THE EFFECTS OF INCREASING RATES OF REINFORCEMENT THROUGH AN ALTERNATIVE FLUENT BEHAVIOR ON THE ACQUISITION AND EXTINCTION OF BEHAVIOR IN DOGS

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Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

August 2012

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Coulter, Laura E. The effects of increasing rates of reinforcement through an alternative fluent behavior on the acquisition and extinction of behavior in dogs. Master of Science (Behavior Analysis), August 2012, 28 pp., 5 figures, references, 20 titles.

The purpose of the present study was to experimentally investigate the effects of interspersing the opportunity to perform a fluent behavior during the acquisition of a new behavior. The experimenter trained left and right paw movements in domestic canines using a multiple treatment design. One paw movement was trained with a typical shaping procedure while the other was trained with an opportunity to perform a fluent behavior, touching the dog’s nose to a plastic disc, following each successive approximation in the shaping procedure. Two extinction phases were implemented during the experiment. The results showed that higher rates of reinforcement were achieved primarily following changes in criteria for reinforcement for the behavior in acquisition. There were no effects on rate of acquisition of the behavior, but adding an alternative fluent behavior may have slowed the differentiation between the reinforced behavior and alternative behaviors for one dog. The behavior trained with the addition of an alternative fluent behavior extinguished more quickly than in the control condition and extinguished at similar rates to the opposite leg movement. This suggests that the technique of offering an alternative fluent behavior may facilitate the chaining of the opposite behavior with the behavior targeted for reinforcement.
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ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Jesús Rosales-Ruiz for his guidance, enthusiasm, and patience. He has taught me to embrace every step of the research process and creates an environment in which a sense of discovery about your own work is possible. I would also like to thank my committee members, Dr. Traci Cihon and Dr. Jonathan Pinkston for taking the time to contribute to my thesis project. Thanks to the department of behavior analysis for contributing to a community that fosters an amazing learning environment. I would like to thank ORCA for always taking the time to listen to my ideas and give thoughtful feedback. Thanks to Thom Currier, Elissa Hamilton, Emilie Anderson, Kat Dignan and Kim Vail for their hard work and patience. Thanks to my parents, Ann and Ken Coulter, and my fiancé, Justin Perkins, for their never-ending patience and encouragement to pursue my dreams. I would like to thank Katie Rossi for her constant support and for lending me her dog, Bernard, whenever needed. Finally, I would like to acknowledge my dog Sam for always being ready to learn something new and for giving me a chance to better understand behavior.
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INTRODUCTION

Shaping is a common method used to teach new behaviors in behavior analysis and animal training. Skinner (1953) states that, “by reinforcing a series of successive approximations, we bring a rare response to a very high probability in a short period of time” (p. 92). Skinner continues to explain that shaping is most useful for a behavior that does not occur or occurs at very low rates. He uses the example of teaching a pigeon to peck a spot on the wall. He explains that with shaping, you can begin with successive approximations like looking at the spot, moving toward the spot, pecking near the spot, and finally pecking the spot; however, this behavior would not be likely to occur in its entirety without using successive approximations. After an approximation is occurring at a high rate, there can be an abrupt change in the criteria for reinforcement to the next successive approximation. This results in a period of extinction that often leads to the next successive approximation, but also reduces the overall rate of reinforcement during the process.

High rates of reinforcement are often recommended for optimal learning (Alexander, 2003; Laurence, 2004; Pryor, 1999). It is difficult to tell where this recommendation originated. High rates of reinforcement have been shown to be important for increasing engagement in one behavior over another (Zanolli & Daggett, 1998); however, little research has been done to evaluate the effects of high rates of reinforcement during the acquisition of a behavior. When considering methods for increasing rates of reinforcement, two related aspects of the acquisition process should be considered. The first is the criteria for reinforcement used during acquisition and the second is the periods of extinction during acquisition.

One method for increasing rates of reinforcement is to decrease the number and size of the successive approximations. One golden rule of shaping is to use small steps. Galbicka (2004) says, “this rule indicates that the smaller the increment in the reinforcement criterion at each criterion change, the less likely it will be that responding will reach a point at which the variation from instance to instance will not include enough reinforceable values to maintain a fair degree of behavior.” (p. 741). The technique of
using small approximations during shaping is often recommended in the animal training community (Laurence, 2004; Pryor, 1999), however there may be instances when this approach is not effective for acquisition. Eckerman, Heinz, Stern, and Kowlositz (1980) suggested that, “large steps are recommended when extinction aids shaping and small steps are recommended when extinction opposes shaping” (p. 309).

Extinction can sometimes be used to our advantage when changing criteria in shaping, but it also has some undesirable effects. Azrin, Hutchinson, and Hake (1966) studied the effects of extinction on aggressive behavior and concluded that extinction was an “aversive event that produced aggression” (p. 191). The literature contains many accounts of extinction-induced aggression (e.g., Herbert et al., 1973; Knutson, 1970; Lerman, Iwata, & Wallace, 1999). Another similar effect that occurs during extinction is resurgence. Resurgence is “the recovery of previously extinguished responding when a recently reinforced response is extinguished” (Doughty & Oken, 2008). Behaviors that have previously occurred at high rates are more likely to occur during resurgence (Reed & Morgan, 2007). Resurgence can work to the advantage or disadvantage of the acquisition process, depending on which responses have been previously reinforced.

Using small successive approximations may help to increase rates of reinforcement, but there are limits to the number of visible successive approximations that can be implemented for a behavior. When this is the case, a method for obtaining high rates of reinforcement is needed. One technique for increasing rates of reinforcement is to intersperse the opportunity to perform a short, easy behavior while waiting for the next successive approximation. For example, Kurland (2008) taught a horse to flex the muscles in his hindquarters as a successive approximation to the target behavior of backing up appropriately. These behaviors are often very difficult to see, especially when divided into small successive approximations. Additionally, the approximations often occur at low rates, resulting in periods of extinction and allowing for the resurgence of other behaviors. In an effort to increase rates of reinforcement, Kurland interspersed
cues for the horse to do a short behavior that was already fluent, such as touching its nose to a plastic cone, with reinforcing successive approximations for backing up. Interspersing maintenance tasks with acquisition trials has been shown to increase motivation and correct responding with child stroke victims (Koegel & Koegel, 1986) and to decrease aggression and self-injurious behavior in children with mental retardation (Horner, Day, Sprague, O’Brien, & Heathfield, 1991). Additionally, high densities of reinforcement, achieved by reinforcing all attempts at a prompted behavior, have been shown to increase the number of correct responses and decrease self-injurious behavior in children (Motiejunas, 2000).

Although it is unclear whether high rates of reinforcement are beneficial to the rate of acquisition of behavior, there are other possible benefits that may arise from implementing a technique to increase rates of reinforcement. If the rate of reinforcement is kept high, the animal is less likely to leave the session. It also may help to increase responding in animals that are reluctant to offer behavior during training if an opportunity to perform a fluent behavior is presented.

The purpose of the present study was to experimentally investigate the effects of interspersing the opportunity to perform a fluent behavior during the acquisition of a new behavior.
METHODS

Participants

Two domestic dogs, *Canis familiaris*, participated in this study. Both dogs were pets in a home environment. Sammy, a female border collie, was 10.5 years old at the start of the study and had a clicker training history of 9 years. Bernard, a male, mixed-breed was 1.5 years old at the start of the study and had a life-long history of clicker training. Both dogs had been previously trained perform the behavior of targeting or touching their nose to a plastic disc.

Setting and Materials

All sessions were conducted in the living room of the dogs’ home. Both dogs were stationed on a platform for all experimental sessions. The platform for Sammy was 17 in. long by 11 in. wide by 1.5 in. tall (43.2 cm X 27.9 cm X 3.8 cm). The experimenter knelt in front and to the side of Sammy to conduct sessions. Treats were delivered on the floor in front of the dog, centered between her paws. The platform for Bernard was 23 in. long by 16 in. wide and 1.5 in. tall (58.4 cm X 40.6 cm X 3.8 cm). The experimenter sat in a folding chair in front and to the side of Bernard to conduct sessions. Treats were delivered from the experimenter’s hand in front of the dog, centered between his shoulders. A video camera was positioned 1.5 m in front of the dog so that the dog faced the camera. The experimenter used beef flavored treats, a clicker, a plastic target disc that was 3 in. (7.6 cm) in diameter, and a timer to conduct the sessions.

Measures

Rate of reinforcement, rate of left and right paw movements, and instances of leaving or returning to the session were measured. The rate of reinforcement was defined as the number of reinforcers delivered per min in each session. The delivery of a reinforcer consisted of the experimenter clicking the clicker and delivering a treat. The number of reinforcers per session was tallied and the duration of the entire session was timed in seconds. The rate of reinforcement was calculated by dividing the number of reinforcers by the duration of the session in seconds divided by 60 s.
During Shaping Step 1, left and right paw movements were tallied when any visible muscle movement of the paw occurred while the dog was in a sitting position on the platform. During Shaping Step 2, paw movements were tallied when there was a break in contact between the paw and the platform surface or when the paw changed location on the platform, while the dog was sitting with the front feet on the platform. For the no target condition, left and right paw movements per min were calculated by dividing the number of paw movements (left or right) by the entire duration of the session in seconds divided by 60 s. For the target condition, the left and right paw movements per min were calculated by dividing the number of paw movements (left or right) by the duration of the session in seconds divided by 60 s minus the total duration of the targeting behavior in seconds. The experimenter excluded paw movements that occurred between the click and the end of treat consumption and movements during the presentation of the target.

An instance of leaving the session was defined as three or more of the dog’s paws not making contact with the platform surface for any amount of time. An instance of returning to the session was defined as three or more of the dog’s paws placed on the platform for any amount of time in any position. When the dog left or returned to the session, the time within the session was recorded.

Interobserver agreement (IOA) was collected for 25% of the sessions. Second observers were trained to score all behaviors from video. Interobserver agreement was calculated by dividing the smaller number by the larger number for the duration of session, duration of session minus targeting, left paw movement number, left paw movement rate, right paw movement number, right paw movement rate, and reinforcement rate. For leaving and returning to session, interobserver agreement was calculated by dividing the number of intervals where observers agreed on instances of the behavior by the number of total intervals.

For Sam’s baseline the IOA was 95.3% for duration (range 93% to 98%), 100% for left paw number, 100% for left paw movement rate, 100% for right paw movement number, 100% for right paw
movement rate, and 85.4% for reinforcement rate (range 75% to 91%). For Sam’s target condition sessions the IOA was 96.5% for duration (range 68% to 100%), 89.9% for duration minus targeting (range 31% to 89%), 79.4% for left paw number (range 20% to 100%), 82.1% for left paw movement rate (range 35% to 100%), 92.8% for right paw movement number (range 68% to 100%), 81.5% for right paw movement rate (35% to 100%), and 96.4% for reinforcement rate (range 68% to 100%). For Sam’s no target condition sessions the IOA was 92.1% for duration (range 59% to 100%), 86.1% for left paw number (range 58% to 100%), 82.1% for left paw movement rate (range 56% to 100%), 83.4% for right paw movement number (range 33% to 100%), 80.9% for right paw movement rate (40% to 100%), and 91.2% for reinforcement rate (range 59% to 100%). For Sam’s extinction sessions, the IOA for left paw movement number was 83.9% (range 0% to 100%) and 86.5% for right paw movement number (range 0% to 100%). The IOA was 100% for instances of leaving and returning to session.

For Bernard’s baseline the IOA was 90.7% for duration (range 67% to 97%), 100% for left paw number, 100% for left paw movement rate, 100% for right paw movement number, 100% for right paw movement rate, and 90.6% for reinforcement rate (range 67% to 97%). For Bernard’s target condition sessions the IOA was 95.3% for duration (range 67% to 100%), 86.7% for duration minus targeting (range 67% to 100%), 91.6% for left paw number (range 50% to 100%), 83.6% for left paw movement rate (range 62% to 100%), 99.4% for right paw movement number (range 90% to 100%), 79.6% for right paw movement rate (range 10% to 99%), and 92.5% for reinforcement rate (range 52% to 99%). For Bernard’s no target condition sessions the IOA was 93.9% for duration (range 89% to 100%), 91.6% for left paw number (range 83% to 100%), 87.8% for left paw movement rate (range 83% to 100%), 91.6% for right paw movement number (range 0% to 100%), 88.4% for right paw movement rate (range 0% to 100%), and 94.1% for reinforcement rate (range 89% to 100%). For Bernard’s extinction sessions, the IOA for left paw movement number was 84.0% (range 0% to 100%) and 84.7% for right paw movement number (range 0% to 100%). The IOA was 100% for instances of leaving and returning to session.
Procedures

Preliminary training. The experimenter first trained the subjects to sit facing forward on the platform. The experimenter altered her position from the left to the right of the dog during training and carried out four training sessions per day with 10 reinforcers per session. During preliminary training, the experimenter initially lured the dog into sitting position on its platform and giving the dog the treat as it sat. The lure was then faded out and the experimenter delivered a click and a treat any time the dog looked ahead at the camera. Finally, the experimenter delivered the click and treat when the dog looked ahead at the camera for 1 to 3 s.

Baseline. The experimenter continued to deliver a click and a treat when the dog looked ahead at the camera from a sitting position on its platform, regardless of other concurrent behaviors like paw movements. Left and right paw movements were recorded in order to ascertain the initial frequency of paw movements. The experimenter continued to alternate her position from the left to the right of the dog across four sessions.

Experimental conditions. The experiment consisted of three conditions: the no target condition, target condition, and extinction. During the no-target condition, a left paw movement was trained. The experimenter cued the dog to go sit on the platform, and then positioned herself in front of the platform, to the dog’s left. The experimenter then waited and clicked and delivered a treat when the dog made any visible muscle movement of the left paw during Shaping Step 1. If the dog made any other body movements, the experimenter did nothing and continued to wait for a left paw movement. This was continued for 10 reinforcers, after which the experimenter gave the release cue “okay” and the session ended. During Shaping Step 2, the same procedure was followed except the experimenter waited to click and deliver a treat for a paw movement that broke contact with the platform surface.

In the target condition, a right paw lift was trained. The target condition was similar to the no-target condition, except that the experimenter would position herself to the dog’s right, facing the dog and
presented the plastic disc to the dog after each reinforced paw movement. When the dog touched the disc with its nose, the experimenter clicked and delivered a reinforcer. Then, the experimenter waited for the next paw movement. This was continued for 20 reinforcers; 10 for paw movements and 10 for targeting. The session ended with the release cue “okay” and the experimenter leaving position.

During the extinction condition, the experimenter cued the dog to sit on the platform and took her position to one side of the dog, with all of the materials used in the target and no-target conditions. She started the timer for 1 min immediately after taking position. Regardless of the dog’s behavior, no clicks, treats, or cues to target were delivered. When the timer went off, the experimenter gave the release cue to the dog and the session ended. The experimenter continued this for four sessions each day, alternating from side to side and always beginning on the dog’s left.

**Design.** A multiple treatment design with an extinction component was implemented. The no-target and target conditions were alternated throughout the experiment, always beginning with the no-target condition. Extinction was programmed for both the target and no-target condition two times in the experiment.
RESULTS

Figure 1 displays the rates of reinforcement for Sam (top panel) and Bernard (bottom panel). The grey line indicates the reinforcers per min for no-target sessions and the black line indicates reinforcers per min for the target sessions. The shaping step is indicated by “S1” (Shaping Step 1) or “S2” (Shaping Step 2).

During baseline, Sammy’s average rate of reinforcement for the target condition was 16 reinforcers per min and 12 reinforcers per min for the no-target condition. The range in frequency for the target condition was 5 to 25 reinforcers per min and 9 to 17 reinforcers per min for the no-target condition. In Shaping Step 1, the average rate of reinforcement for the no-target condition was 12 reinforcers per min and 13 reinforcers per min for the target condition. When Shaping Step 2 began, the rate of reinforcement for the no-target sessions dropped to an average of 6 reinforcers per min during Sessions 18 to 37. For the target sessions, the rates of reinforcement maintained an average of 14 reinforcers per min. The rates of reinforcement during the target condition dropped to the same frequency as the no-target condition for Sessions 38 to 41, with an average rate of 7 reinforcers per min. For the remainder of the phase, the average rate of reinforcement for the target condition was 17 reinforcers per min and for the no-target condition the average was 14 reinforcers per min. Overall, the rate of reinforcement was more variable for the no-target condition than the target condition. In the no-target condition, the frequency ranged from 3 to 19 reinforcers per min and from 12 to 20 reinforcers per min in the target condition. Four sessions of extinction followed with 0 reinforcers delivered in both conditions.

During the second reinforcement phase, the average rate of reinforcement for the target condition was 19 reinforcers per min and 16 reinforcers per min for the no-target condition. For the target condition, the frequency ranged from 12 to 25 reinforcers per min and from 6 to 22 reinforcers per min during the no-target condition. In Extinction Phase 2, 0 reinforcers were delivered for 12 sessions in both conditions. In the third reinforcement phase, the average rate of reinforcement for the target sessions was 21 reinforcers...
per min and 18 reinforcers per min for the no-target condition. The frequency in the target condition ranged from 2 to 44 reinforcers per min and from 1 to 25 reinforcers per min in the no-target condition.

During baseline, Bernard’s average rate of reinforcement in the no-target condition was 7 reinforcers per min and 6 reinforcers per min in the target condition. The frequency in the no-target condition ranged from 6 to 10 reinforcers per min and from 3 to 9 reinforcers per min in the target condition. In Bernard’s first reinforcement phase, for the first three sessions, the average rate of reinforcement for the target condition was 12 reinforcers per min and 9 reinforcers per min for the no-target condition. For the target condition the frequency ranged from 12 to 13 reinforcers per min and from 6 to 13 reinforcers per min in the no-target condition. For the remainder of the phase, the average rate of reinforcement for the target condition was 15 reinforcers per min and 14 reinforcers per min for the no-target condition. During the target condition the rate of reinforcement ranged from 4 to 18 reinforcers per min and from 10 to 20 reinforcers per min for the no-target condition. During the first extinction phase, the rate of reinforcement for four sessions in both conditions was 0.

During the second reinforcement phase, the average rate of reinforcement in both conditions was 18 reinforcers per min. For the target condition the frequency ranged from 15 to 23 reinforcers per min and from 17 to 21 reinforcers per min for the no-target condition. During the second extinction phase, no reinforcers were delivered for six sessions. In Reinforcement Phase 3, the average rate of reinforcement for the target condition was 18 reinforcers per min and 15 reinforcers per min for the no-target condition. The frequency for the target condition ranged from 16 to 20 reinforcers per min and from 7 to 21 reinforcers per min in the no-target condition.

Figure 2 displays the paw movement rates for Sammy in the no-target condition (top panel) and the target condition (bottom panel). The left paw movements per min for each session are indicated by the grey line and the right paw movements per min for each session are indicated by the black line.
During baseline, zero paw movements (left and right) occurred for seven sessions in both conditions. During Shaping Step 1, there was a clear separation between the left and right paw movement rates. The average for left paw rate was 15 movements per min and 3 movements per min for the right paw rate was. The frequency of left paw movements ranged from 9 to 26 movements per min and from 0 to 7 movements per min for right paw movements. During Sessions 18 to 24, the average for left paw movement rate was 15 movements per min and 11 movements per min for the right paw movement rate. The frequency of left paw movements ranged from 11 to 24 movements per min and from 4 to 23 movements per min for right paw movements. After this point, the average rates for the two paw movements separated, but remained highly variable in rate. From Session 25 to 42 the average for left paw movement rate was 8 movements per min and 20 movements per min for the right paw movement rate. The frequency of right paw movements ranged from 2 to 14 movements per min and from 9 to 35 movements per min for left paw movements.

From Sessions 42 to 67, the separation between the two paw movement rates maintained but the variability in the right paw rate decreased. For the left paw movements, the average rate was 3 movements per min and 14 movements per min for the right paw movements. The frequency of left paw movements ranged from 0 to 7 movements per min and from 5 to 22 movements per min for the right paw. For the remainder of the phase, the separation between left and right paw movements maintained and the variability in the right paw movement rate continued to decrease. The average for left paw movement rate was 16 movements per min and 1 movement per min for the right paw movement rate. The frequency of left paw movements ranged from 10 to 23 movements per min and from 0 to 3 movements per min for the right paw movements. During Extinction Phase 1, the initial frequency for the right paw movements was 8 movements per min and 21 movements per min for the left paw movements. At the end of the 4 extinction sessions, the right paw movement rate was 1 per min while the left paw movement rate was 7 movements per min.
During the second reinforcement phase, the average for left paw movement rate was 16 movements per min and 2 movements per min for the right paw movement rate. The frequency of left paw movements ranged from 6 to 22 movements per min and from 0 to 5 movements per min for the right paw movements. During Extinction Phase 2, the initial frequency for the right paw movements was 2 movements per min and 8 movements per min for the left paw movements. Both paw movement rates (left and right) ended with a rate of 0 movements per min.

In the third reinforcement phase, the average for left paw movement rate was 19 movements per min and 1 movement per min for the right paw rate. The frequencies of left paw movements ranged from 2 to 29 movements per min and from 0 to 5 for the right paw movements.

During Shaping Step 1 of the target condition, Sammy’s average for left paw movement rate was 6 movements per min and 8 movements per min for the average right paw rate. The frequencies of left paw movements ranged from 2 to 22 movements per min and from 4 to 14 movements per min for right paw movements. In Shaping Step 2, the left and right paw movement rates continued to overlap for Sessions 18 to 29. The average for left paw movement rate was 12 movements per min and 17 movements per min for the right paw movements. The frequencies of left paw movements ranged from 5 to 22 movements per min and from 8 to 27 movements per min for right paw movements.

For Sessions 30 to 55, the two paw movement rates separated slightly but continued to be variable. The average for left paw movement rate was 20 movements per min and 8 movements per min for the right paw movements. The frequency of left paw movements ranged from 1 to 20 movements per min and from 13 to 65 movements per min for right paw movements.

For Sessions 56 to 82, the separation between paw movement rates became more clear and the variability in the left paw rate decreased. The average for left paw movement rate was 3 movements per min and 18 movements per min for the right paw movements. The frequency of left paw movements ranged
from 0 to 10 movements per min and from 12 to 22 movements per min for the frequency of right paw movements.

For Sessions 83 to 87, the variability in the left paw movement rates returned. The average for left paw movement rate was 7 movements per min and 17 movements per min for the right paw movements. The frequency of left paw movements ranged from 3 to 10 movements per min and the frequency of right paw movements ranged from 10 to 22 movements per min. During Extinction Phase 1, the initial frequency of left paw movements was 18 movements per min and 19 movements per min for right paw movements. The right paw ended at rate of 6 movements per min and the left paw ended at a rate of 3 movements per min.

During the second reinforcement phase, the separation between paw movement rates maintained and the variability in the left paw movement rate remained high. The average for left paw movement rate was 4 movements per min and 21 movements per min for the right paw movement rate. The frequency of left paw movements ranged from 0 to 10 movements per min and from 9 to 35 movements per min for the right paw movements. During Extinction Phase 2, the initial frequency of both paw movements (left and right) was 8 movements per min. Both paw movements (left and right) ended at a rate of 0 movements per min.

During the last reinforcement phase the separation between the two paw movements maintained and the variability in the left paw movement rate decreased. The average for left paw movement rate was 1 movement per min and 18 movements per min for the average right paw movement rate. The frequencies of left paw movements ranged from 1 to 30 and from 0 to 4 for the right paw movements.

Figure 3 displays the paw movement rate data for Bernard in the no-target condition (top panel) and target condition (bottom panel). The grey line indicates the left paw movements per min for each session and the black line indicates the right paw movements per min for each session.
In the no-target condition, during baseline, Bernard moved each paw once throughout six sessions. In the first reinforcement phase, the left and right paw movement rates showed a clear separation with some variability in right paw movement rates throughout the phase. The average for left paw movement rate was 13 movements per min and 1 movement per min for the right paw movement rate. The frequency of right paw movements ranged from 6 to 27 movements per min and from 0 to 7 movements per min for the left paw movements. During the first extinction phase, the initial left paw movement frequency was 15 movements per min and 5 movements per min for right paw movement frequency. Both paw movements (left and right) ended at a rate of 0 movements per min.

During the second reinforcement phase, separation between paw movement rates maintained, and the variability in the right paw movement rate decreased. The average for left paw movement rate was 19 movements per min and 1 movement per min for the right paw movement rate. The frequency of left paw movements ranged from 0 to 6 movements per min and from 0 to 1 movements per min for the right paw movements. In the second phase of extinction, the initial frequency of left paw movements was 4 movements per min and 9 movements per min for right paw movements. The final left paw movement rate was 1 movement per min and the final right paw movement rate was 0 movements per min.

During the third reinforcement phase the separation between paw movement rates maintained. The variability in the frequency of right paw movements also remained low. The average for left paw movement rate was 16 and 0.2 movements per min for the right paw movement rate. The frequencies of left paw movements ranged from 6 to 21 and from 0 to 1 movement per min for the right paw movements.

In the target condition, during baseline, Bernard moved his left paw once and did not move his right paw throughout six sessions. In the first reinforcement phase, the left and right paw movements show clear separation from the beginning with the right paw occurring at a higher rate throughout. The average for left paw rate was 2 movements per min and 13 movements per min for the right paw rate. The frequency of left paw movements ranged from 0 to 7 movements per min and from 6 to 27 movements per min for right paw
movements. During Extinction Phase 1, the initial frequency of left paw movements was 9 movements per min and 4 movements per min for right paw movements. The final left paw movement rate was 0 per min and 4 movements per min for the right paw movement rate.

During the second reinforcement phase, the separation between average paw movement rates maintained and the variability in the frequency of left paw movements decreased slightly. The average for left paw movement rate was 2 movements per min and 16 movements per min for the right paw movement rate. The frequency of left paw movements ranged from 0 to 6 movements per min and from 6 to 20 movements per min for the right paw movement rate. During the second extinction phase, the initial frequency of left paw movements was 3 movements per min and 7 movements per min for right paw movements. Both paw movement rates (left and right) ended at 0 movements per min.

In the third reinforcement phase, the separation between paw movement rates maintained. The variability in the left paw rate continued to occur in this phase. The average for left paw movement rate was 2 movements per min and 16 movements per min for the right paw movement rate. The frequency of left paw movements ranged from 0 to 5 movements per min and from 13 to 20 movements per min for the right paw movements.

Figure 4 shows the extinction data for both extinction phases for Sammy in greater detail. The no-target condition is displayed in the top panel and the target condition is displayed in the bottom panel. Cumulative paw movements per 10-second interval are displayed for left and right paw movements. Each phase change line represents one 60-second session of extinction. The solid arrow indicates the instances of the dog leaving the platform and the dotted arrow indicates instances of the dog returning to the platform.

During the no-target condition in both extinction phases, only half as many right paw movements occurred compared with left paw movements. In extinction phase one, the total number of right paw movements was 20 and 38 left paw movements occurred. In the second extinction phase, the total number
of right paw movements was 16 and 33 left paw movements occurred. In phases one and two of extinction for the no-target condition, Sammy left the session 5 times and returned once before the session ended.

During the target condition, the left and right paw movements extinguished together in Extinction Phase 1. The total number of left paw movements was 28 and the total number of right paw movements was 31. The largest difference between total left and right paw movements was 4 movements. During the first two sessions of Extinction Phase 2, the left and right paw movements extinguished at similar rates. The largest difference between the total left and right paw movements was 6 movements. For the rest of Extinction Phase 2, the left paw movements extinguished at slightly faster rates than the right paw movements. At the end of the phase, 19 left paw movements had occurred and 35 right paw movements had occurred. Throughout the two extinction phases, Sammy left the session 19 times and returned before the session ended 12 of those times.

Figure 5 shows the data for Bernard for extinction phases one and two. The no-target condition is displayed in the top panel and the target condition is displayed in the bottom panel. Cumulative paw movements per 10-s interval are indicated for both left and right paw movements. Each phase change line represents one 60-s session of extinction. The solid arrow indicates the instances of the dog leaving the platform and the dotted arrow indicates instances of the dog returning to the platform.

During the no-target condition, the right paw movements extinguished significantly faster than the left paw movements for extinction phases one and two. In Extinction Phase 1, the total number of right paw movements was 7 and the total number of left paw movements was 30. In Extinction Phase 2, the total number of right paw movements was 4 and the total number of left paw movements was 22. Throughout both extinction phases, Bernard left the session 6 times and returned once before the session ended.

During Extinction Phase 1 of the target condition, the left and right paw movements extinguished together for the first session. In the first session, the largest difference between the two total paw movements was two movements. For the rest of Extinction Phase 1, the right paw movements extinguished
faster. The total number of left paw movements was 22 and the total number of right paw movements was 8. In the second phase, the two paw movements extinguished together throughout. The largest difference between the two paw movement totals was 3 movements. The total number of left paw movements was 8 and the total number of right paw movements was 10. Throughout the two phases, Bernard left the session 8 times and returned before the session ended 3 of those times.
DISCUSSION

The results show that higher rates of reinforcement were achieved with the interspersal of an alternative fluent behavior. During acquisition, for Sam, the rate of reinforcement was higher in the target condition than the no-target condition for the first 20 sessions of Shaping Step 2. For Bernard, the rate of reinforcement was higher in the target condition than the no-target condition for the first two sessions of Shaping Step 2. For the rest of the experiment, the target condition continued to result in higher rates of reinforcement, but the difference was small. Despite higher reinforcement rates, the acquisition of the targeted behavior was not faster with the interspersal of an alternative fluent behavior. In fact, it may have slowed the acquisition of the target behavior for Sam. One difference in the effect of the two conditions was that there was a higher frequency of occurrence of the non-targeted paw movement in the target condition than in the no-target condition. Another difference was that the paw movements extinguished faster in the target condition than the no-target condition.

High rates of reinforcement are often recommended during acquisition; however, the rate of reinforcement is hard to separate from the criteria for reinforcement and the probability of occurrence for the behavior during each successive approximation. For example, Bernard acquired the paw movement behavior in the same number of sessions (six sessions) in both conditions even though the rate of reinforcement was lower for the no-target condition than the target condition in the first two sessions. Similarly, for Sammy, in the first shaping-step, the no-target condition was acquired faster than the target condition, even though the rates of reinforcement were similar in both conditions. In contrast, when the criterion was changed in Shaping Step 2 and some extinction occurred, the behavior was acquired faster in the no-target condition even though the overall rate of reinforcement was twice as high in the target condition than in the no-target condition. This suggests that the probability of behavior generated during extinction is more important for acquisition than the rate of reinforcement as suggested by Eckrman, et. al., (1980).
In the present study, the use of the platform limited the possible responses to the front paw movements because the dog could not stand, move its back paws, or walk around while meeting the criteria for sitting on the platform. However, even with this environmental arrangement the probability of paw movements differed for both dogs. For example Sam’s quick acquisition of the small paw movement behavior in Shaping Step 1 may have been because that was a behavior that was very likely to occur in that environmental arrangement. However, during Shaping Step 2, the larger paw movement was less likely to occur resulting in a longer period of acquisition. For Bernard, the large paw movement was more likely to occur than it was for Sam. As a result, he acquired the large paw movement behavior almost immediately. This suggests that the rate of acquisition is affected by the probability of occurrence of the target behavior rather than the rate of reinforcement. Further research is needed to analyze the differences in acquisition rate with highly probable successive approximations and successive approximations with a lower probability across a range of reinforcement rates.

One difference between the no-target and target conditions was the frequency of the opposite paw movement. For both dogs, the opposite paw movements occurred at a higher frequency in target condition than in the no-target condition. Indicating that the differentiation of the paw movements was better in the no-target condition than in the target condition. The frequency of the opposite movement in the no-target condition at the end of Shaping Step 2 was near 0. In contrast for the target condition, the opposite movement varied from 0 to 10 and was maintained all throughout Reinforcement Phase 2. It is possible that the opposite paw movement may have been inadvertently maintained by the presentation of the target disc or may have become a chained response in the target condition. However, with repeated extinction, this effect was reduced to a near 0 frequency.

Another difference between the two conditions occurred during extinction. For both Sam and Bernard, during the no-target condition, the previously reinforced paw movement initially decelerated from the previous phase while the while the opposite paw movement increased slightly before decelerating. In
contrast, during the target condition, the frequency of the previously reinforced paw movements
decelerated and the opposite paw movements increased to the same frequency of the previously reinforced paw movement and both decelerated at the same rate. This suggests that the two responses may have been part of a behavior chain, as indicated above. Mansfield and Rachlin (1970) taught a two-response chain and then employed punishment, satiation, and extinction on the first behavior in the chain. They measured the number of times the pigeon started the chain, engaging in the first response only, and the number of times the pigeon completed the chain, engaging in both responses. During all three types of disruption, they found that the two responses in the chain decrease together. Kuhn, Lerman, Vorndran and Addison (2006) found the same extinction patterns with children. Interestingly, this faster extinction pattern in with the target condition opposes the idea of behavioral momentum, which holds that richer schedules of reinforcement are more resistant to change than leaner schedules of reinforcement (Grace, McLean, & Nevin, 2003; Nevin 1983). This may be due the fact that behavioral momentum is usually documented during the maintenance of behavior rather that during acquisition.

A further indicator that the extinction process progressed more quickly in the target condition was the extinction of the behavior of sitting on the platform. Both dogs left the session earlier and more often in the extinction phase during the target condition than during the no-target condition.

High rates of reinforcement are often considered to be ideal for learning, however this experiment shows that increasing the rate of reinforcement by reinforcing other behaviors has little impact on the acquisition of a behavior. Perhaps one problem with discussing high rates of reinforcement during acquisition is that rate of reinforcement is a molar variable that depends on the criteria for reinforcement and the behavior generated during extinction. Thus, the focus should be on the criteria for reinforcement rather than the rate of reinforcement when the speed of acquisition is our objective. The combination of the criteria for reinforcement and the occurrence of behavior during extinction is what determines the rate of reinforcement during acquisition.
Although interspersing an alternative fluent behavior did not accelerate the learning process, it may have helped the shaping process by keeping the animal engaged during the acquisition of a behavior when the successive approximations have a low probability of occurrence, as Kurland (2008) suggested. If the difference in speeds of extinction is replicated, interspersing an alternative fluent behavior may also be a useful to accelerate the extinction process. However, if an alternative fluent behavior is used, the experimenter should be careful to avoid the development of an unwanted behavior chain.
Figure 1. Reinforcers per minute for all sessions across both conditions are shown for Sammy in the top panel and Bernard in the bottom panel. The no target condition is indicated by the black line and the target condition is indicated by the grey line. The phase is noted at the top of the graph and the shaping step is indicated by a “S1” or “S2”.
Figure 2. Left and right paw movements per minute per session across all phases for Sammy. The top panel displays results for the no target condition. Bottom panel displays results for the target condition. The first and second shaping steps are indicated by “S1” or “S2”.
Figure 3. Left and right paw movements per minute per session across all phases for Bernard. The top panel displays results for the no target condition. Bottom panel displays results for the target condition. The second shaping step is indicated as “S2” in the first reinforcement phase.
Figure 4. Cumulative paw movements per 10-second interval during all extinction phases with Sammy. Each phase change line represents one session. The top panel displays the data for the no target condition and the bottom panel displays the data for the target condition. In the no target condition the left paw was previously reinforced (gray line). In the target condition, the right paw was previously reinforced (black line).
Figure 5. Cumulative paw movements per 10-second interval during all extinction phases with Bernard. Each phase change line represents one session. The top panel displays the data for the no target condition and the bottom panel displays the data for the target condition. In the no target condition the left paw was previously reinforced (gray line). In the target condition, the right paw was previously reinforced (black line).
REFERENCES


