



Costs and Benefits of Social Behavior

Which of
these is *not* a
benefit of
group living?

1. Honeybees increase their foraging success by sharing information about food sources.
2. Lionesses increase their chances of fighting off males by cooperating.
3. Ants have a decreased vulnerability to infectious diseases as a result of living in a colony.
4. Termites can reduce the effect of a lethal fungus by interacting with other members of the colony that are already immune.

Which of
these is *not* a
benefit of
group living?

1. Honeybees increase their foraging success by sharing information about food sources.
2. Lionesses increase their chances of fighting off males by cooperating.
3. **Ants have a decreased vulnerability to infectious diseases as a result of living in a colony.**
4. Termites can reduce the effect of a lethal fungus by interacting with other members of the colony that are already immune.

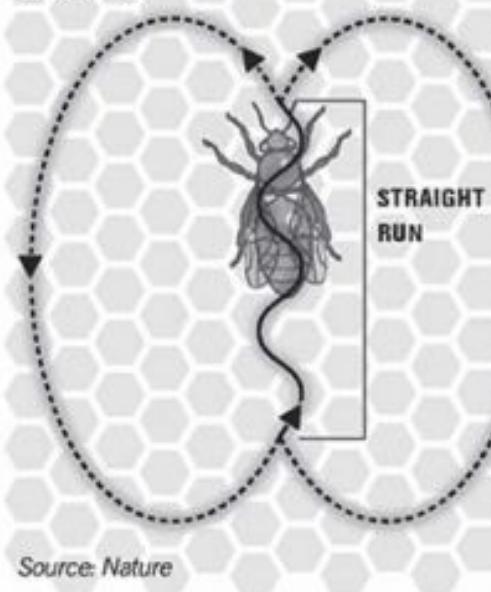


Honeybees: *Apis mellifera*

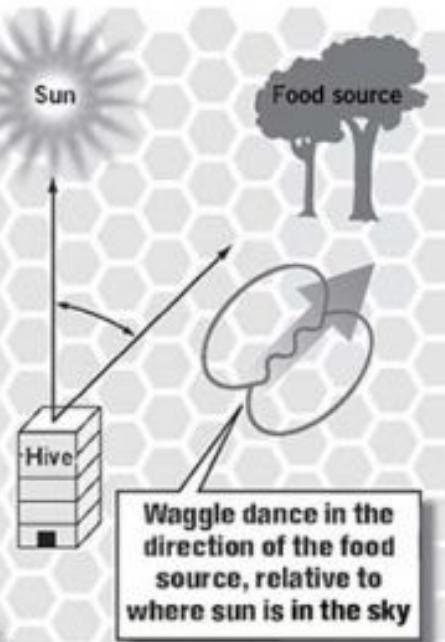
- Eusocial
- Single queen
- Multimodal communication
 - Waggle dance
 - Inhibitory buzzing.
 - chemical

Honeybee speak?

Scientists have long observed the "waggle dance" of honeybees, and most believe their experiments show that the gyrations of a bee inside the hive is a cryptic language telling other bees the distance and direction to a new-found source of rich pollen and nectar hundreds of yards away. First proposed by Karl von Frisch, who won a Nobel Prize for his discovery, the theory has remained controversial for nearly 50 years.



Source: *Nature*



The looping waggle dance has two components:

- ▶ **Straight run** – The orientation of this conveys information about the direction of the food.
- ▶ **The speed** at which the figure-eight part of the dance is repeated which indicates how far away the food is.

JOHN BLANCHARD / *The Chronicle*



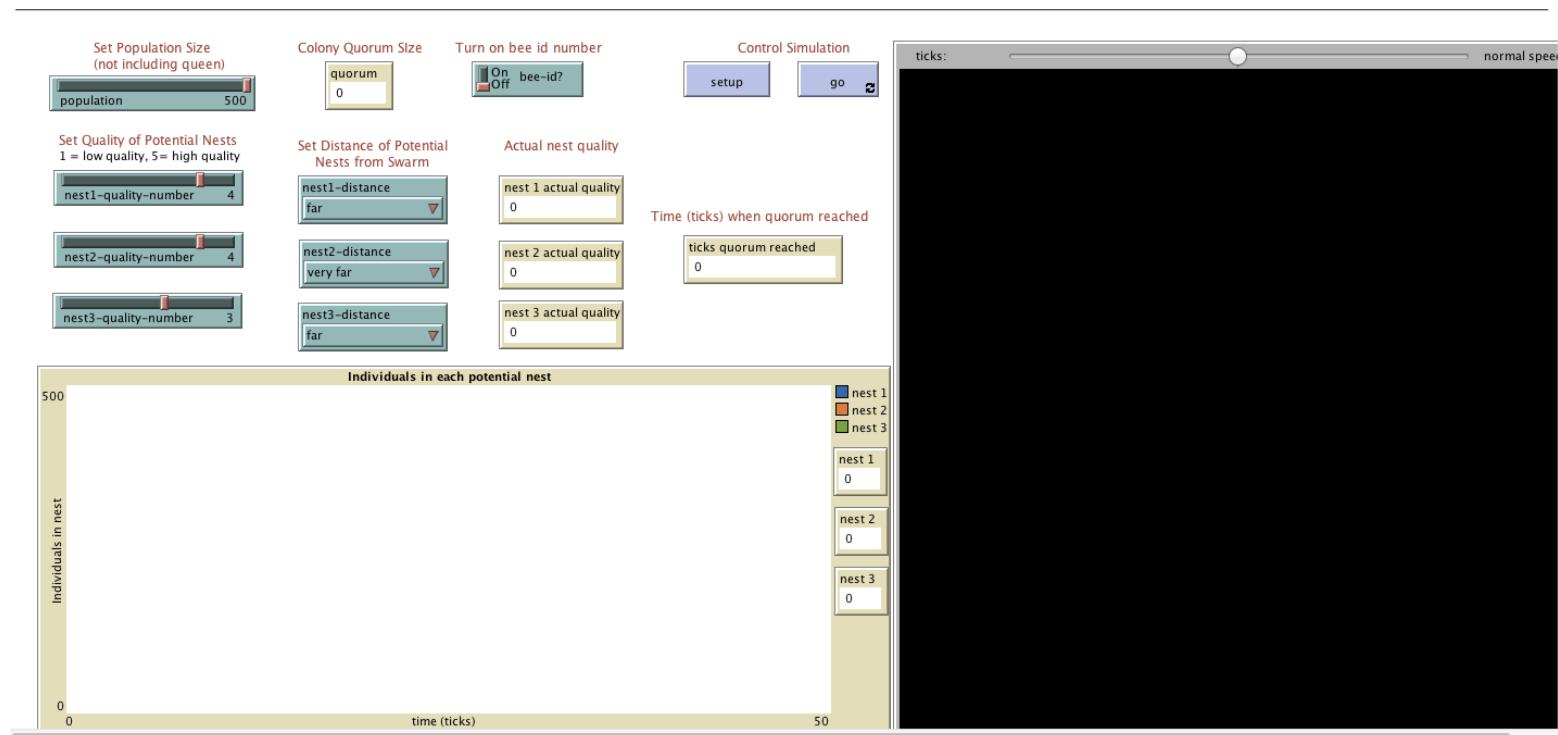
NewScientist

When do honeybees move?

- Environmental conditions become unfavorable
- The colony grows large: swarming
- The old queen leaves with workers to find a new nest site



Why do swarming bees take so long to select a new nest site?

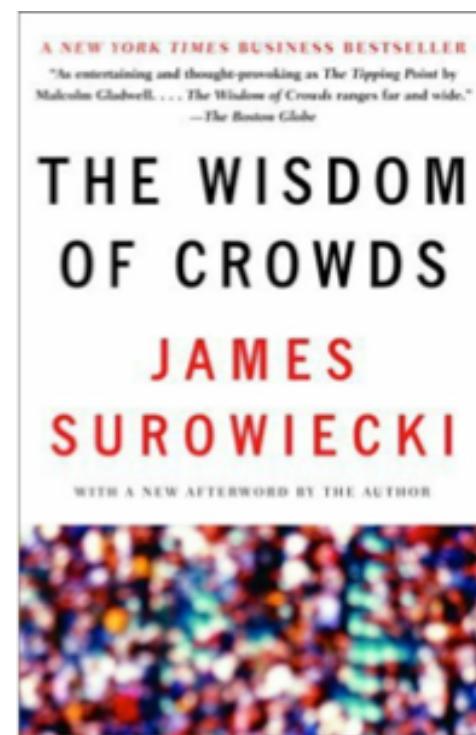


Why do swarming bees take so long to select a new nest site?

- Which parameters did you vary?
- What did you observe?
- Population?
- Nest quality?
- Distance?



Wisdom of the crowd





Collective decision-making



Temnothorax rugatulus



House hunting and
collective decision
making



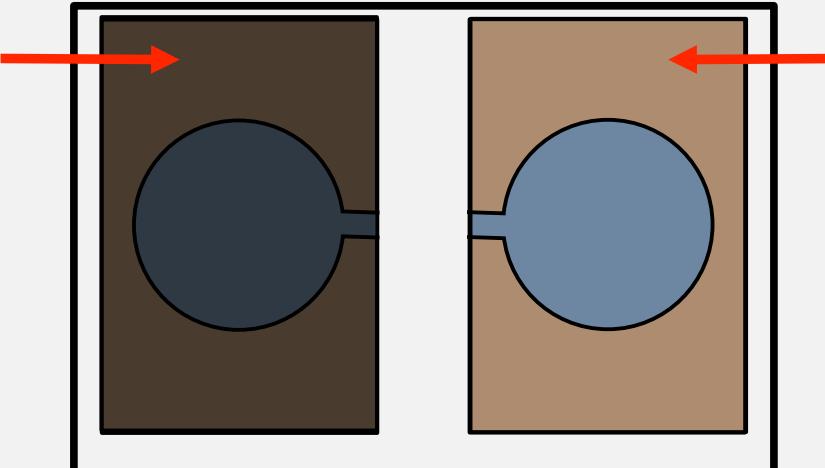
Takao Sasaki



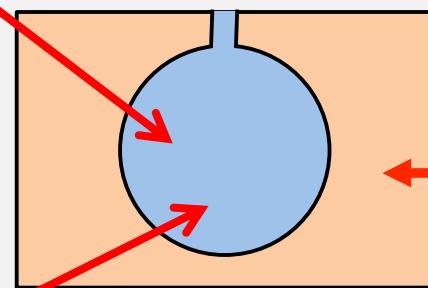
Stephen Pratt



Constant nest
(1 lux)

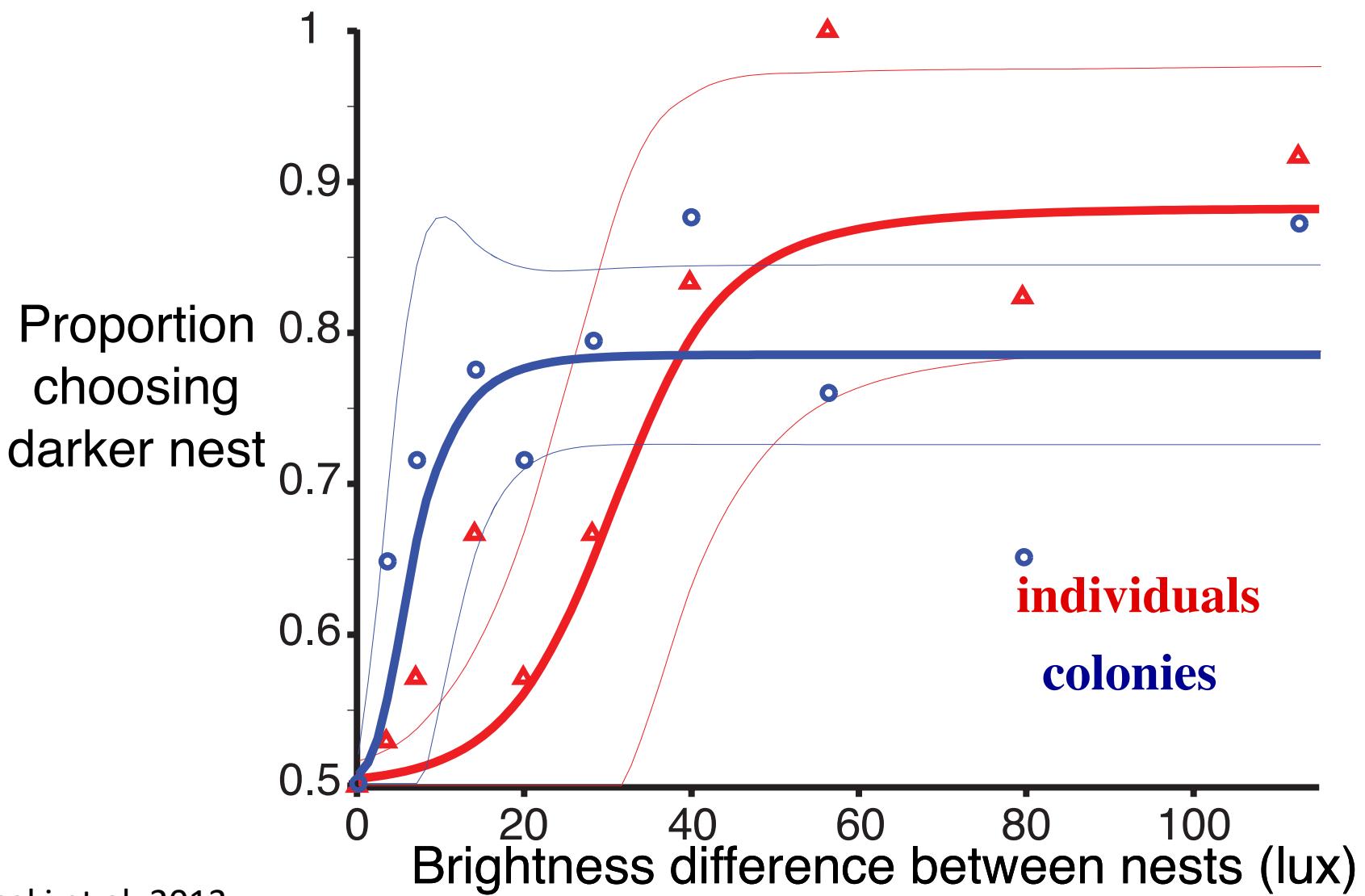


Comparison nest
(7, 14, 20, 28, 39,
56 or 112 lux)



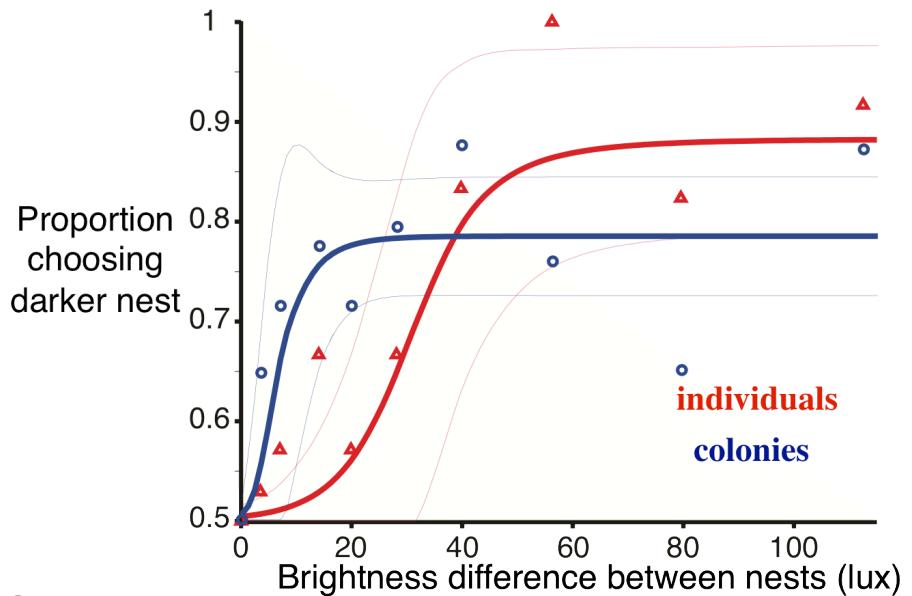
Home nest
(no roof; 1400 lux)





When the nests differ by 60 lux, what proportion choose the darker nest when an individual is making the choice vs a group making the choice?

- A. Individual: 0.86; group: 0.78
- B. Individuals: 0.78; group: 0.76
- C. Individuals: 0.57; group: 0.78
- D. Individuals: 0.78; group: 0.86





Why do swarming bees take so long to select a new nest site?

- Hypothesis: The bees benefit from the collective wisdom of the scouts (which takes time to “develop”).
- Prediction?

Methods designed by class

Treatment 1

- Population: 75
- Nest Quality:
 - Nest 1 quality: 1
 - Nest 2 quality: 5
 - Nest 3 quality: 3
- Distance:
 - Nest 1: near
 - Nest 2: very far
 - Nest 3: far

Treatment 2

- Population: 500
- Nest Quality:
 - Nest 1 quality: 1
 - Nest 2 quality: 5
 - Nest 3 quality: 3
- Distance:
 - Nest 1: near
 - Nest 2: very far
 - Nest 3: far

Repeat each treatment 5 times and record the nest choice for each trial. Enter the data in the Google Form using this QR code.



What were the results of our experiment?



<https://docs.google.com/spreadsheets/d/1xZF04gzTk7oooixpRUTSUruZC-J9kVAbvkWFVR8mifg/edit?usp=sharing>

What can you conclude from our bee experiment?

1. Larger groups make better choices when selecting a nest.
2. Random chance and not group size determine which nest will be selected.
3. Small groups should choose the better nests because they will consider fewer options.
4. Groups have evolved the ability to cooperate in order to help one another

Takeaway

- There are trade-offs of living in groups or as solitary individuals based on fitness costs and benefits
- Given the appropriate cost and benefits, social individuals are able to capitalize on environmental opportunities that solitary individuals cannot