Reference memory error of rats in radial maze of different sizes with suppression of foraging exploration by increased travel distance within larger maze.

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***Abstract*- Aim**: This study aims to examine the effect of radial maze size (number of locations) on learning and performance efficiency of rats, i.e., do rats economize their physical effort when exploring the bigger maze and to assess the effect of sequence of training , 8-arm after 24-arm maze versus 24-arm after 8-arm maze, on relative performance of each rat in the two mazes. **Materials and method:** 22 Albino rats of Wistar strain obtained from National Institute of Nutrition Hyderabad, India were divided into two groups and were trained in 8-arm maze following training in 24-arm and vice-versa. The performance of the two groups were compared after obtaining plateau phase from the 10 trial moving average of Reference memory error for locating the onset of plateau phase. **Results** : One group of rat which were trained in 24 arm maze followed by 8-arm maze shows decrease in percentage Reference memory error in 8-arm maze .i.e., 2nd maze(P-value=0.003). The other group which were trained in 8-arm maze followed by training in 24-arm maze shows decrease in percentage Reference memory error in 24-arm i.e.2nd maze (P value= 0.001). **Conclusion:** The present study shows that rats after being trained in one radial maze perform better in another radial maze as far as Reference memory error in fully trained stage is concerned. This shows that repeated training with allothetic cues improves the ability to perform a task irrespective of maze size .

Keywords: Allothetic cues, Cognitive map, Radial Maze, Reference Memory Error.

I. INTRODUCTION

This study aims to examine the effect of radial maze size (number of locations) on learning and performance efficiency of rats, i.e. do rats economize their physical effort when exploring the bigger maze and to assess the effect of sequence of training, 8-arm after 24-arm maze versus 24-arm after 8-arm maze, on relative performance of each rat in the two mazes.

Since the report of Olton and Samuelson (1976)[1], the radial maze become a popular preparation for the study of animal memory. As rats develop cognitive map while navigating maze these maze studies are used to study spatial learning and memory in rats[2].

The strategies used by rats to find food in mazes with multiple food locations, such as a partially baited radial maze are thought to reflect foraging strategies used by these animals in their natural habitat[3]. For efficient task solving between foraging session, rats must employ a win stay strategies based on long-term reference memory (Ewa Jakubowska-Dogru.et.al.2003) [4].

Studies showed the length of the arm is one factor which can affect the performance in Radial maze in which there is a strong preference for short arms and no evidence for a difference in the ability to discriminate previously visited arms from unvisited arms as a function of arm length (Michael F.Brown,1990)[5]. Likewise, other studies also showed the performance of rats in radial maze is effected by spatial orientation and configuration ,external cues, chunking and even by task which rats have to solve in the maze[6,7,8,9,10].

In the view of such inclusive studies, by focusing on Reference memory , we decided to work on spatial memory of rats in 8-arm and 24-arm mazes to observe the effect of radial maze size on learning and performance efficiency of rats and assess the effect of the sequence of training, 8-arm after 24-arm maze versus 24-arm after 8-arm maze, on the relative performance of each rat in the two mazes.

II. MATERIALS & METHODS

22 Albino rats of Wistar strain obtained from National Institute of Nutrition Hyderabad, India were divided into two groups and were trained in 8-arm maze following training in 24-arm and vice-versa. The performance of the two groups were compared after obtaining plateau phase from the 10 trial moving average of Reference memory error for locating the onset of plateau phase.

The present study was approved by IAEC,544/CPCSEA ,Ref no:IAEC/SS-1/2016/UCM-93.

Animals: The 22 albino rats of Wistar strain were used during the experiments. The rats were obtained from National Institute of Nutrition, Hyderabad, India.

Food Reward: Soaked Bengal Grams.

8-ARM MAZE: Arrangement of Cues: Zero (0) watt light bulbs of different colour; three in numbers each light source is visible from the central choice area. Each bulb was enclosed in different shape.
Arrangement of Rewards: Rewards were placed in three out of eight arms; in such a way that one bait (Arm4) was along a cue, one in an arm (Arm7) in between two cues and one (Arm2) in arm exactly opposite to a cue.

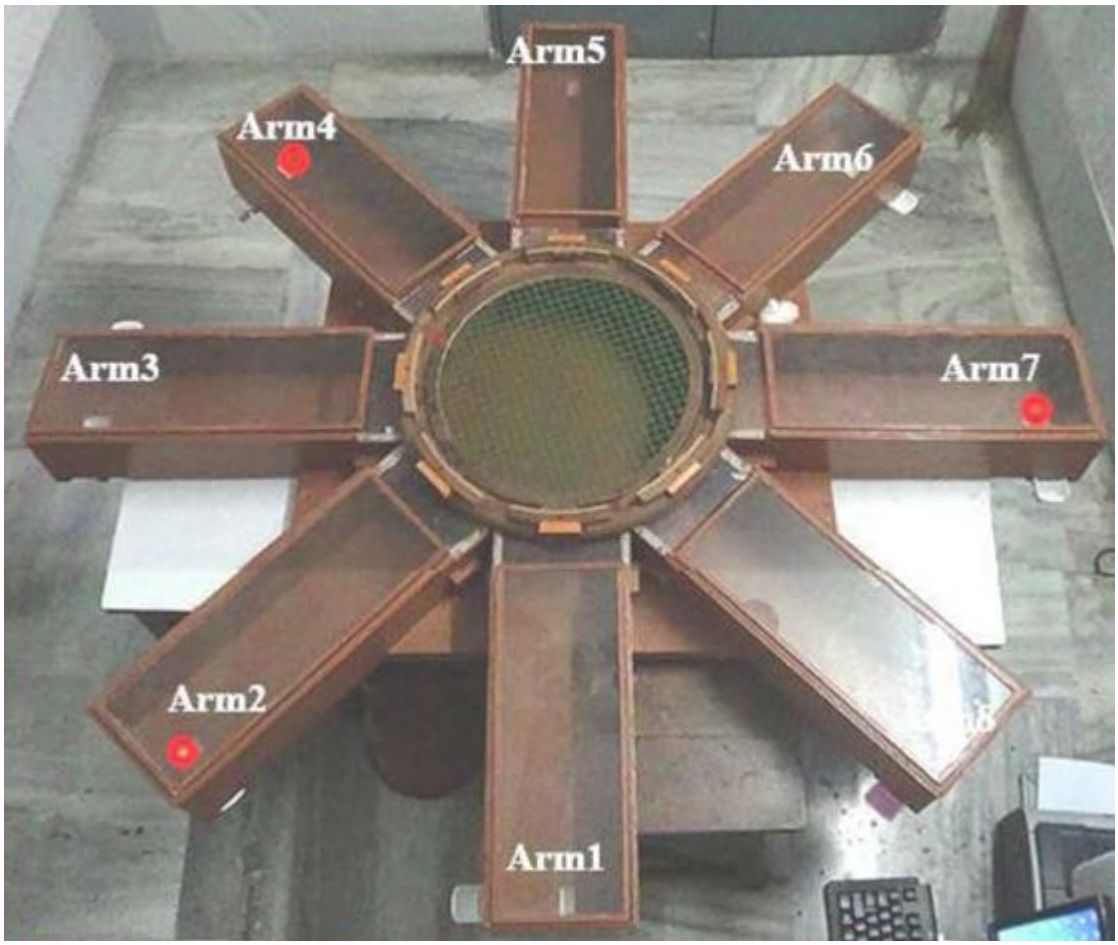

Figure: RADIAL 8-ARM MAZE (red circle showing location of baits).

24-ARM MAZE:

Arrangement of Cues**:** High contrast 3D objects of different shape, seven in number, were placed outside the maze along the arms at regular intervals at such height that these objects could be seen from the large central area.

Arrangement of Rewards: Rewards were placed in five (5) out of twenty four arms distributed non-homogeneously. The baited arms are: West 1,West 2,West 9, East 4and East 8. (shown in figure2)

FIGURE:RADIAL 24-ARM MAZE (Red circle showing location of baits)

Procedure: After group habituation in which food (reward)were placed at each end of each arm and allowing rats to explore the maze, rats were trained in maze to retrieve rewards only from the rewarded arms till performance has reached a plateau. In each trial, working memory error (revisit to any of the previously visited arm),Reference memory error(visit to non-baited arm) and reward gained were recorded.

From the standard error chart Working Memory Error (WME), Reference Memory Error(RME), reward gained),10 trials moving average of RME per trial was done to locate the onset of plateau phase. It is the ‘n’th trials from where the curve gets stabilized at low level, does not show notable fluctuation and does not overshoot the previous level.

III. RESULTS

One group of rat (n=13) were trained in 24-arm maze followed by training in the 8-arm maze. The other group (n=9) were trained in 8-arm maze followed by training in the 24-arm maze and reference memory error were compared.

Table 1: COMPARISON BETWEEN REFERENCE MEMORY ERROR IN RATS (n=13) TRAINED IN 24-ARM FOLLWED BY 8-ARM MAZE.

PERCENTAGE REFERENCE MEMORY ERROR MEAN±SD	24-ARM	8.231±6.170	STATISTICAL ANALYSIS (paired T test) P VALUE=0.003875947
	8-ARM	1.385±2.022	

We compared the percentage of RME of rats between 24 –arm and 8-arm maze. MEAN, SD value for 24-arm and 8-arm maze are 8.231±6.170 and1.385±2.022 respectively. The p-value of percentage error is 0.003875947 which is statistically significant.

Table 2: COMPARISON BETWEEN REFERENCE MEMORY ERROR IN RATS (n=9) trained in 8-ARM FOLLWED BY 24-ARM MAZE.

PERCENTAGE REFERENCE MEMORY ERROR (RME) MEAN ±SD	8-ARM	18.28±4.286	STATISTICAL ANALYSIS (paired T-test) P value=0.001524364
	24-ARM	2.850±3.392	

We compared the percentage of reference memory error in 8-arm maze and 24-arm maze. The MEAN±SD value for 8-arm and 24-arm are 18.28±4.286 and 2.850±3.392 respectively. The P value of percentage error is 0.001524364 which is highly significant.

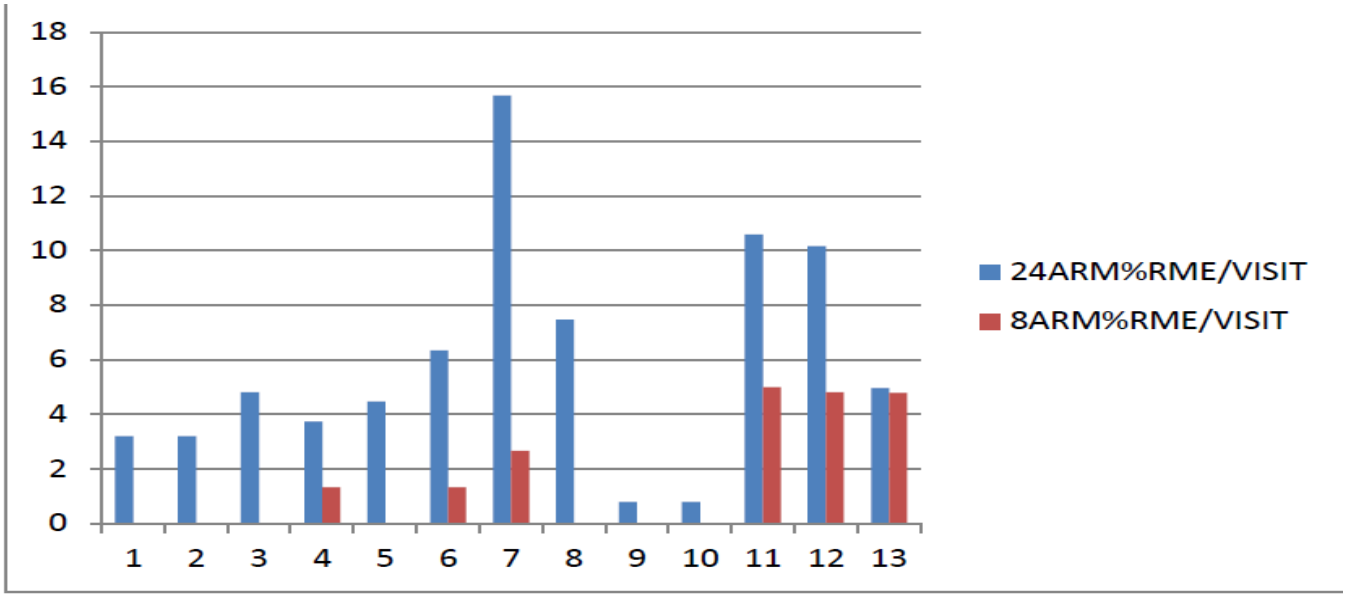

FIGURE1: GRAPHICAL PRESENTATIN OF REFERENCE MEMORY ERROR OF RATS TRAINED IN 8-ARM FOLLOWING PRIOR TRAINING IN 24-ARM MAZE SHOWING DECREASE IN ERROR IN 8-ARM MAZE(2nd maze).

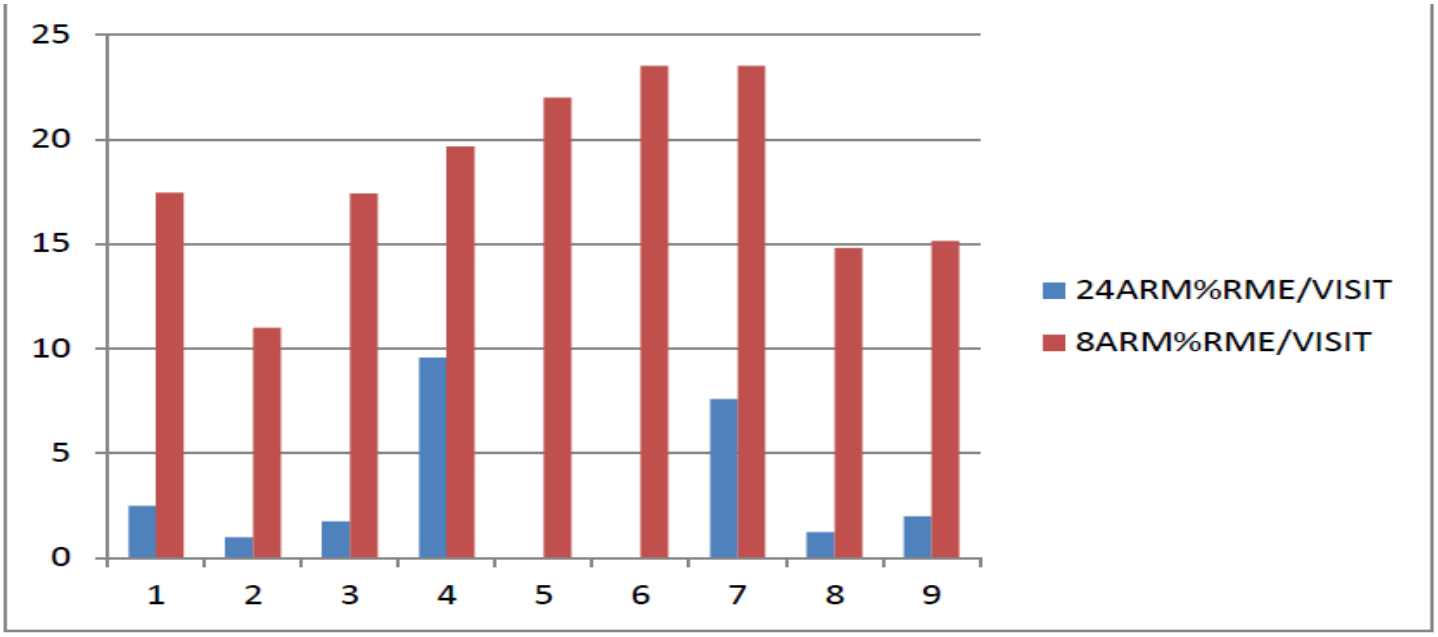

FIGURE 2:GRAPHICAL REPRESENTATION OF REFERENCE MEMORY ERROR OF RATS TRAINED IN 24-ARM MAZE FOLLOWING PRIOR TRAINING IN 8-ARM MAZE SHOWING DECREASE IN ERROR IN 24-ARM MAZE.(2nd maze).

IV. DISCUSSION

In the present study we have trained 13 rats (n=13) to stable performance, first in partially baited 24-arm radial maze (5-arms rewarded) and then in partially baited 8-arm radial maze (3- arms rewarded), as depicted in table 1. These rats performed better in 8-arm maze as compared to 24-arm, in terms of plateau phase errors of reference memory. Percentage of reference memory error is significantly higher in 24-arm maze as compared to 8-arm (p=0.003).

Table 2 depicts the comparison of RME between 8-arm and 24-arm maze where the rats were first exposed to 8-arm and then to 24-arm where the performance in the 2nd maze, although larger was better than the smaller 8-arm maze. The comparison showed statistically significant improvement in the performance in the 2nd maze (p=0.0015).

The statistically significant improvement in reference memory performance in the second maze indicates that prior maze-experience has a significant impact on the reference memory of rats. This conjecture is consistent with the studies of Maaswinkel and Whishaw 1999[11], Stuchlik et al. 2001[12], Wallace et al. 2002[13], who also commented that after additional training with idiothetic cues a stable performance level can be reached.

V. SUMMARY AND CONCLUSION

In the present study, we observed that rats after being trained in one radial maze perform better in another radial maze as far as reference memory in fully trained stage is concerned. This shows that repeated training with allothetic cues improves the ability to perform a task irrespective of maze size. The results of this study neither prove nor contradict the hypothesis that rats visit nonrewarded locations partly as foraging exploration and that rats economize their physical effort when exploring the bigger maze.

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