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Whale Brain, Surprisingly Similar to Human Brain

Behind the amazing whale behavior "stays" a brain full of surprises

Scientists have long considered cetaceans, marine mammals including whales and dolphins, as highly intelligent creatures, with complex social behaviors, being surpassed only by humans and apes. In a new study, scientists at the Department of Neuroscience at Mount Sinai School of Medicine in New York, NY, made a comparison between the brains of several cetacean species and found in the brain of some a certain type of neurons that is also found in apes and humans, revealing a convergent evolution caused maybe by the development of complex behaviors. Cetacean biology is well investigated in many species but their brains are less studied, in order to correlate their anatomy to the extensive behavioral and social abilities. Brain to body mass ratio, a rough measure of intelligence, is lower for the giant toothless whales compared to dolphins, but the structure and large brain size of baleen whales point to a complex and elaborate behavior.Besides, this ratio measurement cannot be extended to large mammals, as, of course, neuronal tissue can not correlate to tons or tens of tons of body mass. The researchers examined the brain of adult cetaceans from two baleen whale species (humpback whale_ Megaptera novaehollandiae and finback whale_ Baleanoptera physalus) and from several toothed whales: three bottlenose dolphins (Lagenorhynchus species), Amazon river dolphin (Inia geoffrensis), sperm whale (Physeter macrocephalus), beluga whale (Delphinapterus leucas), killer whale (Orcinus orca) and several other cetacean species. The humpback cerebral cortex, linked to active thinking in any mammal, was similarly complex to dolphins. All cetaceans present a hugely enlarged area in the cortex linked to acoustic abilities, as these mammals use sound (but especially ultrasounds) to explore their environment and the new study encountered a complex organization in core and belt regions. Instead, there was a substantial difference between the cortex neuronal structure in baleen whales and toothed whales. The way these differences go to distinct brain function and behavior are still not known. A trait in baleen whale's cortical brain that really amazed the scientists was the modular organization of certain cells into "islands", something found in other types of mammals, but not in toothed cetaceans. These structures may promote faster and more efficient communication between neurons. Another shocking and notable trait was the presence of spindle cells in the humpback's cortex, something not encountered anywhere else but in ape's and human's brain. The precise role of spindle neurons is not known, but they are suspected to be involved in cognitive processes and degenerate in debilitating brain diseases like Alzheimer's, autism and schizophrenia. Spindle neurons were also discovered in the brain cortex of toothed whales with the largest brains, thus these neurons must be linked to brain size. Spindle neurons might have appeared in the ape-human lineage about 15 million years ago, since they are present in all great apes and humans, but are absent in lesser apes and other primates; cetaceans might have achieved them earlier, about 30 million years ago. Maybe the ancestral cetaceans carried the genes, but only large brained cetaceans retained them. Or, more plausible, this trait evolved at least twice independently in the two cetacean groups; this process may partially have occurred more recently. Anyway, this is an extremely rare case of parallel evolution, both inside the Cetacea Order and between cetaceans and primates. "In spite of the relative scarcity of information on many cetacean species, it is important to note in this context that sperm whales, killer whales, and certainly humpback whales, exhibit complex social patterns that included intricate communication skills, coalition-formation, cooperation, cultural transmission and tool usage," concluded the researchers. "It is thus likely that some of these abilities are related to comparable histologic complexity in brain organization in cetaceans and in

hominids." "Cetacean and primate brains may be considered as evolutionary alternatives in neurobiological complexity and as such, it would be compelling to investigate how many convergent cognitive and behavioral features result from largely dissimilar neocortical organization between the two orders." This study opens an unsearched and full of surprises field on investigating cetacean brain and behavior, which, due to their habitat and hunting by human, are naturally elusive, poorly documented and often endangered.