Title:

Efferent Neural Activity Regulates Adult Neuronal Recruitment in the Avian Song Control System

Author Block: For posters, generally the presenter will go first, though not always. Underline the presenter.

Tracy A. Larson[1], Nivretta Thatra[1], Karin L. Lent[2], Eliot A. Brenowitz[1,2], Tsu-Wei Wang[3]

Affiliations: Your major's department and the department you work within (PI/mentor's Department(s))

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Text: Aim for 250 - 300 words - don't add filler to bring to 250 words, if can write in less.

Sentence on broad area and importance to audience to draw in readers.

The ongoing birth, migration, and incorporation of neurons into functional neural circuits in the central nervous system of higher vertebrates is a fundamental process of adult neural plasticity.

Sentence on question and importance of question - why critical to ask question.

Given the importance of neural plasticity, it is imperative to understand the mechanisms by which new neurons are integrated into functional neural circuits.

Broad sentence on why chose system you use for asking question.

These mechanisms are best studied in live organisms that perform a discrete, quantifiable behavior under regulation of a plastic, well-characterized neural circuit.

Sentence or two on background - critical information about your system leading to experiment.

The production of song by songbirds provides such an opportunity: song is a learned sensorimotor behavior that is important for territory defense and mating courtship in songbirds and is under the control of a discrete neural circuit that includes HVC (formal name) and its target, the robust nucleus of the arcopallium (RA). New neurons are continuously incorporated into HVC and send functional projections to RA.

Your "problem" (generally a gap in the field that you will fill) and specific hypothesis.

However, very little is known about the role that electrical activity in post-synaptic target neurons plays in the integration of newly born afferent neurons into an existing circuit. We hypothesize that electrical activity in the robust nucleus of the arcopallium regulates functional neuronal incorporation into HVC.

Main results in one to two sentences. Set up sentences to include methods and results.
We show that the recruitment of new neurons to HVC is dramatically altered by manipulating the electrical activity of neurons in the robust nucleus of the arcopallium, to which these neurons project. Decreasing neural activity in the robust nucleus of the arcopallium with intracerebral infusions of muscimol decreased the density of adult born neurons in HVC by forty-eight percent.

Sentence on conclusion and importance of results.
Our results establish the remarkable effects of electrical activity on neurogenesis at the level of a functional neural circuit.

Examples

For Society for Neuroscience 2014:

Efferent Neural Activity Regulates Adult Neuronal Recruitment in the Avian Song Control System

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The ongoing birth, migration, and incorporation of neurons into functional neural circuits in the central nervous system of higher vertebrates is a fundamental process of adult neural plasticity. Given the importance of neural plasticity, it is imperative to understand the mechanisms by which new neurons are integrated into functional neural circuits. These mechanisms are best studied in live organisms that perform a discrete, quantifiable behavior under regulation of a plastic, well-characterized neural circuit. The production of song by songbirds provides such an opportunity: song is a

learned sensorimotor behavior that is important for territory defense and mating courtship in songbirds and is under the control of a discrete neural circuit that includes HVC (formal name) and its target, the robust nucleus of the arcopallium (RA). New neurons are continuously incorporated into HVC and send functional projections to RA. However, very little is known about the role that electrical activity in post-synaptic target neurons plays in the integration of newly born afferent neurons into an existing circuit. We hypothesize that electrical activity in the robust nucleus of the arcopallium regulates functional neuronal incorporation into HVC. We show that the recruitment of new neurons to HVC is dramatically altered by manipulating the electrical activity of neurons in the robust nucleus of the arcopallium, to which these neurons project. Decreasing neural activity in the robust nucleus of the arcopallium with intracerebral infusions of muscimol decreased the density of adult born neurons in HVC by forty-eight percent. Our results establish the remarkable effects of electrical activity on neurogenesis at the level of a functional neural circuit.

For Janelia Farm Conference on Evolution of Behavior 2015:

The evolution of adult neurogenesis: the neural and behavioral consequences of genetic changes in threespine stickleback

T.A. Larson[1,2], F. Orji[1,3], C.L. Peichel[1]

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The addition of new neurons to adult neural circuits is a fundamental process of neural plasticity. However, despite decades of research, the functional role of adult-born neurons still remains elusive. With the aim to eventually identify 'the purpose' of adult-born neurons, we are integrating comparative neuroethological, behavioral genetic, and evolutionary approaches to broadly ask: How do differing spatiotemporal patterns of adult neurogenesis arise across sexes, populations, and species? And, can we exploit the diversity in these spatiotemporal patterns to uncover both ultimate mechanisms and the behavioral consequences of adult neurogenesis? The threespine stickleback complex (*Gasterosteus aculeatus*) provides a unique opportunity to address these questions. Following the last great ice melt (~13,000 years ago), stickleback expanded from marine

environments to fresh water ecosystems including streams and ponds. Adaptations to these environments include morphological changes within and outside of the nervous system, as well as behavioral changes in aggressive, feeding, social and reproductive behavior. We can exploit these differences in morphology and behavior to ask how specialized behavior arises from changes in the genetic and developmental patterning and plasticity of the nervous system. More specifically, we will use both forward (i.e. qualitative trait loci mapping) and reverse (i.e. candidate gene) genetic approaches to identify genomic regions and genetic changes that underly divergence in neural patterning, adult neurogenesis, and behavior among stickleback populations adapted to different ecological habitats. We are currently developing methods to analyze general brain morphology and cytoarchitecture, adult neurogenesis, and sensory system sensitivity and acuity. Our results will provide insight into the genetic changes associated with differing spatial and temporal patterns of adult neurogenesis and behavior. More broadly, identifying ultimate mechanisms of adult neurogenesis in stickleback will provide a transformative framework for the field of adult neurogenesis to ask questions about the evolutionary origins and purpose of adult neurogenesis.

For UW Undergraduate Research Symposium 2005:

Circadian Rhythmicity in Crustaceans

Tracy Larson, Senior, Neurobiology; Cell, molecular and developmental biology; and Psychology, Mary Gates Scholar

Mentor: Horacio de la Iglesia, Department of Biology

Circadian rhythms are biological oscillations with a period close to 24 hours that are synchronized to the solar day. The neural structures and molecular pathways underlying circadian rhythmicity have been studied in several species including Drosophila. The basic molecular clock mechanism relies on feedback loops of transcription and translation of the so-called clock genes, which result in the circa-24 hour oscillation of these genes' products. Intertidal crustaceans exhibit both circadian and circatidal rhythms, namely biological oscillations with a period close to the tidal cycle and synchronized to tides. However, the neural structures and molecular pathways underlying these rhythms in crustaceans are poorly understood. The main goal of my research project is to unravel the molecular and neural basis of circadian and

circatidal rhythmicity in intertidal crustaceans. Using reverse transcriptase-PCR with degenerate primers based on the sequence of clock genes of Drosophila and other invertebrate species, I was able to clone a 500 bp fragment of a homolog of the clock gene timless (tim) in two crab species *Cancer productus* and *Hemigrapsus nudus*. Using a polyclonal antibody against the Drosophila gene's peptidergic product, TIM, I have been able to identify a cluster of two to five neurons within the crab brain that show TIM-like immunoreactivity. I am currently studying tim expression within the brain using whole mount in situ hybridization targeted to the mRNA. I am also seeking the cloning of three other putative crustacean clock genes. My long-term goal is to study the spatial and temporal patterns of expression of these genes' products in the central nervous system of the crab. The characterization of the components of the circadian system of intertidal crustaceans will provide new tools for the study of biological timing, and will represent the first step toward the understanding to the biological basis of circatidal rhythmicity.