Stay complex, my friends

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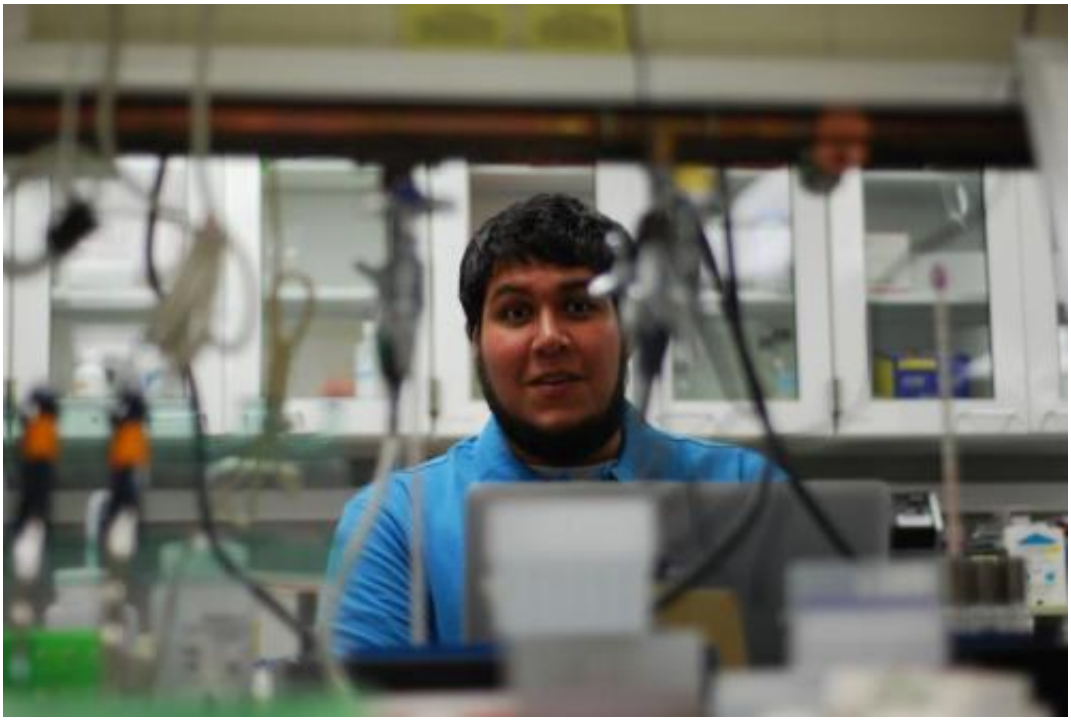

When it comes to evolution, complexity appears to be key for prosperity and propagating future generations. Credit: Michigan State University

The KISS concept – keep it simple, stupid – may work for many situations. However, when it comes to evolution, complexity appears to be key for prosperity and propagating future generations.

Research led by Michigan State University's BEACON Center for the Study of Evolution in Action shows that organisms sometimes have to use increasingly complex defenses to continue evading parasites' attacks

and live longer than their simpler cousins. The results, published in the current issue of *PLOS Biology*, show how the virus-resistant hosts live better, and more fit, lives.

The experiments, conducted in a digital realm, pitted self-replicating computer programs against computer viruses in the domain of the Avida platform for digital evolution. The co-evolution of host and virus ultimately led to organisms with capabilities superior to those of organisms that evolved without battling the viruses, said Luis Zaman, of MSU's BEACON Center.

"The organisms faced off against some pretty nasty viruses, ones that quickly overcame the easy ways of becoming resistant," said Zaman, who's now a postdoctoral researcher at the University of Washington. "This left only more and more complex options for co-evolving hosts. We thought to ourselves, maybe the organisms that were more readily adaptable than the others, more evolvable, would be the ones left standing at the end of the experiments."

The team of scientists showed that the long-lasting hosts were indeed more evolvable.

Zaman conducted the study with fellow MSU BEACON scientists Justin Meyer, now at the University of California-San Diego; Suhas Devangam, who's now at Wayne State University; David Bryson, who's now at Apple; Richard Lenski and Charles Ofria.

They measured how frequently random mutations in the hosts' genetic code provided escape from infection. The scientists found a surprisingly large proportion of these so-called "switching" mutations in the co-evolved hosts ¬- nearly 10 times more than their counterparts that hadn't co-evolved.

They attained these key mutations by deftly dancing with the very agent trying to kill them. Parasite attacks, host evolves, counters and survives. Parasite encodes and thereby metaphorically reviews the entire history of the war in its genetic code, advances and deploys a new weapon. Host blocks with shield. And on and on the fighting rages.

The war doesn't deplete the hosts. The battle-tested organisms instead survive, but only the strong are left. Rather than exile the enemy, hosting the virus is perhaps a better strategy in the long run - one with ramifications well beyond the digital model.

These computer parasites will not be found on unwashed hands or in undercooked holiday hams, but they have provided a model that may explain how evolutionary arms races drive the emergence of complexity.

"Even though we're basically studying computer viruses, we're able to address some of the oldest questions in evolutionary biology," Zaman said. "Co-evolution and parasites are everywhere, and our research with Avida lets us understand their effects on complexity and evolvability with incredible detail."

More information: *PLOS Biology*, www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1002023

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