

Evolution of competitiveness

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Virtually all organisms in the living world compete with members of their own species. However, individuals differ strongly in how much they invest into their competitive ability. Some individuals are highly competitive and eager to get access to high-quality resources, while others seem to avoid competition, instead making prudent use of the lower-quality resources that are left over for them. Moreover, the degree of competitiveness in animal and human societies seems to fluctuate considerably over time. A theoretical study published in *Nature Communications* this week sheds some new light on these findings. The authors demonstrate that the evolution of competitiveness has a strong tendency towards diversification. When competitiveness is externally favoured, it can destabilize animal and human societies and in extreme cases even threaten their survival.

To analyse the evolution of competitiveness, a team of scientists from the Universities of Bonn (Germany), Bielefeld (Germany) and Groningen (Netherlands) developed a model that reflects the idea that competitiveness comes at a price. In the model, individuals that invest a lot into being competitive gain access to high-quality resources, but the features making them competitive hamper them in making maximal use of these resources. "In many organisms, some individuals invest a lot into being successful in the competition with their conspecifics", says Sebastian Baldauf from the University of Bonn, first author of the study. "They grow, for example, weaponry like horns or antlers and do hardly feed in order to be able to conquer and defend large territories. This may secure them many matings, but they might get more fitness out of each mating when they would spend their energy on other activities, like

paternal care."

The simple assumption that individuals with highest competitive ability are not able to make maximal use of the acquired resources suffices to explain the diversity in competitiveness observed in nature. If not too much is at stake, that is, if high-competitive individuals acquire only slightly better resources than low-competitive individuals, evolution leads to the stable coexistence of two types of individuals: one type does not invest into competition at all and is content with lower-quality resources, and a second type that invest an appreciable (but not maximal) part of their energy into being competitive. If much is at stake, such coexistence does not occur. Instead, the model predicts cyclical changes in competitive ability over time. For large periods, there is an arm's race to the top, leading to an ever-increasing degree of competitiveness in the population. This process continues until the costs of competitiveness become too high: competitiveness crashes to zero, but once there the whole rat race starts again. "Hence, the same model explains the coexistence of alternative strategies and the change of competitiveness in time", Baldauf says. "Moreover, the model can explain the variation in competitiveness across populations of the same species."

Heating up the fire

The study also considers how the evolution of competitiveness is affected by external factors. As an example, the authors considered the joint evolution of competitiveness in males and the evolution of preferences in females for either high- or low-competitive males. "We were interested in the question whether females evolve preferences for males with high-quality resources but little energy left for paternal care or for males that are content with low-quality resources but able to compensate by providing much care," says Leif Engqvist, co-author of the study. It turned out that females almost always evolved preferences for highly competitive males, even if mating with uncompetitive but

caring males would have resulted in more offspring. These preferences, in turn, fuelled the males' arm's race towards higher and higher levels of competitiveness. Engqvist: "In stressful times, like periods of food shortage, this process can even lead to population extinction, since the investment in competition exceeds the value of the resources."

"Extreme care is required when transferring insights from a simple evolutionary model to humans", says Franjo Weissing from the University of Groningen. "Our article therefore does not say too much about competitiveness in humans. However, also in humans there is huge diversity in competitiveness, and [individuals](#) with highest competitive ability often seem least prudent in the exploitation of their resources. It is therefore tempting to speculate that the external stimulation of competitiveness by societal pressure, which is analogous to the stimulation of [competitiveness](#) by the female preferences in our model, can lead to such a wastage of resources that our future survival is threatened."

More information: Baldauf, S.A., Engqvist, L. & Weissing, F.J. (2014): "Diversifying evolution of competitiveness." *Nature Communications*, [DOI: 10.1038/ncomms6233](https://doi.org/10.1038/ncomms6233)

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