To Click or Not to Click:
The Impact of Positive Reinforcement Methods on the Acquisition of Behavior

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Abstract

Dog training has a history dating back centuries, yet very few empirical studies have compared different training methods. One currently popular method is clicker training. In clicker training, when the correct behavior occurs a click is produced and followed immediately with food. The purpose of this study is to investigate whether the clicker is the most initially effective training method in decreasing the number of trials in teaching a dog to stay when compared to other positive reinforcement methods. Using naive puppies (aged 2 to 6 months) the current study compares the efficacy of clicker training with 1) the delivery of food alone and 2) the use of a verbal marker. Although there have been a few studies comparing some of these positive reinforcement methods against each other, this is the first study to compare all three within one experimental design. I found that the delivery of food alone facilitated learning in a novel behavior causing a higher proportion of puppies to reach higher shaping approximation levels when compared to clicker training and the use of a verbal marker. These findings are consistent with years of previous research that have also found primary reinforcement to be the most effective positive reinforcement method.

To click or not to click: Positive reinforcement methods on the acquisition of behavior.

In the 1940's B.F. Skinner began to study positive reinforcement empirically. He coined the term within his book, Science and Human Behavior (1953), but its popularity as a training technique began to grow exponentially since the introduction of clicker training in the late 80's (Pryor, 2009). Clicker training is the method of pairing a primary reinforcer such as food with an audible click produced from a device held in the trainer's hand. Supporters of this method believe it also keeps the animal attentive and curious to the training process and facilitates novel behavior (Pryor, 1999).

Karen Pryor is an outspoken advocate of clicker training and claims that using a clicker improves an animal's long term recall and accelerates learning of trained behaviors (Pryor, 1999). Unfortunately her evidence of these phenomena is anecdotal. Since this area of training has become incredibly popular, it would be believed that this topic has been studied and researched effectively. Surprisingly there has not been much research performed on this subject area and what has been found is contradictory.

Two studies (McCall & Burgin, 2002 & Williams, Friend, Nevill & Archer, 2004) tested the effects of clicker training on the acquisition and extinction of a learned novel behavior in horses. McCall and Burgin (2002) matched two groups of horses by age, sex, and breed. The purpose of their study was to compare the difference in training between a secondary reinforcer (clicker) and a primary reinforcer (food). All the horses were trained to pull a lever and then push a flap to receive a reinforcer based upon their group placement. Each group was then introduced to extinction periods in between training periods. Using this experimental design they reported no difference in extinction periods among horses but clicker training facilitated the acquisition of a novel target behavior.

Williams et al. (2004) trained horses to nose touch a target cone to compare the effectiveness of a clicker compared to primary reinforcement. They also tested the effects of reinforcement schedules and reinforcement types that were received during extinction on the trained behaviors. This created six different reinforcement protocols that the horses could be placed within causing the experiment to become unnecessarily complicated. They concluded that the use of a clicker was not more effective at producing shorter training times or shortening the number of trials to extinction than the use of a primary reinforcer.

Smith and Davis (2008) conducted a similar study on dogs. They compared the effects of two methods of training: the use of a secondary reinforcer (clicker) and the use of a primary reinforcer (food) by first training basenjis a target behavior consisting of touching their noses to a cone. Once the target behavior was trained they introduced an extinction period for both methods. They concluded, as supported by previous research (Williams, et. al. 2004), that secondary reinforcers were not more effective in facilitating learning than food alone. However, the clicker training required significantly more trials to reach extinction. No comparison was made in any of these studies between the clicker and another behavior marking stimulus.

Wood (2007) created an experimental design to compare clicker training and a verbal marker to train dogs to nose touch an apparatus. She found clicker training to be most effective at facilitating learning in novel behaviors when compared to a verbal command using the word "good." I believe that the use of the word "good" is a reason why the verbal marker did not compare well against the clicker in Wood's study. It is a word that dogs may hear all the time based on their interactions with humans. Within the human language "good" can take on a multitude of meanings. It can describe food quality ("the milk is still good"), explain how thorough something is ("a good workout"), or show affection to a dog while training is not

occurring ("such a good boy"). Not only are there many uses of the word but we are also forcing dogs to discriminate between a human's everyday use and the word's use as a marker of correct behavior. To counteract this I decided to use the word "next". This is a word that is not typically used as a secondary reinforcer for dogs nor typically used in normal conversation.

These previous reports reveal the contradictions that occur within this field of research. I believe this is due to the complexity of the tasks being trained and the experimental designs in the studies. To counteract these inconsistencies I developed a simple study that tests the acquisition of the behavior "stay". The decision to train a puppy to stay in one place after a command is given was made because it is one that is used often in basic training classes and because the behavior can be shaped by the use of approximations. These are important considerations because it generalizes to the way most trainers would initially begin to train their dog. By keeping this study simple and only testing acquisition in one basic behavior, it will aid in solving the disagreements occurring within this field.

After reviewing the contradictions within the literature and noticing how popular the method of clicker training has become the purpose of this study is to see if there were differences between clicker training, a verbal marker, and primary reinforcer consisting of food.

Methods

Subjects

The subjects were 31 non-trained and experimentally naïve puppies (aged 2 to 6 months) that were in the care of the Alachua County Animal Services. The breeds of each puppy were indeterminable due to the subject pool being from a shelter. When the puppy was selected the experimenter offered it a treat to ensure that it was food motivated and sociable to humans. The puppy was then taken to a significantly quieter testing area.

Testing Area

The testing area I used was a garage in the Alachua County Animal Services' facility. The garage has a door that can be shut to eliminate most distracting noises and allows the puppy to hear us accurately when the experimenter issued commands. The room had a 1m x 1m box measured out on the floor in tape. Another meter was measured away from the box and that distance was also marked by tape. All sessions were videotaped. The experimenter wore a treat pouch on their right hip. This placement was chosen to generalize to the way most trainers wear a treat pouch during training. These objects remained in the same place throughout testing to provide consistency to the testing area.

Experimental Procedure

Once brought into the testing area the puppy was given five minutes to habituate to the new surroundings. This allowed the experimenter time to gather the necessary treats in their treat pouch and determine if the puppy had prior training. The experimenter said "sit" and used a common hand signal found in most puppy training courses. She also tested the puppy on the stay command by saying "stay" and walking away from it. If the puppy followed any of the commands more than three times, it was dropped from the procedure.

After passing the constraints testing, the puppies were randomly placed into one of three conditions: clicker, verbal, or primary reinforcement. The markers for the clicker and verbal conditions were paired with a treat 20 times before training began. In the primary condition the dogs were given 20 pieces of food. Next the experimenter placed the puppy in the measured tape

box and got the puppy's attention. Once the puppy was looking at the experimenter, she said "stay" and waited for a predetermined amount of time. I operationally defined the "stay" behavior as not passing the tape marked box for a certain amount of time based upon the shaping approximations (Figure 2).

If the puppy stepped outside of the box the trial was marked as wrong and the puppy was reset to try again. If the puppy succeeded and stayed within the box for the predetermined time it received the marker for the behavior depending on what condition it was in, a treat, and then reset for the next trial. A reset consisted of picking the puppy up and placing it back in the center of the box. This is done to ensure the puppy did not sit or lay down in one spot for the entire study.

My predetermined schedule is shown in Figure 2. In the first two levels the experimenter stood at the edge of the box and a stopwatch began timing after the experimenter said the command. Every level after that, the experimenter would step back to the marked tape and wait for the predetermined amount of time. At these levels the stopwatch began timing once the experimenter had completely stepped back. To ascend to the next level the puppy must have completed three consecutive correct trials. If the puppy failed to stay within the box two times in a row it was brought back down a level. The trials continued until 50 trials, pass or fail, had been completed. Extra criteria were placed on the 50 trials to end the experimental session early to ensure that the puppy was not forced to fail due to a sudden lack of motivation or focus. Puppies that met these criteria did so by failing level one 10 times consecutively, going back and forth between two levels three times in a row, or not starting a new trial within 10 minutes of the last ended trial.

Results

Achievement Level

A survivorship graph was created that charts the proportion of puppies that reached each shaping approximation in each condition (Figure 1). Lines were drawn for each condition when they reached the median to show the median approximation achievement. These lines show how far in the shaping approximations 50% of the puppies for that condition achieved. Puppies in the clicker condition had a median achievement level of 3 (5s with step back to tape). In the verbal condition puppies had a median achievement level of just under 4 (between 5s with step and 10s with step) and puppies in the primary condition had a median achievement level of just under 6 (Between 20s with step and 30s with step). Figure 1 also shows that the highest achievement level for both the clicker and verbal condition was 6 (30s with step) and only 10% of the puppies in that condition made it that far. The primary condition, however, had 30% of the puppies complete level 6 and 10% went on to complete achievement level 7 (40s with step).

Latency

I also recorded the latency between each trial by using the time stamp from the recordings of the training sessions. The latency times were determined by the time the experimenter gave the puppy a secondary reinforcer, or primary reinforcer if in the primary condition, to when the experimenter said "stay" to start the next trial. The average latency time for the clicker condition was about 37 seconds, verbal condition was about 37 seconds, and the primary condition was about 39 seconds.

Discussion

From the results, it is evident that the clicker and verbal condition both were not as effective in facilitating learning within my experiment's constraints when compared to the primary condition. The median achievement levels (Figure 1) for each condition indicate this result accurately with the clicker condition aiding 50% of the puppies to achieving an approximation level of 3, being far behind the median achievement performance of the primary condition at about level 6. Furthermore, the puppies within the primary condition outperformed the other two conditions once level four was reached as well as 10% of the puppies reaching a higher achievement level (Figure 1). The average latency times having little difference between them leads me to believe that all three methods were equal in holding the subjects attention with the added seconds in primary possibly being due to the time it takes the experimenter to produce a treat from the treat pouch.

I believe that the reasons why my results are different than the previous research are mainly due to the methods used and the magnitude of their experimental design. McCall et.al. (2002) compared the differences between a secondary reinforcer and a primary reinforcer of food by training two groups of horses to perform two novel tasks while also introducing extinction periods in between training sessions. This methodology interrupts training procedures with extinction periods wherein they still provided one group with the secondary reinforcer without food while the other group received no form of reinforcement. A core belief behind clicker training is that the clicker can mark the correct behavior allowing the animal to associate a click as a secondary reinforcer. By providing the secondary reinforcer to one group the experimenters inadvertently provided the subjects with more trials of experience than the primary reinforcement group received.

Williams et al. (2004) compared the effectiveness of a clicker to primary reinforcement while also testing the effects of reinforcement schedules and reinforcement types that were received during extinction on the trained behaviors. This experimental design created six different reinforcement protocols that the horses could be placed within causing the experiment to become unnecessarily complicated. I believe that the reason their results differ from mine is because their design was too complicated especially when not much is concretely known about the true effectiveness of these different positive reinforcement methods.

My study was designed specifically to be simple and not use extinction because I felt that due to the many contradictions within this field there needed to be an understanding on how effective the clicker is in a basic and controlled lab setting and then manipulate it in an applied setting leading to more complex designs, such as the ones provided by Williams et.al. (2004).

Smith and Davis (2008) compared clicker training and a primary reinforcer of food by first training dogs a target behavior consisting of touching their noses to a target then began an extinction period on the subjects after strengthening the trained behaviors. While Wood (2007) created an experimental design to compare clicker training and a verbal marker to train dogs to also nose touch a target. I believe training a horse to nose-touch a target may be a novel behavior in their species, but this does not carry over into dogs. Dogs use their noses to search the surrounding area and to smell for anything of interest (Walker, Walker, Cavnar, Taylor, Pickel, Hall, & Suarez, 2006 & Cablk, Sagebiel, Heaton, & Valentin, 2008) therefore I believe training a dog to nose-touch a foreign object is not a novel task.

Wood (2007) also compared clicker training to a verbal command using the word "good". This is one other aspect of her experimental design which I felt may have affected the outcome

of her results. The experimenter in my design said "next" as a verbal marker throughout the entire session making it, I believe, a clearer verbal marker of a correct behavior.

I believe I achieved my results because between level three and level four I introduce a longer waiting period than the puppy has experienced within the shaping approximations and combine it with a step away from the puppy. These two shaping approximations being required together may produce a tougher behavior approximation for the puppies to achieve. Allowing only the puppies that have truly learned the target behavior to succeed faster and facilitate learning.

I believe that the introduction of a click or verbal marker may cause the puppy to associate the primary reinforcer being produced because of the marker and not because of the behavior. By removing this unnecessary middle-man the puppy is allowed to clearly associate the behavior that is producing a primary reinforcer for it. This is not to say that the primary reinforcer could not have produced its own secondary reinforcement. The puppy may have picked up on other cues that could not be fully controlled within the constraints of my experimental design. Examples of these cues could be the experimenter's hand reaching into the treat bag, or the experimenter coming toward the dog before a treat was given.

While these results are not consistent with previous research that examines the effectiveness of clicker training, further review within studies that compare the use of other secondary reinforcers with primary reinforcement have shown results that are consistent with my findings. These reports show the true effectiveness of primary reinforcement in other aspects of the behavior literature (Herrnstein, 1964 & Peirce & Cheney, 2008).

Some future directions that could be taken are testing a complex target behavior, such as a reaction chain or by creating an extinction period. By increasing the complexity of the task I may be able to test whether one method can facilitate learning in complex tasks when compared to the trends found on a simple task. Creating an extinction period may be an effective way in testing the actual strength of a secondary reinforcer when compared to primary reinforcement within my experimental design. One other avenue of research could be to test the difference between an experienced trainer and a novice trainer. One aspect of debate around the use of a clicker is that it is not necessarily helpful to the animal but more helpful to the trainer because it gives him a better idea of when to mark the behavior. This would give the impression, to a trainer, as facilitating learning and speeding up training time.

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Figures

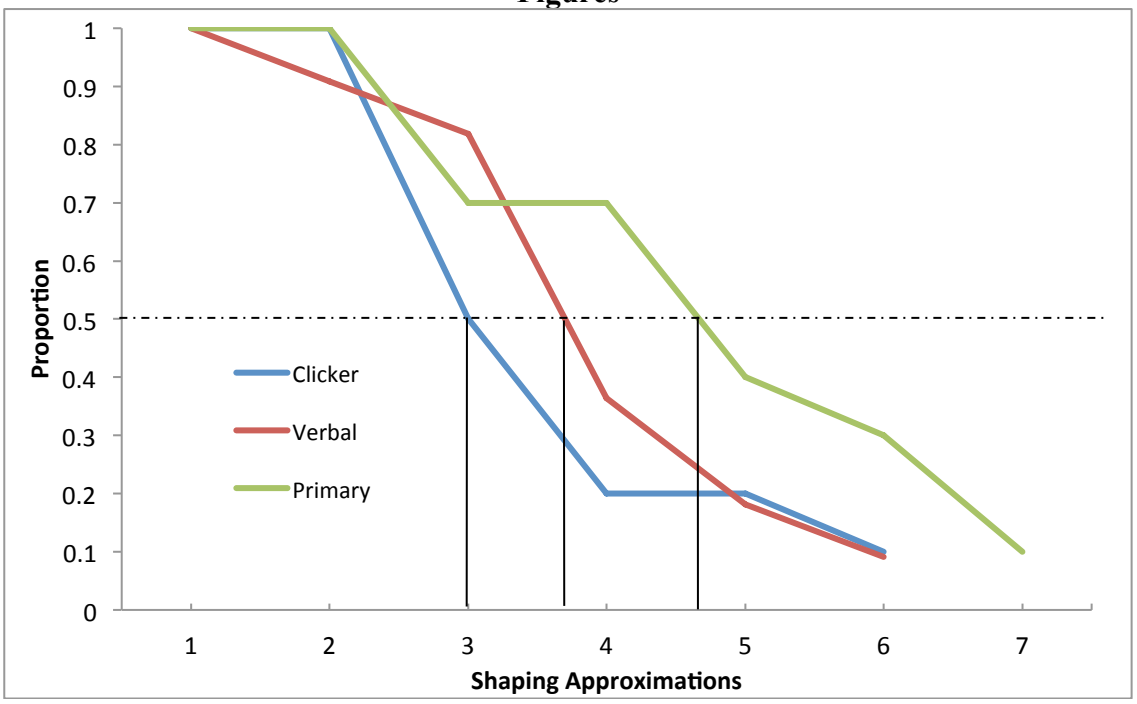

Figure 1. Survivorship Graph showing the proportion of puppies that reached each shaping approximation achievement level. Horizontal dashed line shows the median achievement level for each condition.

Shaping Approximations	
1	1 second with no step away
2	5 seconds with no step away
3	5 seconds with step back to tape
4	10 seconds with step
5	20 seconds with step
6	30 seconds with step
7	40 seconds with step

Figure 2. Table showing the shaping approximation levels of achievement