Prehistoric conflict hastened human brain's capacity for collaboration, study says

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Warfare not only hastened human technological progress and vast social and political changes, but may have greatly contributed to the evolutionary emergence of humans' high intelligence and ability to work together toward common goals, according to a new study from the National Institute for Mathematical and Biological Synthesis (NIMBioS).

How humans evolved high intelligence, required for complex collaborative activities, despite the various costs of having a big brain has long puzzled evolutionary biologists. While the human brain represents only about two percent of the body's weight, it uses about 20 percent of the energy consumed. Other costs of having a large brain include a need for extended parental care due to a long growth period,

difficulties giving birth to larger-headed babies, and some mental illnesses associated with brain complexity. So how did the human brain evolve to become so large and complex?

Another long-running question is how did humans evolve strong innate preferences for cooperative behavior, as cooperative behavior is vulnerable to exploitation by cheaters and "free-riders." A free-rider doesn't contribute or cooperate and thereby undermines the effectiveness of the group's collaborative effort, something scientists call "the collective action problem." Thus, collaborative behavior is expected to be rare, and indeed, in animals it is typically limited to close relatives. Humans, however, are a unique species where collaboration is widespread and not limited to relatives.

In the new study published in the *Journal of the Royal Society Interface*, lead author Sergey Gavrilets, a professor of ecology and evolutionary biology and mathematics at the University of Tennessee, Knoxville, and NIMBioS associate director for scientific activities, developed a mathematical model that offers answers to both evolutionary puzzles.

The model shows that intelligence and cooperative behavior can co-evolve to solve the problem of collective action in groups and to overcome the costs of having a large brain.

The research points to the types of collective actions that are most effective at hastening collaboration. According to the model, collaborative ability evolves easiest if there is direct conflict or warfare between groups, what Gavrilets calls "us vs. them" activities. In contrast, collective activities, such as defending against predators or hunting for food, which Gavrilets calls "us vs. nature" activities, are much less likely to result in a significant increase in collaborative abilities.

The study also predicts that if high collaborative ability cannot evolve,

perhaps for example because the costs of having a big brain are too high, the species will harbor a small proportion of individuals with a genetic predisposition to perform individually-costly but group-beneficial acts.

In addition, the model challenges influential theories on when large-game hunting and within-group coalitions first appeared in humans. Some scientists say that within-group coalitions and collaborative hunting came first and then subsequently created conditions for the evolution of collaboration in between-group conflicts. Yet, Gavrilets' model shows the opposite: that collaboration in between-group fighting preceded both within-group coalitions and collaborative hunting.

"Our ability to effectively collaborate with others is largely responsible for what our species came to be. The big question is how this ability first evolved when there are large metabolic and physiological costs related to human brain size and when collaboration can be easily undermined by free riders. The model offers an answer which emphasizes the role of between-group conflicts in shaping unique human features," Gavrilets said.

More information: Gavrilets S. 2014. Collective action and the collaborative brain. *Journal of the Royal Society Interface*. Published online 26 November 2014. dx.doi.org/10.1098/rsif.2014.1067

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