Unique teamwork secret helps weaver ants double their strength

New research in Current Biology shows that weaver ants do not weaken when working in groups, but actually double their strength thanks to a 'force ratchet mechanism'. The discovery promises to inspire the design of intelligent collaborative robots in the future.

Weaver ants possess a secret to teamwork that humans have never achieved: the more there are, the stronger they are.

Instead of relying on each other like humans do in large groups, these ants double their pulling power by dividing up roles — some hold on for support, while others pull. Scientists call this strategy a 'force ratchet,' which makes each link in the chain stronger as more members are added.

The discovery, published in the journal *Current Biology*, suggests that weaver ants have solved a centuries-old problem of cooperation in humans: as groups get larger, individual effort typically declines.

The phenomenon was first noted by French engineer Max Ringelmann in 1913. In his experiments pulling a rope, he found that while the total force increased as more people pulled, the individual strength decreased. Since then, the 'Ringelmann effect' has been demonstrated in countless contexts, from office meetings to sports competitions.

On the contrary, according to behavioral ecologist Madelyne Stewardson (Macquarie University, Australia), weaver ants cooperate more effectively as the number of members increases, helping to build nests faster and more firmly.

Collective strength

' *As the group size gets larger, individual ants almost double their pulling force – they actually work more efficiently when crowded* ,' says Stewardson.

The weaver ant (Oecophylla smaragdina) lives in trees in tropical regions of Africa, Asia and Australia. It is famous for its ability to build hanging nests by linking its body into a chain, deftly folding leaves and binding them together with silk produced by its larvae.

In the study, scientists 'tricked' ants into forming a drag chain to move an artificial leaf attached to a force gauge.

The results showed that ants divided into two roles:

1. Pull: the ones in front try to pull the leaves.
2. Anchoring: the hind legs stretch out, creating a fulcrum to hold the pulling force.

'force ratchet' mechanism

According to co-author Daniele Carlesso (University of Konstanz & Max Planck Institute for Animal Behavior, Germany), it is this role assignment that creates the 'force ratchet mechanism'.

1. The individuals at the end of the chain are anchored, resisting the rebound force from the leaf.
2. The individuals in front continued to pull relentlessly.
3. The longer the chain, the greater the frictional force, helping the whole group maintain its resonant strength.

'The result is that the individual is not only not weakened, but is strengthened by the collective,' explains Dr David Labonte (Imperial College London).

Applications from ant hills to robot labs

This discovery not only opens up a new perspective on the natural world but also has potential applications in robotic technology.

According to Dr Chris Reid (Macquarie University), currently robots working in groups often only produce the same force as when working individually, that is, linear accumulation. But with inspiration from weaver ants, we can design robots that can 'split roles' more intelligently, creating a force greater than the sum of its individual parts.

Previous research has shown that robots inspired by millipedes (like centipedes) can move better on complex terrain. Now, programming robots with the ant's 'force ratchet' mechanism could lead to more efficient autonomous swarms of robots, opening the door to applications ranging from construction to space exploration.

In short: While humans are often weaker in numbers, weaver ants prove the opposite – the more, the stronger. And who knows, in the future, swarms of robots inspired by these ants will completely change the way we work in groups.