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The inhibition or facilitation of additional learning is a subject that can be investigated with a controlled study. In recent years, there has been an increased interest in the effects of previous learning on the inhibiting or facilitation of additional learning. This study was designed to examine whether or not previous learning (continuous reinforcement in an operant chamber) affects how swiftly a rat learns how to run a maze when compared to naive (untrained) rats. A total of nine rats were used, five were previously CRF trained and the remaining four were experimentally naive. Each rat was deprived of water for 24 ± 1 hour and was tested using a Lashley III maze and water reinforcement. It is the prediction of this experiment that the previously trained rats will make fewer total errors than the inexperienced (naive) rats and will meet criterion significantly faster. Data showed that rats that were previously trained made significantly fewer total errors than

There have been many studies exploring whether or not previous learning facilitates additional learning in humans. The classic work of Hermann Ebbinghaus (1885) showed a decrease in the number of required repetitions of a list of nonsense syllables during a later learning period. Ebbinghaus called this phenomenon savings. Ebbinghaus also tested the theory of proactive interference. Proactive interference occurs when previously learned material impairs the learning of new material (Ebbinghaus, 1885). The goal of this experiment is to apply this phenomenon to a species other than the human race. In similarity to humans, it is questioned whether previous learning will promote faster additional learning in rats.

Researchers Servatius and Shors (1994) exposed rats to inescapable stress (tail shocks) and discovered that the previously stressed rats exhibited continuous sensitization to the unconditioned stimulus (white noise). These results also demonstrated that the effect of stress on classical conditioning is long lasting, in excess of 48 hours. Based on this research one might question whether or not previous learning (including water deprivation, operant conditioning, and extinction) will inhibit previously trained rats from performing better than the naive rats on a new maze learning task.

In an extension of this study, naive rats were placed in an enriched environment and were tested with the same apparatus and criterion (limnel, 2000). There was a signifi-

cant difference in the number of total errors made between the enriched environment rats when compared to the normal environment rats. However, there was no significant difference in the time to meet criterion between the enriched environment and normal environment rats.

Both of these effects will be considered in this study, which will attempt to determine whether or not previous operant learning (shaping, CRF, extinction, then intermittent reinforcement) in rats will facilitate their rate of learning a maze. The hypothesis of this experiment is that previously trained rats will make fewer total errors than the inexperienced (naive) rats and will meet criterion significantly faster. It is also hypothesized that the trained rats will meet criterion for maze running in a significantly shorter amount of time than the naive rats. Overall, this research will explain whether trained (continuous reinforcement) rats have an advantage in learning the maze when compared to the untrained rats.

METHOD

Subjects

The subjects in this experiment were 2 male and 7 female mixed strain (Rattus Norvegicus) rats approximately 120 days old. Five of these rats had previously experienced a CRF/extinction and intermittent reinforcement process within the last two weeks of this experiment via required class experiments. The remaining 4 rats were untrained/naive. All of rats were maintained in a reverse day/night lighting facility and were water deprived for 24 ±_ 1 hour prior to each daily experimental procedure. The 24 hour water deprivation was found to be the approximate time at which the rats were motivated to complete a task in order to receive water.

Apparatus

For this experiment there were several devices that were used. Each rat was kept in a standard housing unit with the same form of food and water. A Lashley III maze, constructed at St. Norbert College, was used to run the animals. This maze, measuring 47 x 16 inches, consisted of 4 lengthwise halls, the 2 end halls leading to an exit on the top and bottom of the maze. Two petri dishes containing a few drops of water were kept at each end of the maze. Each rat's errors were recorded using a hand kept tally sheet. Time was kept with a stopwatch.

Procedure

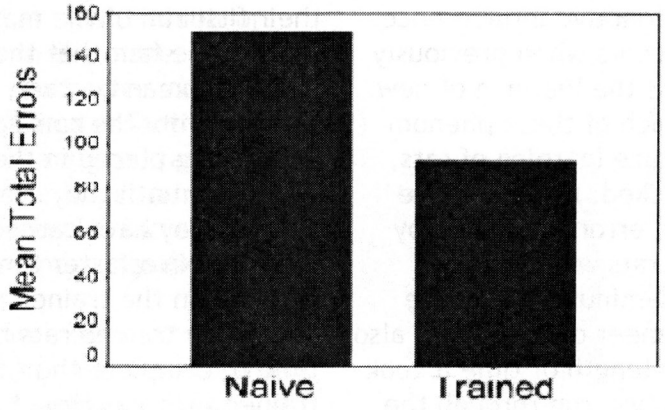
This was a between-subjects experiment in which those of the trained group were compared with those of the untrained/naive group. Upon choosing the rats, they were each given a number by which they were identified. All rats were tested in a Lashley III maze between the hours of 3 and 5 P.M. each day. A dish containing a few drops of water reinforcement was placed at the end of the maze. Each rat was placed in the maze and was monitored to determine how many errors it made and how much time it took the rat to reach the end of the maze (equaling one run). An error consisted of the rat taking a step in the wrong direction. Each trial in the maze lasted a maximum of 50 minutes, as the rats experienced fatigue when run after this time limit and each rat was given an unlimited number of trials in order to meet criterion. If the rat did not meet criterion within the 50 minutes, the rat was returned to its cage, given 7 minutes free access to a water bottle and then deprived again to be run 24 hours later. Criterion was met when a rat made 3 runs in a row without any errors. A stopwatch was used to record how long it took each rat to meet criterion and how long it took each rat to complete its first run. The total time recorded to meet criterion included the first run and was recorded after each rat made 3 runs in a row without error. The errors and run times made by (CRF) trained rats were compared to the errors made by the naive rats.

RESULTS

All of the results were measured by using independent t-tests. The total amount of errors accounted for the total number of wrong turns the rat made before it met criterion. The amount of time (minutes) it took the two groups of rats to meet criterion was also compared as well as the amount of time it took each rat to complete it's first run through the maze.

An independent groups t-test (see Fig.1) showed that the trained rats made significantly fewer total errors than the naive rats, $t(7) = 3.11$, $p = .017$. An independent t test was also used to compare the two groups on the time it

FIGURE 1



Mean Number of Total Errors in Maze Running for Trained and Naive Rats

TABLE 1

Time to meet criterion in minutes	Group Type			
	Trained		Naive	
	Mean	SD	Mean	SD
Time in minutes	77.40	19.83	131.75	48.32

Mean Number of Time to Meet Criterion in Trained and Naive Rats

took them to meet criterion. As shown in Table 1, the results illustrated that there was also a significant difference in the amount of time it took to meet criterion for the trained versus naive rats. The trained rats took less time to meet criterion (M = 77.40) when compared to the naive rats (M = 131.75) that took up to 54 minutes longer on average, t (7) = 2.31, p = .054.

Lastly, an independent t-test found that the naive rats took a shorter amount of time (M = 16.75) to complete their first run through the maze when compared to the trained rats (M = 40.20) who took at least 24 minutes longer on average, t (7) = 2.40, p = .047.

DISCUSSION

This study set out to explore the phenomena of proactive facilitation and proactive interference. The theory of savings suggests that there is a decrease in the number of errors/repetitions needed in the second learning period. It is assumed that these trained rats have benefited from the CRF process, supporting the phenomenon of savings. Hence, these

trained rats may possess better learning strategies, causing them to learn the maze in a shorter period of time. Another way to describe behavioral differences from a first trial to a second is by using proactive interference. Proactive interference occurs when previously learned material weakens the learning of new material. To measure which of these phenomena are present in the maze learning of rats, the rats' errors were tracked. Explicitly, the relationship between the errors produced by the naive versus trained rats was studied throughout a series of 50-minute trials. The time it took each rat to meet criterion was also monitored as well as the length of time it took each rat to complete its first run through the maze.

In support of the initial hypothesis, the trained rats produced fewer total errors than the naive rats. This was originally hypothesized because it was believed that the CRF process had given the trained rats an advantage. The naive rats would not possess this advantage, such as an acquisition of learning strategies. This previous training could have enhanced their learning of the maze with fewer errors when compared to naive rats. The supporting of the first hypothesis shows that this experiment demonstrated the phenomenon of savings over proactive interference. An alternative explanation for this result could include that the trained rats had been previously accustomed to the water deprivation and reinforcement process during CRF training. This familiarity with deprivation and reinforcement could have further motivated the rats to achieve the task at hand, causing them to react more cautiously than the naive rats.

In support of the second hypothesis, the trained rats met criterion for maze running in a significantly shorter amount of time than the naive rats. These results may reflect the fact that the previously trained rats made significantly fewer errors than the naive rats. Since the trained rats made fewer errors, they were able to reach criterion in a shorter amount of time. This result could also be attributed to the lack of motivation from the naive rats, which often sat in the corner of the maze for minutes at a time rather than exploring as the trained rats did.

Though there was strong evidence that trained rats performed better than the naive rats overall, it was found that the naive rats took a shorter amount of time in completing their first run of the maze. This can be attributed to the fact that the naive rats were not used to human contact, or removal from their housing unit. The rats could have been anxious upon being placed in the maze and had run through it until they reached the end. This anxiety may have caused the naive rats to run the maze in a faster time but making far more errors than the trained rats. In opposition, the previously trained rats took a longer amount of time to complete their first run. The previously trained rats may have become familiar with the handling and experimental process and thus, they did not exhibit anxious behavior.

In an extension of this study, similar results were found when naive rats placed in an enriched environment were tested with the same apparatus and criterion (Irnmel, 2000). The enriched environment included being fed with supplemental vitamin food, housing containing a carpeted floor, as well as wheels and other apparatus for the rats to engage in. The normal environment of the rats consisted of a wire cage, generic food pellets, and a water bottle. There was a significant difference in the number of total errors made between the enriched environment rats when compared to the normal environment rats (naive), $t(4) = 3.8$, $p = .019$. However, it was found that there was no significant difference in the time to meet criterion between the enriched environment and normal environment rats (Immel, 2000).

The design of this study is important because it observed trained versus naïve rats with as much limited error as possible. Since the subjects were rats, there was no placebo effect, running the rats during the same time of day controlled fatigue factors, and experimenter bias was monitored closely. Overall, this study minimized error, thus giving the results validity.

The present investigation originally set out to examine the phenomena of proactive facilitation and proactive interference. However, it can be concluded that there are multiple factors that should be taken into account when determining the source of the previously

trained rats' enhanced ability to learn a maze. Such factors that could have influenced the rats' behavior could include the overall health condition of the rat and any previous experiences it may have had that would inhibit or enhance its ability to learn the maze.

Further research can better examine the phenomena of savings and proactive interference by using different assigned tasks other than maze learning. Using a larger number of subjects or participants can also increase the likelihood of finding even more significant results.

The present research demonstrates how training rats through Continuous Reinforcement can enhance their later learning of a maze. This may also suggest that using apparatus other than a maze as well as using species other than rats can examine the phenomenon of savings. These results pose an important conclusion for humans as well. Perhaps the previous learning of an activity helps us in the long run. If we learn from each experience/ task we accomplish, will this make the next one that much easier?

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