Rapid Effects of Androgens on Behavior of Carassius auratus
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Project Summary:

This summer, I investigated the role of androgens on the behavior of the common goldfish, *Carassius auratus*. Steroids are known for their slow, genomic mechanisms in the body to impact physiological and behavioral changes. More recently, the rapid effects of steroids on behavior have been studied, and found to have an impact on social behavior as well. The steroid testosterone (T) is utilized by the body in two different ways. It can either be aromatized - which means it is converted to estrogen and works on estradiol receptors - or it can act directly upon androgen receptors. Rapid estrogenic effects have been extensively studied and shown to work on the visual system, while emerging data points to rapid androgenic effects playing a role in the olfactory pathway. This summer, I investigated just how androgens may be rapidly influencing behavior in goldfish with regards to an olfactory input. In my design, I used the pheromone 15 keto-PGF2α, which has been found in the urine of female goldfish and results in courtship behavior from males (Appelt et al., 2007). I used a plus-shaped tank to test the fish in, with one quadrant designated as the target quadrant containing the pheromone. Ten minutes before the test, I fed each fish a pellet coated with either T or ethanol (EtOH). I then transferred them to the testing tanks where they habituated for 30 minutes. After 30 minutes, I began recording their activity with Limelight tracking software, and at the 45 minute mark, turned on the switch for the pump to infuse the pheromone. Afterwards, their times spent in the target quadrant for the 30-45 minute and 45-60 minute mark were compared.

I designed a pump system that would pump water into 3 of the 4 quadrants, and one that would pump the pheromone into the target quadrant, in order to create a water flow that limited the spread of the pheromone to the other quadrants. There was also a drain in the center of the tank to keep the water flow constant. This design was tested with a food-color test to mimic the pheromone’s path, as well as a food odor experiment. In the food odor test, fish tended to spend more time in the target quadrant, where food odor was being pumped in (p<0.05).

When the pheromone test was performed, however, the flow of water and change in water levels throughout the experiment interfered with tracking, so I switched to a non-pump system, reducing the amount of pheromone pumped into the tank. I also added a visual stimulus, green yarn in 2 of the quadrants (the target quadrant included), because fish did not seem to be responding to the pheromone. When this experiment was performed, we found that fish treated with T decreased the amount of crosses between quadrants (a measure of activity). Usually, the presence of PGF2alpha increases activity (Lord et al., 2009). Thus, the fish may have been spending more time in the 2 quadrants with the yarn, or the dose of T was too high, which may have shut down sensitivity to pheromone. Further tests should investigate this effect using various doses of T.

Blood was drawn from the fish after each experiment, which is available to test in the future. This is important because although hormone levels have been measured in other fish after eating a T-coated pellet before, it has yet to be done in goldfish.

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References
