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SYMPOSIUM INTRODUCTION

Symposium Overview: Integrating Cognitive, Motivational, and Sensory Biases Underlying Acoustic- and Multimodal-Based Mate Choice

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From the symposium "Integrating Cognitive, Motivational and Sensory Biases Underlying Acoustic and Multimodal Mate Choice" presented at the annual meeting of the Society for Integrative and Comparative Biology, January 4–8, 2017 at New Orleans, Louisiana.

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Synopsis The goal of this symposium "Integrating Cognitive, Motivational and Sensory Biases Underlying Acoustic and Multimodal-Based Mate Choice" was to build a more complete framework in which to understand the mate choice brain. The presentations and papers within this symposium incorporate studies of motivational, cognitive, sensory and salience components of mate choice and highlight future directions that are needed to understand the biological basis of mate choice decision-making.

Mate choice is often studied in the context of the sensory and learning biases that guide female decision making (ten Cate and Rowe 2007). It is becoming increasingly clear, however, that social behaviors in vertebrates are guided by diverse neural processes and pathways, of which sensory and learning components are only a piece of the larger puzzle. The underlying mechanisms of any social behavior (and mate choice is no exception) can be compartmentalized into four overlapping processes: sensory, cognitive, salience, and motivational. Our symposium "Integrating Cognitive, Motivational and Sensory Biases Underlying Acoustic- and Multimodal-based Mate Choice" was held to explore how these processes relate to how females choose mates. The resulting articles in this issue cover each of these categories and how they are involved in mate choice with the aim to integrate the neural processes underlying each of these mechanisms to build a framework in which to understand the mate choice brain. This issue also highlights necessary future directions such as the need to understand the neurobiological basis of mate choice in multimodal signaling contexts which will help move this field into developing a fully comprehensive framework describing the female mate choice brain. We focus on cognitive, motivational, salience assignment, and sensory processes that underlie mate choice with the distinct aim of understanding these processes not as modular systems but as a set of interacting processes that function together as part of an integrated phenotype in a mate choice context. Our goal is to build a comprehensive framework in which to understand the neural, hormonal, and behavioral mechanisms underlying decisions made with respect to mates and to identify future research directions in this interdisciplinary area of integrative biology.

Sensory, cognitive, salience, and motivational components of the mate choice brain will be discussed by each of the participants in our symposium. In this issue, sensory processing will be discussed by Sockman and Lyons in "How Song Experience Affects Female Mate-choice, Male Song, and Monoaminergic Activity in the Auditory Telencephalon in Lincoln's sparrows" as well as by Tomaszycki and Atchley in "Pairing Increases Activation of V1aR, but not OTR, in Auditory Regions of Zebra Finches: The Importance of Signal Modality in Nonapeptide-Social Behavior Relationships". Peterson and Hurley will also discuss how sensory information is

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integrated in a context-dependent manner in "Putting it in Context: Linking Auditory Processing with Social Behavior Circuits in the Vertebrate Brain". Motivational processes that underlie female mate choices are also discussed in this issue. Burmeister will demonstrate responsiveness of hypothalamic regions such as the preoptic area to male communication signals in "Neurobiology of Female Mate Choice in Frogs: Auditory Filtering and Valuation". Thus, understanding mate choice requires integration of neural and endocrine mechanisms of sensory, cognitive, and reproductive systems with ecology and evolution, one of the grand challenges of modern biology.

In many ways, the cognitive processes that underlie mate choice and the way in which females assign salience to signals are the least well studied components of the mate choice brain. This is because the primary focus of cognitive processes involved in mate choice is on learning and experience-dependent plasticity. There are countless examples of learning-dependent plasticity in mate choice across vertebrates (Jennions and Petrie 1997); however, learning is not the only cognitive mechanism that underlies female mate choice responses. Yet, most behavioral and neuroethological studies focus on this aspect of cognition. Additional cognitive processes with a clearly established role in mate choice include: selective attention, arousal, vigilance, memorability, and signal categorization. The neurobiological basis of these cognitive processes in the context of mate choice is discussed by Lynch in "Understanding Receiver Psychology in Reproductive Contexts" and by Kavaliers and Choleris in "Social Cognition and Neurobiology of Rodent Mate Choice" as well as by Forlano et al. in "Attention and Motivated Response to Simulated Male Advertisement Call Activates Forebrain Dopaminergic and Social Decision-Making Network Nuclei in Female Midshipman Fish". The way in which breeding females define salience or valence of signals is the final component of mate choice discussed in our symposium. The incentive salience category is the process by which signals associated with reward are transformed into highly desirable, attractive targets that command attention and stimulate pursuit (Berridge and Robinson 1998; Berridge 2007). These processes are a combination of motivational and cognitive processes. These will be discussed by Rodriguez in "To Become Senders, Songbirds must be Receivers First" and by Spool, Jay, and Riters in "Associations between Environmental Resources and the 'Wanting' and 'Liking' of Male Song in Female Songbirds".

Most studies of the neural basis of mate choice frequently present unimodal courtship signals, which only provides a partial picture of the mate choice brain. By presenting female receivers with the full suite of male courtship signals including acoustic, olfactory, tactile, and visual displays, we can build a comprehensive neural network that underlies decision-making in reproductive contexts. The framework presented by Lynch "Understanding Receiver Psychology in Reproductive Contexts" and by Hoke, Shizuka, and Hebets in "Neural Circuitry for Target Selection and Action Selection in Animal Behavior" provides a basis to formulate testable hypotheses concerning the neural basis of receiving multimodal signals. By examining the neural targets of each component of the signal, it is possible to build a comprehensive network of brain regions that underlie mate choice and understand how this network responds to neuromodulators in such a way as to wholly transform females into a state of heightened sexual motivation, altered sensory perception, and improved cognitive processing, including attention and memory. In this issue, Taylor et al. will discuss the importance of multimodal signaling in "Perceived Synchrony of Frog Multimodal Signal Components is Influenced by Content and Order".

Combined, the papers following from our symposium provide a rich overview of current research on how the brain carries out the task of making decisions in reproductive contexts based on auditory and multimodal mating signals. This task—mate choice—is critical for fitness, and depends on the integrated coordination of cognitive, motivational, salience assignment, and sensory processes by the brain. More importantly, the papers following from the symposium provide a blueprint for future integrative studies of mate choice. Traditional approaches to the study of mate choice that examine only sensory or learning biases in isolation of other neurocognitive processes have likely reached an asymptote in the production of new perspectives on mate choice behavior. Future advances will depend on an integrated approach that considers multiple neurocognitive processes of the social brain, as we have highlighted here. Such an integrated approach will be required to link molecular and genomic advances with studies of the ecology and evolution of mate choice behavior and resultant evolution by sexual selection.

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