Competition, loss of selfishness mark shift to supersociety

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How social or altruistic behavior evolved has been a central and hotly debated question, particularly by those researchers engaged in the study of social insect societies – ants, bees and wasps. In these groups, this question of what drives altruism also becomes critical to further understanding of how ancestral or primitive social organizations (with hierarchies and dominance fights, and poorly developed division of labor) evolve to become the more highly sophisticated networks found in some eusocial insect collectives termed “superorganisms.”

In a paper published online May 21 before print by the Proceedings of the National Academy of Sciences (PNAS), a pair of researchers from Cornell University and Arizona State University propose a model, based on tug-of-war theory, that may explain the selection pressures that mark the evolutionary transition from primitive society to superorganism and which may bring some order to the conflicted thinking about the roles of individual, kin, and group selection that underlie the formation of such advanced eusocial groups.

A superorganism ultimately emerges as a result of intergroup competition according to findings by theoretician H. Kern Reeve of Cornell University’s Department of Neurobiology and Behavior and professor Bert Hölldobler of Arizona State University’s School of Life Sciences and Center for Social Dynamics and Complexity.

Reeve and Hölldobler’s model is unique in that it is comprised of two interlocked nested tug-of-war theories. The first piece describes the tug

of war over resource shares within a group or colony (intragroup competition), and the second piece incorporates the effects of a tug-of-war between competing colonies (intergroup competition).

According to Hölldobler, the path to colonial supergiant is first paved by the maximization of the inclusive fitness of each individual of the society. How this might arise, he believes, is that competition that might exist between individuals in the same society diminishes as the incipient colonial society becomes larger, better organized and contains better division of labor and ultimately, cohesiveness.

“Such societies in turn produce more reproductive offspring each year than neighboring societies that are less organized. Thus, genes or alleles that code for such behaviors will be propagated faster,” Hölldobler says.

The second piece of the model takes into account that “as the colonial organization of one group rises, there is a coincident rise in discrimination against members of other societies of the same species.” Hölldobler notes that the competition between societies soon becomes a major force reinforcing the evolutionary process: “In this way the society or insect colony becomes the extended phenotype of the collective genome of the society.”

Hölldobler believes that this model developed with Reeve goes further than others in explaining the evolutionary transition from hierarchical organizations to superorganism, “as it also demonstrates how the target of selection shifts from the individual and kin to group selection.”

Such a nested tug-of-war model, he says, might also be applied “equally well to the analysis of the evolution of other animal societies” and give insight into the evolution of cooperation in non-human and human primates, in addition to such things as collectives of cells and the formation of bacterial films.

Source: Arizona State University