Group decisions: When more information isn't necessarily better

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Fathead minnow (Pimephales promelas) a breeding male displaying tubercles and thickened dorsal pad of mucus-secreting cells. Credit: Rankin1958/ Wikipedia / CC BY-SA 3.0

In nature, group decisions are often a matter of life or death. At first glance, the way certain groups of animals like minnows branch off into smaller sub-groups might seem counterproductive to their survival. After all, information about, say, where to find some tasty fish roe or which

waters harbor more of their predators, would flow more freely and seem to benefit more minnows if the school of fish behaved as a whole. However, new research published in *Philosophical Transactions of the Royal Society B* sheds light on the complexity of collective decision-making and uncovers new insights into the benefits of the internal structure of animal groups.

In their paper, Albert Kao, a Baird Scholar and Omidyar Fellow at the Santa Fe Institute, and Iain Couzin, Director of the Max Planck Institute for Ornithology and Chair of Biodiversity and Collective Behavior at the University of Konstanz, simulate the information-sharing patterns of animals that prefer to interact with certain individuals over others. The authors' modeling of such animal groups upends previously held assumptions about internal group structure and improves upon our understanding of the influence of group organization and environment on both the collective decision-making process and its accuracy.

Modular—or cliquey—group structure isolates the flow of communication between individuals, so that only certain animals are privy to certain pieces of information. "A feature of modular structure is that there's always information loss," says Kao, "but the effect of that information loss on accuracy depends on the environment."

In simple environments, the impact of these modular groups is detrimental to accuracy, but when animals face many different sources of information, the effect is actually the opposite. "Surprisingly," says Kao, "in complex environments, the information loss even helps accuracy in a lot of situations." More information, in this case, is not necessarily better.

"Modular structure can have a profound—and unexpected—impact on the collective intelligence of groups," says Couzin. "This may indeed be one of the reasons that we see internal structure in so many group-living

species, from schooling fish and flocking birds to wild primate groups."

Potentially, these new observations could be applied to many different kinds of social networks, from the migration patterns of birds to the navigation of social media landscapes to the organization of new companies, deepening our grasp of complex organization and collective behavior.

The paper, "Modular structure within groups causes information loss but can improve decision accuracy," is part of a theme issue in the *Philosophical Transactions of the Royal Society B* entitled "Liquid Brains, Solid Brains: How distributed cognitive architectures process information." The issue was inspired by a Santa Fe Institute working group and edited by Ricard Solé (Universitat Pompeu Fabra), Melanie Moses (University of New Mexico), and Stephanie Forrest (Arizona State University).

More information: "Modular structure within groups causes information loss but can improve decision accuracy," *Philosophical Transactions of the Royal Society B* (2019). DOI: 10.1098/rstb.2018.0378 , royalsocietypublishing.org/toc/rstb/374/1774

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