Spatial navigation in corn snakes

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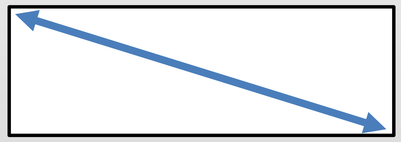
Introduction

- When animals are released in a rectangular environment, they exhibit a particular pattern of behaviour called a rotational error (Cheng, 1986).



- Rotational errors are also indicates that the animals uses geometry of the environment to orient.
- These behaviour patterns have been shown in many species:
  - Insects
  - Fish
  - Birds
  - Mammals (including humans).
- Reptiles have not been researched for rotational errors thoroughly. This study will explore the navigational abilities of a corn snake (*Pantherophis guttatus*).

Method

1. Training Phase:

- Rectangular arena (76”x24”) with four holes in each corner.
- Each hole in the arena is blocked except one true hole which is left open.
- Unique landmark is placed over the true hole. Other landmarks placed near the blocked holes.
- Snake will be released to find true hole.

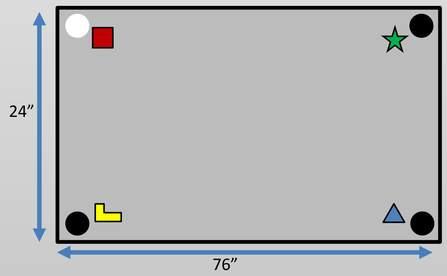


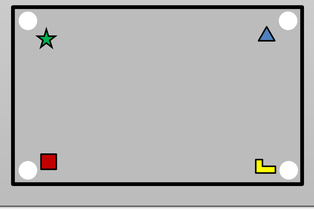
Figure 1. The experimental apparatus for the training procedure. The apparatus is comprised of a rectangular arena with four holes in each corner. Black holes are blocked, and the white hole is open and leads to an escape chamber.

2. Test Phase I: Geometry

- Landmarks removed.
- Correct attempt will be recorded when snake enters the true hole.
- Incorrect attempt recorded when snake enters other holes.

3. Test Phase II: Shift Landmarks

- Landmark will be moved to a different hole than those in the training phase.
- All holes will remain unblocked.



Expected Results

1. Training Phase:

- The snake will learn the association between the landmark and the true hole.
- Overtime, latency to finding the true hole will decrease.

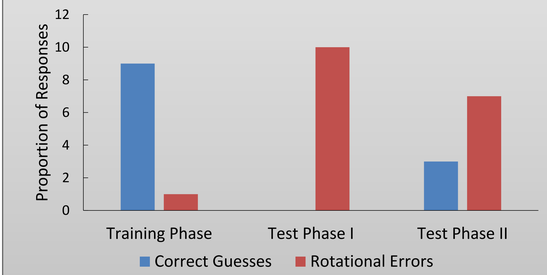


Figure 2. A visual of the predicted results of the experiment. The two categories are the proportion responses where the snake is able to find the correct hole (blue) and the proportion of rotational errors the snake makes (red).

2. Test Phase I:

- In the absence of landmarks, the snake will make more rotational errors between the true hole and the diagonal hole.

3. Test Phase II:

- When landmarks shift, the snake will continue to associate the true hole with the landmark that it had learned in the training phase.
- Alternately, the snake will lose the association between the landmark and the true hole and begin to make rotational errors which will be support for the use of geometry over landmarks.

Conclusions

- If results are significant, in other words, if the snake shows a significant preference for rotational errors over navigation using landmarks, the theory of a geometric module would also be supported in snakes.
- This experiment will show us whether the reptilian brain also codes for geometry like many of the other animal species.
- Perhaps the results of this study could inspire more research on the spatial navigation of amphibians as well, as they are the only other group that has not been tested for a geometric module.

Future research:

- How do snakes discriminate between prey and non-prey items?
- Can amphibians exhibit the same rotational behaviours as shown in almost all classes of animals?
- How can the environment of captive snakes be enhanced to stimulate the natural environment?

Reference

Cheng, K. (1986). A purely geometric module in the rat's spatial representation. *Cognition, 23*, 149-178.