

Place Power – Test How Good Your Memory Is!!

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Introduction

The Radial Arm Maze (RAM) is a model used to evaluate spatial memory in various animals. The ability of neural place cells and memory is tested by the RAM, it determines if an animal is capable of remembering where it has been. This ability is crucial in the survival of certain animals. For example, a bee needs to remember which plants it has harvested in order to be more efficient, a rat needs to remember where his home is, and a human needs to remember where they put their keys. If spatial memory cells do not function than an animal would have no recollection of looking in one place over the others. In humans this would manifest itself as searching under the couch 10 times and not remembering that you checked there. We will use the RAM based on the motivation of food, 8 arms will be arranged with food at the end of each arm. A human and most animals can use their memory to remember where they had been, and where they need to go. The animals that has the best memory will get the food fastest and thus in the real world will get more food increasing his survival rate.

The RAM has been used to assess the effects that surgical, behavioral, pharmacological, age, gender, and radiation have on long and short term memory (1). Multiple experiments have been run using the RAM as a test for how alcohol affects memory (2). Tests have also been run using the RAM to asses the long term impairment of memory following Nitrous Oxide induced analgesia (3). Any time a researcher wishes to test the affect of a drug on memory, the RAM is most likely used. For humans the maze should be easy, thus a modification will be made in which each arm will be concealed by a piece of cloth. This in effect will eliminate the visual cues of the room when the subject is located in the central platform. For the Kids Judge Science Fair we will use the RAM as a model to convey the concepts of neural place cells and memory to children.

We hope that the children will walk away from our display with an understanding that certain parts of our brain (prefrontal cortex, and hippocampus) work to encode our memory (2). We also wish to convey the concept that certain drugs (alcohol, PCP, THC, and mushrooms) can have very serious negative effects on our memory. We will show the various effects of the drugs by either blindfolding the child or spinning the child around in the central platform after each return from an arm. Most of all we just want the children to have a good time while still learning something about their brains. Our hope is that one day this brush with science will spark their interest in a career in a scientific field.

References

1. Cobb BL, Jauchem JR, Adair ER. Radial Arm Maze Performance of Rats Following Repeated Low Level Microwave Radiation Exposure. *Bioelectromagnetics* **25**: 49-57 (2004).
2. Welinton R, Oliveira D, Miyuki E, Palacios N. Haloperidol increases the disruptive effect of alcohol on spatial working memory in rats: a dopaminergic modulation in the medial prefrontal cortex. *Psychopharmacology* **170**: 51-61 (2003).
3. Culley DJ, Baxter MG, Yukhananov R, Crosby G. Long-term Impairment of Acquisition a Spatial Memory Task Following Isoflurane-Nitrous Oxide Anesthesia in Rats. *Anesthesiology* **100**: 309-314 (2004).

Methods and Materials

The maze consists of a central platform that extends out in equal directions with 6-12 arms. Our RAM will consist of 8 arms arranged in the $\pm x$ and $\pm y$ axis with $2(-x=y)$ and $2(x=y)$, labeled 1-8 with $+y$ being 1. At the end of each arm a hidden reward (M&M's) will be placed. An entry down a non traveled arm will be a correct response with repeat entry down another arm being an error. Good performance in the RAM is determined on the spatial memory of the animal tested.

Testing will consist of a 5 min session in which the kid will be placed in the central platform and given only the verbal instruction that "there is candy at the end of each arm. The only rules are is that if you leave the central area you have to go to the end of the arm, and that you cant leave the arms."

Materials

Thick making tape, Sharpies, Red tape, 10 lab coats, 8 shower curtains, rat sized radial arm maze, 1 rat or mouse, candy skittles or M&M's, 8 dinner bowls, 2 by 4's 80 ft, nails, 8 wooden dowels 3ft long, poster with catchy phrases and pictures of the brain, lab timers, blindfolds.

Procedure

Take the 2 by 4's and create 8 doorways 7ft tall by 3ft wide. The top of the door will consist of a wooden dowel on which a shower curtain will be hung. The 8 doorways will be arranged in a circle pattern with 8, 10ft radiations outwards from each door marked by tape. The food will be placed in a dinner bowl at the end of each radiation. The kids will be split into a group of 5-7 researchers and a group of 2-3 subjects (the lab rats). One kid will be placed in the maze and given the simple instruction of getting the candy at the end of each arm, two rules he must follow is that he must not step outside the lines of tape, and must shut every shower curtain after returning to the center of the maze. The other subjects will be blindfolded and run the maze latter. The group of researchers will get lab coats and timers with a sheet designed for taking data. While the subjects run the maze the researchers will gather data. Data can then be posted, and the

subjects can compete against their friends. Drugs will be administered by spinning the kids around, or moving the food after each return from a radiation.

Issues

How to convey that memory is a function that is not centralized in the brain. We will have to only focus on one part of the brain (hippocampus) as being the memory center to avoid confusion. The human brain is more complex than a rat so the model was changed to make it harder to complete the maze (addition of shower curtains to eliminate environmental visual cues). Also if a human learns how the maze works they have an unfair advantage when running the maze.