



The evolution of the frontal cortex in primates: what the sulcal organization tells us?



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Although the relative expansion of the frontal cortex in primate evolution is generally accepted, the nature of its scaling and inter-species anatomo-functional comparisons of the frontal areas remain controversial. Indeed, a large literature has emphasized the link between the extent of gyrification, the rapid expansion of the cerebral cortex, and the complexity of the computational processing performed in a given brain. Although important, these discussions of cortical gyrification have not considered another major dimension of sulcal pattern organization, i.e. its variability.

I present here results showing how the medial and the lateral frontal cortical sulcal organization has evolved through the primate order. By performing within- and across-species comparison of sulcal morphological variability based on neuroimaging anatomical scans, I provide evidences that both regions are comparable anatomically and functionally from Old World monkeys to Hominoidea, at the sole exception of the



ventrolateral prefrontal cortex. In this latter region, although chimpanzees display the precursor of the human ascending sulcus rostrally limiting Broca's area (Area 44), this precursor does not join the insula as in human. This lack of opercularization prevents the formation of the prefrontal extent of the frontal operculum, and consequently prevents the formation of the sulci featuring the pars triangularis and therefore the formation of a full Broca's complex. These discoveries, together with recent paleontological studies suggesting that the prefrontal operculum appears only in Neanderthals concomitantly with modern language abilities suggests that this region might be key to support speech functions.