

Do mealworms have personalities?



This is not a novel idea.

The social insect lab at the University of Arizona studies how individual behavior can affect a colony, system, or interactions.

Do individual insects demonstrate behavioral ‘sophistication’ that contributes to group flexibility or robustness?

Can individual behavior shift or expand complex systems?



Why study personalities and why mealworms?

- Personality traits in humans and some animal species have long been studied.
- Personality traits can be used to predict fitness for tasks or social behaviors.
- Several well-known personality tests measure traits such as agreeableness, extroversion/introversion, conscientiousness.
- Personality traits in animals are important considerations in breeding for temperament or work habits.
- Mealworms are important to ecosystems as decomposers and protein sources.
- Mealworms are capable of consuming polystyrene plastic.

Why insect personality might be important

- Personality traits such as extroversion (exploring) could mean a species is more likely to colonize a new habitat or try a new food source.
- 'Introverted' insects may be more likely to stay within a localized area.
- 'Agreeableness' in insects might indicate food sharing or that communication is occurring.
- Exploratory or bold behaviors in mealworms might indicate more likeliness to approach/feed on other kinds of plastic.
- Greater understanding of what motivates insect behavior could be useful as a model for other species.
- **Our question: Do mealworms express personalities, specifically boldness, curiosity, and agreeableness?**

Materials

- Mealworms (*Tenebrio molitor*) obtained from local pet store
- 2 oz mini cups with lids to house mealworms
- Flax seed meal
- 8.5" x 11" paper printed with concentric circles (1.75 cm apart)
- 8.5" x 11" paper with maze constructed from plastic straws (___ cm through center of maze)
- Apple slices
- Dependent variable = individual mealworm personality
- Independent variable = each mealworm
- Constant = each test

Procedures, methods, predictions (1)

Test 1: will mealworm move towards food source (exploratory behavior)

Test 2: will mealworm move through a maze toward food or shelter (exploratory or curious behavior)

Test 3: will mealworm share food or prohibit other mealworms from eating (agreeableness)

Test 4: will mealworm move toward food or shelter (exploratory)

Test 5: will mealworm move from shelter toward food (exploratory, curious)

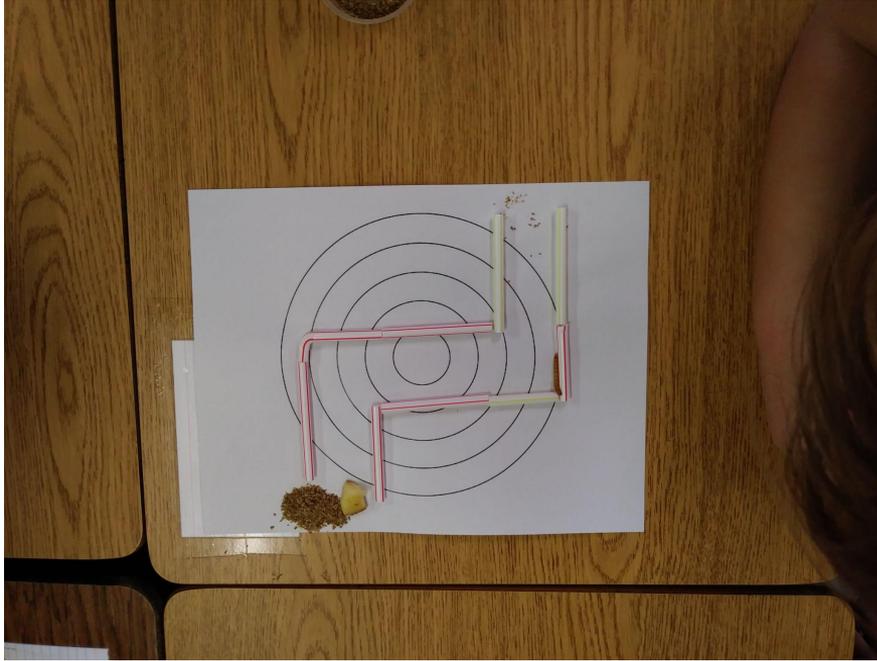
(2)

- Mealworms chosen for uniformity (size, color) since we cannot determine age.
- 6 groups of students separately observed their mealworm through the five tests.
- Test 1: Mealworm placed in center of paper with printed concentric circles. Given 10 minutes to move freely toward apple slice. Students observed mealworm movements.
- Test 2: Mealworm placed on one end of maze constructed of plastic straw pieces with food and shelter placed at maze's exit. Given 10 minutes to move through maze. Students observed behavior.
- Test 3: Mealworm placed on center of paper containing apple slice. Two more mealworms were placed near apple. Students observed behavior for 10 minutes.
- Test 4: Mealworm placed on center of paper with food and flaxseed meal (shelter) on opposite sides. Students observed behavior for 10 minutes.
- Test 5: Mealworm placed on paper, covered with approximately 1 teaspoon of flaxseed meal. Apple slice placed approximately 7 cm away. Students observed behavior for 10 minutes.
- A maximum of two tests per day were conducted so as not to traumatize mealworms. Mealworms were kept in separate containers and had access to food except for 3 hours before we observed them in tests.

(3)

- Based on what students have learned about their own personality differences and personality traits they observe in family pets, students predicted that mealworms would demonstrate differences in 'boldness' or exploratory behaviors, 'shyness' or seeking shelter tendencies, 'agreeableness' or willingness to share food, 'curiosity' by exploring or moving through maze. Students also predicted that mealworms would be more motivated by food than to seek shelter. We predicted that insects would demonstrate personality differences that could affect their survival or even evolution as a species.

Mealworm maze test



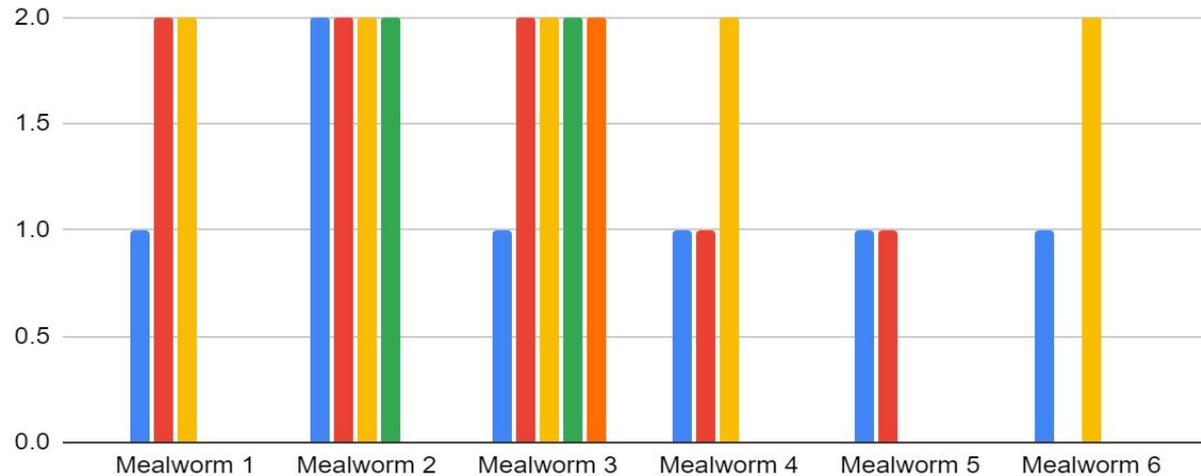
Observations/Results

	Test 1 cm traveled	Test 2 thru maze	Test 3 sharing food	Test 4 exploring	Test 5 shelter to food
Mealworm 1	7 cm all over	yes, 3 min	yes	yes, moved off paper	no, pupa stage
Mealworm 2	7 cm to apple	yes, 2 min	yes	yes, moved off paper then to bran	no, preferred bran flakes
Mealworm 3	7cm all over	yes, 1 min	yes	yes, to bran then away from bran	yes, moved toward food, then off paper
Mealworm 4	0 cm	no, half way, 10 min	yes	yes, away from food and flakes	no, preferred bran flakes
Mealworm 5	3.5 to bran flakes	no, 3/4 way 10 min	no, then yes	yes, moved off paper	no, preferred bran flakes
Mealworm 6	7 cm all over	no	yes	no movement	no movement

Mealworm behaviors: 0 = 'no', 1 = partially, 2 = 'yes'

Test 1 exploring for food, Test 2 maze, Test 3 sharing, Test 4 seeking food or shelter and Test 5 shelter to food

■ Test 1 exploring for food ■ Test 2 maze ■ Test 3 sharing ■ Test 4 seeking food or shelter
■ Test 5 shelter to food



Discussion

Mealworm 1 showed exploratory behaviors during Tests 1 and 2. It crawled all over the target paper, then moved off paper onto table. It took only 3 minutes for move through the maze and did appear to examine the apple slice at the end of maze. Mealworm 1 was active on the paper and allowed 2 other mealworms to eat or be near the apple slice during Test 3. For Test 4, the mealworm was again very active, moving all over the paper and table, but was not motivated by food or shelter. Mealworm 1 turned white and was in the pupa stage during Test 5.

Mealworm 2 moved quickly toward the apple slice and was observing eating the apple during Test 1. It took only 2 minutes to move through the maze, following edges of drinking straws. During Test 3, the mealworm did not prohibit other mealworms from moving toward or eating apple slice. It was observed to repeatedly crawl under paper. During Test 4, Mealworm 2 moved off the paper many times. Students noted it raised its head several times as if looking up/around. At 7 minutes, the mealworm found shelter and stayed there. Mealworm 2 began to move out from shelter after almost 10 minutes, but not toward food source.

Mealworm 3 traveled at least 7 cm from paper center and all over the paper during Test 1. During Test 2, the mealworm found its way into a straw. After crawling back out and restarting, it took only 1 minute to move through the maze and went to shelter first. Mealworm 3 was actively eating apple slice and allowed another mealworm to also eat. During Test 4, it initially moved toward shelter, then away from flaxseed meal. It moved toward apple, then away, and eventually away from both resources. For Test 5, the mealworm crawled toward food, then after 7 minutes, off the paper.

Discussion continued

Mealworm 4 crawled on the paper during Test 1 but not toward food source. In the maze test, the mealworm had only moved to the first corner of the maze and after 10 minutes, only $\frac{1}{2}$ way through the maze. Mealworm 4 went to the apple during Test 3 and allowed other mealworms access to food. During Test 4, the mealworm did not move toward either food or shelter, crawling away from both resources. Mealworm 4 did not move from shelter in flaxseed meal.

Mealworm 5 moved only 3.5 cm toward food source. During the maze test, the mealworm moved only to the first corner of the maze. It did not complete the maze. For Test 3 (food sharing), mealworm 5 exhibited some 'chasing' behavior. Students described it as 'charging' the other mealworms before it moved away. In Test 4, the mealworm moved away from either food or shelter and towards edge of paper. During Test 5, the mealworm did not move from shelter.

Mealworm 6 crawled all over the paper during Test 1 and did not move toward food source. During Test 2, the mealworm did not attempt the maze. It preferred to hug the straw boundary. For Test 3, the mealworm did not attempt to eat and allowed other mealworms to access apple slice. During Tests 5 and 6, the mealworm made no attempt to move, either toward food or shelter, or from the shelter of flaxseed flakes. A few days after we concluded our test, Mealworm 6 went into the pupa stage.

Conclusions

We came to several conclusions after our tests.

- Larger sample size needed.
- Study requires better containment system (mealworms can move far and fast).
- All mealworms showed some exploratory behavior in Test 1, though not necessarily to seek food.
- Mealworms appear to be motivated more by need for shelter rather than food (Test 5—only one mealworm moved from shelter to food).
- Mealworms are active in seeking shelter (flaxseed flakes, under paper, inside straws)
- Some mealworms (1, 2, and 3 in our tests) exhibited more 'exploratory' or 'curious' behavior than others (Test 2/maze).
- Most mealworms exhibit some 'agreeableness' in that they share food sources.
- Do mealworms exhibit same behaviors as adult darkling beetles would be an additional step.
- Would mealworms explore for polystyrene or other plastics if that were the only food source is another question to investigate.



References

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