UNIVERSITY OF MOUNT UNION
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BRUMBAUGH Bytes

Are Raccoons Smarter Than We Think?

Featured scientist: Sage Warner

Collaborating scientist: Adam Zorn, Huston-Brumbaugh Nature Center

Meet the Researcher: Sage Brumbaugh

Sage Warner is a student researcher who wanted to know: Are wild raccoons intelligent enough to adapt to environmental changes like urbanization and deforestation? With tree cover in the U.S. decreasing by 17% since 2000, Sage wondered how animals like raccoons are coping—and whether their intelligence plays a role.

Raccoons are often labeled as pests, but Sage thought they might be misunderstood. Previous studies showed that some animals can recognize themselves in mirrors or use tools. Could raccoons do the same?

Background: Habitat Loss and Urbanization:

Since 2000, the U.S. has experienced a **17% decrease in tree cover**, largely due to urban expansion, agriculture, and infrastructure development. This loss of forested areas directly affects raccoons, which traditionally rely on wooded habitats for shelter, nesting, and foraging. In rural areas, raccoons typically inhabit bottomland hardwoods, upland pine forests, and riparian zones. As these habitats shrink, raccoons are forced to **expand their home ranges** and **seek alternative shelter and food sources**, often in urban environments.

Behavioral Changes Due to Urbanization

Urban environments present both challenges and opportunities for raccoons. Studies show that raccoons in cities:

- **Scavenge human food waste** (up to 32% of their diet in urban areas vs. 7% in rural areas).
- **Adapt nesting behavior**, using attics, basements, and decks instead of tree hollows.
- **Become more nocturnal** to avoid human interaction.
- **Exhibit bolder behavior**, becoming less wary of people over time.

  These adaptations reflect a shift in behavior driven by necessity. Urban raccoons often have **larger home ranges** (50–150 acres) due to fragmented habitats and the need to travel between food sources.

These changes reflect behavioral flexibility. Measuring raccoon intelligence helps researchers understand how they adapt to these new environments and what traits support their survival.

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Why Measure Raccoon Intelligence?

Raccoons are known for their problem-solving skills, dexterous paws, and long-term memory (they can remember solutions to tasks for up to three years). Measuring their intelligence helps researchers understand:

- How raccoons adapt to new environments (e.g., solving puzzles to access food in cities).
- Which traits support survival in human-dominated landscapes.
- How behavioral flexibility (like learning new foraging strategies) contributes to resilience.

For example, raccoons that show cognitive flexibility—the ability to learn and adjust behavior—are more likely to thrive in urban areas. Intelligence testing (like Sage Brumbaugh's mirror, bowl, and tube tests) provides insight into how raccoons navigate habitat loss and develop new survival strategies.

Why It Matters

Understanding raccoon intelligence and behavior helps:

- Inform wildlife management strategies that reduce human-wildlife conflict.
- Promote coexistence by designing urban spaces that accommodate wildlife.
- Support conservation by recognizing raccoons as adaptable, intelligent animals rather than pests.

Guiding Questions:

1. What does it mean for an animal to recognize itself in a mirror?

   _____
   _____
   _____

2. Why might intelligence be important for animals living in urban environments?

   _____
   _____
   _____

3. How does habitat loss affect raccoon behavior?

   _____
   _____
   _____

4. Why measure raccoon intelligence?

   _____
   _____
   _____

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Sage's Experiment:

Sage designed three tests to measure raccoon intelligence:

1. **Mirror Test** – Can raccoons recognize themselves?
2. **Bowl Puzzle Test** – Can they figure out how to get food from stacked bowls?
3. **Tube Tool Use Test** – Can they use tools to get food from a tube?

Each test was placed near a raccoon den and ran for two weeks. Trail cameras recorded the animals' behavior, which Sage later analyzed.

Mirror Test:

Mirror Behavior Code Key:
1 - Social Response - The animal retreats, vocalizations, or attempts to engage with the "other" animal in social play or aggression.
2 - Exploratory Behavior - The animal inspects the mirror or its surroundings, possibly looking behind it or touching the surface.
3 - Contingency Testing - The animal tests the connection between its movements and the mirror image, such as making repetitive movements or performing actions it does not usually make.
4 - Self-Recognition: The animal clearly recognizes that the reflection is itself. This is often indicated by the animal using the mirror to inspect or remove a mark placed on its body.

Bowl Test:

Bowl Behavior Code Key:
1 - Complete Success - Animal approached, manipulated the bowls, and ate all the food
2 - Partial Success - Animal approached and manipulated the bowls and ate food from some bowls
3 - **Minimal Success** - Animal approached and ate from the top bowl, but did not manipulate them
4 - Partial Failure - Animal approached and manipulated bowl but did not eat
5 - Complete Failure - Animal approached the bowls but did not manipulate them or eat any food.

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Behavior Tube Test:

Tube Behavior Code Keys:
Tube Engagement:
0 - No interaction
1 - Minimal Interaction (e.g. sniffing)
2 - Moderate Interaction (e.g. pawing, nudging)
3 - Extended Interaction (e.g. consistent attempts)
4 - Persistent Interaction (e.g. repeated attempts, trying different strategies)
5 - Immediate and Focused Engagement

Tool Use:
0 - No tool use
1 - Ineffective tool use (e.g. incorrect use, no progress)
2 - Limited effectiveness (e.g. partial success with tool)
3 - Effective tool use - (e.g. uses tool to successfully retrieve food)

Success:
0 - No solution found
1 - obtained the food

Mirror Test Questions:

5. Refer to the Mirro Behavior Code Key Reference Table, which behaviors suggest that an animal might understand the mirror reflects itself?

_____

_____

_____

_____

6. Why is self-recognition considered a sign of intelligence?

_____

_____

_____

_____

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Bowl Test Questions:

7. What might partial success tell us about problem-solving ability?

8. How could bowl design affect the results?

Tube Test Questions:

9. What do effective tools use look like in animals?

10. Why might some racoons fail even if they engage with the tube?

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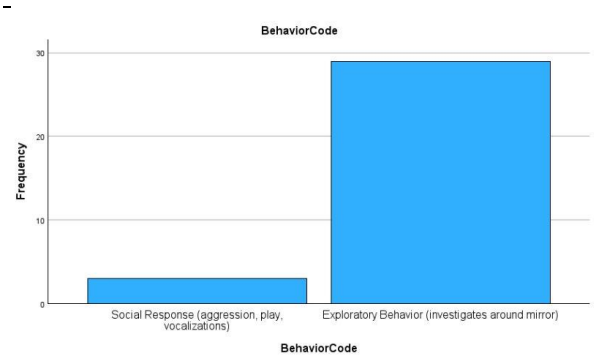
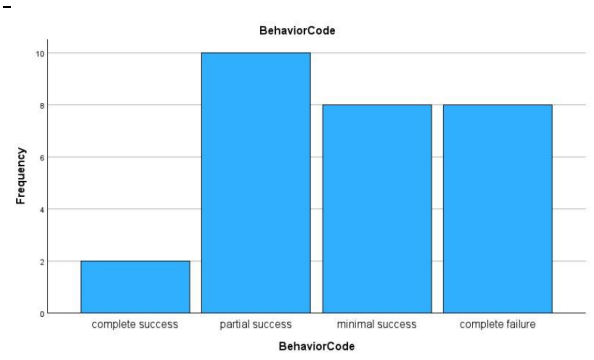
Results & Discussion:

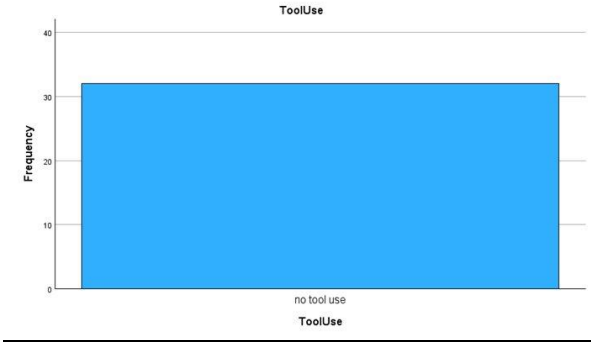
Mirror Test

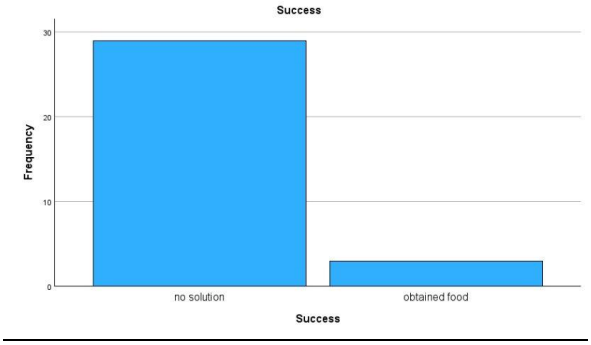


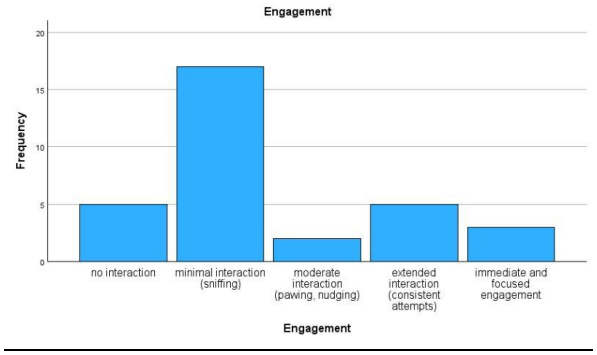
Bowl Test



Tube Test







Sage found that:

- Some raccoons showed signs of self-recognition.
- Many were able to solve the bowl puzzle.
- A few even used tools to get food from the tube.

These findings suggest raccoons are intelligent and adaptable. Intelligence testing helps us understand how raccoons cope with habitat loss and urbanization.

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Graph Interpretation Questions:

8. Which test showed the highest level of success?

9. Which test had the lowest engagement?

10. What might explain the differences in success across the tests?

11. How do these findings challenge the idea that raccoons are pests?

12. What could cities do to better coexist with intelligent wildlife?

Next Step(s) as a Scientist:

13. Science is an ongoing process. What new question(s) should be investigated to build on Hannah's research? How do your questions build on the research that has already been done?

Citation:

1. **Warner, S. (Summer 2024).** *Intelligence Testing in Wild Racoons & Other Small Mammals*. PPT presentation. Brumbaugh Scholar Program. University of Mount Union, Alliance, OH