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Hormones, Neuropathways, and African Clawed Frogs

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Dr. Carr is a Professor in Biological Sciences, with an emphasis in Endocrinology. He has devoted over 30 years to research in neuroscience and endocrinology. His work focuses on hormone modulation and stress and behavioral responses.

Many factors affect human reactions to specific situations including hormone production and learned behavior. These reactions may occur consciously or subconsciously. Dr. James Carr, Professor in Biological Sciences, in collaboration with Dr. Breanna Harris, Research Assistant Professor in Biological Sciences, are studying *Xenopus laevis*, African Clawed Frogs, to determine how hormones affect sensory pathways for feeding.

X. laevis are fully aquatic African frogs that have an interesting way of viewing the world around them. Like all frogs, *X. laevis* do not see things consciously as humans do, but rather observe shapes, sizes and movement and react accordingly. Dr. Carr and Dr. Harris are working to obtain a better understanding of the hormones and neuropathways that modulate how the frogs observe objects subconsciously. "If you see a cookie on the counter you know it is a cookie. If the fire alarm goes off and the cookie is sitting on the counter, you know it is there, but may not see it," Dr. Carr illustrates. This is how *Xenopus* perceive the world through subconscious vision and innate instinct.

Testing the frogs in various situations allows Dr. Carr and Dr. Harris to determine the controlling center of food regulation and predator avoidance. Dr. Carr explains, "*Xenopus* cannot move their eyes to track an object. They must move their body and orient themselves accordingly." African Clawed Frogs not only use vision, but sense vibration changes using lateral lines, visible sensory organs along the sides of the frog. These lateral lines alert the frogs, but it is the subconscious vision that signals if the object is prey or predator. This is also achieved by the size and placement of the object around the frog. If an object is smaller and in front of the frog, this is naturally observed as prey. If an object is larger and above the frog, this is perceived as a predator. This innate response is sensed by a combination of lateral line sensations and the subconscious visual observations of the frog.

Behavioral assays test the frog's responses and movements, but corticotrophin releasing factor, CRF, also plays a vital role in stress responses. If the frog sees an object as a predator, it may reduce its movement and CRF levels will increase. "By measuring response times and body movements, we can gather more information about which pathways they use," expresses Dr. Harris. The current research will allow insight into the separation of hormone regulation and physical responses as well as the extent to which CRF modulates food intake.

CRF is produced in visual areas of the brain coordinating prey detection and predator avoidance. This study, in turn, may open doors to multiple mental health disorders caused by either trauma or genetic mutations. Kluver-Bucy Syndrome is one such mental health disorder where the normal fear processing responses are not expressed or processed due to either trauma or lesions on the fear processing and visual brain areas. Additionally, CRF regulation may also be linked to eating disorders such as bulimia and anorexia. This connection may be essential in brain mechanisms from frogs to humans.

Drs. Carr and Harris were awarded a grant from the National Science Foundation totaling $608,000 to carry out this research. Dr. Carr received an award of $156,110 and Dr. Harris received $76,890, for a total of an initial award of $233,000. The remaining award amount will be dispersed over the next two years. "This research will begin the process of building a bridge between studies on the neural basis of feeding and the adaptive behavior that lies at the heart of ecological tradeoffs," Dr. Carr advises. This grant will allow advancements in the fields of neuroscience and endocrinology in both food modulation and mental health disorders.

Neurology and behavior go hand in hand when it comes to researching food modulation, yet there is still a vast amount of knowledge that is yet to be explored. *X. laevis* hold many answers within the comparatively petite bodies that leave scientists curious to discover more. Drs. Carr and Harris believe that armed with responses from these trials, further breakthroughs and discoveries involving neuropathways and CRF regulation will open doors for tracing mental health and eating disorders.