Do animals have language?

By Rochelle Riley

The world is a wonderful place, brimming with a plethora of animals, the majority of which stick together in their schools, prides and colonies. When living with many others, you need to be able to communicate with each other to successfully survive as one. So the question is: how do animals do this? And more specifically, do animals use language to communicate the way us Homo sapiens do?

Vocalisations, body language, chemical signals, bioluminescence[1]; there are so many different ways animals communicate, most of which humans are not capable of. Cynomys (Prairie Dogs) and Delphinidae (Dolphins) are some animals considered to have the most complex communication systems. Cynomys communicate through territorial calls 'jump-yips', anti-predator calls and mating calls - all examples of vocalisations[2]. On the contrary, Delphinidae communicate using echolocation - a very rare form of communication in which they make a 'click' sound and interpret the sound waves that bounce back other creatures and objects in the ocean[3].

Humans cannot communicate in the way these animals do (apart from some vocalisations), so is our understanding of language and depicting other species' ways of communication human centric or do animals genuinely not have the ability to have language?

What allows humans to have and understand language?

To define what language is and to form the basis for our understanding of if Delphinidae, Cynomys and other complex animals have language, we are going to define what human language is and what parts of the brain are used in language processing.

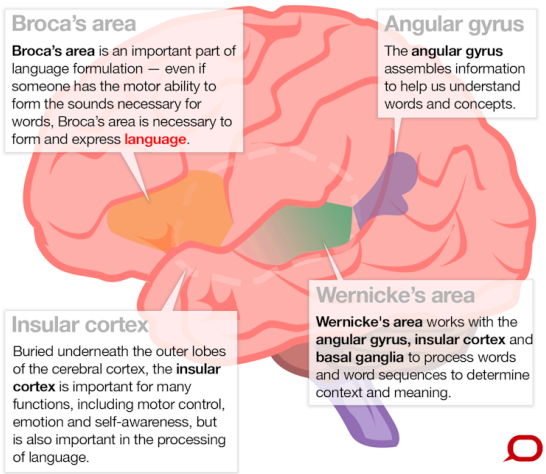

Figure 1 - Shows the parts of the human brain directly linked to language

Located in the brain's inferior frontal gyrus lies Broca's Area. While the entirety of its function is not fully understood by neuroscientists yet, it is confirmed to play a large role in language production, with some functions considered to be grammar, verbal working memory, or the muscle movements needed for speech. It acts as a command center for speech production as it relays signals to coordinate the muscles of the lips, tongue and throat. As well as this, it also plays a role in language comprehension, with research demonstrating Broca's area is activated during sentence comprehension tasks. The consequences of this area being damaged is called Broca's Aphasia, leading to non-fluent speech, reduced vocabulary and grammar impairments[4].

In the temporal lobe on the left side of the brain lies Wernicke's Area, the site of language development. It supports phonologic retrieval, an essential part of speech retrieval which allows mental representation of

phonemes (the smallest units of sound in a language that distinguish one word from another) which are then articulated in their temporal order. This plays a massive role in being able to read aloud, repeat speech and retrieve words. Wenicke's Aphasia - a language disorder - occurs when this area is damaged from trauma or disease, leading to people who suffer from it, making up meaningless words, producing sentences that do not make sense and having difficulty repeating words or phrases. Despite this, they speak grammatically correct, proving that Broca's Area and Wernicke's area work independently from one another[5].

Another structure linked to language in humans on *figure 1* is the Angular Gyrus (AG), located in the posterior part of the parietal lobe. This region has been shown in several meta-analyses to have a role in semantic processing, word reading and comprehension, memory retrieval and more. The AG has been depicted to play a major role in processing concepts rather than percepts due to the large functional neuroimaging literature. It acts as a cross modal hub where converging multisensory information is combined and integrated to comprehend and give senses to events as well as other things[6].

Lastly, on *figure 1* lies the Insular Cortex, located in the cerebral cortex. It is important in gustatory and sensorimotor processing, risk-reward behaviour, pain pathways and more. The insular cortex has been found to do translational work in both animals and humans between the frontal, parietal and temporal lobes as well as the limbic cortex (olfactory bulb, anterior cingulum, hippocampi) and basal ganglia. Due to this work, an injury to this area can manifest with symptoms corresponding to any of these structures[7].

The main areas of a human brain related to language have now been labelled and located, so the next question is: are there any similarities found in the brains of non Homo sapiens, such as the Delphindae and Cynomys, as well as other animals?

<u>Similarities between a human and an animal's brain</u>

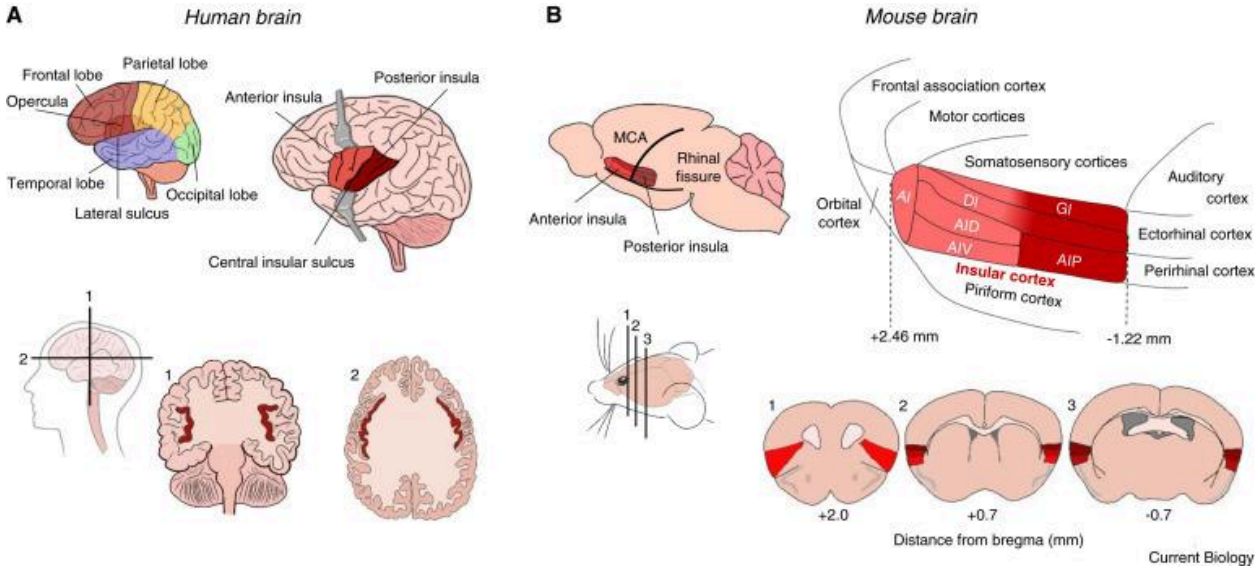

Figure 2 - Location of the insular cortex in both the human and mouse brain

While a mouse was not mentioned previously, this animal, as well as all other mammals (including Delphinidae and Cynomys') have an insular cortex though it is located in different places. In primates, it is found folded deep in the lateral sulcus, while in lissencephalic species (like mice and rats), it lies exposed on the lateral surface of the hemisphere, seen in *figure 2*[8].

A unique feature of the insular cortex in humans, great apes, elephants and some cetaceans - including Delphinidae -, but not Cynomys, is the presence of a special cell type in layer 5 'von Economo neurons'. The precise function of this cell type is not known however, it is known that they are destroyed in frontotemporal dementia and they are unique to animals with large brains and advanced socialisation skills[8], giving us reason to consider the argument that some animals have language.

Broca and Wernicke's areas are both considered to be unique to humans, however, non-human primates - such as apes and monkeys, our closest relatives, - possess cortical areas in similar locations to and have similar cytoarchitecture to Wernicke's and Broca's areas. Evidence suggests that Broca's area, while it is not involved with vocalisations in monkeys like it is in humans; apes and monkeys' version of Broca's area contains mirror neurons involved in the understanding of actions and intentions of others. Wernicke's area, in macaques, is specialised for processing species-specific calls just as in humans, it is specialised for speech comprehension although the anatomy differs between both species[9].

Despite there being evidence for similar structures to both Broca and Wernicke's areas (as well as the Insular Cortex) being present in other animals, Geschwind - who described the angular gyrus as 'the most important cortical areas for speech and language' - claims the angular gyrus is unique to humans[10].

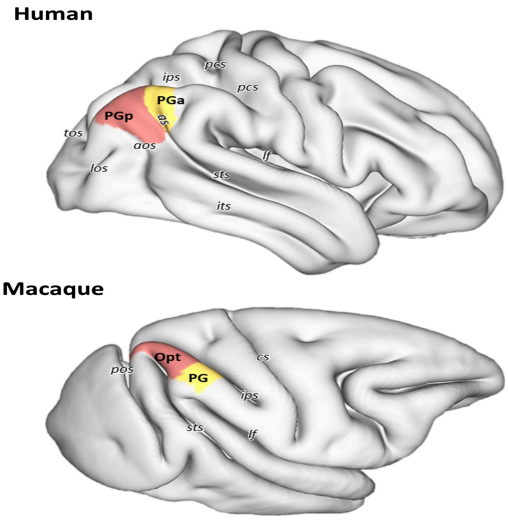

Figure 3 - A 3D reconstruction showing the location of the angular gyrus in a human brain compared to the location of a similar structure found in the brain of macaque

However, as seen on *figure 3,* there is a brain structure found in macaques, once again, that shows functional similarity to the angular gyrus in humans; the posterior IPL. This structure cannot be defined as a macroanatomical homolog of the angular gyrus, but it is similar enough to be compared and contrasted and is now widely accepted[11].

Conclusion: Does this evidence prove animals have language?

To put it shortly, no. We cannot state whether animals do or do not have language based on anatomical similarities between us Homo sapiens and a select handful of animals mentioned in this essay because it is more nuanced than that. It is clear that other mammals, specifically the ones most closely related to us, have undeniable complexities in their brain enabling them to understand and communicate with each other in ways simpler organisms cannot but is very different to the way we do.

To answer the question posed in the introductory paragraph: do animals use language to communicate the way us Homo sapiens do?, the obvious answer is no. There is no other species on earth that can put

together syllables the way we do, forming coherent sentences and utilising grammar. However, this cannot be the basis of what we define language to be. The dictionary definition of language is ‘a system of communication used by a particular country or community’, in which community can also be applied to animals.

So many mammals, insects, reptiles and other animals have a way of communicating that we humans cannot understand or explain, so yes, animals do have language, just not in the conventional way we define language to be, using humans as the default.

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