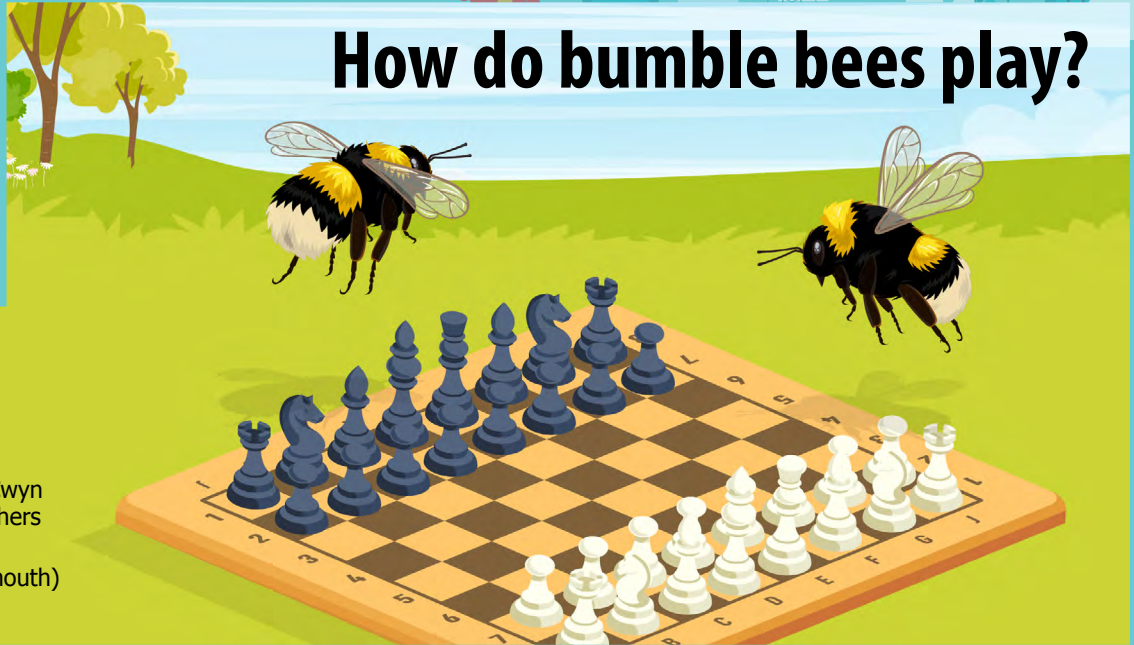


# How do bumble bees play?



## Authors:

Hiruni Samadi Galpayage Dona, Cwyn Solvi, Amelia Kowalewska, and others

## Associate Editors:

Rosy Stanesby (University of Plymouth) and Alexandra Appleton

## Abstract

Have you watched cute cat videos or funny dog compilations? Or primates “monkeying around”? Then you know that mammals love to play. Even the dancing cockatiel has gone viral! But have you ever considered whether insects play “for fun”?

We did an experiment to test whether bumble bees take part in object play. We wanted to see whether they would interact

and play with wooden balls. We found that the bumble bees did play with a ball-rolling action. Their behavior fulfilled our expectations of play in animals. What's more, they also found it rewarding! We ruled out the possibility that the ball rolling was an attempt to look for food or to mate. This suggests that bumble bees may be more capable of feeling than we had thought!

## Introduction

Have you ever heard of a bumble bee (*Bombus terrestris*) rolling a ball? This may not be as crazy as it sounds! Object play is a simple type of play behavior where animals play with objects. For example, dogs love to fetch a stick or chase a ball. As young mammals grow, playing helps to develop their cognitive and motor skills. This is important for their future as adults. But what about the rest of the animal kingdom? Do insects play?

To answer these questions, we need to understand what counts as play behavior.

### The 5 Rules of Play:

1. No functional outcome. Play does not result in the animal obtaining food or other direct benefits.
2. Initiated freely and naturally. Play is a spur-of-the-moment (unplanned) choice. The animal wants to do it!
3. Different movements from functional behavior. Physical movements of play are different from those of functional needs. For example, looking for food or mating.
4. Repeated, varied, and creative.
5. Free from stress. Play occurs when animals are in positive states.

Play must not be confused with a **behavioral stereotypy**. This is a repetitive movement or habitual action caused by stress, such as pacing.

5. Free from stress. Play occurs when animals are in positive states.

We decided to find out whether bumble bees engage in object play. And do they find it enjoyable and rewarding?



Fun fact! According to the World Wide Fund for Nature (WWF), 1 in 3 mouthfuls of food we eat depends on the work of pollinators such as bumblebees. **Photo:** Krzysztof Niewolny on Unsplash.

## Methods

We used a **colony** of forty-five bumble bees for the experiment. We placed the bees in a box separated into different areas (Fig.1). We video-recorded them when they entered the experimental arena. They could walk freely through the object area to the feeding area. They had the option to stay in the areas with **mobile** and **immobile small wooden balls**. We also used different colored balls to see if the bees had a favorite color!

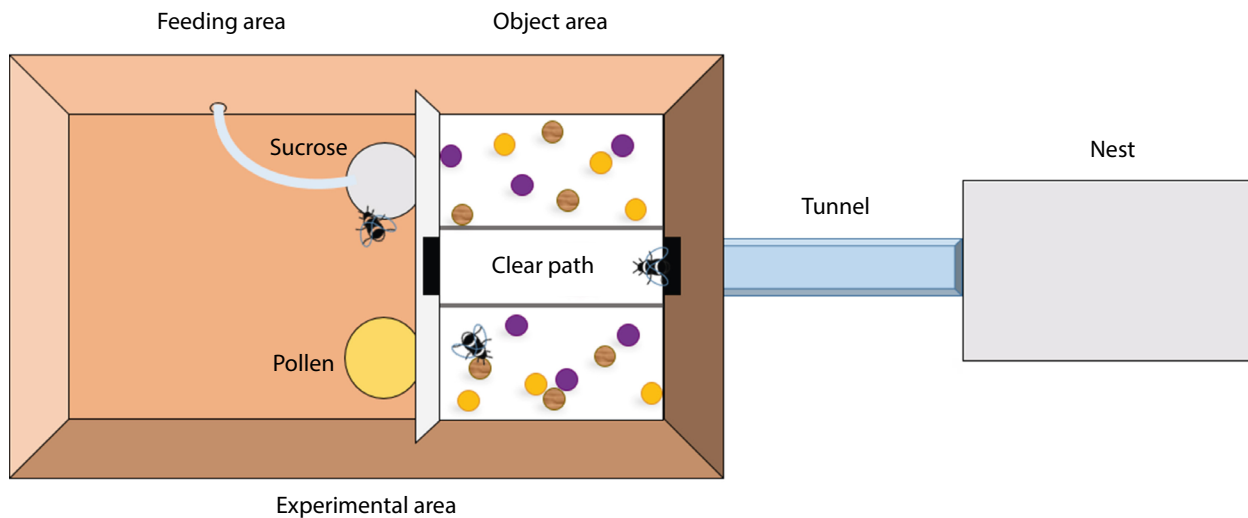
The video recorded:

- ① Bees entering the ball area.
- ② Bees touching a ball with their antennae or legs.
- ③ Bees rolling a ball. (To make sure it was intentional, the

bee had to be in line with the ball and pull it for at least 0.4 seconds.)

It was very important to limit stress within the experimental area. This was so that the bees could act naturally and carry out their normal behaviors. We made sure that:

- Ethical care guidelines were followed.
- A natural day/night cycle was maintained.
- The nest box imitated their natural environment.
- Pollen and sucrose food was always available.
- The bees were not handled unless absolutely necessary.



**Figure 1:**

A bumble bee nest box was connected via a plastic tunnel to the experimental area. The tunnel led to a clear path in the object area. There were colored balls on the sides of the path: nine mobile balls on the right and nine immobile balls on the left. The feeding area had sucrose and ground pollen. The sucrose and pollen were swapped every day to avoid the bees favoring one particular side.

## Results

### Q: Did the bees play with the wooden balls?

A: Yes! Across the 18-day experiment, the bees rolled the balls 910 times. One bee rolled a ball 117 times.

### Q: Did the bees really choose to roll the balls?

A: The bees developed a preference for the mobile ball object area after they had rolled a ball. This suggests the bees returned because they wanted to roll the balls again.

### Other interesting results:

- Ball rolls lasted 0.4–31 seconds (Fig. 2).
- The bees rolled the balls 2–601mm.
- Ball rolling was most common in younger bees, particularly aged 3–7 days.
- Bees had no ball color preference.

Which part of their body does the bee use to touch the ball first?



**Figure 2:** The nine panels show the sequence of a ball-rolling action over approximately 4 seconds. (The time stamps are in red at the top left). The bee (a) approaches the wooden coloured ball, (b) touches the ball with her forelegs, (c) holds onto the ball using all of her legs, (d–h) rolls the ball past the yellow ball and (i) finishes rolling and leaves the ball.

## Discussion

Our experiment showed that bees engage in object play behavior. This is because their ball rolling met the 5 rules of play.

### Ball rolling had no functional outcome.

The bees rolled the balls after eating. They did not extend proboscises onto them. Nor did they stop interacting with the balls after learning they were not edible. The bees rolled

the balls in all directions with no particular destination. The male bees made no attempt to mate with the balls.

### The bees rolled the balls freely and naturally.

The bees had the option to avoid the balls. Instead, they chose to roll them. They engaged with the balls and developed a preference for the mobile object areas.

**Ball rolling movements differed from functional behaviors.**

Ball rolling includes object rotation. This is different from flower handling. The bees did not extend their proboscises or **genitalia** onto balls. They also did not bite, buzz, or sting them. Also, the ball rolling speed did not increase with experience. This is different from functional behaviors which improve over time.

**Ball rolling was repetitive, varied, and creative.**

Ball roll duration, distance, and tracks varied among and within individuals. So, ball rolling differs from stereotypy.

**Bees were free from stress.**

The bees did not show any stress indicators, like defensive buzzing or sleepiness.

## Conclusion

We now know that bumble bees engage in object play, like our pets at home! Knowing this could change the way we view insects. If they can enjoy playing, maybe we need to think more carefully about how we treat them. It is important to keep learning about all creatures throughout the animal

kingdom. Do you have a bug house or wildlife park nearby? Why not go and discover more about the variety of insects that live in your area? See if you notice anything unusual about their behavior!

## Glossary of Key Terms

**Behavioral stereotypy** - behavior that is repeated, unvaried and without function. It can often be caused by stress. For example, pacing or tapping your fingers.

**Cognitive skills** - skills related to the brain and the ability to process thoughts. These skills are learnt and improved during development.

**Colony** - a group of one species that live and interact closely with each other.

**Functional** - a specific behavior that serves a purpose. This means that there is a reason to do it.

**Genitalia** - the organs of the reproductive system.

**Mobile** - able to move or be moved freely or easily.

**Motor skills** - skills related to the body and the use of muscles for movement. These skills are learnt and improved during development.

**Proboscises** - plural of proboscis. A long mouthpart used for feeding and sucking in invertebrates.

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*Goggio Family Foundation*

## Check your understanding

1 Why do animals play?

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2 Identify three ways that stress can be limited in an experiment on animal behavior. Why is this important?

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3 What evidence did we find that ball rolling is fun for the bees? Why does it count as play?

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4 The bumble bee is different from the honey bee. With a partner, look up both species and create a poster that shows their differences.

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