# The Effect of Observation on Latency in Female Rats

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**Abstract**

The Morris water maze (MWM) is a tool used to test the spatial learning of various animals. In using the MWM, a variety of variables can be used. This study used 30 day old, female rats (N=8), and examined the effects of observation on spatial learning. By placing observing rats in a cage above a MWM, observation could be appropriately tested. Based on previous research, a hypothesis was created that assumed observation will induce lower latencies in rats that observed other rats performing the MWM. The results did not support either the hypothesis of this study or the results from previous literature. Data collected from the experiment showed that rats that underwent observation and rats that had not underwent observation yielded comparable results. Based on the comparable data seen between groups, it can be said that observation did not seem to affect the latencies of the rats in the study.

*Keywords:* morris water maze, spatial learning, latency, observation

The Effect of Observation on Latency in Female Rats

Learning can be defined as a relatively permanent change in behavior due to certain experiences (Powell, Honey & Symbaluk, 2013). This aspect of behavior is crucial to both humans and animals alike. By learning, organisms are able to alter and adapt their behavior for any given situation. For instance, changes can be on a macro level, such as learning how to obtain food, water, and shelter; while other in instances changes may occur on a more micro level due to lesser reinforcements.

The Morris water maze (MWM) is a task designed to test cognitive function in animals. This is most often seen testing the spatial learning in rats. Spatial learning is an important area of animal learning that provides investigation into the neurological substrate of animals (Lamberty and Gower, 1991). By placing a rat in the maze, the task is for the rat to learn the location of a hidden platform in order to be removed from the maze. Studying a wide range of variables that affect the performance of the animal, allows experimenters to understand how learning occurs.

One of these variables comes as distal cues in the surroundings of the MWM. Since the platform is not visible, it is generally assumed that the animals reach their goal by using the distal cues. A study performed by Lamberty and Gower (1991) examined how age affects the overall efficiency of distal cues. Their results indicated that both young and old mice showed statistically comparable performance on the MWM. However, a difference was seen in the how quickly the distal cues were learned to a productive method to reach the platform. Older rats took significantly more time to decrease their latencies, most likely due to poor vision that affected their ability to see the distal cues clearly. Nevertheless, the main goal of the study was achieved. To show that no matter the age of the animals being tested in the MWM, spatial cues are important to animal performance.

Along with the spatial cues, comes another variable – sex differences in animals. Sex differences in learning tasks have been reported in both humans and animals (McFadden, Paris, Mitzelfelt, McDonough, Frye & Matuszewich, 2011). Most of the differences are seen on tasks that require learning an objects location, like the MWM. Data has shown that male animals, specifically male rats, have better performance on the MWM. This is best shown by analyzing the swimming patterns of both male and female rats placed in the maze. Males tend to take a more direct route to the designed goal, while female displayed a behavior termed thigmotaxis, or wall-hugging (Rodriguez, Torres, Mackintosh, & Chamizo, 2010). These findings reveal an important distinction in spatial learning among sexes. A study by McFadden et al. (2011) tested this sex differences while inducing unpredictable stress to both male and female rats. It was hypothesized that male rats with stress would perform less effectively on the maze, while female rats undergoing stress would perform more effectively. Results indicated that his was not the case. Male rats still performed significantly better than female rats, although the stress did make the gap between sexes a little closer. However, like the study by Lamberty and Gower (1991), a variable was shown in testing. For this experiment, sex differences will usually impact results.

With the idea that sex differences are seen in MWM performance in rats, is there a way to increase female rat performance using distal cues and some other variable? Recent history would suggest that that may actually be possible. What if there was a way to pre-expose rats to the maze beforehand to give them some type of “advantage.” Both humans and animals experience this pre-exposure throughout life. It happens through observation. Humans and animals learn certain skills or task, such as academics, etiquette, speech, etc. by way of observation. In other words, we learn fundamentals of life through the process of watching others.

By way of observation, the learner is able to acquire new behaviors. However, is it possible to know if observation is actually working? In the past it has been shown that animals are capable of learning through observation; whether it is through natural observation or observation training (Leggio, Graziano, Mandolesi, Molinari, Neri, & Petrosini, 2003). For instance, bottlenose dolphins and monkeys have been shown to mimic the behavior of humans. It would then seem that animals are capable of learning through observation of humans.

So if animals are capable of learning through observing humans, it would appear reasonable that animals can learn through observing other animals. A study by Leggio et al. (2003) would suggest that that is the case. In this study, Lessio et al. (2003) created a new paradigm of learned. This new process instituted observational training in which rats repeatedly observed companion rats performing spatial tasks. Results indicated that observer rats displayed exploration abilities that closely matched the previously observed behaviors. This means it appears that rats are capable of learning complex behavioral strategies by observation.

This type of learning is important in female rats. Since female rats show diminished spatial ability when compared to male rats, observational learning can help change this phenomenon. However, since previous literature is so scarce on the effects of observation on latency in the MWM, it is important to continue testing this concept. Using the study by Lessio et al. (2003) as a stepping stone, studies can be created to test the spatial learning of female rats using the MWM and observation techniques.

Given the previous literature, there is a foundation for further investigation into the effects of observation on spatial learning in female rats. Research has shown that a variety of factors influence spatial learning and that these factors can be manipulated by the use of observation. Therefore, this study seeks to examine the effect of observation on performance in the MWM. It is hypothesized that in this study, the rats that undergo observation will outperform rats who do not undergo observation.

## Method

**Animal Subjects:**

In this study, subjects included eight female, Sprague-Dawley rats (N=8), and were obtained from Charles River Lab. At the beginning of the study, these animals were approximately 30 days old. Animals were housed in pairs in a facility with a 12-hour light-dark cycle and were given access to food and water ad-libitum. Animals were broken up into three groups: Model rats (MRA, MRB), No-observation (NO1, NO2, NO3), and Observation (O1, O2, O3). While housed, the animals were distinguished from each other by the use of black hair dye on their foreheads.

**Materials**

A Morris Water Maze was used for the entirety of the experiment. The maze used was made of aluminum and measured two feet in diameter and was five inches deep. During the course of the trials, the maze was filled with water that had a temperature between 25 and 27 degrees Celsius. The water was mixed with a packet of dried milk to make it opaque. A platform that was three inches in diameter and half a foot from the edge of the pool was placed in quadrant one for each trial. On two sides of the outside of the maze were saw horses, with a see-through piece of plastic placed on top of the saw horses, connecting them. Placed on top of the plastic was a Plexiglas cage, used for rat observation. The cage was a two and a half gallon fish tank that was one foot by half a foot wide.

Surrounding the maze was an abundance of cues. Between quadrants one and two is a large "III" on the wall. A sink can be seen behind quadrant two. An "X" in on the wall between quadrants three and four, and a bulletin board is directly next to the "X." Next, a trash can is behind quadrant three. Finally, a camera is hanging from the ceiling above the maze

**Procedure**

The experiment consisted of three phases: Model rats training, no observation sessions, and observation sessions.

*Model Rats:*

The two model rats were trained to run the water maze before the other two groups were allowed to participate in the study. Each model rat would run the maze separately, so the other rat would not have any pre-exposure to the maze. Training for each rat lasted two days, with three trials a day. A third day was allowed for each rat in case of high latencies. On training days, a model rat was brought into the experiment room and waited while the maze was prepped. For each trial, the goal quadrant was quadrant 1; however, each trial consisted of the animal being released from a different quadrant. The release order was 3, 2, and 4. The overall objective for the model rats was to be able to run the maze successfully two times in a row. This would need to be done flawlessly; since the observation group would be watching them. Before a trial was run each rat was given a free swim, which consisted of two minutes for the rat to familiarize itself with the tank. To run a trial, a model rat would be given two minutes in the tub to find the hidden platform. If rats did not find the platform in two minutes, then they were removed from the maze and the trial was completed. Once the platform was found, the animal would have to stay on the platform for 15 seconds. If during the 15 seconds, the rat fell off, it would have to get back on the platform and the 15 seconds would start again. Once a trial was run, the animal would be taken out of the maze for two minutes and then the next trail would begin. It was a “2 in, 2 out” method.

*No Observation:*

The no observation group followed the same general principal as the model rat group. However, the no observation group was run four consecutive days instead of two. Each rat ran the maze for three trials per day. Before the first trial on the first day, each rat was given a free swim, which consisted of two minutes for each rat to familiarize itself with the tank. As with the model rats, the goal quadrant was always quadrant 1 for the no observation group. Each rat was released in the same order each day (3, 2, and 4). Rats were given two minutes in the maze to find the hidden platform. If the rat did not find the platform in two minutes, then they were removed from the maze and the trial counted. Once a trial was completed, the rat was removed from the maze for two minutes. After the two minutes was finished, the rat was placed back into the maze and the next trial began.

*Observation:*

The observation group featured two differences in their procedure. First, before their four days of trials, each observation rat was placed in the glass cage. This was done to provide them with pre-exposure to the cage, in hopes of familiarity to occur during this time. Pre-exposure was a day, for three times that day. The pre-exposure saw each rat in the cage for five minutes. Once the five minutes was up, the rat was removed for five minutes. After the removal time was completed, the animal was placed back into the cage for another pre-exposure.

The second difference came in the idea of observation. After the model rats successfully mastered the maze, the observation rats were placed in the cage above the maze to observe the model rats. This was done for two consecutive days, three times a day. Once observation was done, the observation rats followed the same procedure as the no observation group.

## Results

The results of this study indicated that there is not a significant difference between groups who observe model rats and rats that do not observe model rats. It can be seen however, that on the first day of trials, the observation group had a mean latency that was about 40 seconds lower that the no observation group. This can be seen in Figure 1. After the first day of trials, it can be seen that both groups have relatively the same latencies throughout the rest of the study. There are only minor fluctuations over the next trials, with each group experiences the differences. Table 1 shows the mean latencies for the no observation groups, and Table 2 represents the mean latencies for the observation groups.

As for the model rats, more variation in latencies was seen. From about trial two to trial eight it can be seen that MRB should much lower latencies than MRA. However, after trial eight, both MRA and MRB showed approximately the same latencies. This can be seen in Figure 2. As compared to the no observation and observation groups, the model rats showed consistently lower latencies by the end of the study. Latency scores can be seen in Table 3 for MRA and MRB.

## Discussion

At the beginning of this study, a prediction was made. It was hypothesized that by the observation group observing the model rats before MWM testing, their latencies would be lower than the no observation group. Based on the data acquired from the study, it can be said that the results do not support the hypothesis.

Data showed that a different pattern was seen. Results indicated that both model rats were sufficiently capable of running the MWM. So the observation rats should have been able to learn the MWM from these animals. Instead a decrease in latency was not seen. Both the no observation group and the observation groups have comparable data. Tables 1 and 2 show the data of no observation and observation groups; a noted data point from these tables is the measure of standard deviation. Higher standard deviations indicate less consistency in learning. It should be noted that the no observation group showed higher standard deviations during the beginning trials, which would seem to indicate less consistency; however the first five trials are task acquisition trials which means that the data does not play into the decision. After looking at the rest of the trials, the no observation group does appear to have higher standard deviations than the observation group, but the numbers are only slightly high and not enough to indicate correlation.

While previous literature found an association between observation and decreased latencies, this study did not find such conclusive results. The study by Leggio et al. (2003) found that observation rats showed exploration abilities that closely matched previously observed rats. Results from this study showed that observation rats showed higher latencies then the observed model rats. This indicated that the results from this study did not match up with previous research (Leggio et al., 2003).

However, this study does contribute to the pre-existing literature on this topic. Results help show that observation in female rats may not actually decrease latencies. With such little research on the topic of observational learning in rats, any new data can help. Most previous research indicated that observation would decrease latencies in tested rats. Conversely, this study will provide data that contradicts this point. There will always be opposite sides to research theories and this study provides a new insight into this topic; a topic that has very little data to make a conclusive judgment.

**Limitations**

There are several possible explanations for these conflicting results. The main issue seen with this study is how the rats observe the model rats. As seen in Leggio et al. (2003), the observer rats may not be interested in the model rat's behavior. The observers may be engaged in self-care or grooming activities instead of watching the model rats perform the maze below. Since the observer rats were placed in a completely dark cage and on a clear platform, the observer rats could have been experiencing high levels of anxiety that caused them to be inattentive to the activity below.

Additionally, data collection could have skewed results. With one group only running nine trials and another group running 15 trials, there was no set standard for the observation groups. Unfortunately, these inconsistencies were seen in the observer groups; the groups where data was the most crucial. If data would have been accurately acquired, results could have shown lower mean scores for the observation group that would have changed the overall conclusion of the study.

**Future Research**

Even though this study did not find a supported hypothesis, it can contribute to future research. Most importantly if this study were to be replicated then the main issue of observation needs to be addressed. Would a different, smaller, cage change results? The cage the rats were placed on was too large, meaning it allowed the rats to roam around and not be forced to watch the activity in the maze. To fix this problem the rats could be placed in a small clear tube instead of a cage. Since rats like confined spaces, a tube would be less stressful for a rat, and with less maneuverability; forcing them to watch the scene below. By fixing this problem, a future study that uses this procedure will be more likely to find conclusive results.

Since previous research along with this study showed that using observation as a variable was possible, these experiments can be taken further. For starters, an all male rats study can be done. This will see if male rats show improvement in spatial abilities after being subjected to observation. Furthermore, a larger study can be conducted that would include both male and female rats being tested using observation. This will provide data to compare both genders on how well they learn using observation. Rather than have multiple studies that use only one gender, having a multi-gender study will provide comparable results.

Overall, this impact has made an impact on the rest of the scientific community. Most interestingly, it provides contradictory results compared to previous literature. This allows for more research to be done on the topic of observation so a more conclusive theory can be made. Additionally, observation can be vital to teach other animals various behaviors. Rather than having an animal learn a task on their own, observation allows them to learn a skill by safely watching another animal. For example, if a young animal loses its mother before it was taught how to hunt for food, this can be a problem. However, if the animal is allowed to watch other animals, from a safe environment, hunt for food, then the animal will be able to pick up hunting techniques. This will allow for the animal to hunt on its own.

Moreover, observing can help enhance a particular skill of an animal. For instance, if a human always finds it difficult catching fish, it may benefit him or her to watch someone else fish to pick up on the other person's techniques. Observation can be practical to all facets of life, and this study will help provide more knowledge about a topic that is so prevalent in life.

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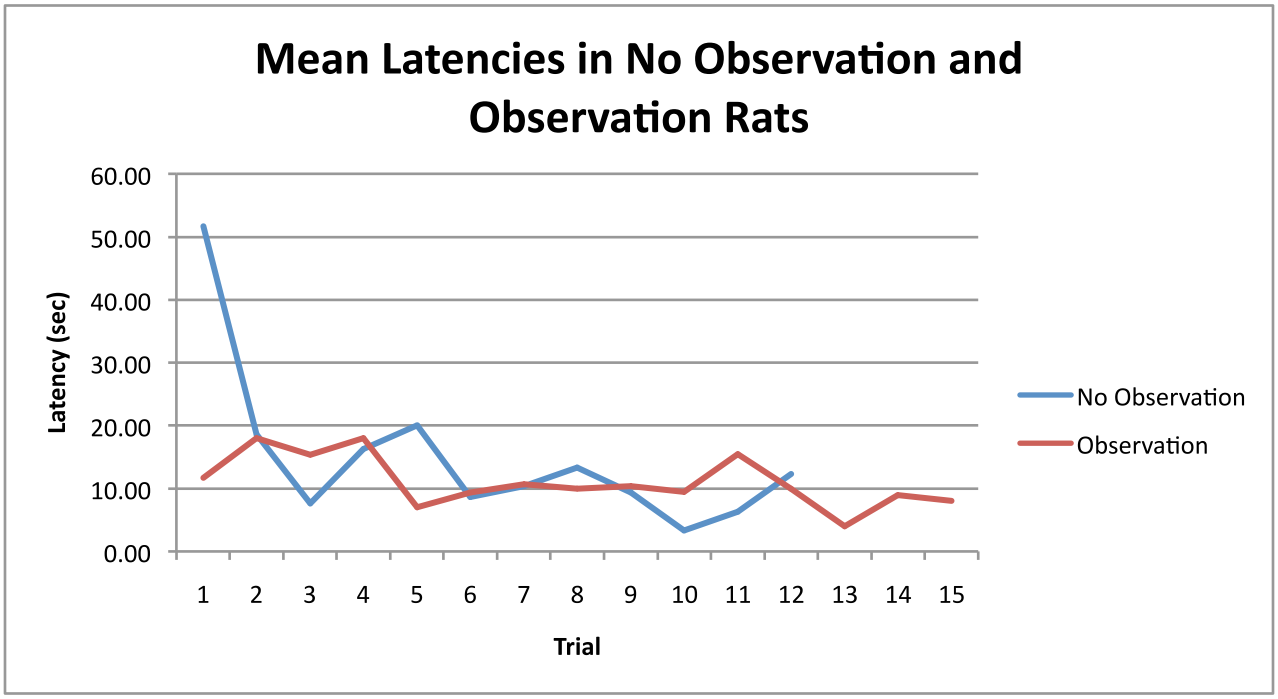


*Figure 1*. Comparison of latencies in MWM performance between no observation and observation groups

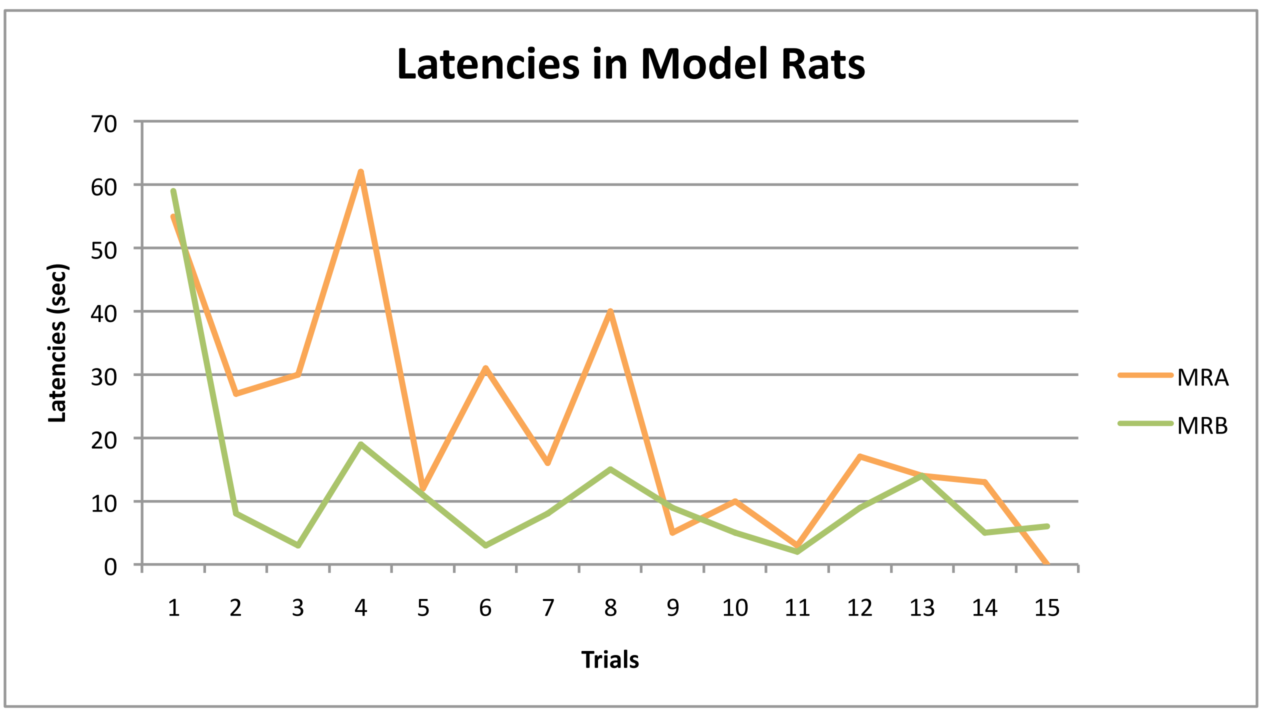


*Figure 2*. Latencies of model rats in MWM

| Trial | NO1 | NO2 | NO3 | Mean | Variance | Standard Deviation |
|---|---|---|---|---|---|---|
| **1** | 11 | 76 | 68 | 51.67 | 1256.33 | 35.44 |
| **2** | 38 | 16 | 2 | 18.67 | 329.33 | 18.15 |
| **3** | 9 | 5 | 9 | 7.67 | 5.33 | 2.31 |
| **4** | 13 | 4 | 32 | 16.33 | 204.33 | 14.29 |
| **5** | 20 | 7 | 33 | 20.00 | 169.00 | 13.00 |
| **6** | 12 | 5 | 9 | 8.67 | 12.33 | 3.51 |
| **7** | 3 | 5 | 23 | 10.33 | 121.33 | 11.02 |
| **8** | 18 | 7 | 15 | 13.33 | 32.33 | 5.69 |
| **9** | 10 | 3 | 15 | 9.33 | 36.33 | 6.03 |
| **10** | 9 | 4 | 9 | 3.33 | 8.33 | 2.89 |
| **11** | 6 | 4 | 9 | 6.33 | 6.33 | 2.52 |
| **12** | 30 | 3 | 4 | 12.33 | 234.33 | 15.31 |
| **Mean** | 14.92 | 11.58 | 19.00 | - | - | - |
| **Variance** | 103.54 | 423.72 | 338.91 | - | - | - |
| **Standard Deviation** | 10.18 | 20.58 | 18.41 | - | - | - |

*Table 1.* Statistical Data for no observation group subjects: latencies, mean, variance, and standard deviations

| Trial | O1 | O2 | O3 | Mean | Variance | Standard Deviation |
|---|---|---|---|---|---|---|
| **1** | 22 | 5 | 8 | 11.67 | 82.33 | 9.07 |
| **2** | 42 | 2 | 10 | 18.00 | 448.00 | 21.17 |
| **3** | 22 | 9 | 15 | 15.33 | 42.33 | 6.51 |
| **4** | 25 | 14 | 15 | 18.00 | 37.00 | 6.08 |
| **5** | 8 | 10 | 3 | 7.00 | 13.00 | 3.61 |
| **6** | 19 | 4 | 5 | 9.33 | 70.33 | 8.39 |
| **7** | 8 | 9 | 15 | 10.67 | 14.33 | 3.79 |
| **8** | 9 | 8 | 13 | 10.00 | 7.00 | 2.65 |
| **9** | 4 | 12 | 15 | 10.33 | 32.33 | 5.69 |
| **10** | 11 | 8 | - | 9.50 | 4.50 | 2.12 |
| **11** | 13 | 18 | - | 15.50 | 12.50 | 3.54 |
| **12** | 14 | 6 | - | 10.00 | 32.00 | 5.66 |
| **13** | - | 4 | - | 4.00 | 0 | 0 |
| **14** | - | 9 | - | 9.00 | 0 | 0 |
| **15** | - | 8 | - | 8.00 | 0 | 0 |
| **Mean** | 16.42 | 8.40 | 11.00 | - | - | - |
| **Variance** | 108.63 | 16.97 | 22.25 | - | - | - |
| **Standard Deviation** | 10.42 | 4.12 | 4.72 | - | - | - |

*Table 2*. Statistical Data for observation group subjects: latencies, mean, variance, and standard deviation

| Trial | MRA | MRB |
|---|---|---|
| **1** | 55 | 59 |
| **2** | 27 | 8 |
| **3** | 30 | 3 |
| **4** | 62 | 19 |
| **5** | 12 | 11 |
| **6** | 31 | 3 |
| **7** | 16 | 8 |
| **8** | 40 | 15 |
| **9** | 5 | 9 |
| **10** | 10 | 5 |
| **11** | 3 | 2 |
| **12** | 17 | 9 |
| **13** | 14 | 14 |
| **14** | 13 | 5 |
| **15** | - | 6 |

*Table 3*. Latencies for model rats