

6SSEL045 – Language Origins
Lecture 2
Nonhuman Communication

There are four possible origins for language:

- It could be a novel system unpresaged by anything in nonhuman communication systems. This is what we used to believe; but nowadays nobody, not even the most dogmatic Generativist, takes this view.
- It could be a system which relies mostly on pre-existing nonhuman communication but has a novel extra component. This is what modern Generativists believe, the extra component being infinite recursion, or MERGE.
- It could be a system which relies wholly on pre-existing nonhuman communication and cognition but uses the components in novel ways. This is what Cognitivists and Functionalists believe, but the area, range, and scope of the novelty is still being debated.
- It could just be another communication system, unremarkably similar to nonhuman communication systems; we consider it different because it is ours. No modern linguist really believes this, but it is a common enough viewpoint in the public forum.

We will be concentrating on the third of these models, so it is important to understand how nonhuman communication actually works.

WHY DO NONHUMANS COMMUNICATE?

There are currently six reasons why nonhumans communicate. This list may grow as we understand more about nonhuman communication.

- **To reproduce:** in Darwinian evolutionary terms, getting your genes into the future is the paramount task for any organism, and many organisms have developed special signalling mechanisms to improve their chances for reproduction. Zahavi & Zahavi (1997) have provided a theory – costly signalling – to explain why animals are willing to expend their resources on overly ostentatious displays, like the peacock’s tail: by carrying around an otherwise-counterproductive display, the animal can signal, “I have this big disadvantage, yet I can still live and thrive because I am extremely fit; I would make a good mate”.
- **To warn about itself:** many animals with dangerous defence mechanisms signal those mechanisms with ostentatious colours or sounds (e.g. the wasp markings and buzz). The message to predators is, “don’t mess with me”. Of course, the message to dragonflies and hornets who habitually prey on wasps is “dinner”. A very recent paper (Holen & Johnstone, 2018) has shown that, contrary to former belief, harmless insects that mimic dangerous prey are not just exploiting the dangerous prey, they dilute the predation; which makes it advantageous for the dangerous prey to mimic the mimics, fixing the ostentatious display into both species.
- **To indicate an emotional state:** many species indicate their current level of danger to others by emotional displays. For instance, by displaying anger the individual can avoid unnecessary conflict; fear displays help them or seek support when they need it, or end a confrontation.
- **To warn others about a third party:** many social mammals have warning systems to alert others in their group to predators or rival groups. These warning systems can become quite sophisticated (as we will see later) and have many of the features we associate with human language.
- **To build alliances:** in any species with a complex and negotiable social structure (such as most primates), the ability to build up a “bank balance” of support helps to mitigate dangerous confrontations. A little light grooming today can become useful support in a fight tomorrow. Many species of primate seem able

to sustain long-term friendships, or alliances, in their social groups.

- **To tell about:** we used to believe that this was a capacity that only humans had. De Saussure believed that it was a key feature of language: the present sign, or signifier, represents the absent thing, or signified. We now have examples of this occurring in nonhuman communication – the classic example being the bee foraging “dance” performed in the hive, and which can indicate the direction and distance of a nectar source outside the hive.

LANGUAGE-LIKE FEATURES OF NONHUMAN SIGNALLING

What should we look for in terms of nonhuman signalling to indicate language-like abilities?

Signals must be reactive, reliable, voluntary and systematic:

- To be **reactive**, the signal cannot be unchangeable or permanent, such as skin colour; it must be produced as a response to a stimulus. The skin pattern on a snake is extant; the skin colour of a chameleon is reactive, so can be used in a language-like way; the male peacock’s feathers are extant, but the displaying of them is reactive.
- To be **reliable**, the signal must be a recognisable indicator of an internal state, or a recognisable response to an external stimulus; and it should, as far as possible, be honest and not deceptive.
- To be **voluntary**, it must be possible for the sender to decide whether to deliver the signal or not. There is, however, a problem with the reliability of voluntary reactive signals – cheap signals won’t work because they can be easily faked. Signals need to be costly to reduce the scope for deception.
- To be **systematic**, the signalling repertoire should not be a series of separate calls, it should form some kind of rules-based system. For many years it was believed that only human language conformed to a rules-based system of meaning; we now know this is not the case, and we have identified several species with systematic communication systems.

HOW DO NONHUMANS MEAN?

Animal utterances can be interpreted as having meaning, both for the sender and the receiver; but they mean in quite a different way from human language.

An example is the Campbell’s monkey eagle warning call. When a Campbell’s monkey makes the call, it is because it is concerned about the presence of an eagle – the call means “eagle” in a strict one-to-one relationship between the signified (eagle) and the signifier (Hok!). However, when a Campbell’s monkey receives the call, it evokes a desire to climb down out of the trees – the call means “climb down” in a strict one-to-one relationship between the signifier (Hok!) and the signified (the receiver’s action). So what does the call mean to the Campbell’s monkey, *eagle* or *climb down*? The context of the monkey as sender or receiver of the signal is integral to the meaning (Font & Carazo, 2010).

DO NONHUMANS USE COMPOSITIONALITY?

Do animal signals have compositionality (segmentation, differentiation, hierarchy, recursion)? The short answer is yes.

- **Segmentation:** Leitaõ et al (2006) have shown that complexity is itself a signal of fitness for male chaffinches: the more segments in a song, the fitter the individual. Other examples of segmentation are: the Campbell’s monkey ‘probably’ boom (Ouattara et al, 2009), which mitigates a predator warning, changing it from a call for immediate action into a call for increased vigilance; and the honey bee waggle dance (von Frisch, 1973) can indicate both direction of nectar and the distance. However, segmentation is also a prerequisite for differentiation, and there is a lot of evidence for that.
- **Differentiation:** Some nonhumans can use differentiation in their signals. This is not just the object differentiation we see in vervet alarm calls, where different predators can be identified with

different signifiers, there are also object-modifier calls, like the Campbell's monkey "probably" boom (see above). Keenan et al (2013) have also shown other types of differentiation used in the Campbell's monkey signalling system; and Arnold & Zuberbühler (2006) have shown that the calls of putty-nosed monkeys have a complex combinatorial system, where context can change the meaning of signifiers. Murphy et al (2013) showed that male blue monkey alarm calls encode information about both predator type and distance; and Cäsar et al (2013) showed that Titi monkey call sequences vary with predator location and type. Slocombe & Zuberbühler (2006) also showed that there is sufficient difference in chimpanzee food calls for the type and tastiness to be identified. It seems that differentiation in nonhuman signalling is widespread.

- **Hierarchy:** Evidence for hierarchy is not so common. Some nonhumans have a limited capacity to use hierarchy in their cognition, and an understanding of the social hierarchy around them is clearly a vital skill for social animals. Baboons, for instance, successfully navigate complex hierarchies both within and between families in their tribe (Cheney & Seyfarth, 2007). However, evidence for hierarchy in communication is contentious. Berwick et al (2011) feel there is evidence of a syntactical hierarchy in some bird song, but they are careful to point out that birdsong does not have semantic content in the same way as human language.
- **Recursion:** Hauser, Chomsky & Fitch, in a famous 2002 paper, claimed that recursion was the difference between human and nonhuman communication. However, in 2006 Gentner et al showed that starlings both recognise and produce recursive patterns in their songs, and this has since been shown to be true for other bird species, such as zebra finches.
- **Bartering:** Some nonhumans seem able to engage in simple bartering (e.g. food for sex – Hockings et al, 2007) and quid pro quo exchanges (e.g. grooming – Port et al, 2009). Capuchin monkeys have even demonstrated a capacity to treat tokens as abstract units of exchange (Addessi et al, 2007). This capacity could be at the roots of negotiation toward meaning; it certainly seems to indicate, on some level, the capacity to use symbols cognitively.

NONHUMANS & SIGNAL COMPLEXITY

So, if none of the features of compositionality are exclusively human, why do only humans have language? The answer seems to be that what makes language distinctive is not a particular exclusive skill but a combination of features. Other animals may have parts of the puzzle, but only we have all the pieces.

Yet there remain some quantitative capacities which seem to be beyond nonhumans:

- Some nonhumans can use phonetic recursion, but semantic recursion is very limited (it is limited in humans, too, but less so).
- The complexity of what-if and speculative planning (modality) seems to be missing from nonhuman cognition, although this is a very hard thing to test for. The hunting of chimpanzees may involve individual role-planning, but there is no evidence of joint attentional planning (Gilby et al, 2006).
- Nonhumans cannot negotiate complex exchanges, and they seem to have problems with altruism.
- No nonhuman has created a highly co-operative social system in which language thrives; but several seem able to live successfully as language-aware guests within our social environment.

WILD MONKEY SIGNALLING

Seyfarth et al (1980) really started the investigation of intentional and accidental meaning in monkey calls when they discovered that wild vervets have three different calls for three different predators (snake, eagle and leopard). These calls were produced reliably and systematically in the presence of the predators, and they produced

reliable activity in other vervets. The calls were not just vocalised panic, they had purpose and meaning.

In linguistics, the finding was treated as a signalling oddity for 20 years; but in the 2000s Klaus Zuberbühler investigated other monkey calls, and his team found many other reactive signals which were reliable and systematic. For instance:

- Zuberbühler (2000) identified that **Diana monkeys** encode predator type into their calls, but they may also encode information about the distance of, and therefore danger from, the predator.
- Arnold & Zuberbühler (2006) found that the sound-units in the calls of **putty-nosed monkeys** (a series of pyows and hacks) seem to have no individual meaning, but the way they are combined can create warning signals about ground predators or aerial predators, and can also be used to co-ordinate group movement to new feeding grounds.
- Murphy et al (2013) found that **blue monkeys** also use a combination of pyows and hacks in their alarm calls, but in a different way. Pyows seem to refer to general threats and may be less urgent than hacks, while hacks are reserved for eagles. They also found that the frequency of calling encoded information about distance: more pyows than hacks indicated an eagle far away, while longer delays between pyows indicated the eagle or leopard was not an immediate threat.
- **Campbell's monkeys** have already been discussed.

PRAIRIE DOGS (CYNOMYS GUNNISONI)

Con Slobodchikoff's work on prairie dog calls is, in animal communication terms, disturbing. His team records the prairie dog calls made to various "threats" – basically, his students and some moving coloured shapes. The calls are then slowed and analysed acoustically. His team has shown that the prairie dog general warning call seems to encode information about the colour of the threat, represented by his students in different-coloured t-shirts (Slobodchikoff et al, 2009); and it also seems to identify the shape and distance of a threat, represented by coloured squares, triangles and circles (Slobodchikoff et al 2012).

His initial research took place in the 1990s, but he could not place his papers for publication for over a decade because of the common belief that the level of sophistication he had identified in prairie dogs was impossible in a rodent. After the discoveries in monkeys by Zuberbühler's team, the research of Slobodchikoff's team has been accepted as mainstream. (Note the variable spelling of his surname).

DOLPHINS

With dolphins, the question is not which structural aspects of language they share with us, it is which socio-cognitive strategies they share with us.

The first of these strategies is naming, or attributing identity labels to other group members. A name-label needs to reliably identify a particular member of a group to other members of the group, so the labels must be communally shared. For dolphins, every individual has a signature whistle (Cook et al, 2004), and they use their own signature whistle to indicate their presence and position to other pod members. This signature whistle remains the same when the dolphin moves to a new group (which they do often), so it is a label the dolphin uses to identify themselves, not a label given to the dolphin by each group. However, like humans, dolphins also use variants of the signature whistles of other pod members to attract the attention of those others (King et al, 2018).

Another shared socio-cognitive strategy is joint attention and joint enterprise. The dolphin capacity for joint attention is greater than that of nonhuman great apes (Pack & Herman, 2006), and their hunting strategies demonstrate a humanlike capacity for joint enterprise and sharing.

A third shared socio-cognitive strategy, related to joint enterprise and sharing, is social intelligence. Richard Connor (2007) showed that the fission-fusion nature of dolphin society imposes heavy cognitive demands on individual dolphins if they are to keep track of all the dolphins they encounter. The alliance structure in dolphin societies also seems to be more complex than for any other nonhuman species, with individuals involved in several levels of alliance simultaneously. This means that, as in humans, there are strong fitness pressures in favour of larger brains and complex communication systems.

Further similarities between human groups and dolphin groups are currently being investigated; the dolphins' lack of appendages able to craft complex tools seems to be less relevant in terms of complex social dynamics than we once believed.

HUMANS AND LANGUAGE

In 1960, Charles Hockett attempted to describe all the features of human language so that he could decide which are shared with other species and which are exclusive to humans. This attempt was a product of its time, and the approach has since been shown to be misguided (Waciewicz & Żywicznyński, 2015). It is offered here as a caution against over-simplifying the process by which language evolved and developed.

Initially, Hockett offered 13 design features of communication, of which three (Displacement, Productivity, and Duality of Patterning) were exclusive to human language. He later revised the list (Hockett, 1963), adding Deceit, Reflexivity and Learnability to the exclusively human list. We now know that all six of the exclusive features are present in the communication systems of at least one other species. It is now generally accepted that exclusively evolved functionality is rare. Nature is conservative: if one species has successfully evolved toward a working fitness solution, the process is likely to be repeated in other species.

WHERE NONHUMAN MEANING RESEMBLES HUMAN MEANING

If nature is conservative then we should be unsurprised to find similar solutions involving meaning in other animals – and that is what we find.

Deception, far from being exclusive to humans as Hockett believed, is common in primates and not unknown in the rest of nature.

For example, Kitui, a low-ranking vervet male, was getting old; so new males joining the group were likely to push him even further down the social ranking. He was recorded giving a leopard alarm call on three separate occasions to keep a new male in a tree away from his troop. However, he didn't understand that his own behaviour should match the call. His failure to climb a tree while calling revealed the lie (Cheney & Seyfarth, 1990, 213-215).

In another example Melton, an adolescent male chacma baboon, had played too roughly with an infant. The infant's screams caused several adults to chase Melton. However, instead of running he stood on his hind legs and began to scan the horizon, a standard behaviour when a baboon sees a predator or a rival troop of baboons. The chasing baboons stopped the chase and also scanned for the danger, forgetting their desire to punish Melton (Byrne, 1995, 125-126). Interspecies deception also occurs. Fork-tailed drongos have their own aerial alarm call, and they also imitate the aerial alarms of glossy starlings, crowned plovers and pied babblers. They use these calls to scare other animals away from food which they then steal. The tactic seems to work not just on the birds, meerkats are also robbed (Flower, 2011).

Calculation is the capacity to see groups of objects as objects themselves. It involves the related skills of judging relative size and counting. Calculation is relatively common in nature. Even bees appear able to count up to four (Chittka & Geiger, 1995).

When taught the size values of 26 symbols (values 0-25) rhesus monkeys were able to correctly identify the symbol which represented the total of two other symbols. This provides evidence that the monkeys are able to perform additive numerical calculation within a closed number system (Livingstone et al, 2014).

Rugani et al (2009) showed that newborn chicken chicks have an impressive – and clearly innate – capacity to understand additive and subtractive effects in numbers up to five.

Anderson et al (2007) showed that orang-utans can identify the larger of two quantities when there were no more than five objects in each set, and the sum of the pair of quantities was no more than eight. There was evidence that older individuals were less accurate than younger ones, but the capacity to add two sets and then compare the totals (a two-stage procedure) was demonstrated. However, humans without the linguistic tools to handle number seem to fare worse at calculation than many nonhumans (Caleb Everett, 2013). It seems that simple calculation may be innate, but language can enhance or impoverish this innate capacity.

Tool-making involves being able to plan constructions, and to convert raw materials according to the plan. This was once believed to be a capacity only humans have, but it now looks to be endemic in the natural world.

Benito-Calvo et al (2015) show that the stone tools used by chimps for cracking nuts tell us about their tool usage and give clues to early human tool use. Boesch & Boesch (1990) showed that chimps frequently make and use wooden tools, and can use two different tools sequentially to get food.

Kenward et al (2005, 2006) showed that New Caledonian crows are particularly adept at tool use and tool making. In the wild they use stiff pandanus leaves to create spears to fish for grubs, cutting them to shape with their beaks; and in captivity they have been seen to bend metal sticks into hooks to retrieve food. Kenward et al maintain, however, that these behaviours are innate – or, at least, that there is an innate capacity for ingenuity in food-finding.

Insects are also effective tool-users, especially eusocial insects. To make their nests they manipulate their environment, adapting it to their needs rather than using what is available. They also use their own bodies as tools: army ants will form living bridges for nestmates to cross large gaps, and honeypot ants feed some workers with nectar so that their bodies can act as reservoirs of food for the colony. Bees, of course, sting and die, making their bodies a tool in defence of the collective nest. In these cases, we can definitely say that the tool-using capacities are innate, but they are tool use nonetheless.

Burrowing owls in North America live largely off dung beetles. To make their life easier they bring the dung close to their nest burrow, and let the beetles come to them (Levey et al, 2004).

Gruber et al (2010) have shown that there is greater tool use by female bonobos and chimpanzees than by males. This gender bias may also be a feature of early human tool use, in which case it is probably not men but women who drove the first technologies. Barnes (2005) has identified a possible use by a beaver of a pre-cut piece of timber as a platform for further cutting. Beavers are already well-known for their dam construction.

However, only humans seem to make complex things cooperatively (Stout & Chaminade, 2009). We also seem to be the only species able to prepare and combine different materials to make sophisticated manufactured items (Wadley et al, 2009); and we are probably the only species to use fire deliberately (Brown et al, 2009).