Birds of a feather flock together, but how do they decide where to go?

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Credit: Angie Bandari

Coordinated behavior is common in a variety of biological systems, such as insect swarms, fish schools and bacterial colonies. But the way information is spread and decisions are made in such systems is difficult

to understand.

A group of researchers from Southeast University and China University of Mining and Technology studied the synchronized flight of pigeon flocks. They used this as a basis to explain the mechanisms behind coordinated behavior, in the journal *Chaos*.

"Understanding the underlying coordination mechanism of these appealing phenomena helps us gain more cognition of the world where we live," said author Duxin Chen, an assistant professor at Southeast University in China.

Previously, it was believed that coordinated behavior is subject to three basic rules: Avoid collision with your peers, match your speed and direction of motion with the rest of the group, and try to stay near the center. The scientists examined how every individual pigeon within a flock is influenced by the other members and found the dynamics are not so simple.

The researchers studied the flights of three flocks of 10 pigeons each. Every bird's position, velocity and acceleration were sampled with time, and the researchers used this data to determine which pigeons have a direct impact on each individual in the group, constructing a causal network that can be used to further observe the deep interaction rules.

They determined a number of trends in flock motion. Depending on factors, like its location in the flock, every pigeon has neighbors it influences as well as neighbors it is influenced by. Additionally, the influencers are likely to change throughout the flight.

"Interestingly, the individuals closer to the mass center and the average velocity direction are more influential to others, which means location and flight direction are two factors that matter in their interactions,"

Chen said.

Though pigeon social patterns were not considered, the researchers found flight competition to be intensive, and previous work has shown flight hierarchies are independent of pigeon dominance factors.

The authors suggest their method is sufficiently general to study other coordinated behaviors. Next, they plan to focus on the collective behaviors of immune cells.

More information: "Inferring causal relationship in coordinated flight of pigeon flocks," *Chaos* (2019). DOI: 10.1063/1.5120787

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