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The Effects of Multiple Clicks Prior to Food Delivery on Performance in a Domestic Dog

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Abstract

In both the experimental and applied animal behavior literature, there is much research that aims to understand the functionality of conditioned stimuli (i.e., previously neutral stimuli paired with primary reinforcers). The "clicker," made popular by the ever growing clicker-training community, is one such stimulus. The purpose of this research is to evaluate the effects of delivering a click (paired via stimulus-stimulus pairing) without also delivering a primary reinforcer (food) on the free operant performance of a domestic dog. Results indicate that when a neutral stimulus is paired with a primary reinforcer, the previously neutral stimulus obtains discriminative stimulus properties, and can disrupt a behavior chain rather than support it when it is delivered without the delivery of a primary reinforcer.

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Clicker training has become a popular technique in animal training. Its favorability is often attributed to its emphasis on positive reinforcement. To use this technique, a trainer will usually condition the clicker (an initially neutral stimulus) by repeatedly pairing it with food (that is, repeatedly presenting the audible click immediately followed by food). This is sometimes referred to as, "charging the clicker" (Alexander, 2003). This procedure is taken directly from the respondent conditioning literature (for an overview see Rescorla, 1982), and, in the applied realm, is the procedure generally described to create a conditioned reinforcer (Cooper et al., 2007).

While the term clicker "training" references the specific type of device used in this training (a small box with a metal plate, that when pressed, emits a clear, succinct, audible "click"), the broader category of stimuli used in this way (e.g., whistles, short words) has gone by a variety of names in the animal training world, as well as in the basic literature (Dorey & Cox, 2018; Feng, Howell, & Bennett, 2016). It has also been referred to as a "bridge" in that it has been thought to extend the gap in time between the desired behavior and the delivery of the primary reinforcer (Bailey & Gillaspy, 2005; Kaplan & Hearst, 1982; Pryor, 2002). It has also been referred to as a "marker," as it may serve to indicate the specific behavior that is being reinforced (Lieberman et al., 1979; Pryor, 2002). More broadly, this stimulus is also referred to as a conditioned (or secondary) reinforcer (Bailey & Gillaspy, 2005; Pryor, 2002; Ramirez, 1999). Each of these terms highlights an assumption as to how this stimulus functions. These assumptions are reflected by animal trainers when they are asked about what they believe the click sound communicates during training. After pairing, some trainers use the clicker to communicate when their animal has done the correct behavior, while others use it to indicate that "a treat is coming" (Feng et al., 2017). The former interpretation suggests that the clicker is serving as a conditioned reinforcer, in that it is reinforcing, or supporting, the behavior directly. The latter interpretation suggests that the click serves as a discriminative stimulus. The method of conditioning determines the functionality of the click, not the interpretation of the trainer.

Understanding these functions is critical. Whether it is a conditioned reinforcer and/or a discriminative stimulus could determine and/or suggest different ways to maintain the effectiveness of the stimulus, as well as how it may affect behavior.

Conditioned reinforcers have been referred to as "learned reinforcers" (Hendry, 1969). That is, they are stimuli that obtain reinforcing properties through an association with a primary reinforcer, often referred to as stimulus-stimulus pairing, or S-S pairing (Hendry, 1969; Hull, 1943). A definition of conditioned reinforcement that involves conditioning through association suggests that respondent conditioning is at play; as such, the same processes that govern respondent conditioning contribute to conditioned reinforcement (Shahan & Cunningham, 2015; Williams, 1994). Given these parallels, one might expect that the presentation of the conditioned stimulus/reinforcer alone would be able to support behavior, or, as suggested by introductory behavioral textbooks, that the "power" of the stimulus is a reflection of the number of pairings it has had with a primary reinforcer (Cooper et al., 2007). This suggests that pairing the clicker repeatedly with primary reinforcers may then produce a stimulus that can be used to communicate to the animal when they have engaged in a desired behavior, but does not require the consistent presentation of a primary reinforcer to maintain its efficacy.

Alternatively, basic behavioral research has shown that simple pairing (contiguity) among stimuli is not necessary nor sufficient to produce a conditioned reinforcer (or conditioned stimulus, in the respondent conditioning case; Rescorla, 1988), but what matters is that the stimulus be a reliable and non-redundant predictor of the primary reinforcer (Kelleher & Gollub, 1962; Rescorla, 1988; Shahan & Cunningham, 2015). This suggests that a conditioned stimulus/reinforcer is only as valuable as the information it provides about the availability of the primary reinforcer. This aligns with the idea that in order for a stimulus to function as a conditioned reinforcer, it must first be a discriminative stimulus (Hendry, 1969; Kelleher & Schoenfeld, 1950; Skinner, 1938). This account that conditioned reinforcers simultaneously have discriminative stimulus functions has been expanded to, more broadly, the view that conditioned reinforcers are valuable because they provide constructive information about the primary reinforcer (Bolles, 1975; Davison & Baum, 2006; Gallistel & Gibbon, 2002; Kelleher & Schoenfeld, 1950; Rachlin, 1976; Shahan & Cunningham, 2015). Based on this interpretation, conditioned reinforcers might serve as feedback, or signposts (see Shahan, 2010, for a review), suggesting that the conditioned stimulus serves as a guide to the primary reinforcer, rather than strengthening the preceding behavior (Shahan, 2010; Shahan & Cunningham, 2015). In this scenario, given that during conditioning the click was presented immediately prior to food delivery, reliably delivering a primary reinforcer after the conditioned reinforcer would be essential to maintaining the clicker's functionality, as well as maintaining the animal's behavior chain, which includes acquisition and consumption behavior of the primary reinforcer.

For an animal trainer, these different interpretations are consequential in that each suggests unique methods for creating and maintaining an effective stimulus for training. For example, if the clicker (or any previously neutral stimulus paired as described) is simply a conditioned reinforcer, and only serves to strengthen responding, one should be able to deliver it with only the periodic delivery of a primary reinforcer and still maintain some level of effectiveness because, given the conditioned reinforcer, the level of effectiveness is directly related to the probability of the primary reinforcer (Pearce et al., 1997; Rescorla, 2010). The behavior chain below provides an example of this kind of usage. If the click is only serving as a conditioned reinforcer, it could be used following multiple behaviors without disruption, and would serve to strengthen behavior:

B1 → "click" → B2 → "click" → approach trainer → consume treat.

If the click only serves the function of supporting previous behavior as described above and is used as indicated (i.e., without a primary reinforcer following every click), it would have several benefits. First, it would diminish satiation effects by reducing the number of primary reinforcer deliveries, which would be desirable for a trainer who might have to rely on a limited array of reinforcers to maintain behavior. Second, it could make training easier by not having to arrange for the delivery of the primary reinforcer. The trainer could reinforce behaviors when the subject is far away and would not have to interrupt the flow of a session or a behavior to deliver primary reinforcers after every click. However, if the click also functions as a discriminative stimulus for the availability of food, delivering it without a primary reinforcer would disrupt this functionality, and have potentially deleterious effects on behavior. The presentation of the click would produce the next link in the behavior chain: acquiring and consuming the primary reinforcer (e.g., approaching the trainer and eating the food). If the goal in using a clicker is only to strengthen the prior behavior through conditioned reinforcement functions and have the animal continue its performance, the discriminative stimulus functions of approaching the feeder would disrupt training and the performance. Further, the unreliable delivery of the primary reinforcer after the click would weaken its discriminative functions. Thus, if the click does acquire discriminative stimulus functions, its presentation should always be followed by a primary reinforcer in order to maintain the integrity and information being provided to the animal. This behavior chain is shown below:

B1 → "click" → approach trainer → consume treat.

The goal of this research is to identify the functionality of the clicker (or any neutral stimulus) when it is conditioned in a manner similar to the conditioning of a conditioned stimulus (as the method is often suggested in the animal training literature (Pryor, 2002; Ramirez, 1999). Specifically, does the use of a clicker that is not followed by a primary reinforcer enhance or disrupt performance? In this experiment, a neutral stimulus (click) was paired with a primary reinforcer (treat) repeatedly. In order to identify the possible functions of the click, the same task (touching two targets) was utilized throughout each phase of the experiment. Across phases, the number of times the click was presented was manipulated: either at the completion of the two target touches, or following each individual response. It should be noted that while the authors used a clicker, the analysis and interpretations could be extended to any neutral stimulus that is paired in the manner described.

Method

Subject

The experimental subject was a 10-year-old female German Shepherd dog. This dog had a long history of training in both free operant and discrete training methods, including clicker training. The clicker training she had experienced always had a 1:1 pairing of click:treat.

Experimental Set Up

The experiment was conducted in a rectangular room. Two rubber squeak toys were affixed to the floor approximately two feet from each other. The experimenter stood five feet away from the two targets so that both targets were equidistant from the experimenter. The experimenter, who remained stationary throughout the session, held a box clicker in their left hand, and had a reinforcer (treat) pouch on their hip. The reinforcers used in this experiment were ¼ inch cubes of Dick Van Patten's Natural Balance Roll®. These treats had traditionally been used with this subject in other training exercises, and had been shown to be effective at shaping novel behaviors and maintaining performances, such that they showed a reinforcing effect. The initial behavior of target touching was captured when the dog put its paws on the target when placed on the ground.

Procedure

All study procedures were carried out following the ethical guidelines for animal use of the University of North Texas. Each session lasted one minute and began when the experimenter gave a verbal, "Okay", and pointed a finger to the targets, cueing the dog to begin. In this free operant set up, no additional cues were provided to the dog throughout the one-minute session with the exception of clicks and food treats. Treats were held in a pouch on the experimenter's hip. When a treat was to be delivered, the experimenter put her hand in the pouch to get a treat, and then extended her hand towards the ground for the dog to retrieve it from her hand. When one minute elapsed, the experimenter said, "Good" and walked away from the training area. Time between sessions was approximately two to five minutes, and five to seven sessions were conducted daily. Sessions were run before the dog's evening meal to ensure similar levels of deprivation across experimental days. In every phase of the experiment, the dog was required to touch both targets (in any order) to receive a primary reinforcer. What changed across phases were the number of clicks delivered (one or two), and the way in which the treats were delivered (normally or discretely).

Each phase was scheduled to include 10 sessions, with any additional sessions needed for stability in the last three sessions (no visible trend). This was done for the first two phases (Single Click and Double Click with 11 and 10 sessions respectively), but was not the case for the Double Discrete condition. During this condition the subject's behavior changed more drastically than the data here show. Panting increased, target touches were more forceful, and while the dog never showed any signs of aggression, there were clear signs of frustration that the authors felt warranted discontinuing the remainder of the sessions. The final Single Click phase (which included the Single Click Discrete sessions) included eight phases due to time constraints.

Experimental Phases

Single Click

In the Single Click phase, the dog was given one click and one treat every time it completed the two target touches (i.e., touched with its paws the two targets placed on the floor in front of the experimenter). The order in which the targets were touched did not matter. For example, the dog could touch Target 1 (no response from the experimenter), then touch Target 2, receive a click and a treat. Alternatively, the dog could touch Target 2 first (no response from the experimenter), then Target 1, and then receive the click and a treat. The ratio between the number of conditioned reinforcers delivered and the number of primary reinforcers in all sessions in this phase was 1:1.

Double Click

In the Double Click phase, a click was delivered after each target touch, but a treat was only presented following the second target touch (when the two-target touch task was completed). The ratio between conditioned reinforcers (clicks) and primary reinforcers (treats) was elevated from 1:1 (as in the previous condition) to 2:1. For example, the dog touched Target 1, received a click (no treat), the dog touched Target 2, received a click and a treat. It is important to note that the task for the dog was exactly the same as in the previous condition; the only change was the presence of the click following the first target touch.

Discrete Double Click

This phase was run similarly to the Double Click phase, with the exception that the experimenter began each session with all the primary reinforcers in her hand (rather than having them in the treat pouch). Following the previous phase, we hypothesized that the subject was relying on visual cues from the experimenter to determine when a treat was being delivered: the overt behavior of the experimenter's hand moving from her side and into the treat pouch. In this phase, when a primary reinforcer was delivered, it was done so by moving a single treat from the palm of the hand to in between the thumb and forefinger. This was a fairly covert behavior that was not clearly identifiable from the video recording (though eating behavior was clearly observed when the dog did receive a treat). Thus, this phase reduced the potential visual discriminative stimulus of the experimenter's hand moving.

Discrete Single Click

This phase was run exactly like the first Single Click phase with the exception that the treat was delivered in the discrete manner described in the discrete double click phase above.

Analysis

All sessions were video recorded and later scored to count the total number of touches to each target (for simplicity, Target 1 refers to the target on the left from the perspective of the experimenter, and Target 2 refers to the target on the right), the number of primary reinforcers earned (treats), the number of times the dog looked at the feeder, and the total duration of looks to the feeder. We defined touch as: the dog using a front paw and making contact with a target so that the experimenter could detect a change in shape of the pliable target. We defined looks to the feeder as: dog's head and/or eyes oriented to the experimenter and/or hand that treats were delivered from. The video camera was placed in front of the experimenter in order to more clearly observe looks to the feeder. Video clips from each session can be found in the supplementary materials and help illuminate the data presented here as well as allow the reader to see the body language of the animal exhibited during each phase. Inter-observer agreement was conducted by an independent observer on 20% of the sessions. Using the count of each behavior for each session there was +90% total agreement on all measures (smaller count/larger count * 100). Any target touches, looks, or reinforcers that occurred outside of the one-minute interval were not counted for that session.

Results

Figure 1 and Table 1 show the number of clicks and treats delivered for each session across all phases of the experiment. In the Single Click and Discrete Single Click phases, a click and a treat was delivered for each completion of the two target touches. Thus, the number of clicks is equal to the number of reinforcers delivered (the only exception is the first session of the second Single Click phase where there was one more treat delivered than click due to trainer error). In the Double Click and Double Click Discrete phases, a click was delivered for each target touch, but a treat was only delivered following the second target touch, hence the elevation of target touches in comparison to the treats.

The subject earned the most reinforcers (i.e., completed the most tasks) in the last two Single Click phases (Single Click M = 7.5, SD = 1.91 per session; Discrete Single Click M = 9.0, SD = 0.00 per session, respectively), followed by the first Single Click phase (M = 7.35 per session). The total number of reinforcers earned decreased during the Double Click phase (earning M = 5.63, SD = 1.74 per session for Double Click and M = 4.50, SD = 0.84 treats per session for Discrete Double Click). Session 16 in the Double Click phase is a clear outlier with only 2 clicks and one treat delivered during the one-minute trial. During this session after completing both target touches and receiving a treat, the subject left the experimental session and did not return for the remainder of the one-minute interval.

Occasionally the subject hit the same target more than once before moving to the next target, or returned to a target it had already touched before it touched the other target. In these cases, these touches are considered superfluous (they are not necessary to obtain the primary reinforcer). Table 1 shows the mean and standard deviation of the number of touches to each target and primary reinforcers earned across each phase. In addition to these values, an additional measure, behavioral efficiency, is shown. Behavioral efficiency is the number of responses made to either target per reinforcer earned. This measure quantifies the superfluous behavior occurring in each phase. Superfluous behavior can serve as an indicator of unclear communication with regards to the contingency and availability of food. The most efficiency that the subject could achieve would be to get a treat for every two target touches. Efficiency is calculated by adding the mean number of total target touches from both targets and dividing by the mean number of primary reinforcers earned in the same phase. Based on this calculation, the closer the value is to two, the more efficient the behavior. The greater the value is above two, the less efficient the behavior in that phase. Table 1 shows that the subject was most efficient in the Discrete Single Click phase (*M* = 2.69 touches per treat), followed by the second Single Click phase (*M* = 2.79 touches per treat), then the initial Single Click phase (*M* = 2.81 touches per treat). The subject was less efficient in the Double Click phase (*M* = 3.25 touches per treat), and the subject was the least efficient during the Double Click Discrete (*M* = 3.78 touches per treat).

Measure	Single Click 1:1	Double Click 2:1	Discrete Double Click 2:1	Single Click 1:1	Single Click Discrete
T1	10.36(1.28)	9.36(3.64)	8.33(2.42)	10.0(1.82)	12.75(2.75)
T2	9.09(1.57)	8.63(3.07)	8.66(3.07)	10.5(2.51)	11.5(2.08)
SR+	7.36(1.28)	5.63(1.74)	4.5(0.83)	7.5(1.91)	9(0)
Efficiency	2.81	3.25	3.78	2.79	2.69

Table 1. Mean and standard deviation of touches to Target 1 (T1), Target 2 (T2), treats (SR+), and the efficiency score across sessions of each phase of the experiment.

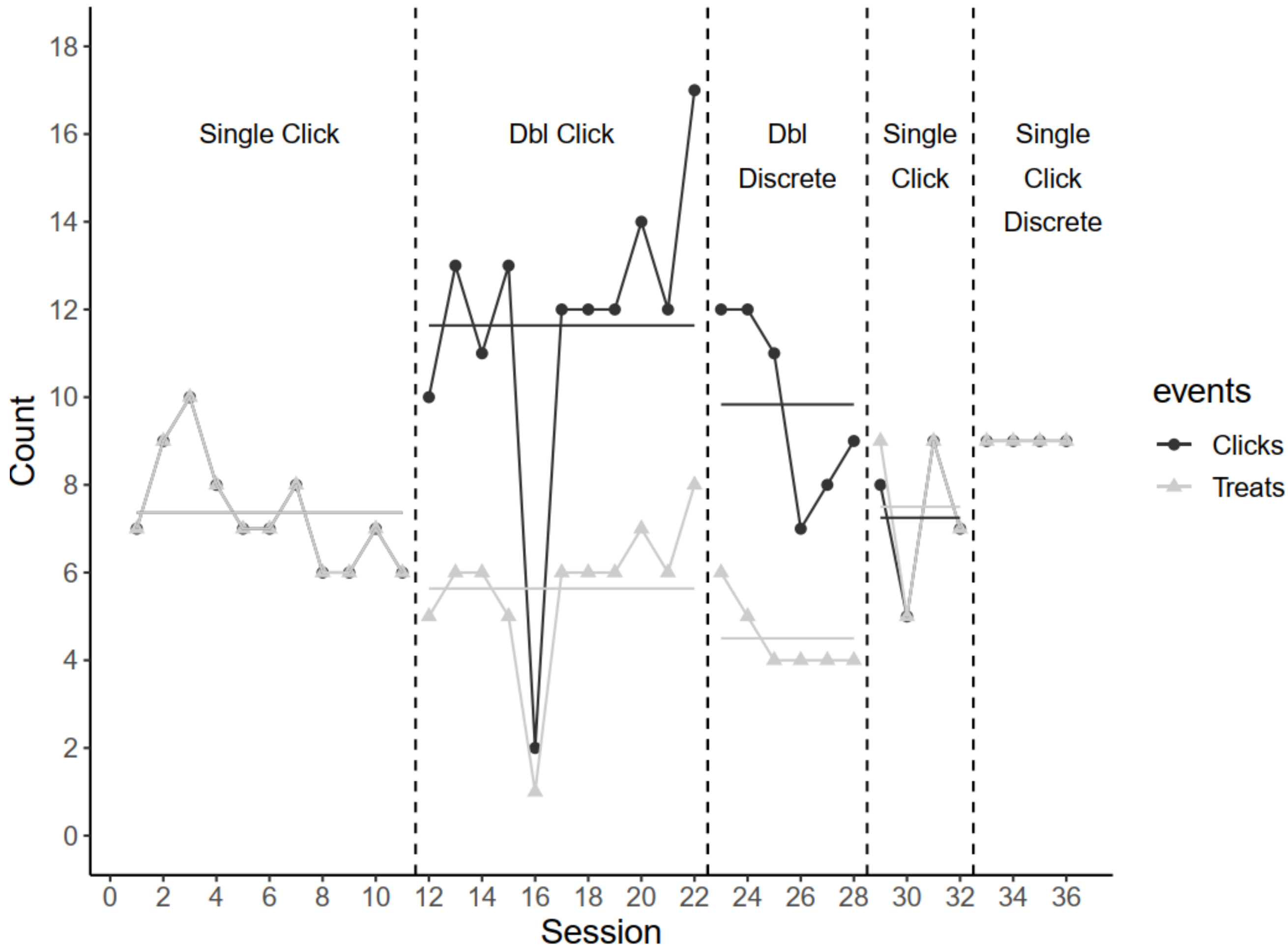

Figure 1. The number of clicks (shown in black circles) and treats (grey triangles) delivered each session for the Single Click, Double Click, Double Click Discrete, return to Single Click, and Discrete Single Click phases. The vertical lines indicate phase changes. The horizontal lines show the mean number of clicks and treats delivered for each phase of the experiment.

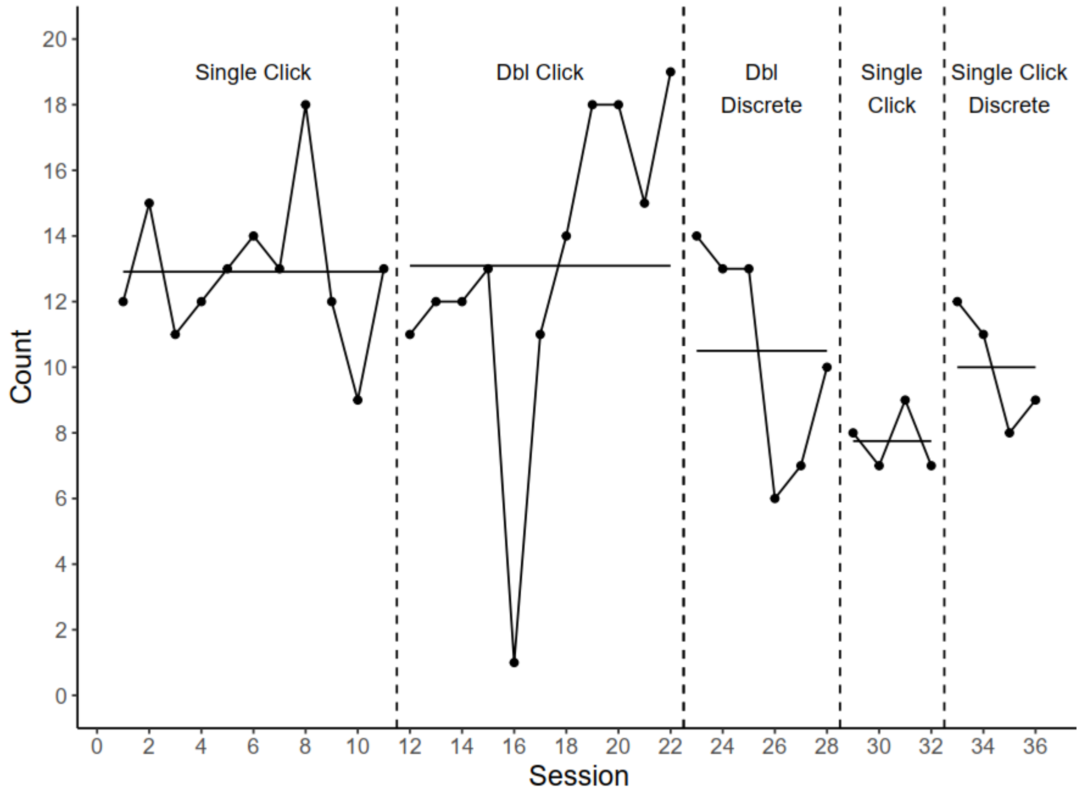

Figure 2. The number of looks to the feeder by the subject for all sessions for the Single Click, Double Click, Double Click Discrete, return to Single Click, and Single Click Discrete phases. The vertical lines indicate phase changes. The horizontal lines show the mean number of looks for each phase.

Figure 2 shows the number of looks to the feeder made by the subject during each session across all phases of the experiment. Though there is some variability, the mean number of looks remained fairly constant between the first Single Click phase (M = 12.9) and the subsequent Double Click phase (M = 13.09). The number of looks decreased during the Double Click Discrete phase (M = 10.50), and decreased further during the following Single Click session (M = 7.75). The number of looks increased, however, again during the Discrete Single Click phase (M = 10.00).

Perhaps more informative is the amount of time the subject spent looking towards the feeder, shown in Figure 3. The mean amount of time spent looking at the feeder was 5.08 s during the first Single Click phase and nearly doubled to a mean of 9.39 s in the Double Click phase. Total time spent looking at the feeder decreased in the Double Click Discrete (M = 6.84 s). The mean total look time decreased again during the return to the Single Click phase (M = 3.04 s), but increased again slightly in the Discrete Single Click phase (M = 5.06 s).

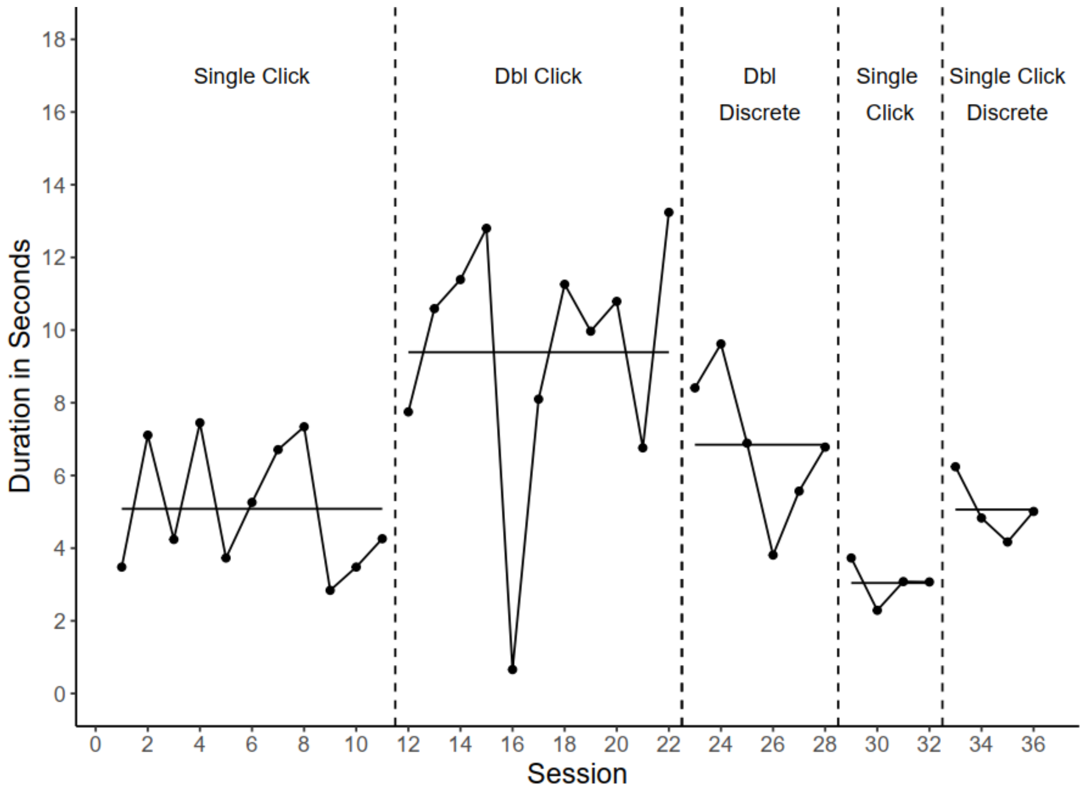

Figure 3. The amount of time in seconds the subject spent looking at the feeder for each session across all phases of the experiment.

Discussion

We investigated the functionality of a clicker established through pairing directly with food and manipulated whether a primary reinforcer (food) was delivered after every click or not. These data suggest that when paired in this way, the clicker acquires discriminative stimulus functions, such that not delivering a primary reinforcer after each click disrupts the dog's performance.

Though the subject needed to perform the exact same task throughout all phases of the experiment, the additional presentations of the clicker altered behavior. The number of reinforcers earned, indicating the number of successful tasks completed by the subject, decreased in the Double Click phases compared to the Single Click phases (see Figure 1). This suggests that the addition of the click following the first target touch disrupted behavior in some way that kept the subject from completing as many tasks as it was able to in the Single Click phases.

Figure 3 may help illuminate the source of this disruption. While the number of looks to the feeder remained fairly consistent during the Double Click phase (2), the total duration of look time increased between the Single and Double Click phases. If the dog spent more of the one-minute interval looking to the feeder, there was less time that could be used to complete the task. Why would the addition of a click increase look time? We hypothesized that the increased time spent looking may have been to detect an alternative cue that would more reliably predict when a treat was available (i.e., the physical movement of the experimenter's hand to the treat pouch became the reliable discriminative stimulus for food availability). In the Single Click phases, the click served as a reliable discriminative stimulus that food was available, whereas in the Double Click phases, it was not. As such, the dog had to rely on other cues, such as the experimenter's hand movement, to reliably predict food availability in the Double Click phase, but not in the Single Click phase.

We tested this hypothesis by removing the overt cue of the experimenter's hand moving to the treat pouch in the Discrete Double Click phase. When this overt cue was removed, the dog's behavior deteriorated further. The number of reinforcers earned (Figure 1) and the level of efficiency (Table 1) were the lowest observed across the entire experiment. The number and duration of looks to the feeder both decreased from the Double Click phase. This supports the hypothesis that the increase in look duration during the Double Click phase was due to the subject seeking more reliable information about the delivery of food. When this information was removed (Discrete Double Click), the behavior deteriorated further. With no reliable cue of food delivery (no click or hand movement), the subject engaged in many more target touches than necessary, earned fewer reinforcers, and did not look to the feeder as much as other phases where the experimenter's hand movements provided information about food delivery.

The reversal back to the Single Click phase following the Discrete Double Click shows that when the click returned to being a reliable indicator of food delivery (a click was delivered with a treat every time), the number of reinforcers returned to previous Single Click levels, the efficiency of the behavior was restored, and the duration of looks returned to previous levels. This continued even when the overt hand cue was removed during the final Single Click phase. This final phase was conducted to demonstrate any effects the overt hand cue might have had on the Single Click phase behavior. It is clear from these results that the subject was not relying on the overt hand cue during the Single Click phase. When it was removed, the number of reinforcers earned, and the efficiency of the behavior remained similar to previous Single Click phases. This suggests that when the click is a reliable indicator of food delivery, the subject does not need to rely on other alternative cues.

General Discussion

These results have clear implications for those working in applied settings. First, these results suggest that when a previously neutral stimulus is paired with food in a 1:1 manner (generally described as a conditioned reinforcer), the stimulus obtains discriminative stimulus properties. That is, it becomes a cue that informs the subject that if they approach the feeder/trainer, food will be available. Peiris & Rosales-Ruiz (2022) found a similar disruption in performance when moving from a 1:1 to 2:1 ratio of clicks:food, although it is unclear if this was due to the click:food change as the schedule for primary reinforcement changed concomitantly from an FR-1 to an FR-2. Our study did not have this confound of an altered schedule of reinforcement, such that our results point directly at the discriminative stimulus function as being a driving factor of the observed decrement in the dog's performance.

If the reliability of the discriminative stimulus functionality is compromised, as was shown in the Double Click phase, the subject might be able to maintain its behavior to some degree by relying on alternative cues (e.g., movement of hand to treat pouch). These alternative cues are generally not as reliable or effective as the click. For example, if a trainer believes that the click is the cue that their animal is waiting for, but the animal is actually attending to their hand movements, the trainer may inadvertently be cueing their animal to move to the feeder for a treat by moving their hand prematurely of the appropriate behavior (before a click is delivered). Additionally, this might result in the animal engaging in undesirable behaviors. For example, if the trainer wants the animal looking forward and not back at the trainer, such as a scent detection dog or an elephant holding still for a blood draw from its ear, the animal might engage in undesirable gazing to the trainer if the trainer's hand movement has become the most reliable predictor of the availability of the primary reinforcer. This could potentially create a poor performance from the animal or even an unsafe environment for both trainer and the animal. In the example of an elephant blood draw, the head movement of the elephant may be slight, but, given the size of the animal, this movement could be very dangerous. The needle in the elephant's (now moving) ear could pose a risk to the elephant, and, without clear communication, the keeper standing close by may not be anticipating this movement, creating a potentially dangerous environment. Additionally, if the conditioned reinforcer (e.g., clicker) was initially established with a 1:1 pairing with the primary reinforcer, using it in a double click fashion can disrupt the animal's performance, as the discriminative stimulus properties of the conditioned reinforcer result in the animal engaging in behavior to ascertain the availability of the primary reinforcer or acquire the primary reinforcer. Additionally, as mentioned in the procedures above, the subject showed clear signs of frustration in the double click conditions. While physiological data were not collected, it was clear to the authors that the change in experimental procedure not only negatively affects the target behaviors observed for this research, but produced additional emotional responding as well. None of these possibilities are desirable in the applied animal field. The safest, most effective training occurs when communication between the animal and the trainer is clear. Clear communication is only possible when both trainer and animal are relying on the same cues.

As mentioned in the methods, the subject used for this study had a history of clicker training. Questions remain whether or not a subject novel to the clicker would have responded the same way. While this is an empirical question, it seems safe to assume that any animal undergoing conditioning of a neutral stimulus directly paired with food is going to, in the future, expect food to be available when that stimulus is presented. Whether or not food is made available (i.e., the trainer delivers food), does not change the functionality of that stimulus. The animal will engage in necessary behaviors to more reliably determine if/when food is available. As shown in this research, this leads to the animal checking in with the trainer in the presence of the stimulus to see if alternative cues (i.e., reaching in the treat pouch) are present that more reliably indicate the availability of food. While introducing multiple clicks to treat ratios earlier in their conditioning experience may alter the overt appearance of these behaviors (the animal may get very good at covertly checking in for these cues or may identify alternative cues from the trainer that reliably predict food availability) the subject is still going to rely on the most reliable cue that food is available.

While the experimental literature has provided quite a bit of discussion and empirical evidence about the functionality of conditioned stimuli on behavior, it is important that these concepts be tested in applied settings. While the clicker (and similarly conditioned stimuli) are conditioned reinforcers and referred to as such (Bailey & Gillaspy, 2005; Pryor, 2002; Ramirez, 1999), the definition of a conditioned reinforcer tends to focus on the methods used to create that stimulus, rather than the effects on behavior. The term “reinforce” suggests that the stimulus alone can support behavior, which may lead a trainer to believe that they can thin the schedule between the primary reinforcer and the conditioned reinforcer without ill effects. The results of this experiment show that this is not the case, and that the discriminative stimulus properties also need to be included when making decisions about how to use these stimuli in applied settings.

This paper has focused on the functional properties of a conditioned stimulus that has been conditioned by pairing it directly with food. These results show that this pairing procedure produces a stimulus with discriminative stimulus properties that can serve as a step in a behavior chain (i.e., cue the animal to stop whatever behavior they are engaging in and engage in acquisition behaviors for the primary reinforcer), which could end a desirable performance when the animal engages in reinforcer acquisition behavior. Does this mean that a conditioned reinforcer always needs to be paired with a primary reinforcer? Evidence from the basic behavioral research suggests that this is not necessarily the case (Shahan & Cunningham, 2015). Stimuli can be conditioned by being paired with other conditioned reinforcers, or links in a larger behavioral chain that end with primary reinforcement. Thus, it may be possible to condition stimuli that provide specific information regarding behavior (i.e., move to the next behavior in the chain) and the availability of food. For example, a trainer may want a cue to reinforce the correct behaviors in a behavior chain (B1, B2, and B3 below), and also indicate when the chain is complete (that is, a discriminative stimulus (SD) that reliably indicates when it is appropriate to approach the feeder to get a treat), shown below:

B1 –> CSR+ –> B2 –> CSR+ –> B3 –> CSR+ –> SD –> approach –> consume treat.

In order for both of these stimuli to function in a way that enhances behavior they need to provide different information. The “CSR+” (conditioned reinforcing stimulus) in the above example presumably serves to communicate that 1) the previous behavior was correct (conditioned reinforcer function) and 2) to move to the next behavior (discriminative stimulus function, but not one that supports primary reinforcer acquisition). The SD communicates that 1) the previous behavior was correct, and 2) an approach to the feeder/trainer will produce a primary reinforcer. The results of this study have shown that pairing a novel stimulus with a primary reinforcer directly produces a stimulus with SD properties, and disrupts behavior if it is presented mid-behavior chain. Future research should be conducted on alternative conditioning procedures and testing the functionality of the conditioned stimuli produced.

References

Alexander, M. (2003). Alexander: Click for Joy!: Questions and Answers... – Google Scholar. https://scholar.google.com/scholar_lookup?title=Click%20for%20Joy!&author=Alexander&pu

Bailey, R. E., & Gillaspy, J. A. (2005, October). Operant psychology goes to the fair: Marian and Keller Breland in the popular press, 1947–1966. The Behavior Analyst, 28 (2), 143–159. doi: 10.1007/BF03392110

Bolles, R. C. (1975). Learning Theory. New York, NY: Holt, Rinehart & Winston.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). Applied behavior analysis (2nd ed.). Columbus, OH: Merrill Prentice Hall (Second ed.). Columbus, OH: Merrill Prentice Hall.

Davison, M., & Baum, W. M. (2006, November). Do conditional reinforcers count? Journal of the experimental analysis of behavior, 86 (3), 269–283. doi:10.1901/jeab.2006.56-05

Dorey, N. R., & Cox, D. J. (2018, September). Function matters: A review of

terminological differences in applied and basic clicker training research. PeerJ , 6 , e5621. doi: 10.7717/peerj.5621

Feng, L. C., Howell, T. J., & Bennett, P. C. (2016, August). How clicker training works: Comparing Reinforcing, Marking, and Bridging Hypotheses. Applied Animal Behaviour Science, 181, 34–40. doi: 10.1016/j.applanim.2016.05.012

Feng, L. C., Howell, T. J., & Bennett, P. C. (2017). Comparing trainers' reports of clicker use to the use of clickers in applied research studies: Methodological differences may explain conflicting results. Pet Behaviour Science 3, 1-18 (2017).

Gallistel, C., & Gibbon, J. (2002). The symbolic foundations of conditioned behavior. Mahwah, NJ: Lawrence Erlbaum Associates.

Hendry, D. P. (1969). Conditioned Reinforcement. Homewood, IL: The Dorsey Press.

Hull, C. L. (1943). Principles of Behavior. New York: Appleton-Century-Crofts.

Kaplan, P. S., & Hearst, E. (1982). Bridging temporal gaps between CS and US in autoshaping: Insertion of other stimuli before, during, and after CS. Journal of Experimental Psychology: Animal Behavior Processes, 8 (2), 187–203. doi:10.1037/0097-7403.8.2.187

Kelleher, R. T., & Gollub, L. R. (1962, October). A Review of Positive Conditioned Reinforcement. Journal of the Experimental Analysis of Behavior, 5 (4 Suppl), 543–597. doi: 10.1901/jeab.1962.5-s543 Kelleher, R. T., & Schoenfeld, W. N. (1950). Principles of Psychology. New York: Appleton-Century-Crofts.

Lieberman, D., McIntosh, D., & Thomas, G. V. (1979). Learning when reward is delayed: A marking hypothesis. Journal of Experimental Psychology: Animal Behavior Processes, 224–242.

Pearce, J. M., Redhead, E. S., & Aydin, A. (1997). Partial Reinforcement in Appetitive Pavlovian Conditioning with Rats. The Quarterly Journal of Experimental Psychology Section B, 50 (4), 272–294.

Peiris, P. L., & Rosales-Ruiz, J. (2022). Some detrimental effects of conditioned reinforcement on the maintenance of dog behavior. *Journal of the Experimental Analysis of Behavior, 118*(2), 337-348

Pryor, K. (2002). Don't shoot the dog (3rd ed.). Ringpress Books.

Rachlin, H. (1976). Behavior and Learning. San Francisco: W H. Freeman.

Ramirez, K. (1999). Animal training: Successful animal management through positive reinforcement. Chicago, IL: Shedd Aquarium.

Rescorla, R. A. (1982). Effect of a stimulus intervening between CS and US in autoshaping. Journal of Experimental Psychology: Animal Behavior Processes (8), 131–141.

Rescorla, R. A. (1988). Pavlovian conditioning: It's not what you think it is. American Psychologist, 43 (3), 151–160. doi: 10.1037/0003-066X.43.3.151

Rescorla, R. A. (2010). Within-subject partial reinforcement extinction effect in autoshaping. The Quarterly Journal of Experimental Psychology Section B, 52 (1).

Shahan. (2010, March). Conditioned Reinforcement and Response Strength. Journal of the Experimental Analysis of Behavior, 93 (2), 269–289. doi:10.1901/jeab.2010.93-269

Shahan, & Cunningham. (2015, March). Conditioned reinforcement and information theory reconsidered. Journal of the experimental analysis of behavior, 103, 405–418. doi: 10.1002/jeab.142

Skinner, B. F. (1938). The behavior of organisms: An experimental analysis. Oxford, England: Appleton-Century.

Williams, B. A. (1994). Conditioned Reinforcement: Neglected or outmoded explanatory construct? Psychonomic Bulletin & Review, 1 (4), 457–475.