

# Taking out the trash: The role of olfactory cues in leaf-cutting ant waste management

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## Introduction

Leaf-cutting ants rear a symbiotic fungus, the colony's main food source, which is very susceptible to contaminants and pathogenic fungi. Workers continuously clean the symbiont of exhausted material and infected mycelium, which they then transport out of the fungus chambers (Fig. 1). Because pathogens may grow in the waste (Fig. 2), where to dispose of this potentially dangerous material could be crucial to the health of the symbiotic fungus, and with it to colony survival.

We investigated whether leaf-cutting ants (*Atta laevigata*)

(1) try to avoid disposing waste material near their symbiotic fungus and (2) use volatiles originating from waste and fungus as odor cues for waste disposal.

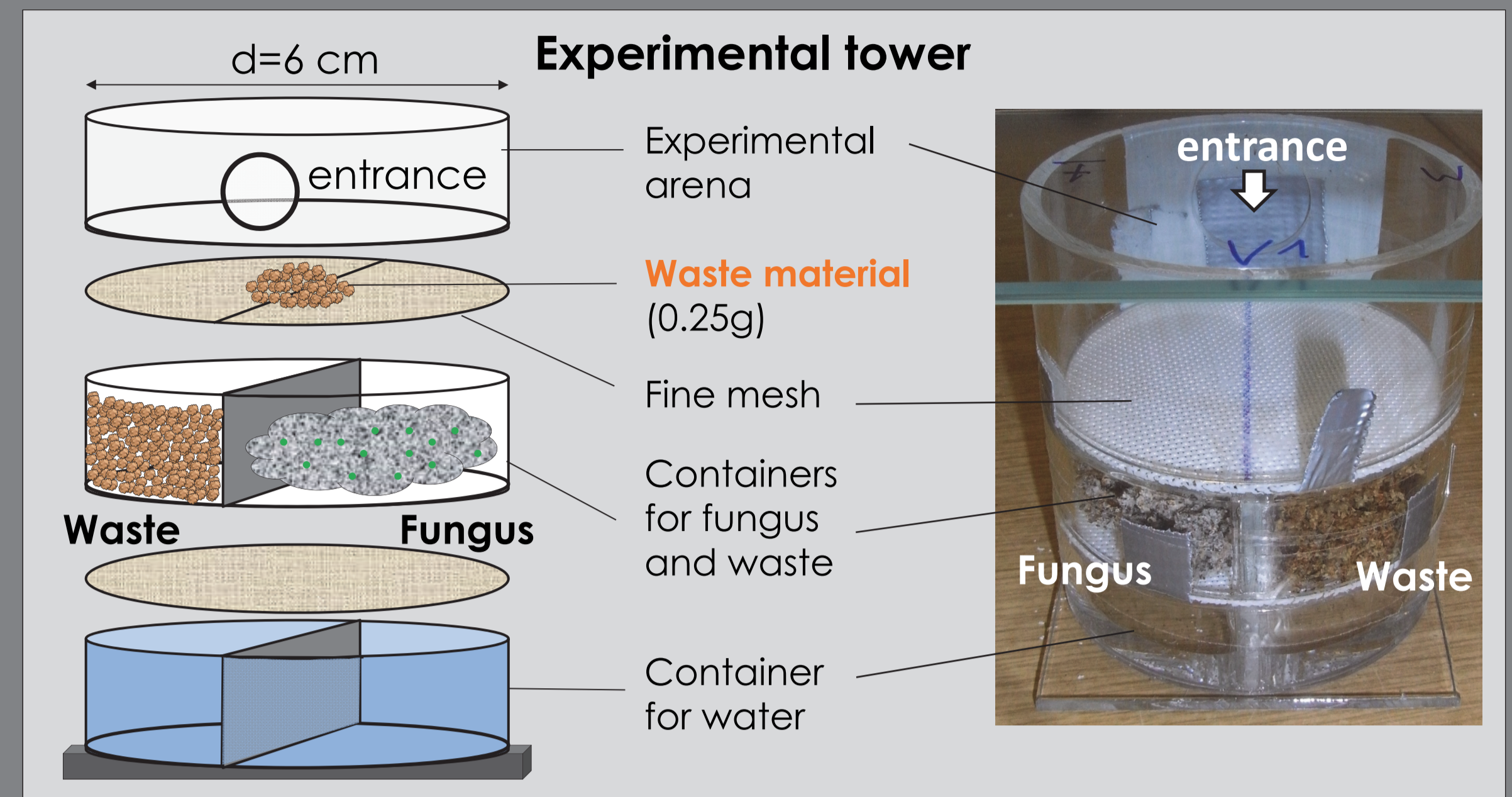


Fig. 1 Waste transport to refuse chamber in *Atta laevigata*



Fig. 2 Waste in refuse chamber (exhausted fungus, dead ants and plant material)

## Methods



Part of an *Atta laevigata* colony (a fungus filled box, 19x19x9 cm) was connected to the experimental tower. Workers from the fungus garden could then freely relocate the waste material deposited in the middle of the experimental arena.

Four experiments were performed,

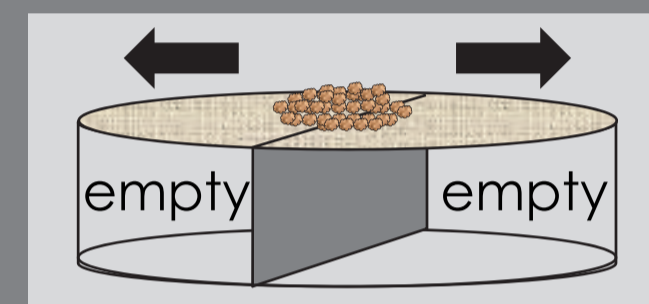
in which the waste was exposed to the following volatiles:

1 None vs. None

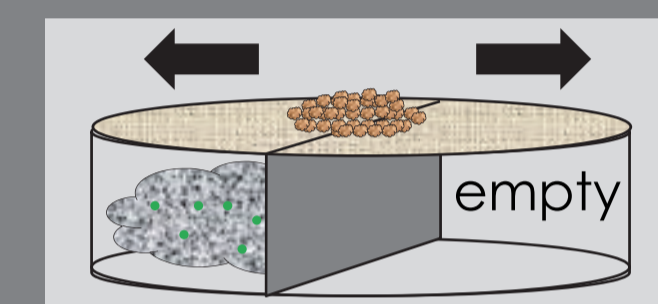
2 Fungus vs. None

3 Waste vs. None

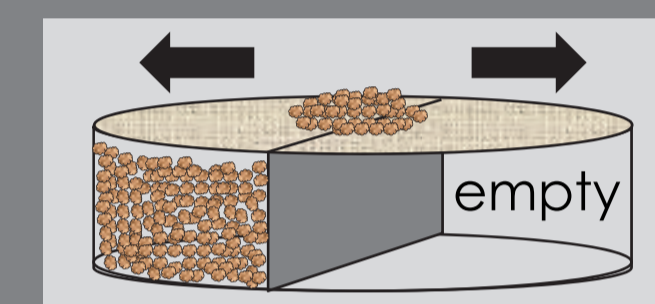
4 Waste vs. Fungus



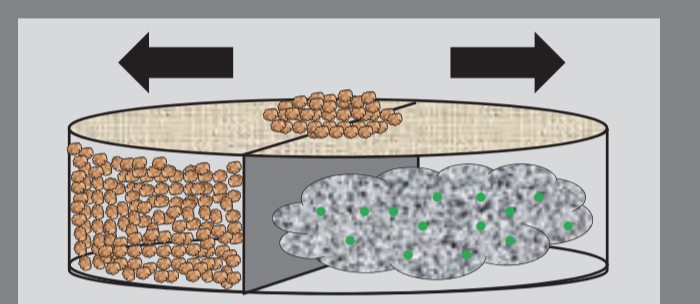
No waste removal?



Waste removal from fungus odor?

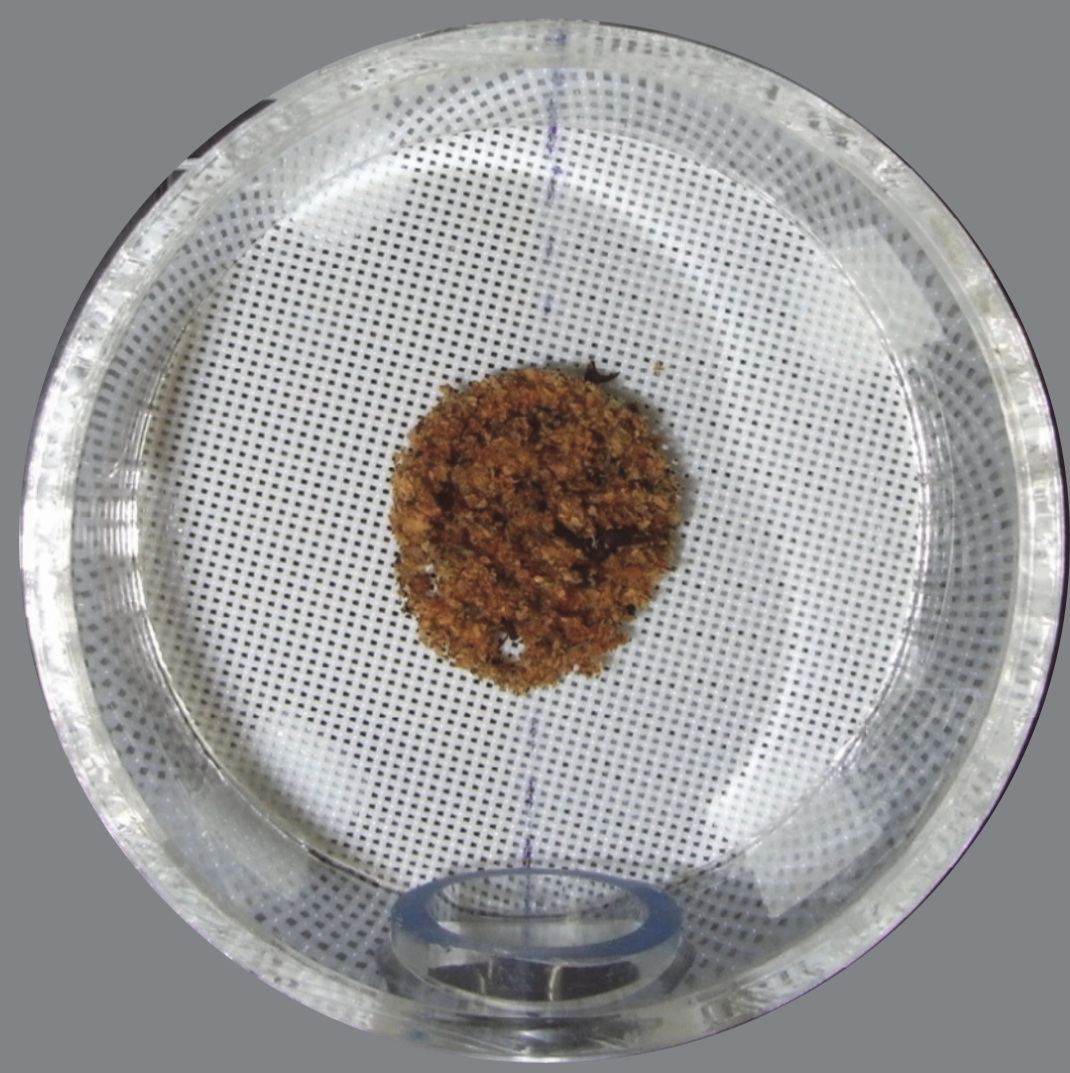


Waste removal towards waste odor?



Amplification of relocation behavior?

Start



relocation

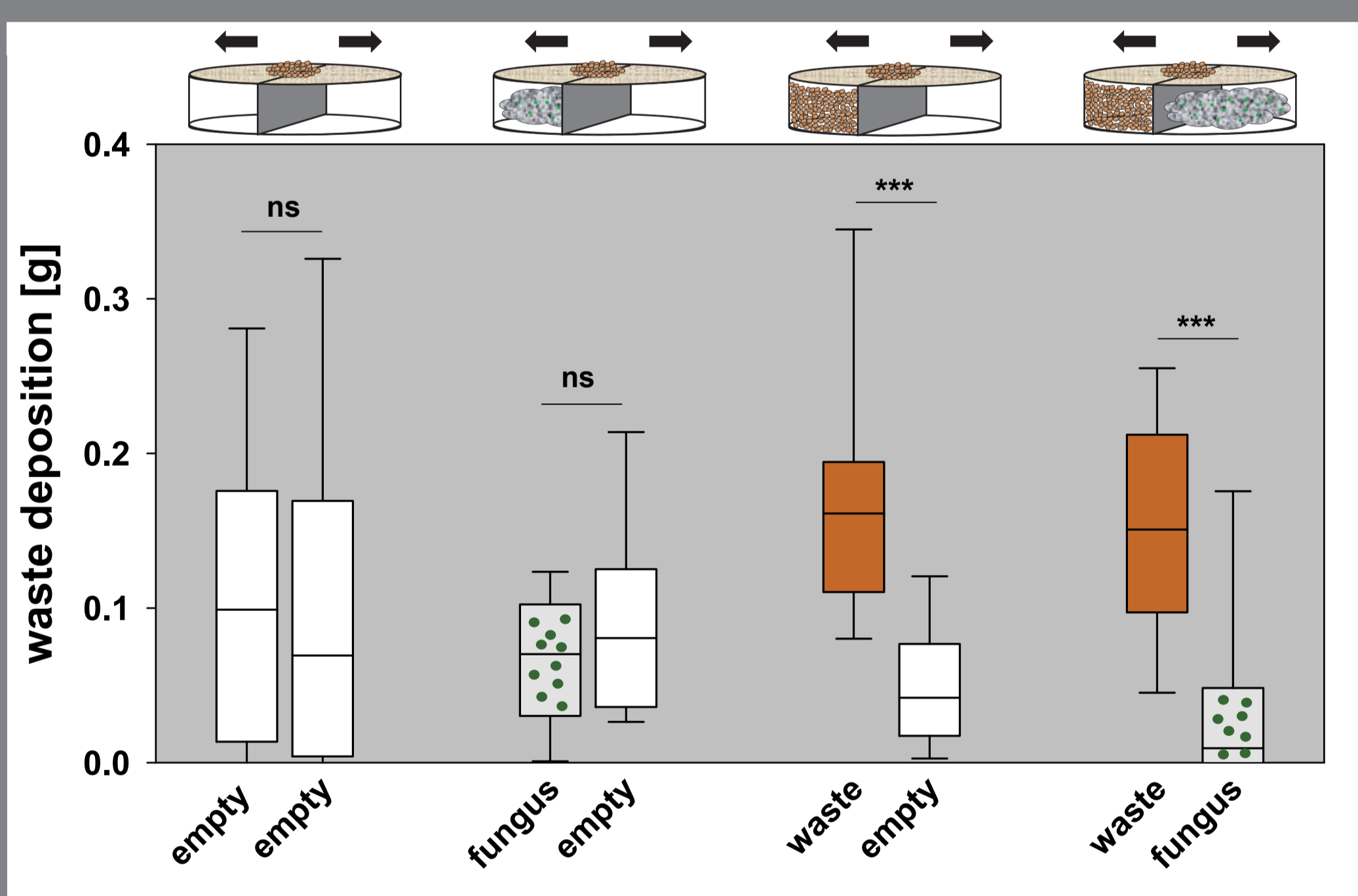
Video (4:29 min)



4 h



End



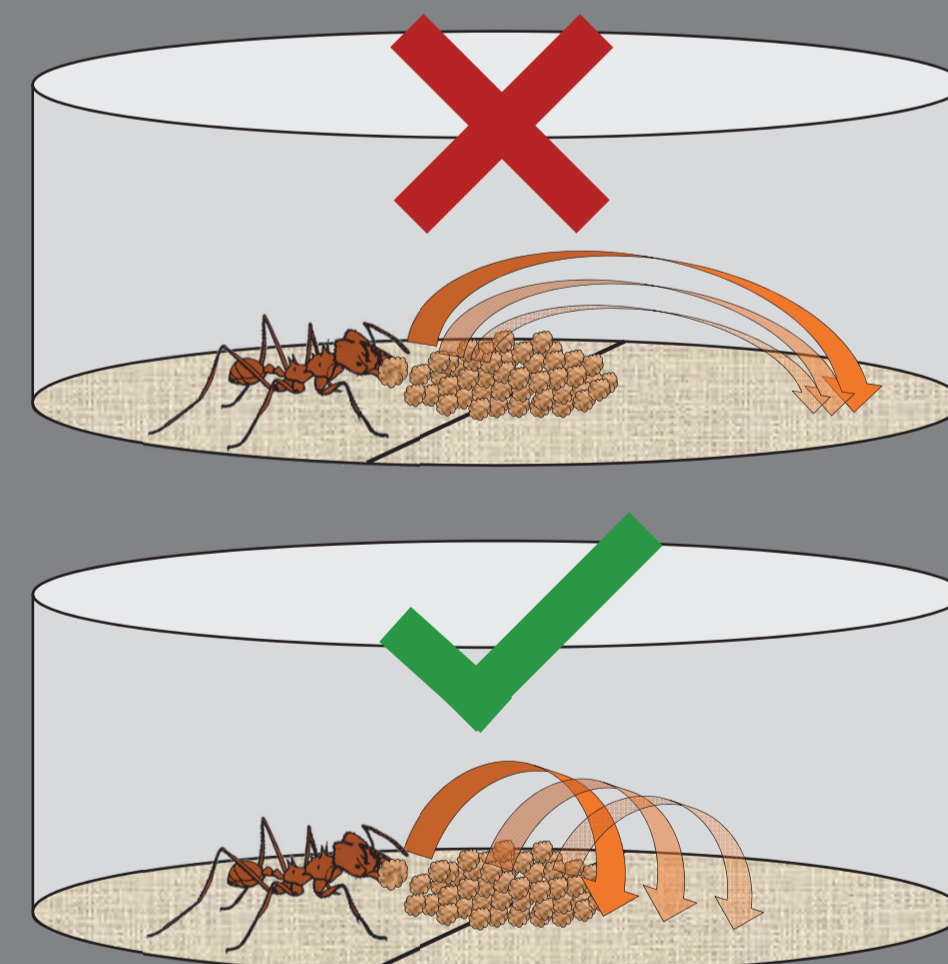
Workers did not remove the waste particles from above the fungus volatiles (as in the control). They did however remove the waste heap towards the side releasing waste volatiles, independent of the other side emitting no odor cue or fungus volatiles.

➡ Workers seem to use odor cues during waste management. Relocation 'towards waste' rather than 'away from fungus'

➡ Perhaps only a direct physical contact between healthy fungus and potentially hazardous waste particles leads to cleaning of the fungus.

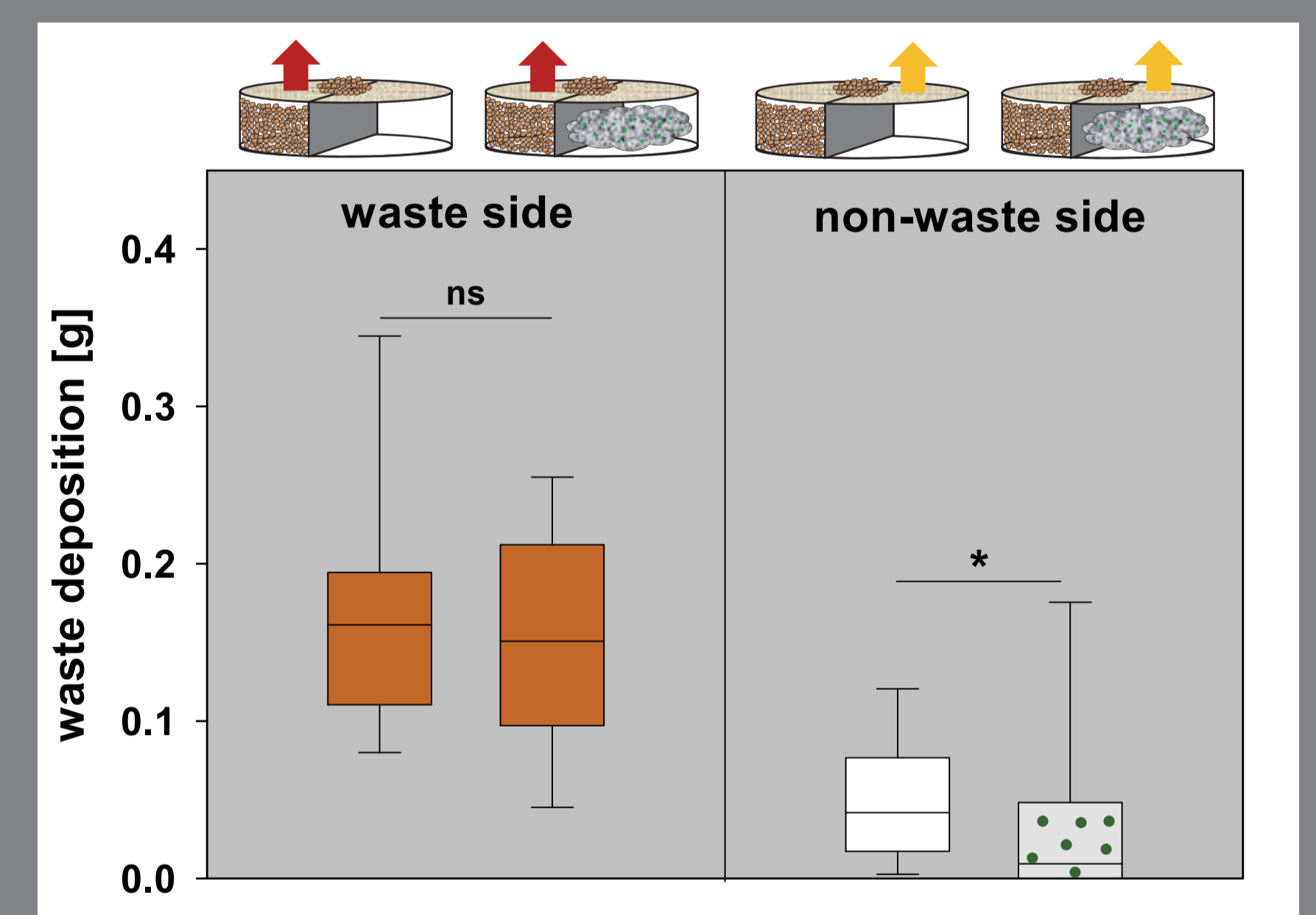
## Results

Relocation of waste material



Workers did not remove waste particles from the original heap to a separate location in the preferred arena half.

Rather, a particle was picked up on one side of the heap and deposited on the other side of the same heap. This way, the waste heap 'moved' across the arena floor towards the half emanating waste volatiles. Sometimes additional waste, carried from the fungus garden box, was added.



Was the waste removal stronger when both volatiles, rather than only waste odor, were presented?

Workers removed more waste material from above the non-waste, i.e. fungus, container, when both volatiles were presented.

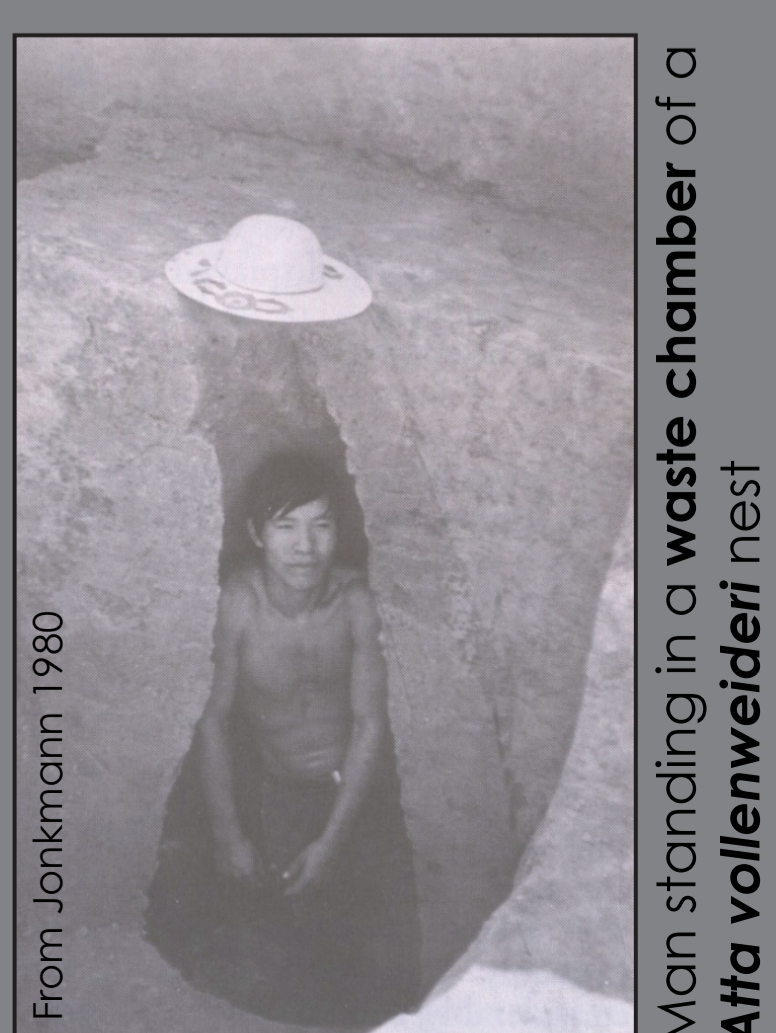
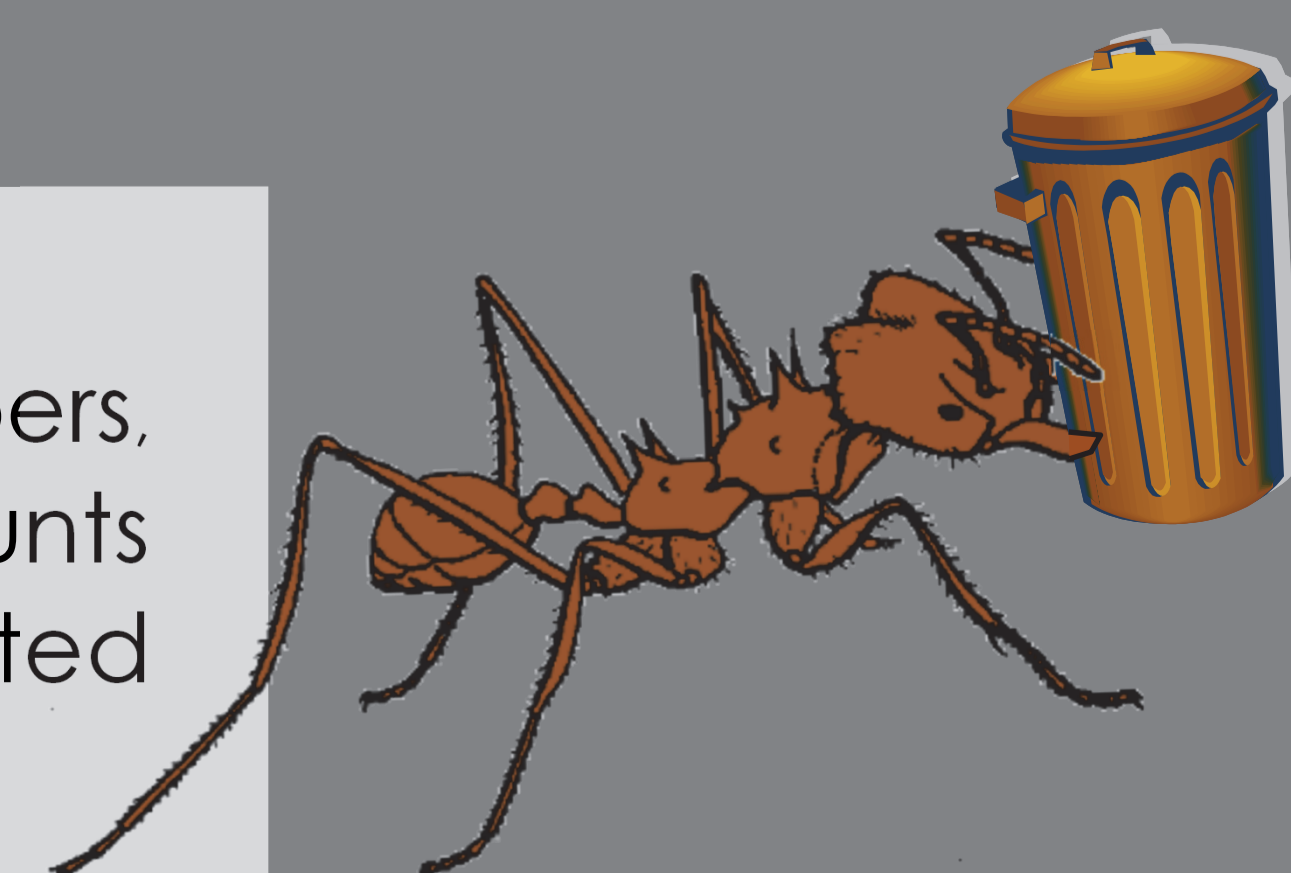
➡ In a natural nest, usually both volatiles are present and can be used as cues. The resulting stronger waste removal reaction exhibited by the workers would ensure fast and thorough cleanup of waste particles from a fungus chamber and a reduction of pathogens' threat.

## Conclusion

Leaf-cutting ants strong **waste relocation** behavior **towards** a source emitting **waste volatiles** could explain the accumulation of huge quantities of waste at an already established place

within the nest.

In these special waste chambers, excavated by the colony, vast amounts of waste material can be accumulated (see picture, left).



From Jonkmann 1980

Man standing in a waste chamber of a *Atta vollenweideri* nest