Evolutionary explanation for why some lessons more easily learned than others

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It's easy to guess why it doesn't take long to learn to avoid certain behaviors and embrace others. But how do we know what drives these predilections? A study led by Aimee Dunlap at the University of Missouri-St. Louis, and co-authored by University of Minnesota researcher David Stephens, offers insight into the evolutionary underpinning of animals' innate ability to quickly absorb critical life lessons.

Animals are flooded with stimuli, but survival often depends on their ability to form specific associations that enhance fitness while ignoring others entirely. Psychologists have a name for it: the Garcia Effect. In the 1960s, John Garcia showed that rats are primed to learn certain associations (taste and illness) and not others (light and illness).

"Different learning abilities evolved in different environments, and we had a hypothesis about how that should happen," says Stephens. "What we wanted to know the general properties that cause natural selection to favor some learned associations over others."

Dunlap and Stephens tested their hypothesis using techniques associated with experimental evolution. "Experimental evolution is different than artificial selection," says Stephens. Instead of selecting for specific traits, the idea is to create specific environments and ask whether they generate selection in the predicted way.

By testing their hypothesis over 40 generations of fruit flies in

environments designed to evoke specific associations (between quinine and color or odor). They were able to produce some populations of flies who learned quinine-color associations, and others who learned quinine-odor association. This confirmed the hypothesis that statistical reliability across many generations of selection determines what animals can learn and what they can't.

"We're coming to know quite a lot about the underlying neural and molecular biological mechanisms that cause associations to form," says Stephens. "If you know odor makes a stronger association for this population and color for that population, that raises a really interesting mechanistic question of what's happening inside the neural systems of these flies—how these different learning abilities arise."

More information: The study was published online in the *Proceedings of the National Academy of Sciences* July 28.

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