Spring 5-3-2012

Associative Spatial Learning in Mice

Ryan M. Yoder
Indiana University - Purdue University Fort Wayne, yoderrm@ipfw.edu

Associative spatial learning in mice

Ryan M. Yoder

Department of Psychology Indiana University - Purdue University Fort Wayne Fort Wayne, Indiana 46805

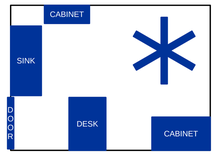
Introduction

- Cognitive map theory predicts that unrewarded pre-exploration of a maze environment will facilitate subsequent learning of reward locations within that environment – a phenomenon known as latent learning.[1]
- In the traditional radial arm maze discrimination task,[2] rats appear to consider each arm position as a discrete stimulus rather than as a mapped component of the environment.[3]
- Associative learning theory predicts that unrewarded pre-exposure to a discrete stimulus impairs its associability – a phenomenon known as latent inhibition.[4]
- Rats that pre-explore a 3-arm radial maze show latent inhibition if the baited arm is not adjacent to the unbaited arm, but show latent learning if the baited arm is adjacent to the unbaited arm.[5]
- No studies have evaluated the influence of unrewarded pre-exploration on the traditional multi-arm radial maze discrimination task. Further, no studies have evaluated the effects of unrewarded pre-exploration on subsequent maze learning in mice.

Method

Subjects & Apparatus

- Six-arm radial maze
- Male C57BL/6J mice



Procedure

1. **Random assignment to one of two groups:**

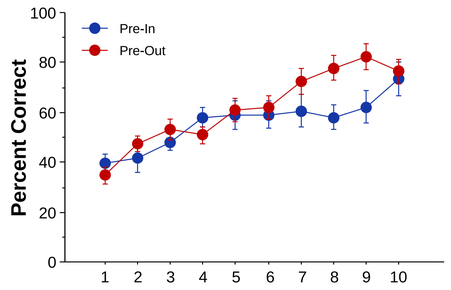
   Pre-In (*n*=8): explored the unbaited maze in the same environment that would later be used for training

   Pre-Out (*n*=7): explored the unbaited maze in an environment that was different from that used for training

2. **Pre-exploration:**
   - 10 min per day, for two days
3. **Training:**
   - Two arms baited
   - Four trials per day, for ten days

Results

Percentage of Correct Arm Choices per Trial

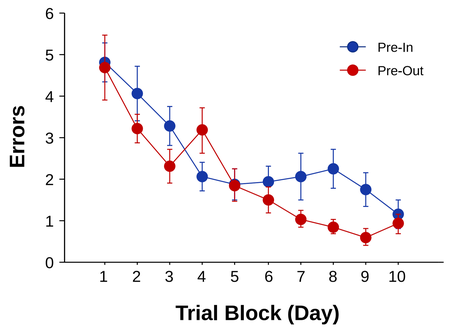


Pre-In and Pre-Out mice performed similarly overall, but learning rates differed

Between Groups:
$F(1,13) = 1.63$, $p = .22$

Group x Trial Block:
$F(1,9) = 2.56$, $p = .01$

Total Errors per Trial

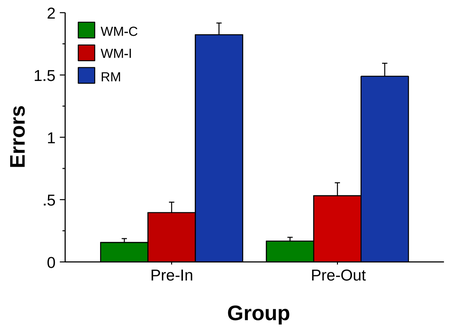


Pre-In and Pre-Out mice showed similar numbers of errors, but the errors decreased at different rates across days

Between Groups:
$F(1,13) = 1.87$, $p = .20$

Group x Trial Block:
$F(1,9) = 2.02$, $p = .05$

Error Types per Trial



Reference memory errors predominated for both groups

Pre-In:
$F(2,237) = 146.8$, $p < .01$; all *post-hoc* comparisons $p < .03$

Pre-Out:
$F(2,207) = 63.03$, $p < .01$; all *post-hoc* comparisons $p < .01$

Discussion

- Mice appeared to consider each arm as a discrete stimulus instead of as a mapped component of the environment.
- Unrewarded pre-exploration of the maze and training environment produced latent inhibition, as predicted by associative learning theory.
- Reference memory errors occurred more frequently than working memory errors, as reported previously in mice.[6]

Conclusion

Associative learning theory accurately predicts the spatial learning performance of mice on the radial arm maze discrimination task.

References

1. Tolman, E. C. (1948). Cognitive maps in rats and men. *Psychological Review, 55*(4), 189-208.
2. Olton, D. S., & Papas, B. C. (1979). Spatial memory and hippocampal function. *Neuropsychologia , 17*(6), 669-682.
3. Brown, M. F., Wheeler, E. A., & Riley, D. A. (1989). Evidence for a shift in the choice criterion of rats in a 12-arm radial maze. *Animal Learning & Behavior, 17,* 190-205; Brown, M. F. (1992). Does a cognitive map guide choices in the radial-arm maze? *Journal of Experimental Psychology: Animal Behavior Processes, 18*(1), 56-66.
4. Lubow, R. E. & Moore, A. U. (1959). Latent inhibition: the effect of non-reinforced pre-exposure to the conditional stimulus. *Journal of Comparative and Physiological Psychology, 52*(4), 415-419.
5. Chamizo, V. D. & Mackintosh, N. J. (1989). Latent learning and latent inhibition in maze discriminations. *The Quarterly Journal of Experimental Psychology, 41B,* 21-31; Trobalon, J. B., Sansa, J., & Chamizo, V. D. (1991). Perceptual learning in maze discriminations. *The Quarterly Journal of Experimental Psychology, 43B,* 389-402.
6. Schmitt, W. B., Deacon, R. M., Seeburg, P. H., Rawlins, J. N., & Bannerman, D. M. (2003). A within-subjects, within-task demonstration of intact spatial reference memory and impaired spatial working memory in glutamate receptor-A-deficient mice. *Journal of Neuroscience, 23*(9), 3953-3959.

Financial Support:
IPFW Faculty Summer Grant

Acknowledgements:
The author thanks Katrina George, Amber King, Seth Kirby, Gregg Lamott, and Robert Miller for assistance with data collection.