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[Altruism and natural selection](#)

By [mrriley](#), March 29, 2010 2:59 am

The standard theory of natural selection explains both the process and the purpose of adaptation in which heritable characteristics associated with greater reproductive success will accumulate within a population. However, there are a number of observations which, at least on first look, don't seem to be adequately fit by this model.

Natural selection can sustain cooperative behavior in single-shot prisoners' dilemma games (in prisoners' dilemma, cooperation always gets a lower payoff for oneself and a higher payoff for one's opponent than defection).

Richard Dawkins' "selfish gene" concept, in which the replicating agent in evolution is the gene rather than the individual, explains one possible source of altruism in relatives. If a gene is carried by a young individual also appears in its relatives, then sacrifices by the relatives can be seen as selfish behavior by allowing the gene in the younger individual to prosper. Altruistic behavior then can be seen to be selfish when applied within closely related individuals. However, how can altruism be explained when the interaction does not involve close relatives?

Hamilton's theory of inclusive fitness shows how natural selection could lead to behaviors that decrease the fitness of an individual and either benefit (altruism) or harm (spite) other individuals (Science 1341, 327, 2010). Hamilton's work leads to the concept that natural selection leads organisms to appear designed as if to maximize their fitness for the environment within which they are found.

Three key debates on the role of altruistic and spiteful behavior on evolution has been discussed by West and Gardner (Science 1341, 327, 2010).

1. is the evolution of extreme altruism (such as sterile workers in populations of social insects) driven by genetics or environment?
2. does spite really exist in nature?
3. can altruism be favored between individuals who are not close kin but share a "greenbeard" gene for altruism? A greenbeard is a concept first proposed by Dawkins to represent individuals who may have some external traits in common but have no substantial underlying relatedness (think of the separated at birth stories).

All of these questions can best be addressed by a combination of observation and modeling.

The answer to the first question on extreme altruism, such as seen in species of ants, bees, wasps, termites, and beetles, appears to be a result of strict lifetime monogamy within the species. Monogamy leads to a potential worker (an offspring) being equally related to a queen's mother's offspring (her sisters). This hypothesis simplifies our understanding of how such social behavior evolved, emphasizing that the interaction between relatedness and ecology is rather not a competition, but a driving factor.

West and Gardner go on to address the other two questions in their article. Their examples demonstrate that in regards to evolution, the debate between genetics and environment is highly artificial and in many cases leads to unhelpful lines of inquiry. What matters most is how they interact and cannot be taken as independent components of evolutionary pressures.

As biological engineers work to design microorganisms to perform complex tasks, the environment in which these organisms operate is as much important as their genetic blueprint. Getting a microbe to function well under highly idealized conditions is a positive step, but only a small step when utilization in a complex environment is the end goal. Similar problems have challenged the field for many years as evidenced by cell culture selection for pharmaceuticals, genetic modification of plant species, and design of wastewater treatment facilities.

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