Research on adaptation, evolution should consider life-history trade-offs alongside organism performance capacities

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For nearly 40 years, one of the cornerstones of the study of adaptation has been the examination of "whole-organism performance capacities"—essentially, measures of the dynamic things animals do: how fast they can run; how hard they can bite; how far, fast, and high they can jump; and so on. Together, these functional attributes determine the performance of a species' ecology: the types of food one can eat; the ability to capture or locate prey; the ability to avoid predation; the ability of males to intimidate or, in some cases, prevent rival males from invading a territory; and many more.

Because whole-organism performance capacities are so integral to survival and fitness, performance has been extremely well studied. Such studies have generally been performed within the context of a theoretical framework called the ecomorphological paradigm, which states that an organism's whole-organism performance abilities (1) are affected by the organism's morphology and (2) affect that organism's fitness. The ecomorphological paradigm has been very successful as a heuristic guide for studying performance, but it is a relatively simple framework that leaves out a lot of important details about how performance is determined and evolves.

An organism has a finite pool of acquired energetic resources that it can invest in specific phenotypic traits, and so it cannot invest optimally in everything simultaneously. As a result, trade-offs in phenotypic trait expression occur at different stages of the organism's life history, where investment in certain traits is prioritized over investment in others. In the December 2014 issue of *The Quarterly Review of Biology*, Simon Lailvaux (University of New Orleans) and Jerry Husak (University of St. Thomas) posit that in order to get a more complete picture about the evolution of performance, an examination of whole-organism performance capacities must include a consideration of an organism's life-history trade-offs.

In their article, Lailvaux and Husak demonstrate that whole-organism performance capacities are subject to life-history trade-offs with other key determinants of fitness such as immunity, fecundity, behavior, and sexual signaling, and even with the expression of other kinds of whole-organism performance traits. They develop and suggest an extended ecomorphological paradigm that takes these trade-offs, as well as the integrative and multivariate nature of many kinds of performance, into account. They highlight studies that have adopted this life-history perspective on performance, and they show that this approach holds significant promise for understanding both the ecology and the evolution of performance traits. They also highlight specific aspects of the study of performance they believe deserve more attention in this regard, and they suggest several lines of future research likely to yield further insight into the nature of performance evolution.

More information: S. P. Lailvaux and J. F. Husak, "The Life History of Whole-Organism Performance." The *Quarterly Review of Biology* v89n4 (December 2014), pp. 285–318.
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