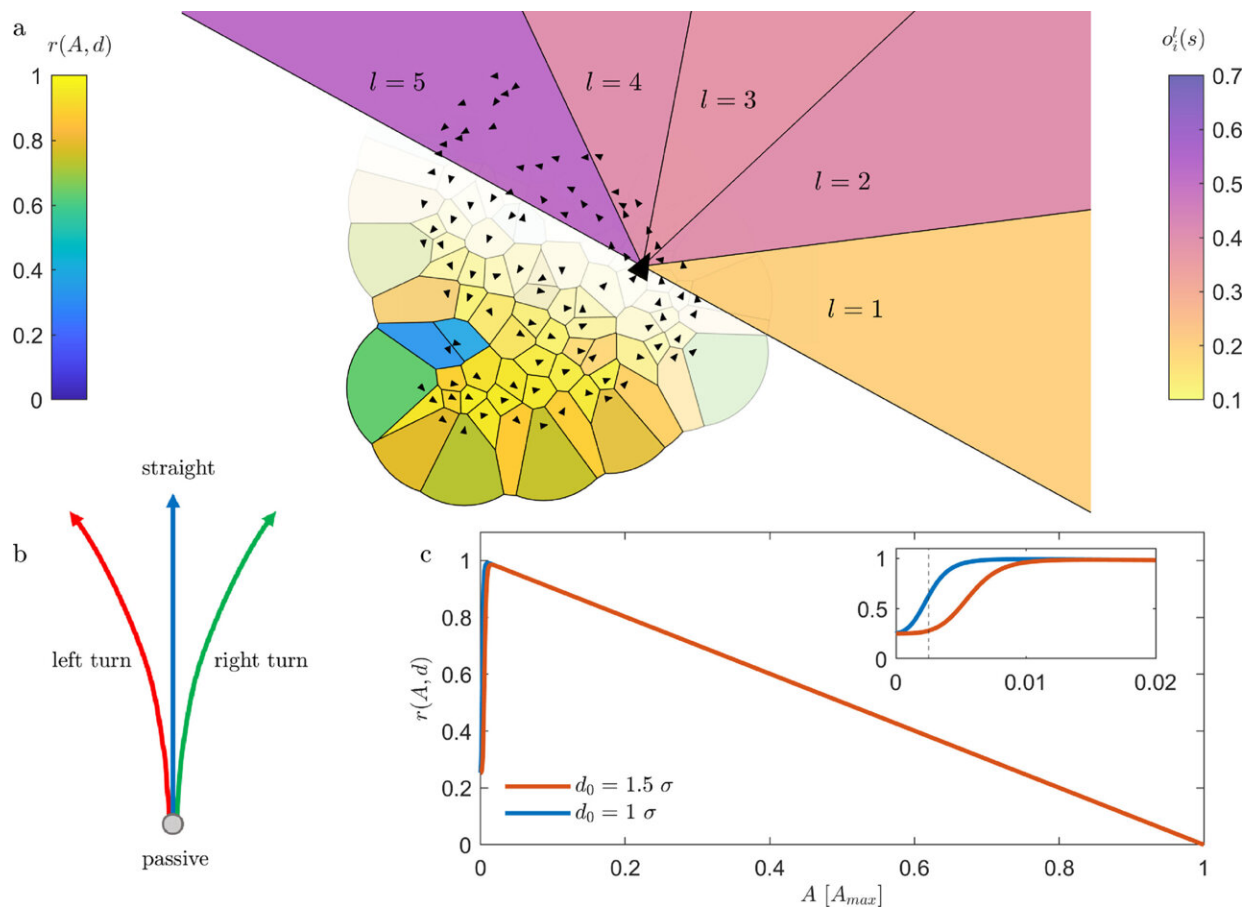


# How selfishness can lead to fairness: Dynamics and risk sharing in groups of selfish individuals

February 15 2023



Credit: *Journal of Theoretical Biology* (2023). DOI: 10.1016/j.jtbi.2023.111433

In a study published in the *Journal of Theoretical Biology*, researchers used computer simulations to explore how herd animals can reduce their predation risk. The study is based on the idea suggested by W.D. Hamilton in 1971, that individuals in a herd position themselves so that their own predation risk becomes reduced at the expense of their neighbors.

"Surprisingly, when individuals act out of pure selfish reasons, this can lead to a fair situation within the group," says physics professor Clemens Bechinger.

The reason why many animals organize themselves in herds is not necessarily the result of gregariousness or social behavior. One example is seals: On their own, they are easy prey for orcas or sharks. Instead, it is much safer within a group, because then the danger of an attack is spread out among many individuals.

It is safest in the middle of the group where animals are crowding together in a very small space and an attack there is more likely to target a close neighbor than oneself. At the edge of the group with only a few neighbors, on the other hand, the predation risk is considerably larger. Each animal therefore tries to get to one of the coveted spots in the middle.

## **Selfishness leads to a fair distribution of risk**

With the help of [artificial intelligence \(reinforcement learning\)](#), Clemens Bechinger and his colleagues studied how individuals must alter their positions optimally to keep the distance between themselves and others as small as possible, which, in turn, reduces their own risk of being attacked.

"Because this strategy increases the risk for neighbors, it is clearly

considered a selfish motivation," says Veit-Lorenz Heute, who is working as a doctoral student on the project. Just as Hamilton predicted, the physicists observed that individuals that were spread out at first then formed a dense [herd](#), because this decreases their distance to neighbors and thus reduces the individual risk of being attacked.

"Considering reinforcement learning for collectives opens up a range of new possibilities in understanding animal behavior," Iain Couzin, speaker of the CASCB and Professor for Biodiversity and Collective Behavior at the University of Konstanz adds. "It provides an elegant way to ask how adaptive behaviors may emerge in the complex social context characteristic of flocks and swarms."

The researchers were surprised, however, to see what happened after the herd had formed.

Their simulations show that the time-averaged [predation risk](#) is exactly equal for all individuals. Obviously, members at the center of the herd are not able to defend such advantageous positions as other animals push towards this coveted spot.

"This is a result of the high dynamics within the group which makes it impossible for individuals to maintain specific optimal positions," says Samuel Monter, who is also involved in the study. Another interesting observation is that, as a result of this permanent competition for the best positions, the group begins to rotate around its gravitational center, similar to what is observed in many herds of animals.

"Our study shows that the formation of groups does not necessarily result from their gregarious behaviors but can also be explained by the entirely selfish motivations of individuals to gain an advantage at the expense of others," Bechinger concludes. "Not only does our study help to understand collective behaviors in living systems, but the results may

also be useful in the context of finding optimal strategies of how autonomous robotic devices have to be programmed to master collective tasks."

"We have long observed vortices in animal groups and this work provides an insight into why that may be the case," Iain Couzin adds. "If each individual acts to reduce risk, by approaching others, but is also penalized for collisions, rotating swirls, as we see in fish schools and even some herding animals, naturally emerge."

**More information:** Samuel Monter et al, Dynamics and risk sharing in groups of selfish individuals, *Journal of Theoretical Biology* (2023).

[DOI: 10.1016/j.jtbi.2023.111433](https://doi.org/10.1016/j.jtbi.2023.111433)

Provided by University of Konstanz

Citation: How selfishness can lead to fairness: Dynamics and risk sharing in groups of selfish individuals (2023, February 15) retrieved 11 May 2024 from

<https://phys.org/news/2023-02-selfishness-fairness-dynamics-groups-selfish.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--