to actually communicate with others, then the physiological and psychological effects these same gestures have when produced involuntarily simply don’t occur. Also, the experienced observer should be able to tell the difference between the involuntary and voluntary forms of the same thing. Here we

have the birth of social deception!

Perhaps it is useful to consider one of the strangest displays that can be seen in many different mammalian species – “yawning”. The purpose of yawning has been the subject of intense speculation by a small group of scientists and I receive monthly e-mail bulletins from a French-based society dedicated to this subject (www.baillement.com). This is indeed a curious behavioural display and is a beautiful example of an involuntary expression that is pleasurable and that we, as humans, use voluntarily to deliberately communicate boredom. It is also highly infectious with yawning, perhaps even more than smiling, being likely to induce the same display in others that see you doing it. Recent brain imaging studies have even suggested that observed activation in the temporal lobe during perception of yawning may actually be directly triggering “imitation” of this behaviour.

If we consider for a moment the amazing ability of non-verbal displays of positive emotional states (smiling, laughing and yawning for example) to provoke similar displays in others we start to appreciate another even more important aspect of communicating your feelings to others in this way. By causing almost reflex mimicry of these expressions in others you are in turn promoting their experience of pleasure that strengthens the social bonds between you. Therefore, while expressing your positive emotions may selfishly enhance your own pleasure it also gives pleasure to others and this helps forge social bonds with them. Even expression of negative emotions, notably anger, seems to evoke similar reactions in others although this is far less automatic and is likely to rely more on shared experience of context than simply perceiving the behaviour of a specific individual.

Communication of information through language: is this a unique human trait?

In considering whether other species are capable of comprehending and communicating using human symbolic languages it is not my intention to try to provide a detailed analysis of all the complexities of human language. Some of the best accessible books on this have been written by Steven Pinker (The Language Instinct 1994 and Words and Rules: the ingredients of language 1999). What is more important in the context of this lecture is whether any other species can comprehend and use the kinds of symbolic languages we take for granted.

In a series of intensive studies starting back in the 1930s, behavioural scientists and psychologists have made repeated attempts to show that chimpanzees, bonobos, gorillas, dolphins and parrots can actually both comprehend and use at least some aspects of human language. This quest has arguably provided some of the greatest controversies in social science with psychologists, neuroscientists, anatomists, anthropologists, zoologists and naturalists, linguists and philosophers all contributing.

I will try to tread carefully and objectively through this minefield of controversy to try to reach unbiased conclusions, although it is fair at the outset to state that my position at the start of embarking on this lecture series was to show that there is nothing fundamentally different between us and other species as far as potential behavioural repertoires are concerned and the way that the brain controls them. The obvious large differences in sophistication and utilisation of complex cognitive and emotional traits between us and other species I therefore consider to be more a matter of degree. These have been contributed to by the increased computational power of enhanced brain size in humans that has evolved primarily through our motivation to

control rather than to co-exist with the environment in order to survive. Arguably it is this latter motivation to control our environment, rather than the development of some unique biological hardware, that may really distinguish us from other species. It is also the information power of words and numbers that allows knowledge to be both communicated and retained which has given man the ability to control his world. The image of God preventing man from unlocking his secrets by confusing his ability to use a universal language at the Tower of Babel is highly pertinent in this respect.

As Pindar has also put it:

> “Words have a longer life than deeds” - Pindar (522-443BC) Nemean Odes

Isn’t any form of communication a language?

One might be forgiven at the outset for wondering what all the fuss is about concerning the potential uniqueness of human language. We all know that other animals can communicate with each other using smells, calls, touch, body language and other visual cues. From the discussion above we know that the majority of communication between humans (over 90%), like many other species, is actually non-verbal and through different forms of body language. So aren’t all these forms of interpersonal communication a kind of language?

The simple answer to this question is that while they may be to some degree, human verbal language differs qualitatively from these other forms of communication. The main defining features of human language are that it uses different combinations of abstract symbols (words) to represent and qualify places, objects and actions and that these are organised into ordered structures using syntactical rules (grammar). Whatever human language you consider each has these key features and through the use of quite limited numbers of symbols and rules they can effectively create an infinite number of combinations to convey information. While I will consider in a moment in more detail whether there is any evidence at all that another species uses any elements of this kind of language system naturally, it is clear from the outset that it is likely to be non-existent or, at best, very limited. However, the key question for many is not whether animals have developed human like language strategies to cope with their environment but rather could they do so if required. But first let’s look briefly at how humans acquire and use language and how the brain has adapted to carry out this important task.

How are language skills developed and used by humans?

We can probably all think of some plausible reasons for why humans developed language use. One of the more amusing is by Lily Tomlin who suggests that:

“Man invented language to satisfy his deep need to complain”

The first, and most obvious, thing to point out is that among mammals humans are the only species to have developed the necessary vocal tract anatomy to produce the necessary range of speech sounds. This allows us to use combinations of both vowel and consonant sounds which are essential for verbal communication whereas other species without the appropriate positioning of the vocal tract and associated musculature can make some vowel-like sounds but not combined with consonants. Thus no other mammal has the necessary

vocal equipment to produce speech and the only animal species that can are birds such as parrots.

The speed and efficiency with which modern human children acquire language skills is surely the most impressive of human natural attributes. It has led many experts such as Stephen Pinker to propose that human language is an instinct and that, as such, one should not therefore expect it to be present in other species.

We seem to have some remarkable interpretational skills to help us comprehend and use language. For example, looking at sound spectrogram of human speech for the first time the most striking thing is that there are no gaps between words and yet our brains have no problem in interpreting where words start and finish. Another example of this interpretation process is that when we hear the sounds of different letters merged together by a computer there should be points where two sounds such as “p” or “b” are so mixed that this should cause confusion. However, it does not since for us it seems that there is a sudden change from one sound to the other and we do not perceive the progressive merging of the two sounds.

We also seem to have innate skills in learning grammatical rules for combining words so that their sense is easily comprehended and we can assemble an encyclopaedic vocabulary of some 60,000 different words within a short space of time. Indeed, in the early stages of language acquisition we may be acquiring up to 20 new words a day.

Sound production is also an amazing skill since in order to produce sounds at an acceptable speed your vocal musculature is already forming the next word you are going to speak while you are still producing the current one.

For all those studying the origins of language however the major problem is deciding how it has evolved. It would seem that the changes in the orientation of our vocal tracts and increase in brain size occurred before we actually started to use language. There are two main schools of thought on this. The first argues that a random mutation provided us suddenly with language abilities and this conveyed immediate survival advantages (i.e. human language is basically the result of a fortuitous spontaneous mutation). The second argues that language acquisition is the result of a progressive adaptation where selection occurred over time for those with the best abilities to comprehend and use symbolic language. The main problem with the former argument is that it is difficult to see how such a rapid evolutionary step could have taken hold since having language skills does not immediately convey individual survival advantages unless everyone else can understand you. The main problem with the second idea is similar in that it is difficult to see what significant survival advantage a small increase in language skills would have to make this trait worth selecting for.

A possible way out of this is to consider that language did not evolve as an independent trait at all, but co-evolved progressively on the shirttails of enhanced cognitive skills. The latter do have clear survival advantages in terms of improved resource provision and ability to cope with altered environmental conditions. If this is the case then a clear prediction is that since we have no problem in accepting the idea that cognitive skills have evolved progressively in mammalian evolution then ability to comprehend and even use symbolic language should also be demonstrable in other animals. As with cognitive skills however we would expect to see a huge disparity in language skills in other species compared with humans.

Are there unique areas of the human brain dealing with language?

If language were a unique human facility one might have expected us to have developed new brain areas for it; this is not the case. There do not appear to be new regions in the human brain that have evolved to control our production and comprehension of speech. For humans the main functions of language are controlled by Broca's and Wernicke's areas in the left brain hemisphere and these regions are more developed in the left than the right hemisphere. However, these same regions are also found both to be present and more developed in the left hemisphere of chimpanzees (Cantalupo C and Hopkins WD 2001). They are also readily identifiable in most other primates.

What is interesting is that these brain regions controlling different aspects of language are not just involved in word or number perception and production. Reading musical notes and producing and interpreting sign language also engages them (Bavelier et al 1998). The same is also true for Braille readers. It would seem therefore that they represent a specialised system within the brain for interpreting any arbitrary symbolic signs. Because non-verbal gestures and signs are processed by these same spoken/written language systems this has led to the view that the latter may have evolved from the former. Perhaps therefore it is no accident that we often feel like using hand gestures at the same time as we speak. Recent brain imaging work has actually shown that when we speak there is a parallel activation of areas of the brain controlling hand movements (Floel et al 2003).

The large increase in the size of the human brain neocortex, particularly in areas responsible for making associations between things e.g. the frontal cortex, has meant that the extent to which human language can be used to help assimilate, retain and communicate information has been vastly enhanced. We are still left however with concluding that what the human brain has mainly done is to re-shuffle the existing pack of cards to help play this new communication game rather than to invent a whole new set of cards to do so. Thus, other animal species should have some abilities to comprehend and use symbolic language too.

Is language required for consciousness, tool use and representational art?

While it might be tempting to postulate that it was the development of language skills that promoted the faculty of consciousness this cannot be the case. It is the classic chicken and egg situation since consciousness is an absolute pre-requisite for the development of any symbolic communication system. The capacity for consciousness must therefore have evolved first. We also only have to look at ourselves to realise this fact since children are capable of consciousness before they can either comprehend or use language, and individuals that cannot unfortunately use language are clearly conscious as well. Indeed, Einstein is famous for stating that his thoughts did not depend on language:

"The words of language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The physical entities which seem to serve as elements in thought are certain signs and more or less clear images". Albert Einstein

It seems therefore fair to conclude that "words do not make a mind, although they may show whether the mind you have is worth communicating with!" (Keith Kendrick)

In terms of tool use, which for a considerable period was considered to be a uniquely human characteristic, this is also not dependent upon the faculty of language. Many species of monkeys and apes and birds make use of tools, although it is harder to find evidence of making tools to shape other tools.

While there are numerous examples, and even exhibitions of, chimpanzee and gorilla art it is hard to interpret these as being truly representational. The language-trained animals that produce the art may give such works of art meaningful titles, and perhaps one can speculate that they have rejected the art of the real in favour of radical impressionism. However, it seems more likely that while they can quite easily comprehend the meaning of true representational art and pictures, they do not either have the manual skill or interest in developing artistic representation. Interestingly, it has been speculated that evidence for cave paintings produced by the genus homo did not occur until well after we had evolved our present form. This may indeed have corresponded to the period when we finally found out what use we could make of our newly positioned vocal tract.

Do other animals communicate with each other normally using language?

This is a difficult question to answer. We can be fairly confident in concluding that no animal-based language system has the same ability to convey an infinite set of meanings with a finite set of symbols and grammatical rules. We however also have the problem identified by Wittgenstein to take into consideration:

“If a lion could talk we would not understand him” Wittgenstein

As he concludes, if customs and cultural conventions create barriers between different human societies how could we possibly expect to understand the mental processes of another animal species? There are many anecdotal observations cited by observers of animal behaviour where information seems to have been passed on from one member of a group to others, such that the group seems to act with “one mind” when exposed to an environment that only a single individual has any knowledge of (finding something that has been hidden or new for example). It is very difficult to rule out more trivial explanations however.

One can make the simple argument that no other species has found itself pressured into selecting for improved communication traits that allow for better control and understanding of the environment outside of that which can be immediately perceived. This of course raises the immediate question of what would happen if the power of this kind of communication system could be revealed to them. To do this one obviously has to teach animals to comprehend and use a language system and this is precisely what many scientists have attempted to do.

So can other animals really acquire human language skills?

Millions of owners of companion animals will tell you immediately that their pets understand a large amount of what they say. However the simple fact of the matter is that they do not. They have no problems hearing specific words that we use but what these animals do is to form simple learned associations between specific words and specific desired activities (like going for a walk) or other rewards (like food). This repertoire can become quite extensive – perhaps 20-30 words or more but this is not language comprehension. For example if you say: “Fido lets go out and have a walk in the park”, he will probably comprehend “Fidoxxxxxxxxxxwalk”

or at best “Fidoxxxxxxxxwalkxxxxxxxxxpark”. Fido can, of course, also respond to the non-verbal emotional tones you use when you say the words. Recent Japanese developments to convert dog (Bowlingual) and cat (meaowlingual) sounds into human speech sounds must largely be regarded as unfortunate gimmicks which one suspects may be irritating for the animals and deluding their owners.

To illustrate just why it is necessary to be very careful to attribute human-like symbolic skills to other animals one needs only to recount the famous story of “Clever Hans”. Wilhelm Von-Osten was a Russian aristocrat who owned a stallion (Hans) he claimed to have taught basic arithmetic to. He did this in 1888 using skittles, an abacus and a blackboard with carrots for a reward. It took two years to do this with Hans giving the answers to problems by tapping the answer with his hoof and with an apparent sophistication of a 12-year old child. On 6 th September 1904 a commission of 13 people (including a psychologist (Professor Carl Stumpf), a vet, a Circus trainer and, for good measure, a politician). They pronounced themselves to be convinced by the demonstration. However a more observant scientist Oskar Pfungst discovered that the horse’s skills were indeed clever, but not arithmetical. He found that Hans only got the questions right when Von-Osten knew the answer and could be seen by him. By a series of experiments he showed that when Hans was counting with his hoof Von-Osten inclined his head downwards to see the hoof. When the correct answer was reached he would either straighten-up slightly or raise an eyebrow or even slightly flare his nostrils. Pfungst was even able to achieve the same level of performance by Hans using these tricks himself. Von Osten died a disillusioned man in 1909 and has provided a source of potential worry to animal behaviourists ever since.

All this of course takes us back to body language again. Animals are indeed very good a reading cues from the body language of both other members of their own species and humans!

What about our nearest living relatives, the great apes?

Close observation of the great apes in particular has prompted many to consider their capacity for understanding human language. In the context of Gresham College and the City of London perhaps the most appropriate person to quote in this respect is Samuel Pepys on seeing such an animal:

“a great baboone”. “I do believe it already understands much English; and I am of the mind it might be taught to speak or make signs”. Samuel Pepys Diary 24 th August 1661.

It has to be said from the outset that whereas human children develop language comprehension and production with consummate ease and not as a result of rigorous training regimes, attempts to do this in our nearest relations, the great apes, have needed to use intensive training as their primary tool. This requires a level of scientific dedication that few can aspire to and a considerable rapport with the animals that you are working with. The problem with this (as illustrated by the Clever Hans story) is that it is all too easy to produce an animal that is highly sensitive to what you want it to do and is an expert mimic and an experimenter who while ostensibly maintaining rigorous objectivity is nevertheless highly prone to an interpretational bias fuelled by their emotional rapport with the animal. On the other hand those individuals who do not work daily with the animals cannot possibly see or experience all of the evidence that has gradually convinced the behavioural scientist that the animal is using language. It comes as no great surprise therefore to see that it is mainly the individuals who work directly with the animals that claim they have some language abilities whereas it is mainly those who do not who oppose this view.

The major attempts to study language acquisition and comprehension in great apes have mainly involved humans (usually husband and wife teams!) raising individual animals in their own families from a very young age. All the studies have been carried out in the USA and so we only know about ape attempts to learn American/English.

Kellogg and Kellogg (1930s) raised a chimpanzee, Gua, with their son Donald but unlike their son he did not develop any form of speech.

Hayes and Hayes (1952) raised a chimpanzee, Vicki, and tried to teach her speech sounds. She learned just four (Mama, Papa, cup and up) and did not use them in any language-like way. The work on Vicki is claimed to have inspired the films “Bedtime for Bonzo” and “Bonzo goes to college” starring Ronald Regan, where cultural effects on Chimp intelligence are the main storyline! So even future American Presidents were getting in on the act at this stage!

Gardner and Gardner (1969) raised a chimpanzee, Washoe, and taught her American sign language. Washoe was very successful and was able to use learned signs in a variety of contexts. She acquired around 150 different signs. Many of these were clearly learned by imitation although she was able to provide novel combinations of them – “dirty Roger” used as an expletive and “water bird” to describe a swan. She also learned to use sentences including the pronouns “I” and “you”. Perhaps her most impressive achievement was to teach 50 signs to an adopted infant Loulis without any training of the latter by humans. Washoe illustrates that chimpanzees may consider language skills of sufficient use to actually use them to communicate with one another.

Premack and Premack (1966) raised a chimpanzee, Sarah, and taught her to use different coloured and shaped chips to represent words. She placed these on a board to make sentences. First she learned the symbol for an object (apple), then to string symbols together to form sentences (first Mary + apple, next Mary + to give + apple, and finally Sarah + to give + apple + Mary). At the end she had acquired 130 signs and could make sentences up to eight units long. However Sarah did not spontaneously ask questions although she would practice sentences on her own.

Rumbaugh (1980) rather than raising a chimpanzee with humans tried to avoid imitation problems by using a symbolic keyboard (lexigrams) and automated symbol learning using computers. The chimpanzee involved, Lana, learned to use the symbols but only as a means of receiving something desired.

Terrace (1979) raised a chimp named Nim Chimsky (a take off of Noam Chomsky!). He was also taught to use sign language (like Washoe) and amassed 125 different signs in forty-four months (nouns, verbs, adjectives, pronouns and prepositions). Initially there was great excitement since Terrace seemed to find evidence for sensitivity to semantic word order (i.e. elementary syntax). However close examination showed that Nim’s sentences never increased in length, he repeated the same sentences over and over until he received his object. He also never added new information or took turns in communicating. In short he had mainly just learned to imitate his trainers. Terrace published his damning findings in Science in 1979 (Terrace et al, 1979) and this threw the whole of the ape language research into a spin (The Clever Hans story was invoked once again!).

He concludes in this paper that:

“Sequences of signs, produced by Nim and by other apes, may resemble the first multiword sequences produced by children. But unless alternative explanations of an ape’s combination of signs are eliminated, in particular the habit of partially imitating teachers’ recent utterances, there is no reason to regard an ape’s utterance as a sentence” (Terrace et al, Science 1979).

Light at the end of the tunnel?

Chantek the orang-utan has been taught by Dr Lyn Miles a repertoire of 500 signs and can use them to tell lies and to talk about places he cannot actually see at the time. He also seems to be able to string together novel combinations of words and to understand complex sentences. (seewww.chantek.org/)

Koko the gorilla . Has been taught by Dr Penny Patterson to use a similar repertoire of 500+ signs. You can even view the transcript of an Internet chat with her from 27 April 1998www.geocites.com/RainForest/Vines/4451/KokoLiveChat.html). Videos of her at the Gorilla Foundation complex show quite clearly that although her sentences are brief they do convey her own thought processes and cannot be considered in any way as simple imitation of human trainers. She rhymes and jokes and, for example, once used a metaphor of an elephant to refer to herself when she pretended a long tube was her trunk. In the film “A Conversation with Koko” produced by the Gorilla Foundation (Nature Video Library Cat No EBC-0128D) the sequences where she is choosing a potential mate from a series of video clips of potential suitors are particularly revealing and amusing. Again she also seems to comprehend complex sentences produced by her human trainers and carers.

Dr Sue-Savage Rumbaugh has probably done the most to provide evidence for human-like language skills in the great apes. She has used the symbolic keyboard approach first developed by her husband Duane with Lana and has described her results in a compelling book “Kanzi: The Ape at the Brink of the Human Mind” (Rumbaugh and Lewin, 1994). However the most important difference in her approach has been to try to engender a full comprehension of the meanings of words rather than just the ability to simply associate a word with an object. She argues that as we learn language, words are not merely associated with objects they become inculcated with them and their usage becomes truly referential. For example, the word “Mountain” engenders thoughts and images of mountains.

Austin and Sherman (chimpanzees) – Sue Savage Rumbaugh taught these two animals very slowly to use lexigram symbols to refer to desired objects and activities without trying to get them to build sentences. The format was to first show an object (a banana for instance) and the animal had to press the right key that represented the object in order to receive it. The animals were then trained to use the symbols they had learned to refer to the objects even when they were not actually given them (i.e. to show they understood the meaning of the symbol not just that choosing it got them a banana for example). Sue then set up an ingenious experiment to get the two animals to use their lexigram skills to communicate with one another in order to obtain some form of reward. Here one individual was shown a food being hidden and which the other could not see. He then had to indicate using his keyboard what food had been hidden and the other individual had to press this same symbol on his keyboard in order for both of them to receive the hidden food. They were thus in this case able both to understand that one had knowledge that the other did not and also to be able to

communicate and respond to that knowledge. In a further phase this communication strategy involved a further requirement that one of the animals also had to inform the other about what tool was required to access hidden food. Interestingly, they had also learned through their own experiences to associate abstract symbols with objects since they were able to spontaneously communicate what type of food was hidden to each other when their keyboards were turned off by picking up discarded labels from the appropriate tins and showing them to each other (they had never been trained to do this).

Kanzi and Panbanisha (Bonobos) – The Bonobo Kanzi is arguably the most accomplished non-human user of symbolic language. Sue Savage Rumbaugh has taught her to use the same lexigram keyboard as Nelson and Sherman. She has a remarkable repertoire (using 500+ symbols and understanding several thousand words) and can put together novel sentences as well as showing clear understanding ordering of complex human sentences. Perhaps the most remarkable aspect of the work with her was that she actually learned 50 or more symbols simply by watching her adoptive mother Matata being taught to use them. She did not reveal this fact until after she had been separated from her mother and was being trained to use the computer keyboard for the first time! She also uses her language skills to indicate that two different third parties should perform some activity (like playing, chasing or tickling) independently. Once again you can view a transcript of a telephone interview with Kanzi on the Internet from 15 February 1994 (http://pubpages.unh.edu/~jel/kanzi.html)

Attempts to teach language skills to other species

The most extensive attempts to do this are by Irene Pepperberg in African Grey Parrots (Pepperberg, 2002). The star of the show here is called Alex who for over 20 years has been taught by her to communicate. To date he can recognise 50 different objects by name, distinguish quantities up to six, recognise seven colours and five shapes and can understand the concepts “bigger”, “smaller”, “same” and “different”. Her experiments have been conducted very carefully to avoid falling into the pitfalls illustrated by the Clever Hans story.

One might have expected a large amount of work to have been carried out on dolphins, but since they cannot produce speech like sounds or be trained to use sign language this has made it difficult. However some attempts are underway at the EPCOT centre in Florida with Dolphins communicating with humans using computers and touch keys representing up to 30 different symbols.

Some final conclusions

We must be careful not to conclude from all of this that other species are capable of developing full human-like language abilities. One can imagine that if it took parents 20 years to get their kids to master use of a few hundred words and perhaps some simple grammatical rules the birth rate would be likely to encounter a severe decline! Just like their cognitive skills any language skills that have been revealed are vastly inferior to our own. It is also easy simply to define human language in such a way that none of the animal studies outlined above would pass the qualification test. Many experts are convinced that there are features of human language that are unique and they have a very good case (see Pinker, 1994 and Hauser et al, 2002).

However, one can argue that at least some of the animals described above have provided good evidence for language comprehension skills and appropriate use of words to represent objects, either present or absent, and some concept of simple sentence structure.

It is disappointing to some that the animals do not really seem to progress beyond a certain point. Their language skills are reminiscent of monosyllabic e-mail text messages and rarely go beyond what might be expected of a 2-year old child! Indeed, many have concluded from this lack of progression that what they have learned cannot really be language at all. However, any student of animal behaviour will tell you that above all you must consider what the animal actually wants to do. If your main aims in life are basically in the domain of short term gratification within a time frame that may not extend more than a few days into the future there is not much to be gained from mastering a social communication system involving up to 60,000 different elements and a shed-load of rules.

The important point that has been made is that some animals can convey their desires and exchange simple information using a symbolic communication system and can comprehend reasonably complex spoken instructions. Since they seem prepared to use what they have learned to communicate with other animals, and will help teach them to do this, they must presumably see that this type of communication has some advantages. However, it is equally true that they can derive most of the necessary information for conducting their everyday lives through their various non-verbal methods in the same way that we can.

So at the end of the day while we can safely dismiss the possibility that humans and other animals can discourse as equals using human language, it is less easy to dismiss the possibility that if another species were to experience conditions where improving communication skills could benefit survival they might have enough of the necessary toolkit for natural selection to re-organise the brain progressively to do this. After all, the brains of apes and monkeys appear to have the right hardware to do this and even seem to have the same gestural and symbolic specialised processing role. As I have already pointed out however, the most likely scenario would be for another species to require enhanced general cognitive skills to survive (which are clearly needed to remember 60,000 symbols in the first place!), and development of sophisticated symbolic language would then probably co-evolve in any social species.

Finally, many might question the utility and/or ethics, of trying so hard to get other animals to communicate with us using symbolic language. One could argue that the effort required to teach these skills to animals does not considerably enhance our understanding of them above what we could learn through careful observations of their natural behaviours (see Cheney and Seyfarth, 1990 for example). However, it does allow for the first time a real potential direct meeting and appreciation of minds – at least between humans and the great apes. After all it is only through the use of language that we can really understand the mental processes of others. For humans there has also been a major additional benefit in that what has been learned about language training in these animal experiments has had a major impact on therapeutic strategies to help unfortunate individuals with severe language dysfunction.

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