

LEARNING BY INTERACTION WITH PEERS:
FROM NAIVETY TO EXPERTISE

By

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Abstract

Social learning is learning and imitating a behavior and understanding the consequences through observation. Social learning allows for acquisition of information without the costs of learning on an individual basis. Learning by observation is present in humans and animals. The purpose of this study was to evaluate the extent of social learning in rats. Two experiments were performed, a procedural motor task and a spatial memory task. Each of these tasks representing primary function in different areas of the brain. Each experiment consisted of a test day (a rat being exposed to the task alone), day 1 (a rat joined by a peer rat for the task, then placed alone), day 2 (a rat joined by an expert rat for the task, then placed alone). The data for the procedural task revealed that the performance of the rats improved on day 2 after being with an expert rat. The memory task data revealed that the rats were proficient in the procedural task. The performance on the memory task was not significantly different between the three days, indicating the need for memory related pre-training. Further studies will be conducted to assess the social learning potential of a memory task.

Introduction

“Perhaps one of the most underrated human learning abilities is learning from the observation of the behavior of another person” (Zentall, T., 2006). From birth, humans learn by interacting with the people around them. This tendency of social learning continues throughout life. Social learning is the idea that we can learn behavior from our peers (Myers, 2008). This is an amazing ability that humans as well as animals possess that allows for acquisition of information without the costs (risks and time) of learning on an individual basis (Castro, L. & Toro, M., 2004).

There are several key terms used in social learning theory that help to better define situations in which social learning takes place. Social learning or observational learning is learning and imitating a behavior and understanding the consequences by observation (Myer D., 2008). Often times, goal emulation is the result of understanding the consequences of a demonstrators actions. Goal emulation occurs when the observer emulates the results of the demonstrator, but in a different way than the demonstrator. This is a form of imitation that results in the same observed outcome, but that was achieved in another way (Zentall, T., 2006).

Imitation is the reenacting a behavior that has been witnessed being done (Caldwell, C. & Whiten, A., 2002). So in comparison to social (observational) learning, imitation is the action of an acquired behavior (an action that mirrors what was observed). In experimental settings an imitational action is used as a sign that learning by observation has taken place. True imitation is thought to occur only when an observer can understand the intentions of the demonstrator which, by that strict criterion, would mean that only verbal humans can imitate. There are several simple mechanisms that lead one to believe learning by observing has taken place but have been argued not to be indicative of imitation.

First, if motivational factors, such as reinforcement, are present it is thought that an observer could spontaneously perform the task by receiving reinforcement. This would lead to the conclusion that the task could be learned individually as opposed to learning through means of imitation (Zentall, T., 2006).

Second, incentive motivation is when there is observation of the demonstrator receiving reinforcement for a task. This would make the observer perform the task for the reward and not necessarily to intentionally imitate the demonstrator.

Next, perceptual factors include local enhancement and stimulus enhancement. Local enhancement is when attention is drawn to a location and stimulus enhancement is when the demonstrator draws attention to an, often fixed, object. In these cases, the observer is not imitating the demonstrator but rather drawn to the object or location that the demonstrator is near. Through perceptual factors an observer would learn the task independent of the demonstrator (Zentall, T., 2006). This argument reminds me of the saying “you can lead a horse to water but you can’t make it drink”. In these situations a demonstrator may provide a cue to a location or object that is important, but what will the observer do with the information unless it is shown by a demonstrator?

Discriminant following is described as an observer following a demonstrator, but failing to do the task when the demonstrator is not there, therefore imitation did not occur. Last, Observational conditioning is the act of pairing an action with food and a Pavlovian association occurs. This means that the task is being done by the observer to

receive food, that is already visible to the observer before doing the task, and not because it is trying to imitate the demonstrator (Zentall, T., 2006).

These are some of the issues raised that, if present, question whether or not imitation has occurred, but the logic seems flawed. It is valid to consider all of the aspects that could possibly affect an experimental evaluation of imitation, but many of the concerns raised against determination of imitation are unrealistic, given experimental animal models. It seems the reason an observer would imitate a demonstrator is for some benefit, whether it be for reward or for some other beneficial end. Unlike humans, animal in nature would not imitate for imitations sake.

Another facet of social learning to be considered is social facilitation, which is the tendency to perform complex or unfamiliar tasks worse and simple or familiar tasks better in the presence of an observer (i.e. doing better on an exam that you studied for in a room full of students vs. your boss standing over your shoulder watching you work on your first day) (Zajonc, R., 1965). Social facilitation (learning in the presence of others, but the others do not do the task) is different than observational learning by imitation (observing a task being done by others, and potentially participating in the task, i.e. reenacting the steps that an aerobics instructor gives) in that social facilitation results in a stimulus effect, where a observer produces more dominant correct choices due to the stimulus of the presence of another individual (Caldwell, C. & Whiten, A., 2002). Having an active conspecific present increases the activity level of the observer by increasing the general arousal and decreasing the fear of the observer (Zentall, T., 2006).

Deferred imitation is an important criterion to determining if learning has taken place and ruling out the effects of social facilitation. Deferred imitation requires that an observer is able to imitate the actions of the demonstrator following the removal of the demonstrator and after a significant amount of time has passed (Caldwell, C. & Whiten, A., 2002, Zentall, T., 2006).

From an evolutionary perspective social learning is an adaptive mechanism that can increase an individual's fitness (Castro, L. & Toro, M., 2004). There is interspecific variation that corresponds to the species' diversity in their ability to socially learn, with the most proficient species being those that live in social groups and are opportunistic foragers (Caldwell, C. & Whiten, A., 2002). Both cooperation among individuals and competition between individuals are mechanisms found in populations of organisms. These are evolutionary mechanisms that increase individual fitness (Freeman, S. & Herron, J., 1998). Social learning falls into these two categories. Cooperation allows a group of individuals to become more efficient as a whole while individuals are independently helping themselves. An example of cooperation is seen clearly in social insects. Also, socially acquired knowledge might be advantageous to an individual that must compete for limited resources compared to an individual that does not have that knowledge.

In cases where the social interaction mechanism fails we see detrimental results to human development. A lack of social interaction can be seen in cases of severe isolation, such as the case of feral children. One such case is of a girl named Genie who was severely deprived of human interaction by abusive parents until the age of 13. She was not able to walk, talk or use the bathroom (Pines, M., 1997). This is an extreme example that demonstrates that social learning is required for even the basic functions of life.

Another situation where we see a breakdown of the ability to socially interact is in

the case of autism. Autism symptoms include; delayed or absent speech, disturbance of social interaction and social skills and inappropriate response to objects and people (Ritvo, E. & Freeman, B.J., 1977). Interesting research on mirror neurons may lead to answers in the brain dysfunctions behind autism. Mirror neurons are premotor and parietal cells that have been discovered in the macaque brain that fire when an individual both performs a task and when that individual observes the task being done by another. These findings strongly suggest that mirror neurons are responsible for imitation and for understanding the intentions and emotions of others. Since autism is a socially isolating disorder with an observed decrease in imitational ability of affected individuals, mirror neurons might provide insight into its cause and cure (Iacoboni, M. & Dapretto, M., 2006).

Examples of socially transmitted behavior can be seen in natural systems. Examples of this are seen in primates, rats and birds. In the case of primates there is strong evidence of social imitation. Japanese macaques have developed novel behaviors, throughout an island population, such as potato washing and wheat separation. The behavior was first seen in juveniles, then in females and finally in the male individuals of the population (Choleris, E. & Kavalierst, M., 1999). Various tit species in England, Scotland, Wales and Ireland began being able open milk bottles. This is thought to be a situation of social transmission by observation as well (Galef R., 1976). A very interesting example is seen in *Rattus norvegicus*. Members of a rat colony living on the bank of the Po River have been found to dive to the bottom of the river to retrieve bivalves as a food source, while colonies living adjacent to this one do not. It has been found that the diving behavior is not socially transmitted; the tendency to dive for food sources is accelerated in the presence of a trained swimmer and also reinforced by the presence of the food source (Galef, R., 1980)

Some experimental work has been done on social learning in animals, including work with cats, rats, mice, Japanese quail and ravens.

The experimental study with cats included two experiments. The first experiment was a stimulus controlled (foot shock and buzzer) approach or avoidance. The observer, a naïve cat watched student cats being trained on the shock-avoidance task and then watched the teacher cats perform the task following the student cats. This occurred every day until the student cats reached 90 percent performance. The naïve observers were then trained. They found that 5 of 6 pairs of naïve cats learned the stimulus avoidance faster than the student cats had. In the second experiment there was a feeder with a bar to press to receive food. In the first group two cats were put together (one teacher and one naïve). A second group was used as the control group to eliminate effects facilitation through the mere presence of another cat. The third group consisted of cats taught to press the bar for food without a teacher. The bar pressing procedure and time of acquisition of the task was evaluated between the groups. The result was that the cats with a teacher acquired the task faster and performed the task in the same way as the teacher, demonstrating that observational learning had taken place (John, R. & Chestler, P. & Bartlett, F. & Victor, I., 1968).

A study of observational learning in rats was done by a procedure that had 4 possible combinations of performing a task. The experiment put a naïve rat with, a rat that knew both parts of the procedure, a rat that only knew one part of the procedure, a naïve rat and an empty box. The study showed that observational learning and social

facilitation occurred. Results were that rats observing both parts (bar pressing and drinking) learned faster than those observing one part (just drinking) and those in turn learned faster than those with the empty box but rats in those three groups all learned significantly faster than the group with the naïve rat. The author deduces that this may be a distraction effect of the other rat being present (Zentall, T. & Levine, J., 1972).

The study of Japanese quail looked at observational learning of pecking vs. non-pecking models. There were three groups. In the first a naïve quail observed a quail trained to peck when there was a light. In the second a naïve quail observed a quail that was trained not to peck with and without a light. The third group there was no observation. The results were that observational learning was strong. The number of correct responses was greatest with the observation of trained pecking quail, the next was when there was no observation and least correct responses was with observation of non-pecking with and without a light. This demonstrates that the quail not only learned to peck by observing but also not to peck by observing (Sanavio, E. & Savardi, U., 1980).

Another study uses C57BL/6j mice to assess observational learning. In this experiment there are two groups of observers. In the first, an observer in a box with a mesh screen observes another mouse doing a complex task. The second group was a control group, where a mouse was in a covered box. The results were that 6 (only males) of 15 mice could solve the task following observation. None of the controls could solve the task. This study supports that visual clues are sufficient in social transmission of behavior (Carlier, P. & Jamon, M. 2006).

A study involving ravens was also found. The experiment was done by exposing naïve ravens to ravens trained to open a container that can be open in multiple ways, in a very specific way. There was also a control group that did not observe the task. They found that observers performed the opening of the box in the same way that the models did opposed to the controls that never opened the box the way the models did (Fritz, J. & Kotrschal, K., 1998).

Rats are an ideal model for a social learning experiment. Rats are like humans in that they live in social colonies. There has also been evidence found suggesting that rats have metacognition, the thinking and reasoning about one's thinking. The idea that one can weigh the consequences of their actions and can make decisions based on their ability to perform a task, while considering the benefits of a choice, which has previously only been found in humans and primates (Foote, A. & Crystal, J., 2007).

Methods

Subjects:

Ten food deprived male rats were used for two separate sets of experiments. Eight of the rats used were Brown Norway Hybrids; two of these rats were Fischer344 rats. The average weight (free food) of the rats was 414g (9-15 months of age). Rats were classified as naïve (no previous experience with the task, Junior (procedural experience with the task but never learned a sequence) and expert (rats that have learned the sequence in the past).

Apparatus:

A circular table, 120 cm in diameter, with eight equally spaced peripheral feeders

equipped with sugar water droppers and blinking lights were used in these experiments (Bower et al). The concentration of the sugar water was 165g sugar to 800ml of water and individual drop size weight was 1g. The program used for these experiments was developed in house. This program allowed a given sequence of feeders to be used. In the cue phase of the experiment the lights would blink on each feeder in accordance with the input sequence. Once a rat got close to the feeder the light would stop blinking, a sugar drop reward would be given and the next light in the sequence would start blinking. In the non-cued phase of the experiment, lights were delayed for several seconds to give the rat enough time to reach the next feeder in the sequence using memory alone. Non-cued repeats of the sequence were delivered several times during the recording session to help evaluate the extent of learning. The rats were tracked on the table by a reflective jacket and an overhead camera. In experiments where two rats were simultaneously present on the maze, the experimenter would manually trigger the release of a reward since two rats could not be tracked by the program at the same time.

Procedure:

Two sets of experiments were conducted.

Procedural experiment:

The procedural social learning experiment required the use of one naïve rat, and one expert rat.

The experiment started with a test day, where the naïve rat was exposed to the task alone. The day begins with 5 minutes of sleep (see Fig. 1, panel A). Sleep periods were used to clearly separate behavioral stages of the experiment. Then a cued sequence (a sequence that the experts have experienced; all sequences randomized) was started and the rat was placed on the table for 10-20 minutes. When he went to a feeder in the sequence it was recorded with a time stamp and the number of the feeder in the lab book. Or the rat wore a jacket that would allow automatic time stamping by the computer, as well as the tracking data. This was followed by sleep for 5 minutes.

Day 1 is the control day where two naïve rats are run together. The day started with 5 minutes of sleep for both rats. The same sequence from the test day was started and both rats were placed on the table for 15-20 minutes. Then both rats were stopped and a 5 minute sleep session was conducted. Then each rat was placed back on the table, separately, with the same sequence as before. The feeders that they went to were recorded and time stamped in the lab book, or done automatically through jacket tracking. This was followed by 5 minutes of sleep.

Day 2 a naïve rat was paired with the expert rat. The day starts with 5 minutes of sleep for both rats. The same sequence as the test day and Day 1 was started. The naïve and expert were placed on the table together for 15-20 minutes. Typically, the expert rat performed the task with little interference from the naïve rat, who was observing the expert. The naïve rat would occasionally participate in retrieving rewards, but initially it was by chance and in later days and experiments was intentional, once he had begun learning the task. The rats were stopped and they had a 5 minute break. The naïve rat was placed back on the table with the same sequence for 10-20 minutes. The feeders that he went to were recorded with time stamps in the lab book or automatically with jacket tracking. He was stopped, and sleep was conducted for 5 minutes.

Memory experiment:

This experiment pairs an expert rat, with a junior rat, as previously stated a junior rat is already familiar with the procedural task of going to a cued light but does not know the sequence. The expert is proficient with the sequence. In these experiments the expert rat is trained several days before the experiment on the sequence.

The experiment started with a test day where the junior rat is alone and given a new sequence. The day started with 5 minutes of sleep (see Fig. 1, panel B). The junior rat was placed on the table and allowed to explore randomly (free recall) and the feeders he visited were recorded. This is to ensure that he has no preference for any particular feeder or sequence of feeders. The junior rat was again allowed to sleep for 5 minutes. The junior rat is then placed back on the table with sequence 1 (a subset of 3 sequences used in the experiment) for 15-20 minutes. The sequence has periods of being cued and non-cued. This data was recorded using the tracking jackets. He was stopped and sleep was conducted for 5 minutes.

On day 1 the junior rat is placed with another junior rat and both are given a sequence that neither of them knows. Day 1 is started with 5 minutes in sleep. The junior rat was placed on the table and allowed to explore randomly and the feeders he visited were recorded. Sleep was then conducted for 5 minutes. The junior rats were placed on the table with sequence 2 (a subset of three sequences used in this experiment) for 15-20 minutes with cued and non-cued periods. They are both stopped and sleep was done for 5 minutes. The junior rat was again placed on the table with sequence 2 for 15-20 minutes. The feeders visited and the tracking data were recorded.

On day 2 the junior rat was run with the expert rat. The day starts with 5 minutes of sleep for both rats. After this the junior rat is allowed to do free recall until he stops, and the feeders he visits are recorded. Sleep is conducted for 5 minutes. After sleep the junior and expert rats are placed on the table with sequence 3 (a subset of 3, that the expert knows) for 15-20 minutes with periods of the sequence being cued and non-cued. Since the junior rats know the procedural task of going to the cued feeders they are actively involved in retrieving rewards from the given sequence, but since the experts know the sequence they are more efficient with the cued and especially the non-cued feeders of the sequence. Sleep is done for 5 minutes. The junior rat was then placed on the table alone with sequence 3 with delayed cues and rewards for 15-20 minutes. The tracking data and the feeders visited are recorded and saved. Sleep is conducted for 5 minutes.

Data analysis was done using Excel spreadsheets. Our criteria for making sure the data was an accurate representation of the performance data was only accepted that had at least three completed sequences and time between feeders that was not greater than 30 seconds was considered, any greater than that would be due to an error, and was not used. The rats sometimes used a circling behavior to get to the correct feeder, in these cases data containing greater than 3 circles was not used.

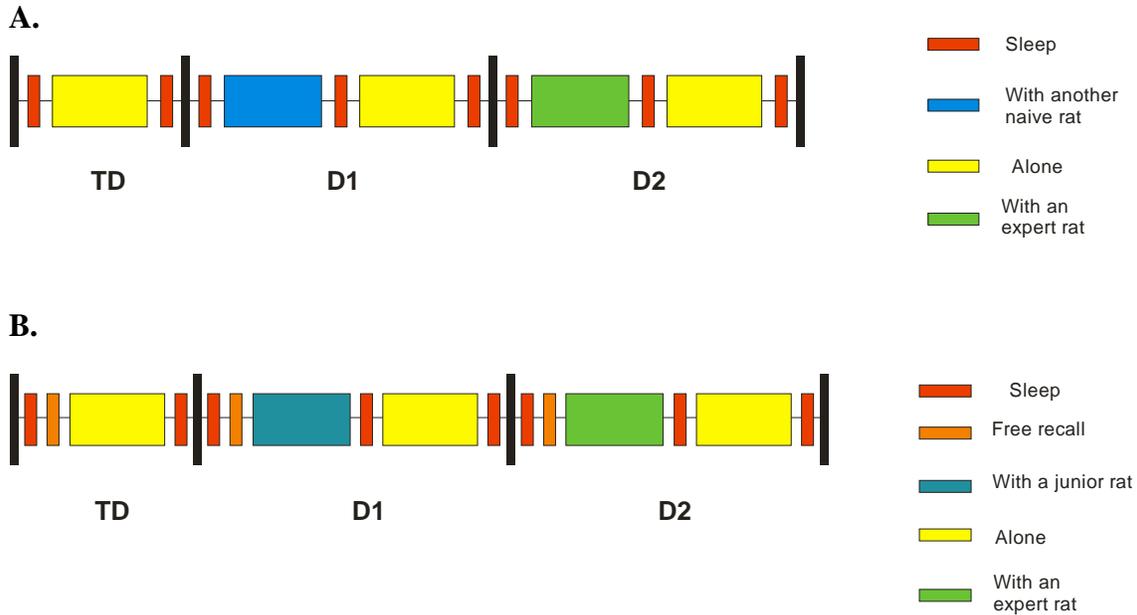


Figure 1- Representation of time allotment and series of events for each day of the experiment. **A.** Procedural task representation. **B.** Memory task representation.

Results

Procedural task:

The average number of correct feeders for 5 rats in 15 session increased from TD to D2 (Fig. 2). The average number of correct feeders was 7.6 ± 3.58 on TD, 15.6 ± 6.08 on D1 and 34 ± 13.78 on D2. The average number of wrong feeders of 3 rats across 7 session also increased from TD to D2 (Fig. 3). The average number of wrong feeders was 45.11 ± 25.84 on TD, 55.05 ± 14.16 on D1 and 70.61 ± 36.91 on D2. The average performance per session was evaluated and demonstrated greater performance on D2 (Fig. 4). The proportion of wrong feeders on TD was $62.01\% \pm 27.33$ compared to $37.98\% \pm 27.33$ of right feeders. The proportion of wrong feeders on D1 was $58.04\% \pm 16.41$ compared to $41.95\% \pm 16.41$ of right feeders. On D2 the proportion of wrong feeders was $45.8\% \pm 23.28$ compared to $54.16\% \pm 23.28$ of right feeders. The average time between correct feeders for 4 rats across 13 sessions decreased from TD to D2 (Fig. 5). The average time between correct feeders was 67.08 ± 46.76 seconds on TD, 47.47 ± 34.34 seconds on D1 and 30.05 ± 21.05 seconds on D2. There is a trend from TD to D2 of increasing number of correct feeders, but with the percentage of rights vs. wrongs increasing. This indicates that more errors occur with more exploration, and that performance after exposure to an expert rat is better than after exposure to a naïve rat. There is also a trend of decreasing time between correct feeders from TD to D2. This indicates progressive faster movement to correct feeders.

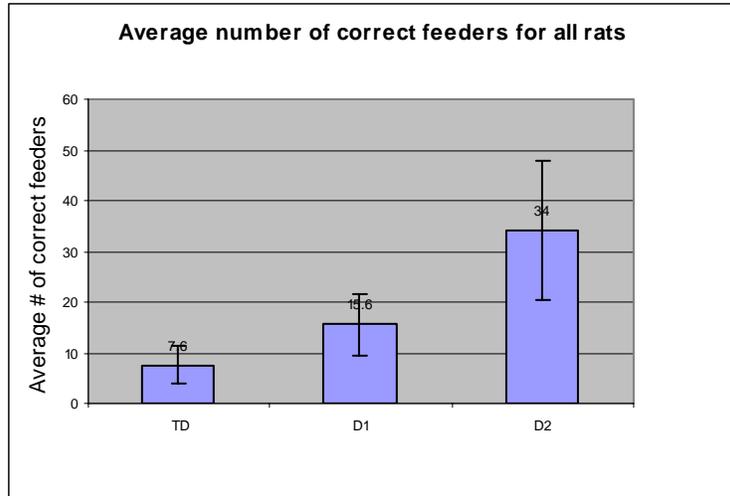


Figure 2- Average number of correct feeders across 5 rats and 15 sessions.

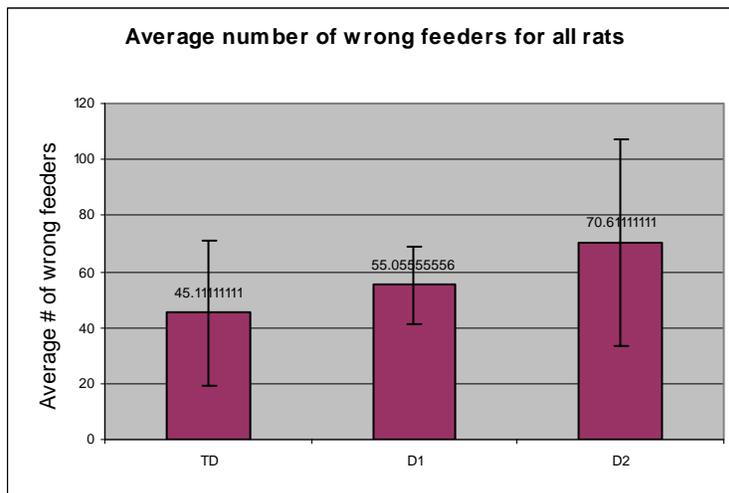


Figure 3- Average number of wrong feeders across 3 rats and 7 sessions.

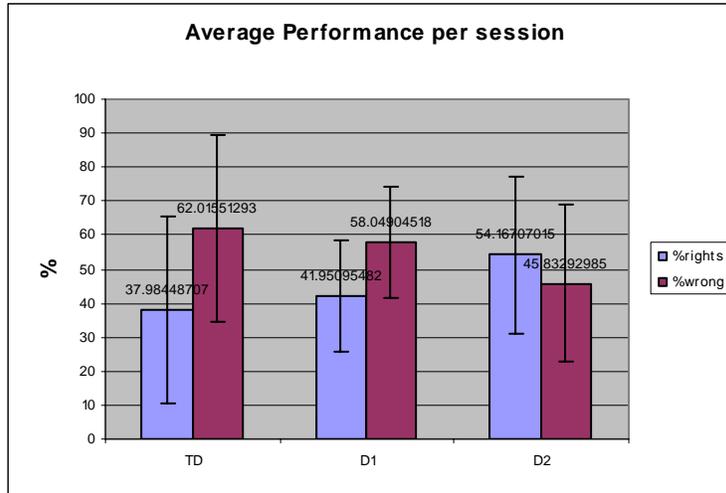


Figure 4- Average performance per session across 3 rats and 7 sessions.

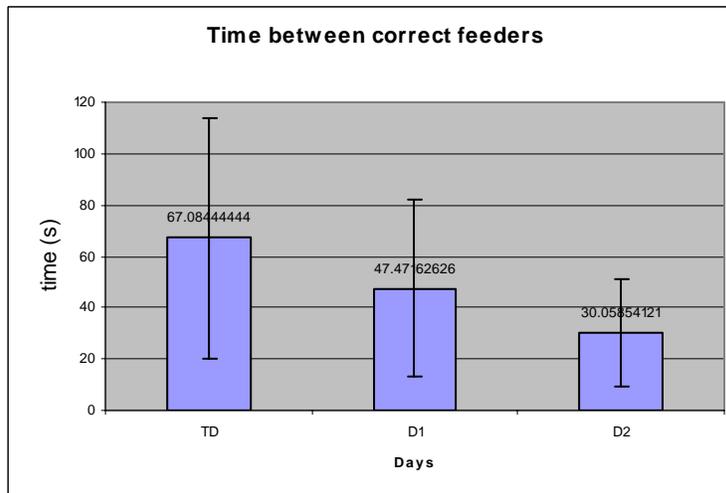


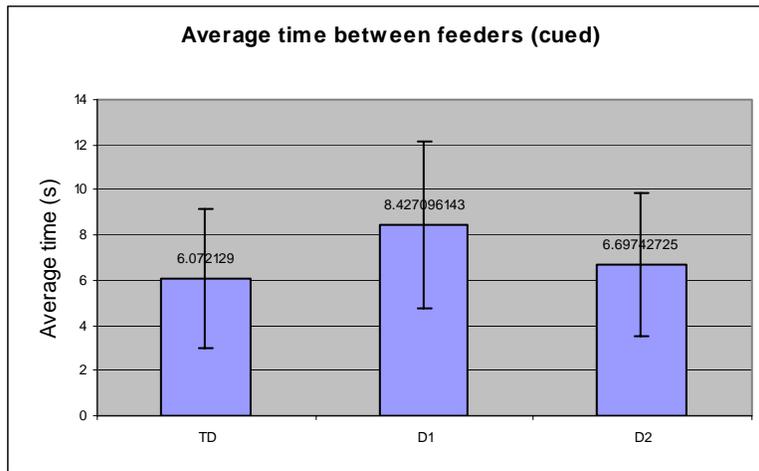
Figure 5- Average time between correct feeders across 4 rats and 13 sessions.

Memory task:

The average time between correct cued feeders for 3 rats 8 sessions varied slightly between the three days (Fig. 6 A.). The time between correct cued feeders was 6.07 ± 3.07 seconds on TD, 8.42 ± 3.68 seconds on D1 and 6.69 ± 3.19 seconds on D2. The average time between correct non-cued feeders also varied between the three days (Fig. 6 B.). The time between correct non-cued feeders was 6.13 ± 0.82 seconds on TD, 7.52 ± 1.87 seconds on D1 and 7.02 ± 1.18 seconds on D2. The average number of wrong feeders of cued sequences varied between the three days (Fig. 7). The average number of

wrong feeders was 4.76 ± 2.95 on TD, 6.93 ± 3.25 on D1 and 4.87 ± 2.86 on D2. The percent of correct feeder per non-cued sequence varied slightly between the days (Fig. 8). The percent of correct non-cued feeders was 18.37 ± 8.11 on TD, 11.51 ± 12.01 on D1 and 16.38 ± 16.14 on D2. On all three days the rats quickly respond to the cue, demonstrating that they are proficient in the procedural task. The performance on the memory task is not significantly different between the three days. This lack of performance may be due to an insufficient amount of memory related training prior to TD.

A.



B.

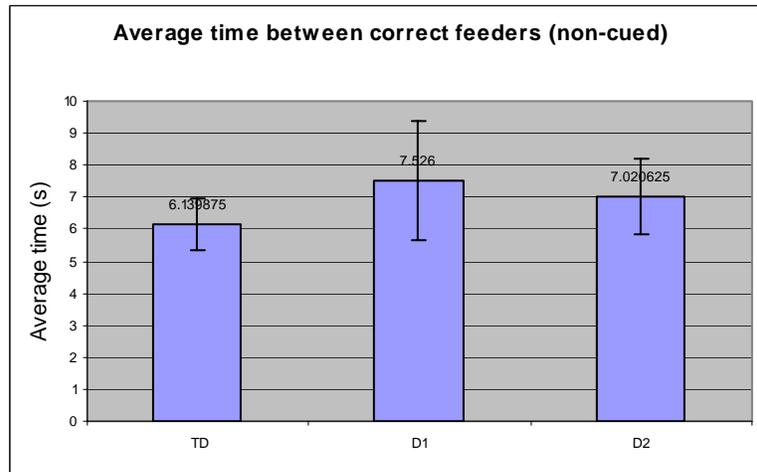


Figure 6- Average time between correct feeders across 3 rats and 8 sessions. **A.** Cued feeders. **B.** non-cued feeders.

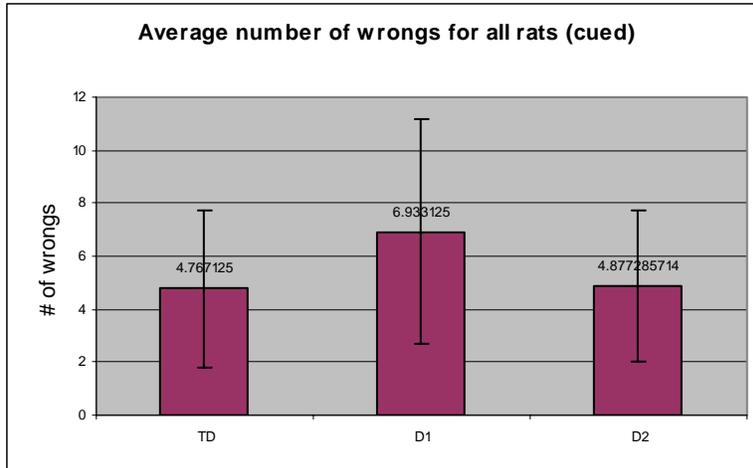


Figure 7- Average number of wrong cued feeders across 3 rats and 8 sessions.

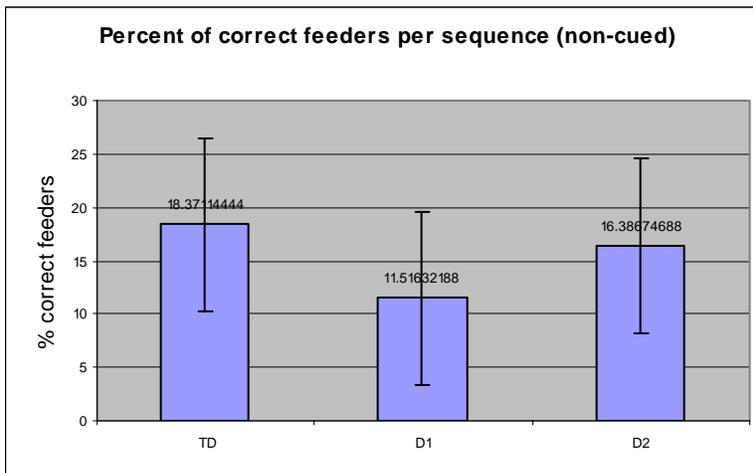


Figure 8- Percent of correct feeders per sequence across 4 rats 9 sessions.

Observations:

Prior to using a five feeder sequence for the memory tasks, three and four feeder sequences were tried. Using a three feeder sequence in the memory initially resulted in both rats trying to go to the blinking feeders but after a short time the expert rat would remain at one feeder and the junior rat would move back and forth to the remaining two feeders. With the four feeder sequences each rat would initially try to go to all of the feeders as well, but after a short time of often getting to the same feeder at the same time each of them would go to two of the feeders. Another interesting observation was seen during the procedural experiments. The experts used for the last set of rats that were trained on the procedural experiment had previously trained another set of rats. When the expert rat was performing the task with the naïve rat on the table the expert would seem to try to trick the naïve rat. If the naïve rat were of closer proximity to the blinking feeder

than the expert, the expert would initially go to the feeder adjacent to the correct feeder and once he was close enough to the correct feeder make a sharp turn to it.

Discussion

Using both a procedural and a spatial memory task allowed assessment of learning at two different levels. The procedural learning experiment required that the observer learn a novel task that involves a perceptual motor response, from an expert (learning a particular motor skill). Learning a perceptual motor task involves primarily the basal ganglia region of the brain. The spatial memory task required that the observer learn a five feeder sequence from an expert (memorizing a sequence). A memory task involves primarily the hippocampus.

Procedural task:

The standard deviations for all of our figures were high, but trends can be seen. For the procedural task there was a trend of increasing average number of correct feeders visited as well as increasing average number of wrong feeders visited from TD to D2. In regards to performance, there it has been found that there was a greater proportion of right to wrong feeders on D2 compared to either TD or D1 that had a greater proportion of wrong to right feeders. From this we can conclude that there is more exploration from TD to D2 that contributes to the increase in average number of wrongs, but the proportion of rights to wrongs is greatest on D2 and therefore we can conclude that the performance of the rats improves on D2 compare with TD or D1. This means that a procedural task is acquired faster by learning from an expert. The increase in exploration that leads to more rights and wrongs from TD to D1 can be attributed to stimulus affects of having another rat present, as well as learning over the course of several experimental sessions. The improvements from TD to D2 are greater, and are indicative of learning from an expert.

Memory task:

There was a great amount of variation in the data for the memory task, with very high standard deviations. Looking at the average time between feeders for both the cued and non-cued sequences, there is not a significant difference between any of the three days in either Figure 5 or Figure 6. Nor was there a significant difference in comparing cued and non-cued time between feeders. The times varied from 6.01 seconds to 8.4 seconds, which is about the amount of time it would take for a rat to move from one feeder in the sequence to the next feeder in the sequence. The average number of wrong feeders of the cued sequence across all rats varied slightly, but not significantly, between the three days. The range was from 4.76 feeders to 6.93 feeders. The percent of correct feeders per non-cued sequence varied from 11.51% to 18.37%. This data reveals that the rats were proficient in the procedural task, but were not sufficiently pre-trained on the spatial memory task. There can be no conclusions made at this time about the effects of learning a memory task from an expert. Further experiments are required.

Observations:

The observation of the expert remaining at one feeder while the junior moved back and forth between feeders during the three feeder sequences as well as the junior and expert going back and forth between two feeders during the four feeder sequences is

very interesting. It suggests that there is a good amount of motive behind their actions. Once realizing that it took more effort to try to get all of the rewards and then sometimes not get there before the other rat, they developed a cooperative relationship. This partnership resulted in equal net gain between the two rats; the expert rat had to expend less energy but only got one reward while the junior had to expend more energy but got two rewards. In the case of the four feeder sequence they both expended the same amount of energy and received the same number of rewards.

In the procedural task of apparent avoidance of the blinking light by the expert followed by a swift movement to the correct feeder seems to demonstrate a competitive behavior. It appears not necessarily to be socially learned but from having previous experience with other rats.

These experiments are the first step in understanding the mechanisms behind social learning. It is important to have a good behavioral experiment that can help unravel the underlying brain functions responsible for social learning. Understanding the physiology behind social learning will give insight into dysfunctions that occur, as with the case of autism. The first step in developing a treatment or therapy is knowing the cause of the problem. More experimentation may give greater insight into the genetic and evolutionary roots behind social learning as well; with potential benefits in medicine. Additionally, with social learning and social facilitation experiments, knowledge can be gained about an optimal way of learning, which could potentially impact educational approaches. There is no limit to the value that a better understanding of the mechanisms behind social learning can provide, and this is just the beginning.

Future studies:

Future studies will include; 1. Having a control rat for the procedural task that will be exposed to the task across several experiments without being exposed to an expert rat. This will ensure that the rats learned from an expert rat and did not learn on his own due to repeated exposure to the task. 2. Looking at the data recorded from the expert rats on D2, while with another rat. This will help to evaluate to what extent the role of social facilitation plays in the performance of a well known task in the presence of an observer. 3. Run another memory task experiment following pre-training of the rats on the memory procedure, making sure that they have reached 80-90% performance criteria.

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