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Expansion modes of primate nervous system structures in the light of the Prosomeric Model

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The expansion of human and non-human primate central nervous system structures has been a paramount question for classic and contemporary studies in comparative vertebrate neuroanatomy. These studies can benefit from framing data analysis within the Prosomeric Model, which defines a common Bauplan for all vertebrate species, including mammals. According to this model, the vertebrate nervous system is composed of several Fundamental Morphological Units (FMUs) that are defined and delineated by characteristic gene expression profiles. Thus, the expansion of neural structures can be traced back to heterochronic neurogenesis, cell lineage specification, and axon growth in their corresponding FMUs. In the present article, we exemplify the use of the Prosomeric Model as the proper theoretical framework for analyzing the expansion of the cerebral and cerebellar cortices, the pontine nuclei, the striatum, the nigrostriatal dopaminergic system, the thalamus, and the amygdala in primates compared to rodents. We describe the quantitative (volume and neuron number) and qualitative (cytoarchitectonic and cell type differences) expansion of these structures in primates versus rodents and define different expansion modes. Then, we relate these modes to the developmental primary events of specification and secondary events of histogenesis, like neurogenesis. We conclude that the systematic analysis of the molecular regulation of primary and secondary developmental events in each FMU in rats, primates, and other mammals could provide the necessary insight to identify the causal mechanisms of the expansion modes described in the present article.

KEYWORDS

genoarchitecture, columnar model, field homology, fundamental morphological unit, histogenesis, morphogenesis, cerebral cortex, rhombic lip

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