

Enforcement of female-specific parenting behavior in cichlid fish by pheromone and androgen signaling

Summary:

Parental behavior is found across numerous clades of invertebrates and vertebrates, suggesting that the control mechanisms have deep evolutionary origins. Significant progress has been made in identifying genes, hormones, and neurons that regulate parental care in rodents, but the vertebrate bauplan for parenting circuits, and the evolutionary changes that lead to variations in its function, remain elusive. Cichlid fish exhibit very high levels of parental care, but across their ~2000 species the behaviors vary in form, extent, and sex of caregiver. We have used molecular approaches to understanding cichlid behavior, including CRISPR gene editing and transgenesis. We find that olfaction plays a central role in enforcing female-only care in which cichlids carry developing offspring in the mouth for ~2 weeks. We discovered a specific pheromone receptor that drives avoidance of mouthbrooding, and males lacking this receptor initiate care. In addition, a cichlid species in which males provide care carries a mutation in this receptor, indicating that both sexes have circuits for parenting, but evolution of olfactory signaling regulates the parenting strategy. These circuits for parental care are also regulated by gonadal hormone signaling: males in which androgen receptor beta signaling is disrupted also exhibit parental care. These results suggest that androgens alter the processing of olfactory information that guides parental care decisions, enabling the flexible expression of behavior across sex and species.