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Language connection discovered in chimpanzee brains

Language processing in humans depends on the neuronal connection between language areas in the brain. Until recently, this language network was thought to be uniquely human. Now, in a discovery about the evolutionary basis of our language, researchers of the Max Planck Institute for Human Cognitive and Brain Sciences, in collaboration with the Max Planck Institute for Evolutionary Anthropology and the Alfred Wegener Institute, have identified a comparable neuronal connection in the brains of chimpanzees. Their findings have been published in the journal Nature Communications.

At the centre of this discovery is the arcuate fascicle (AF) — a bundle of nerve fibres linking language areas in the brain. In humans the AF connects to the middle temporal gyrus (MTG), this connection has now also been demonstrated in chimpanzees for the first time. “Our results suggest that the neuronal architecture that is crucial for language is not completely new in humans,” explains first author Yannick Becker. "Instead, it likely evolved from an evolutionary older, pre-existing structure. The connection is significantly weaker in chimpanzees than in humans and may therefore not allow complex human language.”

For their study, the researchers employed high-resolution magnetic resonance imaging to analyse the brains of captive, and for the first time of wild chimpanzees who had died naturally in the African jungle. “We were able to visualise the detailed course of the nerve fibres between the different brain areas with unprecedented precision,” says Alfred Anwander, last author of the study, describing the method. Strikingly, in all twenty chimpanzee brains examined, the researchers identified a clear connection of the AF with the middle temporal gyrus — a feature previously thought to be exclusively human.

The findings suggest that the neuronal architecture for complex communication was already present in the last common ancestor of humans and chimpanzees approximately seven million years ago and made the evolution of human language possible. However, as the brain of the common ancestor of humans and chimpanzees has not been preserved, the evolution of the neuronal basis of our language system may only be analysed by comparing it with our closest living relatives, the chimpanzees.

"Until now, it was assumed that the anatomical structures supporting language only emerged in humans," says Angela D. Friederici, co-author and director of the Department of Neuropsychology at the Max Planck Institute for Human Cognitive and Brain Sciences. "Our results fundamentally reshape our understanding of the evolutionary origins of language and cognition."

Looking ahead, the research team plans to deepen their investigation. "Through our international consortium — collaborating with African wildlife reserves, sanctuaries, and European zoos — we can now correlate behavioural data gathered during the lifetimes of great apes with their brain structures," emphasizes Yannick Becker. "This will allow us to explore the neuronal foundations of cognitive abilities in great apes in even greater depth."

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“Long arcuate fascicle in wild and captive chimpanzees as a potential structural precursor of the language network”

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