Development of GAD2 Expressing Cells in the Zebra Finch HVC during Critical Periods of Song Learning

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Learning is crucial to the adaptability of a species and is a behavior influenced by both innate and experiential factors. The learning of key behaviors like language is marked by critical periods, time frames in which experience has its peak influence on behavior. Exposure to adequate stimuli during these periods is necessary to the development of a behavior. To better understand the neurobiological mechanisms that accompany and/or facilitate critical periods, this study utilizes the zebra finch, a model organism that exhibits vocal learning critical periods. Due to the parallels between human and zebra finch vocal learning in both progression and circuitry and the presence of well defined brain nuclei that control singing behavior in the zebra finch, these songbirds are ideal for a vocal learning study. The HVC is an important nucleus in the songbird brain that connects the two brain pathways that control song learning/behavior. In situ hybridization was used to label the primary neurons in the HVC so that development of these cells could be tracked. An analysis of HVC cell data vs. age revealed increases in average cell size and significant decreases in cell density within the HVC, with the most drastic changes occurring between two major critical periods of learning. The time frame of these developmental changes suggests that HVC neuron development plays an important role in mediating the transition between critical periods of learning. This study identifies a developmental mechanism that influences the facilitation of critical periods in zebra finches. Understanding the mechanisms that govern learning in finches can provide insight to the neurobiology behind learning in humans and could potentially aid in the future treatment of learning/memory disabilities.

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