Whales boast the brain cells that 'make us human'

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Whales may share our kind of intelligence, researchers say after discovering brain cells previously found only in humans and other primates.

They were touted as the brain cells that set humans and the other great apes apart from all other mammals. Now it has been discovered that some whales also have spindle neurons – specialised brain cells that are involved in processing emotions and helping us interact socially.

Spindle cells, named after their long, spindle-shaped bodies, are the cells that are credited with allowing us to feel love and to suffer emotionally. Their discovery in whales will stimulate debate both on the level of whale intelligence and on the ethics of hunting them.

The cells occur in parts of the human brain that are thought to be responsible for our social organisation, empathy, speech, intuition about the feelings of others, and rapid "gut" reactions (see *The cell that makes us human*).

Anthropomorphic angle

Now it turns out that these spindle cells also exist in the same brain areas in humpback whales, fin whales, killer whales and sperm whales.

What is more, whales appear to have had these cells for at least twice as long as humans, and early estimates suggest they could have three times as many spindle cells as us, even accounting for the fact that whale brains are larger than ours.

"It's absolutely clear to me that these are extremely intelligent animals," says Patrick Hof of the Mount Sinai School of Medicine in New York, and co-discoverer of the whale spindle cells with Estel van der Gucht of the New York Consortium in Evolutionary Primatology, both in the US.

"We must be careful about anthropomorphic interpretation of intelligence in whales," says Hof. "But their potential for high-level brain function, clearly demonstrated already at the behavioural level, is confirmed by the existence of neuronal types once thought unique to humans and our closest relatives."

"They communicate through huge song repertoires, recognise their own songs and make up new ones. They also form coalitions to plan hunting strategies, teach these to younger

individuals, and have evolved social networks similar to those of apes and humans," Hof says.

Express trains

As with humans, the spindle cells were found in whales in the anterior cingulate cortex and frontoinsular cortex – two brain regions vital for "visceral" reactions. Such reactions require fast but emotionally-sensitive judgments, such as deciding whether another animal is suffering pain, and the general feel of whether an experience is pleasant or unpleasant.

In addition, unlike in humans, the researchers also found spindle cells in the frontopolar cortex at the back of the brain, and they were sparsely dispersed elsewhere. Hof says he does not yet know the significance of spindles found in areas other than those that contain the cells in humans and great apes.

Exactly how spindle cells function in whales is still under investigation, but Hof believes the long, high-speed connections may fast-track information to and from other parts of the cortex. "The velocity of the signal is faster, and they miss out junctions on the way," says Hof. "They are like the ☒express trains' of the nervous system" that bypass unnecessary connections, enabling us to instantly process and act on emotional cues during complex social interactions.

Hof and van der Gucht suggest that whales probably evolved the spindle cells completely independently of humans and apes – a process called convergent evolution. Moreover, they probably evolved them as long as 30 million years ago, twice as long ago as humans and apes.

Spindle cells are most likely to emerge in unusually large brains which need extra circuitry to handle increasingly complex social interactions, Hof says.

Cognitive parallels

"The discovery of spindle neurons in cetaceans is a stunning example of neuro-anatomical convergence between cetaceans and primates," says Lori Marino of Emory University in Atlanta, Georgia, US. "The common ancestor of cetaceans and primates lived over 95 million years ago, and such a highly specific morphological similarity as the finding of spindle cells is clearly due to evolutionary convergence, not shared ancestry," she says.

"This is consistent with a growing body of evidence for parallels between cetaceans and primates in cognitive abilities, behaviour and social ecology."

However, many highly intelligent but smaller cetaceans examined by Hof and van der Gucht did not have the spindle cells. The explanation could be that these smaller cetaceans, including bottlenose dolphins, evolved different but equally complex alternatives to the spindle cells. "In this respect, it will be interesting to discover what mental capacities might

distinguish humpback whales from dolphins," says Keith Kendrick of the Babraham Institute in Cambridge, UK.

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