Characterization of the circuits mediating innate reproductive and defensive behaviors from the amygdala to the hypothalamus

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To Him, my rock and my strength

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ABSTRACT

All metazoan organisms must reproduce and defend themselves in order to survive as individuals and as a species. These innate behaviors are so crucial that they are "hard-wired" into the brain during the animal's development. They are also released primarily by the olfactory stimuli detected by the AOB, which synapses into the MEA. The MEA in turn projects to the medial hypothalamic behavior control column, which contains a series of nuclei orchestrating either reproductive or defensive behaviors. These amygdalar-hypothalamic projections are topographically organized, and the sub-circuitries controlling reproduction and defense are segregated both functionally and anatomically.

The topographically organized projections suggest that these neural pathways for reproduction and defense are likely genetically determined, but genes that might control their wiring have not yet been identified. Such a parallel circuit organization with very few cross-talks between the two sub-circuits also poses the problem of how rapid decisions between competing reproductive and defensive behaviors are made by organisms faced with conflicting cues.

Using oligonucleotide microarrays and laser-capture microdissection, I identified that several LIM homeodomain transcription factors mark different regions of the MEA involved in either reproductive or defensive behaviors. I have characterized the projections of these neurons to the hypothalamus, using both genetically encoded anterograde and traditional retrograde tracers. I have also carried out behavioral experiments to assess their differential activations by reproductive and defensive stimuli.

My results indicate that *Lhx6* delineates a reproductive pathway, which involves neurons in both MEApd and BSTpr, and their projections to the three reproductive nuclei in

the hypothalamic medial behavioral control column (MPN, VMHvl and PMv). Further analysis reveals, counter-intuitively, that VMHvl receives inhibitory projections from this reproductive pathway, and a convergent excitatory projection from neurons in MEApv that are activated by a predator odor. The results suggest that this point-of-convergence may serve to “gate” the expression of reproductive behavior, under conditions where animals are exposed to threatening stimuli. Thus, my data identifies a potential neural substrate within the hypothalamus for controlling behavioral decisions in the face of conflicting cues and a transcription factor family that may contribute to the development of this substrate.

TABLE OF CONTENTS

LIST OF TALBES AND ILLUSTRATIONS

Appendix