Brain regulates initial stages of sex change in social fish

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New findings about how the brain enzyme aromatase influences sex change in social goby fish could help explain the complex interaction among the brain, physiology, and behavior that forms the biological basis of human sexual identity.

While changing sex from female to male, the highly social bluebanded goby becomes more aggressive. At the same time, the conversion of testosterone to estrogen slows in the brain, but is unaffected in the changing gonads, according to a Center for Behavioral Neuroscience (CBN) study in the current on-line edition of Proceedings of the Royal Society B. The finding, which suggests the initial stages of sex change in fish are regulated in the brain, could help better explain the biological basis of human sexual identity.

Like many fish species, the bluebanded goby switches sex in response to changes in its social environment. In a socially stable group, removal of the dominant male typically results in the dominant female changing sex to fill the void. During this process, the female experiences an array of behavioral changes and the transformation of her sex organs to male.

In the study, CBN researcher and Georgia State University biology professor Matthew Grober, PhD, CBN and Georgia State post-doctoral fellow Michael Black, PhD, and researchers Jacques Balthazart, PhD, and Michelle Baillien, PhD, of the Center for Cellular and Molecular Neurobiology at the University of Liege in Belgium, attempted to determine the correlation between behavior and sex hormone conversion

in four groups of gobies: a control group of females; a control group of males; dominant females who were beginning to change to males; dominant females who recently changed sex to males.

The researchers measured the activity of aromatase, an enzyme that converts testosterone to estrogen, in the gonads and the brain. Previous studies have implicated aromatase in sexual development in a variety of vertebrates, including humans. The researchers found that dominant, sex-changing females and recently sex-changed males had lower brain aromatase levels than control females. Control males had the lowest brain aromatase levels and lower gonadal aromatase levels than all groups, except the sex-changing females.

In response to the removal of dominant males from their social groups, sex-changing females displayed more aggressive behavior that corresponded with lower brain aromatase levels. Fish with the lowest brain aromatase levels had the greatest relative increase in aggressive behavior.

"Our finding suggests social cues rapidly initiate the sex change process in the brain which eventually influences behavioral and gonadal transformation," said Grober.

The researchers' next step is to determine whether aromatase activity affects aggression or aggression influences aromatase activity. "This study shows us that sexual identity involves a complex interplay among the brain, physiology and behavior," said Grober. "If you accept sexual variation is a part of the normal human condition, we can ask questions in fish that may tell us more about who we are." CBN, a National Science Foundation (NSF) Science and Technology Center, is a research and education consortium of eight metro Atlanta colleges and universities, including lead institution Georgia State University, Emory University, Georgia Institute of Technology and the five institutions of

the Atlanta University Center (Morehouse College, Morehouse School of Medicine, Spelman College, Clark Atlanta University and Morris Brown College). More than 90 neuroscientists lead the research program to understand the neurobiology of complex social behaviors. CBN studies have led to a breakthrough treatment for anxiety-related disorders and new understanding of the neural basis of social bonding between animals. In addition to research, CBN has a comprehensive education program designed to improve science literacy and attract more women and underrepresented minorities to neuroscience programs. The center is supported by more than $53 million in grants from NSF and the Georgia Research Alliance.

Source: Emory University Health Sciences Center