

## REPRESSION OF COMPETITION AND THE EVOLUTION OF COOPERATION

STEVEN A. FRANK

*Department of Ecology and Evolutionary Biology, University of California, Irvine,  
California 92697-2525*

*E-mail: [safrank@uci.edu](mailto:safrank@uci.edu)*

***Abstract.*** Repression of competition within groups joins kin selection as the second major force in the history of life shaping the evolution of cooperation. When opportunities for competition against neighbors are limited within groups, individuals can increase their own success only by enhancing the efficiency and productivity of their group. Thus, characters that repress competition within groups promote cooperation and enhance group success. Leigh first expressed this idea in the context of fair meiosis, in which each chromosome has an equal chance of transmission via gametes. Randomized success means that each part of the genome can increase its own success only by enhancing the total number of progeny and thus increasing the success of the group. Alexander used this insight about repression of competition in fair meiosis to develop his theories for the evolution of human sociality. Alexander argued that human social structures spread when they repress competition within groups and promote successful group-against group competition. Buss introduced a new example with his suggestion that metazoan success depended on repression of competition between cellular lineages. Maynard Smith synthesized different lines of thought on repression of competition. In this paper, I develop simple mathematical models to illustrate the main processes by which repression of competition evolves. With the concepts made clear, I then explain the history of the idea. I finish by summarizing many new developments in this subject and the most promising lines for future study.

***Key words.*** Altruism, kin selection, levels of selection, social evolution, symbiosis.