Shining a light on the effects of habituation and neural adaptation on the evolution of animal signals

February 29 2024, by Mallory Gevaert

Credit: Pixabay/CC0 Public Domain

A new paper published in *The Quarterly Review of Biology* examines the possible effects of two properties of receiver playing fields documented

in studies of animal psychology—habituation and neural adaptation—on the efficacy of mate choice signals.

In "A Bridge between Animal Psychology and Sexual Selection: Possible Effects of Habituation and Neural Adaptation on Mate Choice Signals," William G. Eberhard notes that researchers have paid little attention to habituation and neural adaptation in relation to sexual selection.

Eberhard argues in favor of adding further dimensions to studies of female choice, noting that standard procedure has been to ask whether the female responded more to one male signal than to another.

Eberhard says, "It seems inevitable that differences in female responses are often due to female mechanisms of analyses of signals that are the result of properties of her sense organs and her nervous system." He writes that in order to understand the evolution of mate choice signals, it is necessary to ask, "Which properties?"

The paper describes the mechanisms as likely bias selection by female choice. It presents evidence of their importance in tactile courtship, noting that habituation and neural adaptation likely favor variation in mate choice signals such as their intensity, duration, and timing.

The multiplicity of mechanisms affecting habituation and neural adaption may help explain the general evolutionary trend for male mate choice signals to diverge rapidly. Avoidance of female habituation and sensory adaptation may explain the previously unremarked but widespread trend in vertebrates and arthropods for male genitalia to make rhythmic, repetitive movements during copulation.

"The central question here is not whether habituation and neural adaptation occur in female responses to male mate choice stimuli (the answer is surely yes); rather it is what effects they may have had on the

evolution of these signals, and how strong and widespread these effects may have been," Eberhard writes.

The paper presents a summary of the current knowledge of habituation and neural adaptation from animal psychology, emphasizing the aspects that seem most likely to be important for understanding sexual selection on male courtship signals before going into ways in which sexual selection on mate choice signals might favor particular male and female adjustments to female habituation and neural adaptation.

It examines how empirical observations (and lack of observations) of a "widespread but hitherto puzzling trend" in somatosensory stimulation during copulation can be explained by male adaptations to reduce female habituation and neural adaptation.

Because sexually selected signals show a clear pattern of rapid divergent evolution relative to other traits, Eberhard emphasizes the complexity of the mechanisms that produce habituation and neural adaptation, "because greater complexity in mechanisms probably promotes greater evolutionary variation and diversity; increased complexity in mechanisms is likely to be often associated with an increased variety of alternative mechanisms to achieve the same result."

There is also an emphasis in the paper on the need to include the effects of female "playing field" traits to address the problem of overly simplified, typological concepts that fail to reflect more complex biological realities accurately. Eberhard suggests that simplistic, typological discussions of animal signals in models of sexual selection should be modified to include how a female's reception and analysis of male stimuli affects the female's responses to his signals, and thus more closely approximate biological reality.

More information: William G. Eberhard, A Bridge between Animal

Psychology and Sexual Selection: Possible Effects of Habituation and Neural Adaptation on Mate Choice Signals, *The Quarterly Review of Biology* (2024). DOI: 10.1086/729257