Investigating the co-localization of ERB in the retina of *Carassius auratus*

Shanna Yue, 2016

Sex steroid hormones play an important role in modulating behavior and sensory processing in animals. Traditionally, these steroids are thought to act in a genomic mechanism by binding to receptors, moving into the nucleus, and then affecting gene expression and protein synthesis. This process can take up to hours or days before behavioral changes are observed. Recently, it has been shown that sex steroid hormones can also elicit rapid (within the hour) changes in behavior by binding to receptors on cell membranes and activating second messenger pathways. Downstream effects can then go on to affect cell physiology and ultimately influence behavior. Due to the short time course involved, this non-genomic mechanism allows sex steroid hormones to play a dynamic role in behavioral regulation in a wide variety of species.

These rapid effects are seen in our model organism, the common goldfish (*Carassius auratus*). Two sex steroid hormones in particular, estradiol and testosterone, elicit rapid behavioral changes in male goldfish when they are placed in a reproductive context. In males, an injection of estradiol (E2) increased approach responses towards the visual cues of females within 30-45 minutes. This same effect was seen with an injection of testosterone (T). However, treatment with the aromatase inhibitor fadrozole blocked T’s behavioral effect, which indicates that testosterone may be acting through its aromatization into E2. (Lord et al, 2009). These rapid behavioral changes suggest that sex steroid hormones are acting through a non-genomic pathway, modulating visual processing. The retina, a key area of visual processing, has been shown to contain high levels of aromatase, the enzyme that converts testosterone to estradiol. Additionally, ERβ, one type of estrogen receptor, is present in non-nuclear processes in the retina, suggesting a non-genomic mechanism.

My research this summer has focused on further characterizing the presence of ERβ in the retina and looking for co-localization of ERβ with other proteins, which may give us insight into how estradiol is working to affect visual processing. Via immunohistochemistry, non-nuclear ERβ was found to be co-localized with Muller cells running through the ganglion cell layer up into the inner nuclear layer. During the academic year, we will use antisense knockdown techniques to confirm that the signal is real. I am also looking at whether or not testosterone increases neuronal activity in the retina of male goldfish when they are exposed to the visual cues of females, using the c-fos protein as a marker for neuronal activity. I will be able to see where in the retina testosterone may be having its effects, and the types of cells on which testosterone could be acting. I expect to see more c-fos expression in males injected with testosterone compared to males that are injected with the control, as testosterone may be increasing sensitivity within visual pathways that consequently leads to rapid behavioral changes. I will continue to process and analyze this data during the upcoming academic year.

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**References**