Chronological construction of telencephalic sensory processing circuits in amniotes

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The evolutionary origin of the neocortex is reflected in the early generation program of the pallium. The developmental novelties that triggered neocortical evolutionary formation can be now identified as events happening in the mammalian dorsal pallium. Here we present results of our group in the search of those divergent events by comparing the early developing pallium of mouse and chick. We focus on the neurogenic timing of pallial neurons.

Developmental events must maintain an equivalent timing in order to be considered homologous. Therefore, the chronological order in which the different neurons of the cortical circuit are born should be preserved in any cortical homologue of non-mammalian species. To test the homology the dorsal ventricular ridge, a suggested neocortical homologue in birds, we injected chick embryos with the thymidine analogue EdU at selected developmental timepoints. We describe the chronological generation of neurons at each of the nuclei of the visual and somatosensory pallial circuits. We researched the birthdate of both GABAergic interneurons and glutamatergic projecting neurons at the specific nuclei of the tri-synaptic pallial circuit: entopallium, dorsal nidopallium and arcopallium. Interestingly, interneurons and projecting neurons of each nuclei are generated synchronously, a feature common to mammals. However, we found that the neurons participating in the sensory circuit of the avian dorsal ventricular ridge were not generated in an equivalent order to that of the mammalian cortical canonical circuit. Essential divergences are 1) the birthdate of thalamic-recipient sensory neurons, which are the first ones generated in the avian circuit, and 2) the lack of contribution to the sensory circuit of the latest generated neurons. These crucial developmental differences suggest that both circuits are not derived from a common ancestor circuit, and their functional correlation could be a product of evolutionary convergence.