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How do groups of ants make shared decisions?

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Abstract

Have you ever noticed that animals living in groups tend to work together? For example, African elephants typically walk in a line for safety and follow the age and experience of the oldest and largest female. This is called "follow the leader" strategy. But what about the humble ant? Ants often work together to transport large food items back to their nest. Since ants can't talk to each other to make decisions, they must rely on other senses to work as a team. We wanted to find out how weaver ants cooperate to move large items. So, we observed ants in the lab trying to move objects. We discovered that no single ant takes the lead. Instead they pool their opinions to decide on which direction to go. This is known as the "wisdom of the crowd" strategy!

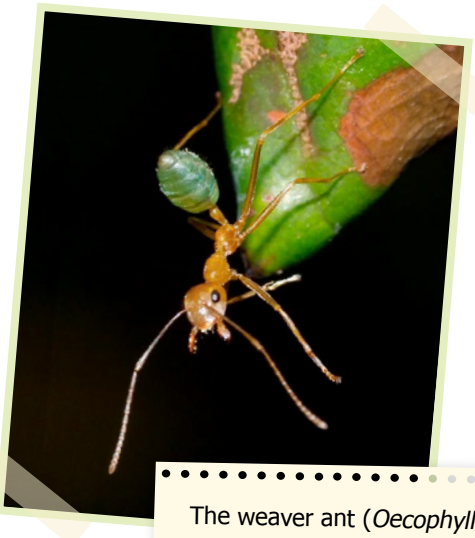
Introduction

Animals that live in groups need to be great at problem-solving and working as a team. They must have **consensus** to avoid conflict and keep the group together. There are two ways to achieve consensus:

- "Follow the leader" – one or a few individuals have control over the group's decisions.
- "Wisdom of the crowd" – the group makes a decision by bringing together all the members' opinions.

An example of when groups need consensus is during **cooperative transport**. This is when several individuals work together to move a large object from A to B. This is only really seen in ants and humans. We can simply talk to each other, but it's not quite that easy for ants. They can only rely on local information gathered from their environments. We have seen evidence of cooperative transport in over 40 ant species from all over the world. It helps ants retrieve much larger items of **prey**, allowing them to feed the **colony**.

We examined the cooperative transport behaviour of weaver ants (*Oecophylla smaragdina*). Weaver ants can forage for large prey items through cooperative transport. They have even carried birds back to their nests! But we wanted to know how they are so successful. Do they "follow the leader" or use the "wisdom of the crowd"?



The weaver ant (*Oecophylla smaragdina*).
Photo: Giorgio Venturini

Methods

To help answer our question, we observed weaver ants carrying objects in the laboratory. We used more than 2,000 ants from nine **queenright colonies** in our experiments. We released the ants into a large arena. We hadn't given them any food for 24 hours to make sure they were hungry.

We put grasshoppers in the arena for the ants to transport. They were cut into pieces to represent light, medium, and heavy items. We tied the grasshopper pieces to the floor of the arena with a thin string, one piece at a time. The string stopped the ants from bringing the grasshoppers all the way to the nest. But it still allowed the group to swing from side to side (Fig. 1). We recorded the ants' behavior once the ants picked up the grasshopper piece and fully extended the string. We looked at the size of the group and how far they moved away from the average direction of travel.

We also wanted to know what would happen when ants could move freely in a complex environment. So we set up a corridor at a right angle to the arena entrance. Then we placed a grasshopper piece in the middle of the corridor for the ants to find and transport. We recorded the ants' behavior again. This time we looked at how fast the ants moved and how often they stopped. We also looked at how straight their path was and whether they ever retraced their path.

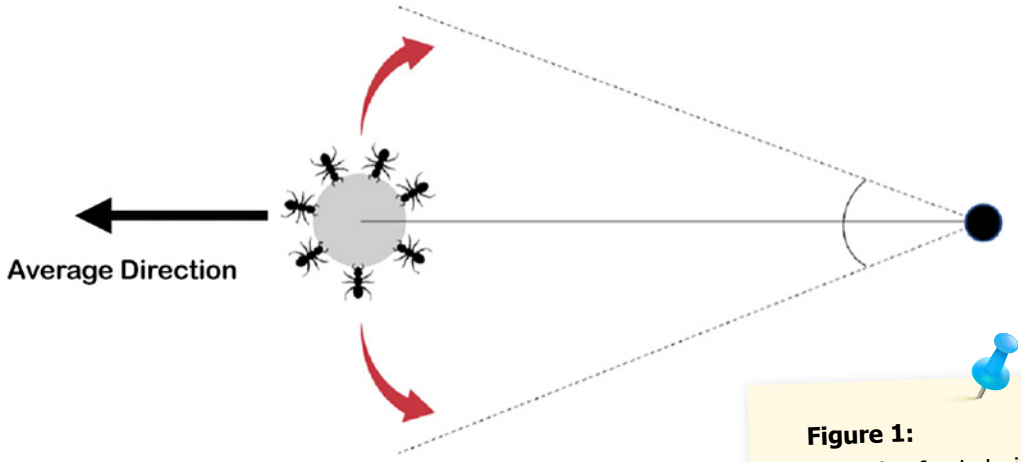


Figure 1:
Example of ants trying to move something tied to the ground.

Results

We found that the heavier the piece of grasshopper, the larger the group of ants that transported it. Also, the heavier the piece was, the less side-to-side movement the group had. The groups that carried the lightest grasshopper pieces moved the farthest from their average direction of travel. So, as the groups got bigger, their paths became straighter. This matches what we would expect from the "wisdom of the crowd" strategy.

When we made the environment more complex, we saw similar results. Ants moved more slowly within the corridor than the rest of the arena (Fig. 2). When ants carried lighter grasshopper pieces, they stopped less. They also stopped less when they were in the open arena, no matter how heavy the piece of grasshopper.

Please see Figure 2 on page 3

How did the speed of the ants change when they moved from the corridor out into the open arena? How did the weight of the grasshopper pieces impact their speed?

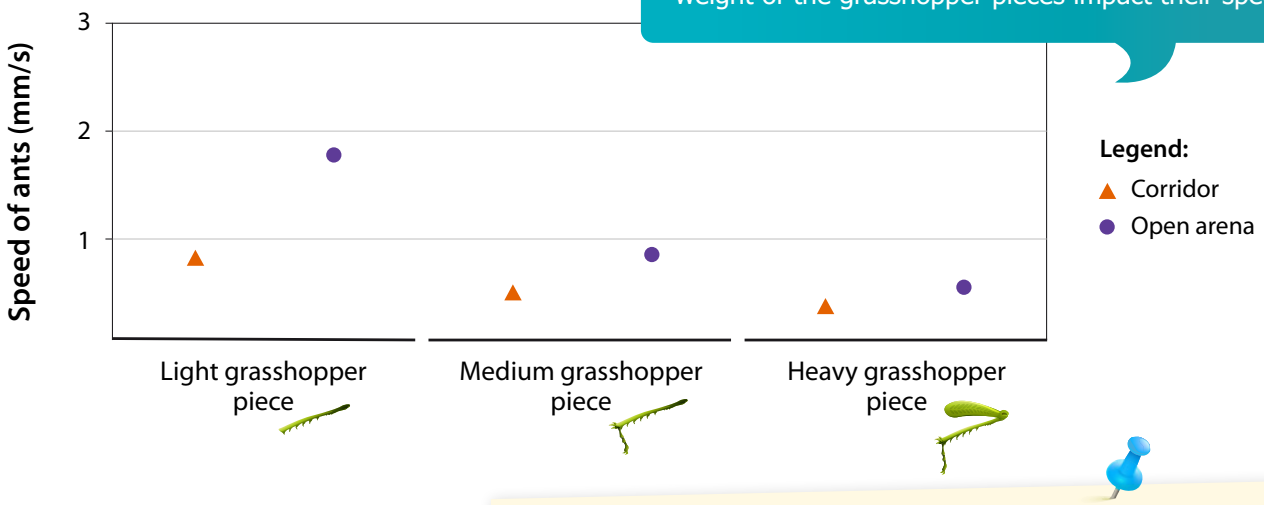


Figure 2: How quickly the groups of ants moved pieces of grasshopper of different weights when the environment was more complex.

Discussion

We found that weaver ants work together to navigate accurately while transporting heavy objects. We saw that their path gets straighter with more ants helping. This shows that they use the "wisdom of the crowd" strategy. Each ant has their own sensory mechanism telling them where they should be going. They pool together their information to increase their accuracy. They are able to sense the forces produced by the other ants through the object they are carrying. As the group size increases, the accuracy increases. If individual ants make errors in the direction they pull, it gets canceled out. This means that larger groups end up taking more direct routes.

We confirmed this by looking at how weaver ants navigated when they could move freely within the environment. They slowed down and stopped more when they were in the corridor. This is because they had more conflicting ideas about which direction to travel. When the group made it to the open arena they were able to speed up. This is because more individuals agreed with each other. In contrast, ants that "follow the leader" don't slow down or stop more in similar experiments. They just follow the leader!

What makes weaver ants so special? They live in complex habitats and likely have knowledge of the route back to their nest. They use visual, magnetic, and **olfactory** cues to help them navigate. This then allows them to contribute their information to the effort of the group.

Conclusion

You can do things with a team that you might not be able to do by yourself. Just like weaver ants! There are also lots of different ways to work with a team. Think about how teamwork plays a role in your own life. It might be at home or at school. How do you communicate with those around you? Does it vary depending on the environment you're in? Or on the number of participants? When do you tend to follow a leader (or be the leader!) and when do you cooperate to make decisions?

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Glossary of Key Terms

Colony - a group of organisms of the same species that live together. In the case of weaver ants, a colony is made up of around 2,000 individuals.

Consensus - a general agreement among members of a group.

Cooperative transport - when two or more individuals work together to carry an item to another location.

Olfactory - related to the sense of smell.

Prey - an organism that is eaten by another organism. Prey can be either an animal or a plant.

Queenright colony - a colony that has a queen who is healthy, mated, and laying eggs.

Check your understanding

1. What is the difference between the "wisdom of the crowd" and "follow the leader" strategies?

2. Think back to the part of our experiment when the ants were given pieces of grasshopper tied to the ground. How did group size affect the "wisdom of the crowd" strategy?

3. What did the weaver ants do when they could move freely in the arena with the corridor? Why do we think they behaved this way?

4. What cues do weaver ants use during cooperative transport?

5. Can you think of another example of animals who use the "follow the leader" strategy and one more example of animals who use the "wisdom of the crowd" strategy? Explain how using these strategies helps them survive.

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