Mosaic evolutionary history of brain circuits through the lens of neurodevelopment

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Vertebrate brains display an astonishing variability at structural and functional level, supported by the greatest diversity of cellular types across nature. However, during early embryonic stages all vertebrate brains reflect the same morphological pattern, a unique template that unifies every brain. **How this embryonic brain, repeated across species, is capable of producing so many different adult brains?**

In the lab, we try to understand the divergent developmental processes in the common embryonic brain that produce brain diversity. Our lab enjoys the innovative merge of tools and theoretical frameworks from neurobiology, developmental biology and evolutionary biology.

Considering both the *homogeneity* of the early embryonic brain and the contrasting *diversity* of the mature brains, we hypothesize that the vertebrate brain circuits evolved as a mosaic: tightly preserving essential circuits and allowing creative divergence on association circuits. For this project, we aim to reveal the developmental program giving rise to several known circuits in the vertebrate brain, such as the cerebellum of the sensory pallium. By means of experimental embryology and single cell RNA sequencing on three selected amniote species (chick, gecko, mouse), I will show some brain circuits that are generated following a tightly conserved developmental plan throughout vertebrates. The neurogenic program responsible for the formation of the cerebellar circuit follows the same timing and rules in amniotes. But I will also show how other circuits, similar in structure and functionality across species, are built through divergent developmental programs. Neurogenic rules are not conserved in these circuits, a difference also reflected at the transcriptomic level of their neuronal components. I will present a provocative hypothesis on the mosaic evolution of brain structures, on which divergent, homologous and convergent circuits evolved simultaneously on different regions of the vertebrate brain.