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An Evaluation of Target Training on Trailer Loading Cattle

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Abstract

Trailer loading cattle can be stressful for both the cattle and handlers and could lead to injury (Detering, 2006; Fisher et al., 2009). Few studies have evaluated non-aversive techniques with cattle such as conditioning procedures that incorporate appetitive stimuli to positively reinforce and shape behavior (e.g., Lomb et al., 2021). Given the risks associated with trailer loading, it may be important to understand the efficacy of non-aversive techniques with cattle. Therefore, the purpose of this study was to replicate and extend Ferguson and Rosales-Ruiz (2001) to evaluate the efficacy of target training three heifers for easing trailer loading. Results of the study suggest target training was an effective method for decreasing problematic loading behavior and latency to loading for two heifers when loading individually and for trailer approaches for one heifer.
Keywords: trailer loading, cattle, target training

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An Evaluation of Target Training on Trailer Loading Cattle

Trailer loading cattle involves a handler pushing or driving penned cattle into a transport trailer. In some situations, loading cattle into a trailer can be high stress for both the cattle and handlers (Detering, 2006). Cattle may engage in behaviors such as vocalizations, kicking, and running (Smith, 2015) as fleeing is their normal response to a perceived threat (Detering, 2006). This flight response may be exacerbated by confining cattle in a penned area, resulting in overly aggressive and flighty behavior that can be dangerous for both the cattle and handlers (e.g., charging, stampeding; Detering, 2006). Increased levels of cortisol in cattle have been reported following trailer loading and transport (Fisher et al., 2009), which can lead to a decrease in reproduction success (Fernandez-Novo et al., 2020) and disease such as immunosuppression (Roth, 1985). Problematic loading behavior can lead to animal injury or health problems, handler injury or death, and financial loss for the producer (Detering, 2006; Fisher et al., 2009). Although there are many risks with trailer loading cattle, trailer loading is necessary as there are many reasons why cattle may need to be transported. For example, cattle may need to be transported for veterinary care, to change pastures, or to be sold at auction. Therefore, it is important to identify trailer loading techniques that reduce cattle problematic behavior and stress through low-stress cattle handling (María et al., 2004).

One strategy that may be effective in trailer loading cattle is target training (Ramirez, 2017). Target training has been used with a variety of animals and breeds to train various behaviors (e.g., cooperative care; Davis, 2006; Ramirez, 2017). Wild and domestic animals have been trained to touch body parts to different objects to help with veterinary procedures (Ramirez, 2017), horses have been trained to load into a trailer (Ferguson & Rosales-Ruiz, 2001), and aquatic animals have been trained to do a variety of tricks (e.g., Garner, 2018). Target training can be a two-step process which creates a bridging stimulus between the behavior and the subsequent reinforcer (Horwitz & Landsberg, 2022). First, clicker training often involves pairing the noise of a small clicking device (i.e., neutral stimulus) with a primary reinforcer (i.e., unconditioned stimulus) such as a preferred edible. There are several ways to pair stimuli (Balsam, 1984; Machado & Silva, 2004). For example, in delay conditioning, a neutral stimulus is presented closely in time with the unconditioned (often an appetitive) stimulus such that the presentation of the two stimuli overlap at a delay. After the clicker becomes predictive of the appetitive stimulus via pairing, the sound of the clicker can then be used as a bridging stimulus (i.e., conditioned reinforcer) as it immediately signals that the animal has performed the correct behavior. This allows for the shaping of novel behaviors in which the appetitive stimulus cannot be immediately presented to the animal (Chiandetti et al., 2016).

Second, target training is introduced once the clicker has been established as a conditioned reinforcer. The handler begins by presenting the target to the animal. Any interest in the target is reinforced with a click and an appetitive stimulus, such as an edible. Subsequently, the handler can reinforce successive approximations to the desired targeting behavior such as the animal touching the target with their paw, nose, or another body part. Once the "basic" targeting behavior is established, variability in responding is shaped through varying the target or body part, training multiple targets, extending the target on a pole, or placing the target in various locations until the final behavior reliably occurs (Ramirez, 2017). For example, Davis (2006) discussed the Audubon Zoo's use of target training for tortoises in shaping moving the tortoises into a position to allow for blood draws.

Ferguson and Rosales-Ruiz (2001) evaluated the effects of target training and shaping on trailer loading five horses with aversive trailer-loading histories (i.e., use of whips and ropes) using a multiple baseline design across horses. Similar to cattle, loading horses into trailers can pose a risk to both the horse and the handler. During baseline, the handler led the horse to the trailer and prompted "step up." The handler prompted "step up" every five seconds if the horse was facing the trailer. If the horse turned away from the trailer or froze, the handler led the horse in a circle and then back to the trailer. If the horse froze again, the handler prompted the horse backwards while pushing the lead rope towards the horse's chest. The handler ignored head tossing and rearing.

During target training, the researchers implemented clicker training during which food was paired with a clicker. Then, the researchers implemented target training sessions in which the handler presented a target close to the horse's nose and contingent on the horse touching the target with their nose, activated the clicker and delivered food. Once the horse reliably touched the target, the handlers moved the target to different locations in a field (e.g., ground, fence posts) and moved the target to a different location prior to each trial while adding a cue (i.e., "touch"). Once the horse was reliably touching the target, the researchers implemented trailer training.

During trailer training, the handler led the horse to the trailer and prompted "touch" while a second handler held the target inside the trailer. Contingent on touching the target, the handler activated the clicker and delivered food. The second handler moved the target forward into the trailer following each successful load. Similar to baseline, if the horse froze or backed out of the trailer, the first handler led the horse in a circle and then back to the trailer. The duration in which the horse remained in the trailer, a trailer extension, and the side in which the horse loaded were varied during trailer training. Target training and shaping were effective in training all five horses to load into a trailer while decreasing problematic loading behaviors. Considering the success of target training and shaping with horses, a similar procedure may be effective with cattle.

Although not directly evaluated, target training may also be appropriate for cattle; however, no research has evaluated the effects of target training with cattle. Several researchers have used conditioning and shaping techniques with cattle (e.g., Lomb et al., 2021; Wredle et al., 2006). For example, Wredle et al. (2006) trained 10 milk cows to approach a milking station in response to an acoustical sound. All cows were fitted with a collar that emitted an acoustical sound. The researchers paired the acoustical sound from the collar with food when the cows were in the milking barn across 12 training sessions such that the acoustical sound became a conditioned reinforcer. Researchers then shaped the cows' entry into the milking unit at the sound of a tone, allowing for specific cows to be called for milking at various times of day while minimizing the need for handlers to gather cattle for milking. Of the 10 cows trained, eight approached the milking station when the sound was played when released back into typical management conditions (i.e., in the pasture with other herd members). While not directly related to target training cattle, the results of Wredle et al. suggest the effectiveness of conditioning an auditory stimulus to change and shape cattle behavior, which is an important step in target training.

More recently, Lomb et al. (2021) conducted research on the effectiveness of an appetitive stimulus for maintaining calm behavior of heifers when receiving subcutaneous injections. Twenty-four heifers between six and nine months were broken into three groups (e.g., agency heifers, habituation heifers, and naïve heifers). Agency heifers were trained to stand unrestrained with an open headlock device to receive a sham injection through shaping. First, agency heifers were placed in the training area in which the heifers had free access to a bucket of grain on the ground such that the heifers became habituated to the training area and eating out of a bucket. They were then trained to step forward through a headlock and then subsequently remain standing calmly in the headlock for increasing amounts of time. Heifers were offered grain to reinforce calm responses when stepping into and staying in the headlock for the targeted amount of time. Once the heifer was able to stand calmly in the headlock for 10 seconds between grain deliveries, counter conditioning of the injection procedure began. Counterconditioning involved desensitizing the heifer to different sensations such as touch (e.g., grabbing the neck, touching with a dull needle). The habituation group was allowed to come into the training pen and spent as much time in the training pen as the agency heifers did but did not undergo any type of training to stand in the headlock calmly. The naïve heifers had no exposure to the training pen. Cattle in the agency group, the group that had undergone training to stand calmly in the headlock and desensitization, had far less undesirable behavioral responses than cattle in the habituation or naïve group when given an injection at the end of the training period. These data suggest the delivery of appetitive stimuli contingent on calm responses and desensitization training can decrease problematic behaviors experienced by cattle during medical procedures.

Given the success of target training various animals, as well as the demonstration of the effects of conditioning, shaping, and reinforcement of cattle behavior, it is possible that cattle could learn to successfully trailer load through target training. Therefore, the purpose of this study was to systematically replicate Ferguson and Rosales-Ruiz (2001) to evaluate whether target training (i.e., clicker training cattle combined with a shaping procedure) would ease the trailer-loading process. Implications of this study are multi-tiered. First, no literature exists on the utility of clicker and target training cattle. Second, training of this type has the potential to decrease the stress of loading, improve cattle well-being, and protect the cattle and the handler through the reduction of cattle resistance to trailer loading and handler drives and pushes.

Method

Participants

Subjects were three Angus cross heifers, between the ages of two and four years, from Wildflower Cattle Company's herd. Heifers were selected for training to ensure that behavior changes in cows with calves did not influence handler safety or efficacy of clicker and target training. The heifers selected were hand raised and either had known difficulties with or had never experienced trailer loading. Heifer 0 was two years old (222.5 cm long), black, had two blue fly tags in both ears, and had never experienced trailer loading. Heifer 1 was two years old (228.6 cm long), black, had an orange #1 ear tag in her left ear, and had never experienced trailer loading. Heifer 6 was three years old, pregnant with her first calf (213.4 cm long), mostly black with white on her face, had a blue #6 ear tag in her left ear, and had known difficulties with trailer loading, mainly freezing and refusing to enter the trailer.

Setting and Materials

One handler from Wildflower Cattle Company (i.e., first author) was present for each session. All sessions were video recorded. The heifers were familiar with the handler. The handler conducted sessions at Wildflower Cattle Company's 60,702.80-m^2 winter pasture. Within the pasture there was a smaller 4,046.86-m^2 pen broken into two halves. The south half of the pen was pasture grass with one feed bunk (i.e., a wood and concrete structure front fitted with stanchions approximately 0.60 m by 1.22 m by 0.60 m that allowed the heifer to stick their head through). The north half of the pen was also pasture grass and contained the transport trailer, loading pen, and one feed bunk.

The heifers underwent clicker training, target training, and trailer testing in the north half of the smaller 4,046.86-m^2 pen. The two sections of the smaller pen allowed the handler to isolate and train individual heifers if needed. Clicker and target training sessions required a clicker, range cubes (i.e., 0.03 m x 0.01 m pressed food pellets), a feed bunk, and a blue potholder (0.02 m x 0.23 m) attached to a string. The handler used a blue potholder as the target during target training. Baseline and trailer testing sessions required Wildflower Cattle Company's transport trailer and paint sticks. The transport trailer was a 7.32-m step up, straight load (see Appendix A for a picture of the transport trailer). The step-up height was 0.28 m. The inside and outside of the trailer was painted red. The trailer dimensions were 7.32 m long, 1.97 m high, and 1.96 m wide. The inside contained two dividers such that there were three equal sections, each 1.96 m wide, within the trailer. The first divider was 2.57 m within the trailer. The second divider was 5.13 m within the trailer. The trailer allowed the handler to load approximately 15 cattle at a time, five per section. Additionally, the handler used nontoxic and weatherproof All Weather Paint Stiks to mark Heifers 1 and 6 in initial baseline sessions using the numbers 1 and 6 for ease of data collectors differentiating heifers during group loading. The

Paint Stiks were ineffective in marking cattle as the paint smeared off the heifers quickly, and the heifers were not tolerant to having the paint applied.

Response Measurement and Interobserver Agreement

The researchers trained data collectors to score data using recorded videos. During baseline, trailer loading training, and generalization, data collectors measured resistance to trailer loading, driving or pushing the cattle, and latency to loading during 5-minute sessions.

Resistance to trailer loading included (a) turns, defined as heifers turning away from the trailer and turning their head back toward the direction of the handler or turning their whole body around while being pushed or prompted toward the trailer; (b) freezes, defined as the heifer stopping for five seconds or more on the way to the trailer or refusing to enter the trailer while at the trailer; or (c) exits, defined as any body part of the heifer coming out of the trailer including turning around and exiting, attempting to exit, or backing out of the trailer once loaded. Data collectors scored turns and exits using frequency within 10-second intervals, and freezes were scored using partial-interval recording. Five-minute sessions were broken into 30, 10-second intervals. The percentage of resistance to trailer loading was calculated by dividing the number of intervals with problematic loading behavior by the total number of intervals and multiplying by 100.

Driving or pushing the cattle was defined as the handler applying pressure by stepping into the animal's point of balance. Driving or pushing the cattle caused heifers to move in the direction the handler would like for them to go. The point of balance was determined by the wide angle of vision the animal had and was usually its shoulder. Stepping behind the point of balance drove the animal forward, while stepping in front of it caused the animal to back up (Grandin, 2022). The number of drives or pushes was recorded and scored using frequency within 10-second intervals. The rate of drives or pushes was calculated by dividing the number of drives or pushes by the session time.

Latency to loading was defined as the time it took the heifer to completely enter the trailer. During baseline and generalization sessions, latency was calculated from the time the handler indicated the start time of the session until the heifer completely entered the trailer. During trailer testing, latency was calculated from when the handler said "touch" to when the heifer entered the trailer.

During clicker training, data were collected on the number of pairings, as well as the heifer's responsiveness to the clicker. Responsiveness to the clicker was defined as the heifer turning their head towards the handler within five seconds of the clicker sounding while eating hay from the feed bunk. The data collector recorded yes if the heifer turned their head within five seconds, and no if they took longer than five seconds or did not turn towards the clicker.

During target training, data collectors scored how quickly heifers responded to the target using three categories. If the animal touched the target or moved toward the direction of the target within five seconds of presentation, the data collector scored responding within five seconds. If the animal touched the target or moved towards the direction of the target after five seconds, the data collector scored responding after five seconds. If the animal made no attempt to touch the target (e.g., walked a different direction, ran off, started to graze), the data collector scored no response. The percentage of responding within five seconds, after five seconds, and no responses was calculated by dividing the total number of responses within five seconds, after five seconds, or no responses by the total number of responses and multiplying by 100.

A second, independent data collector observed for an average of 55% (range, 42%-63%) of sessions per heifer across each condition. Mean-count-per interval was used to calculate interobserver agreement (IOA) for turns, exits, and driving or pushing the cattle. Mean-count-per interval was calculated by dividing the proportion of agreement within each interval between each observer by the number of intervals, multiplying by 100. Interval-by-interval was used to calculate IOA for freezes. An agreement was scored when each data collector marked freeze as occurring or not occurring during an interval. Interval-by-interval was calculated by dividing the number of intervals with agreement by the total number of intervals, multiplying by 100. Total duration IOA was used to calculate IOA for latency to loading by dividing the smaller recorded latency by the larger recorded latency and multiplying by 100. Finally, trial-by-trial was used to calculate IOA for responsiveness to the clicker and target during clicker and target training. An agreement was scored when each data collector recorded the same response during the same trial (e.g., both observers scored yes during clicker training or both observers scored responding after five seconds for target training). For all heifers, mean agreement 99.3 (range, 98%-100%) for turns, 100% for exits, 98% (range, 97%-100%) for driving or pushing the cattle, 96.3% (range, 94%-100%) for freezes, 100% for latency to loading, 100% for responsiveness during clicker training, and 93.3% (range, 91%-96%) for responsiveness during target training.

Treatment Integrity

Data on the handler's behavior were collected for 30% of sessions per heifer across each condition to ensure accuracy of procedure implementation. During clicker training, the number of pairings were measured to ensure there were 30 pairings. Additionally, correct delivery of the range cube was measured. A correct delivery was defined as the range cube being delivered within one second of the clicker sounding. During baseline and target training, target placement, the handler giving the cue "touch," the clicker being sounded when the animal touched the target, and range cube delivery following the sounding of the clicker were assessed. Sessions were scored such that handler behavior was marked as correctly occurring, incorrectly occurring, or not occurring. Thus, treatment integrity was calculated by dividing the total number of behaviors correctly occurring by the total number of opportunities and multiplying by 100. Average treatment integrity for all heifers was 100%.

Procedures

Sessions were conducted one to two times per day between 4:00 p.m. and 6:00 p.m. on Mondays, Wednesdays, Thursdays, Fridays, and the weekends. Depending on the condition, sessions were one to three minutes in length. Target and trailer training sessions were conducted before and during mealtimes, and clicker training sessions were conducted during meals. At the end of all sessions, the handler delivered praise (e.g., “Good girl!”).

Baseline

During baseline, the handler placed the heifer in the small catch pen that adjoined the trailer in the north half of the small 4046.86-m^2 pasture. If the heifer was not orientated and moving towards the trailer, the handler drove or pushed the heifer toward and into the trailer. If the heifer attempted to exit the trailer, the handler allowed the heifer to exit. There were no programmed contingencies for successful trailer loading. Sessions ended once the heifer was loaded or when five minutes elapsed, whichever occurred first.

Range Cube Introduction

Prior to starting clicker training, heifers were exposed to range cubes during their evening feeds in the north half of the small 4046.86-m^2 pasture at the feed bunk. On the first day, the handler poured a 5-gallon bucket of range cubes into the feed bunk with all heifers present. On subsequent evenings, the handler offered the heifers range cubes from her hands until the heifers were reliability placing the range cubes in their mouth across five consecutive opportunities.

Clicker Training

Clicker training occurred in the north and south half of the 4046.86-m^2 pasture with a single heifer. Once the heifer was reliably placing the range cube in their mouth, the handler presented the heifer with the range cubes 30 times each evening. During each presentation, the handler sounded a clicker and immediately (within one second of the click) delivered a range cube. Once the heifer demonstrated responsiveness to the clicker and range cube pairings, the handler sounded the clicker while the heifer was eating hay from the feed bunk. These presentations continued until the heifer turned its head towards the handler within five seconds of the clicker sounding while eating hay from the feed bunk on five consecutive opportunities.

Target Training

After completion of clicker training, heifers moved into the target training phase. Target training sessions were conducted in the north half of the small pasture with a single heifer. Target training consisted of three steps: (a) target held in various locations 0.30 m in front of the heifer (Step 1), (b) target placed in hanging position on a fence (Step 2), (c) target placed on back end of the closed transport trailer (Step 3). Regardless of step, the handler presented either 10 or 15 trials in which they held the target in front of the heifer or placed in a location and gave the cue, “Touch.” When the heifer sniffed or licked the target, the handler sounded the clicker and paired the clicker with the presentation of a range cube to ensure the clicker remained a conditioned reinforcer (Martin & Friedman, 2011). Once the heifer reliably sniffed or licked the target (defined as 85% touches within five seconds across two sessions), the handler moved the target to the next step.

Trailer Loading Training

Once the animal consistently touched the target on the back end of the closed trailer, the handler started trailer loading training. Trailer loading training sessions were similar to baseline and target training; however, the handler conducted one trial (similar to baseline). Trailer loading training consisted of two steps for Heifers 1 and 0: (a) target placed on the inside of the open trailer door (Step 1) and (b) target placed on the closed first divider gate located approximately 2.57 m inside the transport trailer (Step 2). For Heifer 6, the handler added a third step: target placed in the middle of the open trailer door between the entrance and the first divider gate (Step 1b). If the heifer was not orientated and moving towards the trailer, the handler drove or pushed the heifer toward and into the trailer. If the heifer attempted to exit the trailer, the handler allowed the heifer to exit. When the heifer sniffed or licked the target, the handler sounded the clicker and paired the clicker with the presentation of a range cube to ensure the clicker remained a conditioned reinforcer (Martin & Friedman, 2011). Once the heifer independently touched the target on the inside of the open trailer door, the handler advanced the target to the second step. There were no programmed consequences for resistance to trailer loading. The handler regressed the target if the heifer did not successfully touch the target. Mastery criteria for trailer loading training were the heifer independently entering the transport trailer and touching the target on the closed first divider gate on eight of 10 consecutive sessions.

Generalization

Generalization was similar to baseline; however, the handler placed three head of cattle (e.g., two heifers and a steer) in the small catch pen.

*Target Present***.** The handler placed the target on the front of the closed first divider gate in the transport trailer.

*Target Absent***.** The target was not present.

Experimental Design

The researchers use a nonconcurrent multiple baseline design across heifers (Gast et al., 2014) to evaluate the efficacy of target training on decreasing heifers' resistance to trailer loading. Heifers remained in clicker training until baseline loading levels were stable. Following baseline, the researchers moved heifers into the training procedures in a stepwise, staggered fashion as is common with a multiple baseline design. Heifers entering training phases in this manner ensured that each heifer had a different amount of time spent in baseline and that changes in their behavior were due to the independent variable.

Results

Although not graphically depicted, Heifer 1 experienced eight clicker training sessions, Heifer 0 experienced six, and Heifer 6 experienced 20. When presented with five opportunities to respond to the clicker while eating hay from the feed bunk, each heifer turned their head within five seconds of the clicker sounding.

Figure 1 depicts the target training data for Heifers 1 (top panel), 0 (middle panel), and 6 (bottom panel). Sessions are scaled to the x-axis, and percentage of responses is scaled to the y-axis. The closed circles denote percentage of responses within five seconds, closed squares denote percentage of responses after five seconds, and closed triangles denote percentage of no response. Dashed phase change lines denote changes in location of the target, and breaks in the x-axes for Heifers 0 and 6 denote a three-month break in time. Regardless of the location of the target, Heifer 1 engaged in a high, consistent level of responding within five seconds with low to zero levels of responding after five seconds and no responses across 14 sessions. Interestingly, there were small, immediate decreases in responding within five seconds following changes in location of the target. Except for a single session (session 6) in which three trials were conducted, Heifer 0 engaged in a high, consistent level of responding within five seconds and zero levels of responding for responding after five seconds and no responses across 12 sessions. Heifer 6 also engaged in consistently high levels of responding within five seconds with minimal variability regardless of the location of the target.

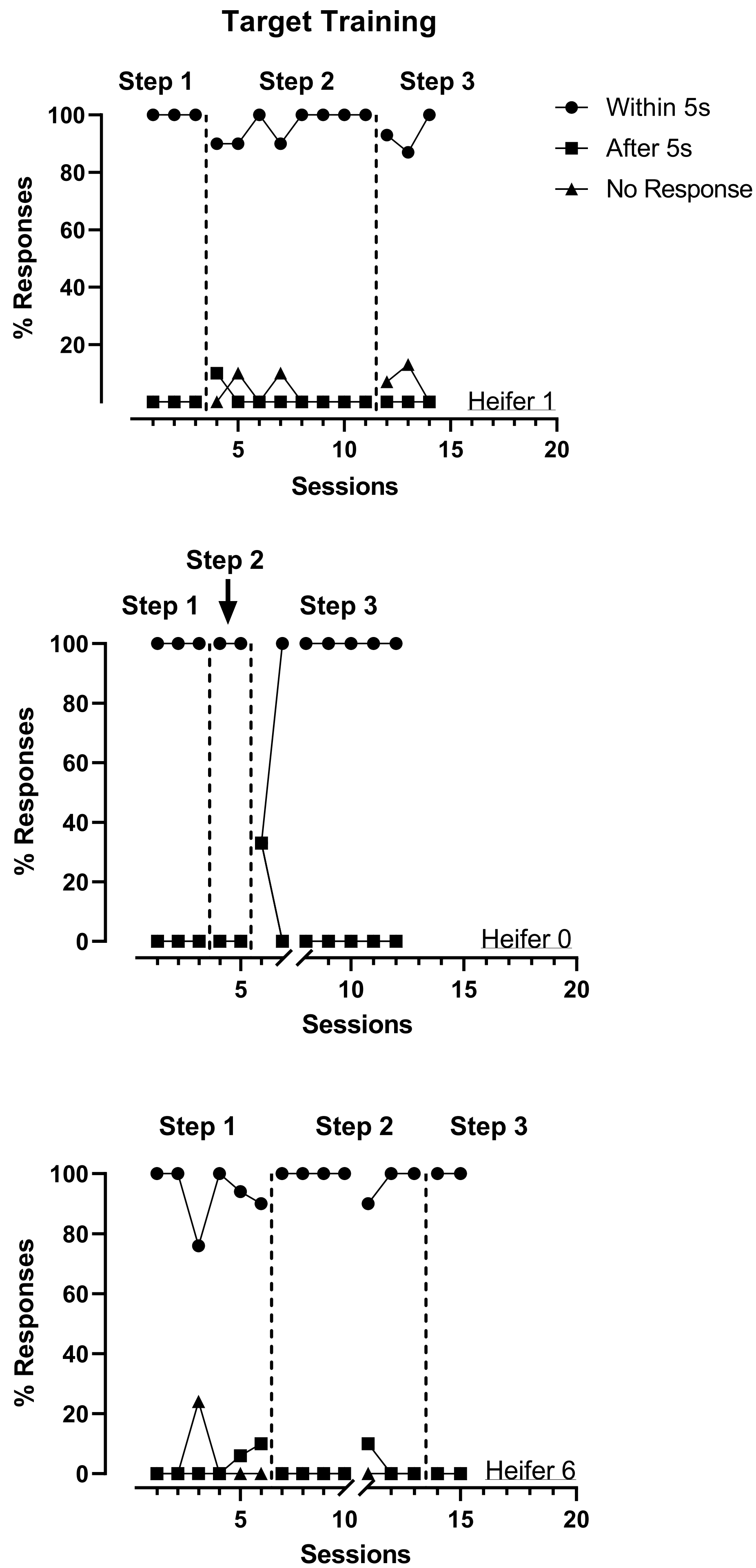

Figure 1. *Target Training for Heifers 1 (top panel), 0 (middle panel), and 6 (bottom panel). The closed circles denote percentage of responses within 5 s, closed squares denote percentage of responses after 5 s, and closed triangles denote percentage of no responses. The dashed phase*

change lines denote changes in location of the target, and breaks in the x-axes denote a 3-month break in time for Heifers 0 and 6.

Figure 2 depicts the data for Heifers 1 (top panels), 0 (middle panels), and 6 (bottom panels). Left panels display percentage of problematic loading behavior and rate of drives/pushes during baseline, trailer loading training, and generalization. Percentage of problematic loading behavior is denoted by the circles (scaled to the left-y-axis), and rate of drives/pushes is denoted by the squares (scaled to the right y-axis). Dark grey data points denote generalization sessions in which the target was present, and open data points denote generalization sessions in which the target was absent. Right panels display the latency to loading (scaled to the left y-axis). Dark grey data points denote generalization sessions in which the target was present, and open data points denote generalization sessions in which the target was absent. For both sets of panels, sessions are scaled to the x-axes.

During baseline, Heifer 1 engaged in variable, moderate to high levels of problematic loading behavior. The handler delivered variable, moderate to high rates of drives/pushes. Problematic loading behavior and drives/pushes were also variable during generalization probes; however, they occurred at a low to moderate level. During Step 1 of trailer loading training, problematic loading behavior and drives/pushes immediately decreased. These decreases maintained during Step 2 of trailer loading training. During generalization probes, problematic loading behavior occurred at a similar level when the target was present, and the handler delivered a similar rate of drives/pushes compared to the generalization probes during baseline. A higher percentage of problematic loading behavior and drives/pushes occurred when the target was absent.

Patterns of responding for latency to loading were similar for Heifer 1. During baseline, Heifer 1 engaged in a moderate, increasing latency to loading. With the exception of one generalization probe, the latencies to load during generalization probes were shorter. Following target training, Heifer 1's latency to loading decreased immediately to shorter, more consistent latencies during Step 2 of trailer loading training and the latencies to loading during generalization were similar to those obtained during baseline.

During baseline, Heifer 0 engaged in variable, moderate levels of problematic loading behavior. The handler delivered variable, moderate levels of drives/pushes. Problematic loading behavior and drives/pushes were also variable during generalization probes; however, they occurred at a low to moderate level. During Step 1, problematic loading behavior and drives/pushes for Heifer 0 immediately decreased and maintained at a zero level during Step 2 of trailer loading training. During generalization probes, problematic loading behavior occurred at a lower level when the target was present, and the handler delivered a similar rate of drives/pushes as compared to generalization probes during baseline. A higher percentage of problematic loading behavior and similar rate of drives/pushes occurred when the target was absent.

Patterns of responding for latency to loading were similar for Heifer 0. Heifer 0 engaged initially in short latencies to load followed be in increasing trend. Latencies to load during generalization probes were similar to baseline. Following target training, Heifer 0's latency to loading immediately decreased to shorter, more consistent latencies during Step 2 of trailer loading training. Heifer 0's latencies to load when the target was absent during the generalization probe was similar to baseline latencies; however, the latency to loading with the target present was longer.

During baseline, Heifer 6 engaged in variable, moderate levels of problematic loading behavior, and the handler delivered variable, moderate levels of drives/pushes. Problematic loading behavior and drives/pushes were also variable during generalization probes; however, they occurred at a low to moderate level. During Step 1, Heifer 6's level of problematic loading behavior and drives/pushes immediately decreased to a zero level. Pushes/drives maintained at a zero level through trailer loading training. During Step 2, Heifer 6's problematic loading behavior increased. Following a return to Step 1, problematic loading behavior decreased to a zero level. With the exception of two sessions, Heifer 6's problematic loading behavior maintained at a zero level during Step 1b.

Patterns of responding for latency to loading were similar for Heifer 6. During baseline, Heifer 6 engaged in variable latencies to load. Latencies to load during generalization probes were similar to baseline. During Step 2, Heifer 6 did not load (graphed at 300 s).

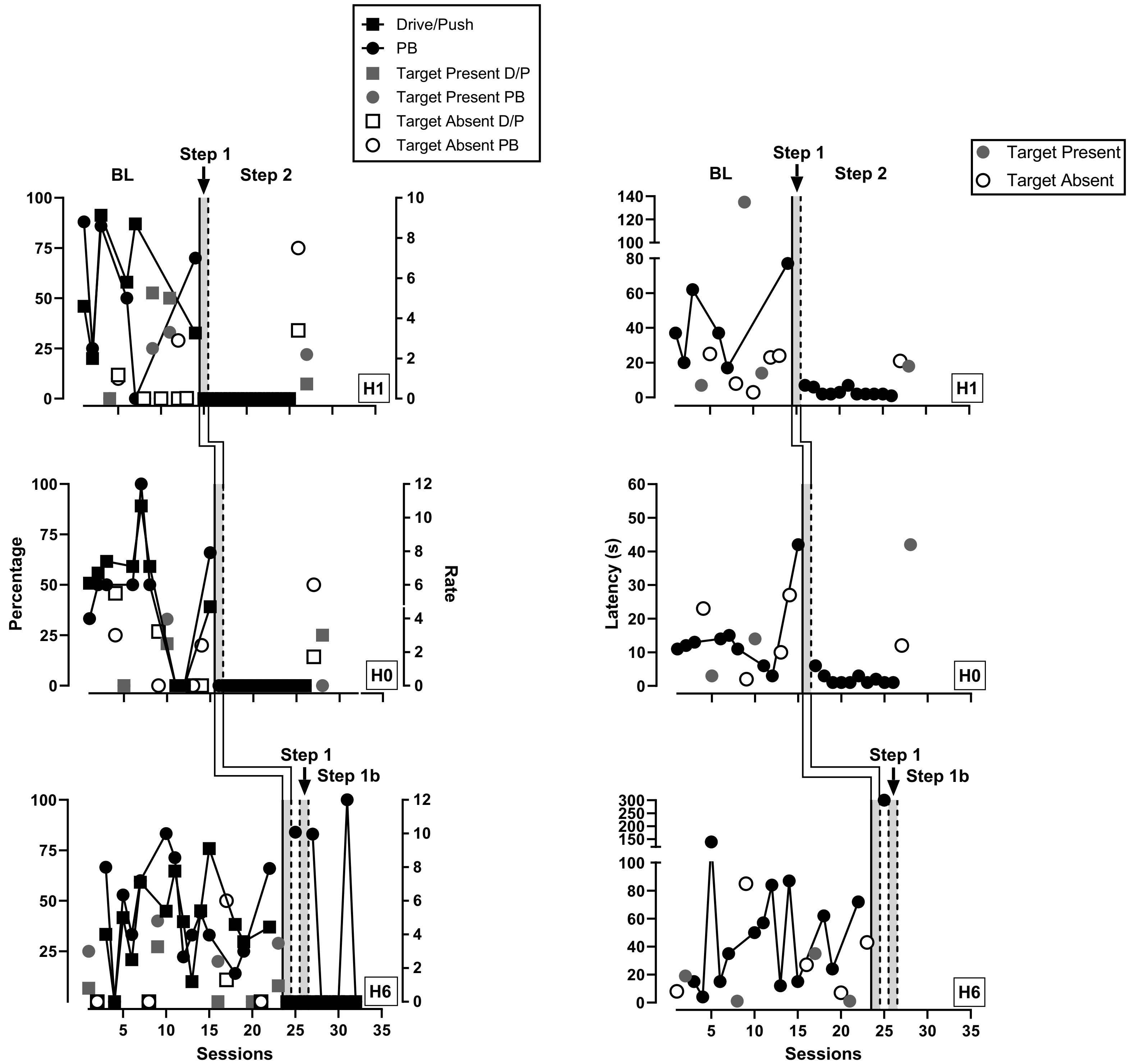

Figure 2. *Percentage of problematic loading behavior (left panels), rate of drives and pushes (left panels), and latency to loading (right panels) across baseline, trailer loading training, and generalization for Heifers 1 (top panel), 0 (middle panel), and 6 (bottom panel). The percentage of problematic loading behavior is denoted by the circles (scaled to the left y-axis), and the rate of drives/pushes is denoted by the squares (scaled to the right y-axis). Dark grey data points denote generalization sessions in which the target was present, and open data points denote generalization sessions in which the target was absent.*

Discussion

The purpose of this study was to replicate and extend Ferguson and Rosales-Ruiz (2001). Specifically, whether target training was effective for easing the trailer loading process with cattle (i.e., resistance to trailer loading, handler drives/pushes, latency to loading). Results suggest that target training cattle was an effective method to reduce problematic loading behavior and drives/pushes for all three heifers, as well as decrease the latency to loading for two heifers (Heifers 0 and 1). For two heifers (Heifers 0 and 1), problematic loading behavior maintained at a low level when trailer loading individually. For one Heifer (Heifer 6), problematic loading behavior maintained at a low level when approaching the trailer. However, when trailer loading in a group, findings were mixed for two heifers for which generalization was evaluated.

Target training was effective for all three heifers in decreasing resistance to trailer loading (Heifers 1 and 0) and/or approaching (Heifer 6) behavior. That is, problematic loading behavior and drives/pushes decreased for all three heifers, and latency to loading decreased for two heifers. There are many reasons why target training may have been effective. First, target training consists of shaping (i.e., reinforcing successful approximations and placing previously reinforced approximations on extinction). Thus, the range cubes and clicker functioned as reinforcers for the heifers. As the heifers advanced through the shaping steps, the handler reinforced the next step in the shaping chain while withholding reinforcement for previous responses, placing previous responses on extinction. Additionally, the range cubes may have been more effective given when sessions were conducted as there was likely an establishing operation in place, as the heifers had not had their evening meal yet. Second, the target may have functioned as a prompt or discriminative stimulus, signaling the availability of reinforcement (Ferguson & Rosales-Ruiz, 2001), thereby increasing the likelihood of trailer loading.

Although two of the three heifers successfully trailer loaded individually, successful loading did not generalize when loading with a group. Problematic loading behavior persisted for both heifers for which generalization was evaluated when the target was absent. When the target was present, Heifer 0 engaged in a lower percentage of problematic loading behavior; however, drives/pushes and latency to loading were similar to what was obtained during baseline generalization probes. It is possible trailer loading in a group presented distractions (e.g., other cattle, losing sight of the target) that may have weakened the stimulus control of the target as the stimuli in group loading sessions were significantly different from those in the individual loading sessions. Martin (2020) suggested that while environments with minimal distractions are key to learning new behaviors, those new behaviors should be then trained to generalize across novel environments and possible distractions. Thus, it may be necessary to program additional stimuli into sessions once the trailer loading response is acquired to increase the likelihood of generalization or systematically increase the number of cattle present during sessions. Another variable that changed was the space available within the first divider for each animal. That is, there was less space when loading in a group as compared to loading individually. This change in space is another variable that could have affected the aversiveness or effort of loading. Thus, trailer loading in a group could possibly be more successful if the loading area in the trailer had been larger. Finally, it is possible the heifers may have lost sight of the target while loading in a group. Thus, researchers might consider programming a larger target or placing it in a location that is more visible when loading cattle in a group.

Although we did not obtain generalization for drives/pushes, problematic loading behavior (when the target was absent), and latency to loading, anecdotally there were instances in which the handler successfully used the target in different contexts following completion of the study. For example, when the handler attempted to move Heifer 0 out of a pen such that she could isolate another animal in the pen for medical purposes, the handler picked up the target, instructed the heifer to touch, and the heifer exited the pen to touch the target. These instances may suggest the current training supported response generalization to other individual contexts.

There were several limitations of the study. First, Heifer 6 was not able to complete the whole training process due to calving before the study was over, thus limiting experimental control. Although pregnant, Heifer 6 was included in the study because she consistently displayed problematic loading behaviors during herd loading prior to the study beginning. Additionally, the initial anticipated end date of the study was months prior to her calving. Prior to calving, Heifer 6 would not step up into the trailer. Although she would not step into the trailer, the heifer still demonstrated behaviors such as reaching her nose inside the trailer toward the target. While the range cube functioned as a reinforcer during target training and the first stage of trailer training, it is possible stepping into the transport trailer was effortful. Several studies have demonstrated that as response effort increases, stimuli may lose their reinforcing efficacy (DeLeon et al., 1997). A ramp could have been added to the back of the trailer to decrease response effort or more than one range cube could have been offered to increase the likelihood of successful loading for Heifer 6.

Second, the occurrence of drives/pushes could have been more systematic instead of at the handler's discretion. Without such a system in place, the current work may be difficult to replicate. The handler drove/pushed cattle based on experience working with cattle, was careful to not over prompt cattle, and only drove/pushed when no progress toward the trailer was being made. Thus, it may be important to establish when and how the handler should drive/push during trailer loading procedures. Such procedures could involve the handler waiting a certain amount of time between each push/drive or after a certain amount of time with no progress toward the trailer. Third, this study could have also benefited from inclusion of maintenance measures to evaluate the short- and long-term effectiveness of target training. While not directly evaluated, all three heifers underwent approximately a three-month period during which they were not exposed to the target (depicted by the gaps on x-axes in Figure 1 for Heifers 0 and 6) or ranges cubes (data not depicted in current study). Interestingly, no heifers regressed in their performance when the target and range cubes were reintroduced, suggesting maintenance in the skill across a relatively extended period of time.

There are many avenues for future directions. First, similar to Ferguson and Rosales-Ruiz (2001), researchers could vary the position of the target within the transport trailer such as the different sections of the transport trailer. This may increase the likelihood of generalization to group loading. Second, researchers should evaluate whether the targeting behavior would generalize to other contexts such as catching cattle in a pen or walking down an alley way toward a chute in the absence of driving/pushing. Anecdotally, it appears generalization will likely occur when used individually with heifers. Third, researchers could also investigate how long animals would continue to touch a target when schedules of reinforcement are faded from a fixed ratio to a variable ratio, giving insight into how long conditioning may last. Fourth, researchers should consider replicating these procedures with less socialized cattle to determine whether the procedures are effective. The heifers in the current study were hand raised, which may have increased the efficacy of target training procedures.

Finally, it would be interesting to evaluate whether training the "leader" of the herd would result in observational learning from other cattle during trailer loading. Cattle tend to have dominant members within the herd that are often older (Houpt, 2018). The older, more dominant herd members are often at the front of the herd when traveling short distances and grazing. While the behaviors of the herd are not dictated by one member, the herd may engage in observational learning such that the behavior of the more dominant cattle influence the behavior of other members of the herd. If observational learning occurs, observational learning would result in greater scalability of target training to larger herds and minimize the training time needed from the handler.

Overall, target training heifers to load into a trailer was successful for two of the three heifers. For the third heifer, target training was successful up until the last step (stepping into the trailer). These data are encouraging and suggest other cattle handling practices such as catching cattle in a pen or confining them for veterinary procedures may benefit from conditioning procedures that incorporate appetitive stimuli to positively reinforce and shape behavior such that handling cattle is safer and easier for both the handler and the cattle. Dissemination of these procedures may result in less aversive training or handling methods, which ultimately benefits the cattle and handler.

Declarations

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Data Availability: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix A: Wildflower Cattle Company's Transport Trailer