

Balancing Acrobats: Grass-Carrying Ants avoid Falling Over by Controlled Head Movements

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Leaf-cutting ants of the species Atta vollenweideri harvest grass. Individual workers carry grass fragments many times longer and heavier than their body weight over considerable distances to their nest.

How do they avoid falling over?

Are they able to control the position of the fragment and if so, how do they do this?

lateral view:

1. Do grass-cutting ants carry short and long fragments in a different way?



Ants were allowed to harvest standardised paper fragments that had been soaked in orange juice. Individual ants carrying a fragment were recorded with three synchronised high-speed cameras.





The fragment angle $\boldsymbol{\alpha}$ was calculated trigonometrically.

30 mm

digitised fragment length $\alpha = \arccos\left(\frac{d}{a}\right)$

actual fragment length

3. Is the ant's head reaction dynamic during walking?

Workers were forced to walk uphill, then horizontally, and then downhill



 α Long fragments were carried at a significantly steeper angle than short fragments of the same weight

15 mm

When walking uphill, workers carried fragments at a significantly steeper angle and when walking downhill, at a significantly shallower angle than ants on a horizontal trail

20





Similar head movements were also performed by unloaded workers walking uphill and downhill

Conclusions:

٥°

Slope

 $+20^{\circ}$

- 20

6

g

20

2

0

head angle γ (ຶ)

Load carrying Atta vollenweideri avoid falling over by adjusting the fragment position so that the shift of the centre of gravity is reduced.

The angle of the fragment is controlled by head movements.

On slopes, ants without loads performed similar head movements to those that maintain stability in load-carrying ants.



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2. How do ants control the angle of the fragments?

Calculation of the "mandible" angle β between head and fragment and the head angle γ :

side view recordings.

vectorially calculated:







fragment

Two reference points of the head and the surface were

three-dimensionally reconstructed from the two

The angle between the head and the surface was

Workers did not hold fragments in a different way between their mandibles, but they altered their head position