Domestication by selecting for tameness increases adult hippocampus neurogenesis along the septo-temporal axis in fox

Huang S (1,2,3), Slomianka L (1), Farmer AJ (4), Kharlamova AV (5),
Gulevich RG (5), Herbeck YE (5), Trut LN (5), Wolfer DP (1,2,3), Amrein I (1,2)

(1) Institute of Anatomy, University of Zurich, Switzerland
(2) Neuroscience Center & Laboratory Animal Center, University of Helsinki, Finland
(3) Institute for Human Movement Sciences and Sport, ETH Zurich, Switzerland
(4) Roche Diagnostics International Ltd., Rotkreuz, Switzerland
(5) Institute of Cytology and Genetics of the Russian Academy of Sciences, Novosibirsk, Russia

Several earlier findings suggest that the regulation of adult hippocampal neurogenesis (AHN) might be modified during domestication. However, there is no laboratory rodent model which can allow us to compare the change of AHN in different degree of domestication. Here we compare AHN along the hippocampal septo-temporal axis in farm-bred silver foxes selected for tameness in comparison to unselected foxes. We used design-based stereological methods to estimate the numbers of proliferating cell (Ki67+) and young neurons (doublecortin, DCX+) in defined septal and temporal regions.

Higher neurogenesis is observed in tameness-selected foxes, notably in an extended subgranular zone of the middle and temporal compartments of the hippocampus. Increased neurogenesis is negatively associated with aggressive behavior. Across all animals, strong septo-temporal gradients are observed, with higher numbers of proliferating cells and young neurons relative to resident granule cells in the temporal than in the septal hippocampus. The opposite gradient is found for the ratio of DCX/ Ki67 positive cells. When tameness-selected and unselected foxes are compared to rodents and primates, proliferation is similar, while the number of young neurons is higher. The difference may be mediated by an extended period of differentiation or higher rate of survival.

In conclusion, our results indicate that selection of foxes for a single behavioral trait key to domestication, i.e. genetic tameness, is accompanied by global and region-specific increases in neurogenesis.