Research sheds light on altruism: Digital evolution techniques help show how species become altruistic

September 21 2010

Using digital evolution techniques that give scientists the ability to watch evolution in action, Michigan State University researchers have shed new light on what it is that makes species altruistic.

Defined as the ability to sacrifice yourself for the sake of others, altruism has been a bit of a genetic mystery. Understanding why altruism evolves is one of the fundamental challenges in evolutionary theory.

However, a paper published online in the journal Proceedings of the Royal Society B by researchers affiliated with MSU's BEACON Center for the Study of Evolution in Action has shed new light on the subject. This study marked the first time that scientists have been able to test such generalizations of kin selection theory.

"The ability to conduct research in digital systems enabled us to learn nuances of kin selection theory that may have been difficult to discover via evolutionary experiments in natural systems," said team member Charles Ofria.

Using digital evolution technology, the team learned how altruism evolves by setting up different experimental situations. Through this, the researchers found that genes were more likely to help others that were physically similar to them, as opposed to strictly helping those that are related to them.

"Sometimes, by chance, relatives do not share genes, while complete strangers do," said Jeff Clune, a postdoctoral fellow at Cornell University who recently earned his doctorate from MSU. "A potentially better strategy, then, is to help individuals who are very physically similar to you, which may be a proxy for genetic similarity."

"By observing digital organisms that had the ability to sense genetic similarity in addition to kinship, we confirmed that, if given the choice, populations of organisms that were being altruistic toward kin will evolve to stop doing so, and instead help those organisms that are genetically similar," said Rob Pennock, a BEACON researcher and paper co-author.

Testing these predictions is difficult in biological systems because it is hard to take a group of organisms that are all acting altruistic toward their relatives and experimentally give them a new ability to base altruism on genetic similarity.

"One of the great things about digital evolution is that it allows scientists to explore alternative evolutionary trajectories besides those that have already occurred on Earth," Clune said. "This experiment raises the interesting prospect that life on other planets may not revolve around familial units, but could instead be based on shared genes."

Another possibility was that organisms may choose to help only individuals who carry specific markers to indicate the presence of an "altruism gene." The mechanism, described as a "greenbeard gene," involves a conspicuous marker, such as a green beard, which indicates the presence of the altruist gene. It was theorized that in such a system all organisms with green beards would recognize and be altruistic toward each other.

Clune and his collaborators gave the digital organisms the equivalent of

greenbeard genes to see if they would use them to choose who to help.

"To our surprise," said team member Heather Goldsby, "the digital organisms did not evolve to base altruism on the presence of greenbeard markers - instead, they continued to rely on overall genetic similarity."

Why did the digital organisms ignore the greenbeard markers? It was discovered that the greenbeard mechanism was too inflexible: It did not allow the organisms to adjust how altruistic to be.

"The greenbeard mechanism cannot evolve to increase the minimum amount of altruism that needs to be performed to join the greenbeard club," Clune said. "For that reason, greenbeards have an incentive to do the minimal amount necessary to reap the benefits of being in the club, and no more. Unfortunately for them, that means they cannot take advantage of the benefits of increased amounts of altruism."

Provided by Michigan State University