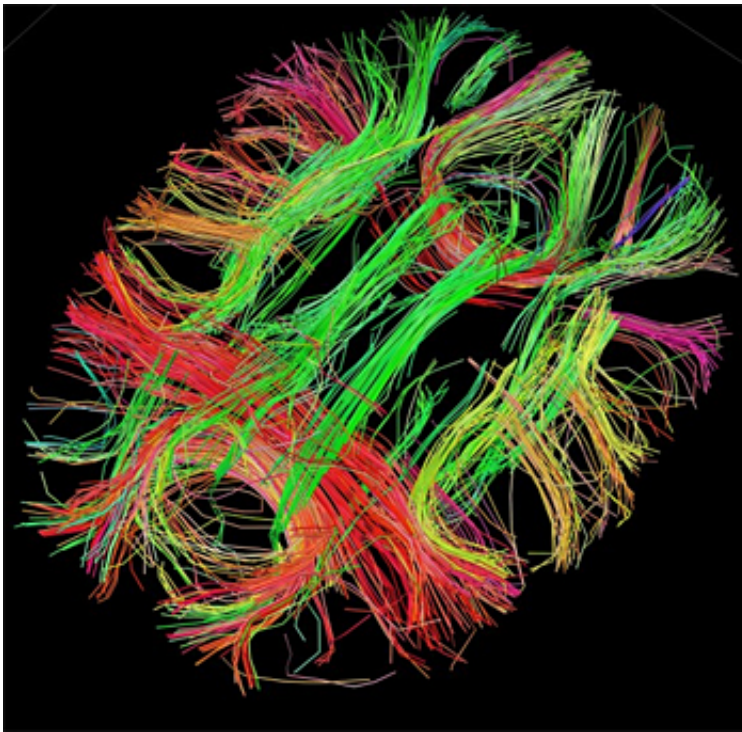


Study of monotreme and marsupial brains suggests hemispheres communicated before development of corpus callosum

September 4 2018, by Bob Yirka



White matter fiber architecture of the brain. Credit: Human Connectome Project.

A team of researchers with The University of Queensland has found evidence suggesting that mammalian brain hemispheres had a means of communicating long before the development of the corpus callosum. In their paper published in *Proceedings of the National Academy of*

Sciences, the group describes mammalian brain studies they conducted using MRIs and what they found.

The corpus callosum is the largest mass of white matter in the human [brain](#). Its purpose is to serve as a bridge between the two hemispheres, allowing fast, smooth communications between the two. All placental mammals have a corpus callosum, but for some reason, the other two main groups of mammals do not. Instead of a corpus callosum, marsupials (pouched mammals) and monotremes (egg laying mammals) have a simple network of [nerve](#) fibers that connect their brain hemispheres. In this new effort, the researchers wondered if the nerve fiber networks once occurred in placentals prior to the evolution of the corpus callosum. To learn more about that possibility, the researchers studied the nerve fiber network of a fat-tailed dunnart (a marsupial) and a platypus (a monotreme) using MRI scans.

The researchers found patterns in the scans reminiscent of the corpus callosum in both the marsupial and monotreme brains. The patterns included long range connections between hemispheres, which, the researchers noted, suggests similar functions. They claim this is possible evidence showing that the corpus callosum did not evolve independently, but is due to the continued evolution of the nerve fiber networks that all three types of mammals once shared.

The researchers also suggest their findings indicate that mammalian brains require very specific types of connections in order to facilitate proper communication between hemispheres—the types of connections found in both nerve fiber networks and the corpus callosum. The study also shows the likelihood that nerve fiber networks developed approximately 80 million years before the development of the [corpus callosum](#). The team concludes by pointing out that their findings could prove valuable for research in other areas, such as studies of people with abnormal brain connectivity problems.

More information: Rodrigo Suárez et al., "A pan-mammalian map of interhemispheric brain connections predates the evolution of the corpus callosum," *PNAS* (2018).

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Abstract

The brain of mammals differs from that of all other vertebrates, in having a six-layered neocortex that is extensively interconnected within and between hemispheres. Interhemispheric connections are conveyed through the anterior commissure in egg-laying monotremes and marsupials, whereas eutherians evolved a separate commissural tract, the corpus callosum. Although the pattern of interhemispheric connectivity via the corpus callosum is broadly shared across eutherian species, it is not known whether this pattern arose as a consequence of callosal evolution or instead corresponds to a more ancient feature of mammalian brain organization. Here we show that, despite cortical axons using an ancestral commissural route, monotremes and marsupials share features of interhemispheric connectivity with eutherians that likely predate the origin of the corpus callosum. Based on ex vivo magnetic resonance imaging and tractography, we found that connections through the anterior commissure in both fat-tailed dunnarts (Marsupialia) and duck-billed platypus (Monotremata) are spatially segregated according to cortical area topography. Moreover, cell-resolution retrograde and anterograde interhemispheric circuit mapping in dunnarts revealed several features shared with callosal circuits of eutherians. These include the layered organization of commissural neurons and terminals, a broad map of connections between similar (homotopic) regions of each hemisphere, and regions connected to different areas (heterotopic), including hyperconnected hubs along the medial and lateral borders of the cortex, such as the cingulate/motor cortex and claustrum/insula. We therefore propose that an interhemispheric connectome originated in early mammalian ancestors, predating the evolution of the corpus callosum. Because these features have been conserved throughout

mammalian evolution, they likely represent key aspects of neocortical organization

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