WHEN TO SAY IT: ESTABLISHING A VERBAL CUE

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Dog trainers sometimes teach verbal cues by saying the cue as the dog is performing the desired behavior. However, there is disagreement about when to say the cue. In this study, a pet dog was trained to go to three different apparatus, the cue for each of which was given at a different time, in a multi-element design. The cue "hoop" was given just as the dog began to move to the hoop apparatus. The cue "carrier" was given as the dog was stepping into the carrier apparatus. The cue "platform" was given after the dog was sitting on the platform apparatus. To test if the dog had learned the cues, the trainer had the dog sit and gave the cue. During testing, if only the correct apparatus was present, the dog responded to all three cues. However, when all three apparatus were present, the dog only responded correctly to the "hoop" cue. This suggests that giving the cue just as the learner is beginning to perform the desired behavior is the most effective teaching method.

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INTRODUCTION

Verbal cues are very common in dog training. Many trainers advocate that all dogs learn certain cues for their safety and to facilitate future training (Geller & Grotenstein, 2010; McMillan, 2016; Rosengarten, 2004). The exact cues suggested vary, but "sit," "come," and "leave it" are widely considered essential verbal cues for dogs. Dodman (2008) notes that clear communication between owner and dog, including verbal cues, can reduce the likelihood of problem behaviors, anxiety, and stress on the dog's part, as well as allowing the dog to be more involved in the owner's life.

Dog owners also believe that responding to verbal cues is important. Shore, Burdsal, and Douglas (2008) found that dog owners rate disobedience/not listening as a moderately severe problem, with a mean rating of 6.87 on a scale from 1 (not a problem) to 10 (a very serious problem). While many problem behaviors were rated as more severe than not listening (for example, aggression towards people at 9.23, escaping at 8.38, or chewing inappropriate items at 7.79), not listening was considered more of a problem than excessive barking (6.51), hyperactivity (5.09), or fear of people/noises (4.12). On the other hand, Eaves (2005) asked dog owners and prospective adopters to select the two traits from a list of seven (obedience, companionship, dedication, attachment, empathy, protection, and entertainment) that were "most important in a good dog" (p. 95). Obedience, defined as "follows given commands" (p. 95), was the second most commonly selected trait of a "good dog," after companionship. While neither of these studies specifically mention verbal cues, both use language that suggests verbal cues ("doesn't listen," "follows given commands").

Despite the value placed on responding to verbal cues, it seems that many dogs are not responding the way their owners want. Eaves (2005) had dog owners to rate their own dog's and a hypothetical ideal dog's level of all seven traits (obedience, companionship, dedication, attachment, empathy, protection, and entertainment) on a 10 point scale, with 10 being the highest. She found that the largest gap between ideal and actual behavior was in obedience (which had an ideal mean of 8.50 and an actual mean of 6.56).

Research on how to teach a dog to respond to verbal cues is therefore quite valuable to dog owners and trainers, but is virtually nonexistent. Murrey (2007) was the only study found that specifically examined the effects of different training methods to get a dog to respond to verbal cues. In this study, Murrey taught a dog to come using two different cues and training methods. In the positive reinforcement alone condition, the trainer said the cue "ven," then clicked and delivered a treat for approximations to the target behavior of coming to the trainer. In the positive and negative reinforcement together condition, the trainer said "punir" and, if the dog did not complete the target behavior of coming to the trainer within two seconds, the trainer pulled the dog to her using a leash. In that condition, once the dog came, regardless of whether he did so by himself or was pulled, the trainer clicked and delivered a treat.

Murrey (2007) found that the "ven" cue was learned faster and with fewer errors than the "punir" cue. In addition, the dog appeared to have a much more positive emotional response during the "ven" training, characterized by frequent tail wagging with the tail held high in the air and quick responses to the cue. In contrast, during the "punir" training, the dog tended to hold his tail lower, was more likely to whine, and responded slowly to the cue. In addition, the dog made few errors in the "ven" condition, even when the training environment

was changed, while the dog continued to make errors throughout the “punir” condition, especially in new environments. These findings suggest that, while it is possible to teach cues by physically manipulating the dog into position and then delivering food reinforcers, it is much better to shape the behavior using positive reinforcement alone.

Other research on verbal cues with dogs tends to focus either on species-specific responding to different types of cues or factors that affect the likelihood of a correct response to a previously taught cue. While the information from this research does not help when it comes to selecting a training method, it may still be helpful when selecting what cues to use and how to use them.

One study looking at responding to different types of cues examined how the pitch and speed of the cue might affect behavior (McConnell, 1990). McConnell found that four short, rising notes was a more effective cue than a single long, descending note for behaviors that required an increase in movement (coming to the trainer), while both were effective cues for behaviors that required no movement (sitting). This suggests that short, repeated sounds may produce more movement in dogs and may therefore be a more effective cue when movement is desired. This study did use sounds similar to a sheep dog handler’s whistles rather than words, but the sounds otherwise fit the same pattern as verbal cues — short auditory discriminative stimuli that the learner has a limited amount of time to respond to.

Another study, Skyrme and Mills (2010), compared visual and verbal cues. The authors trained dogs to respond to a visual and a verbal cue that were given simultaneously, then tested the dogs using each cue alone. They found that dogs performed significantly better following the visual cue than the verbal cue. Additionally, when the dogs were simultaneously

given contradicting verbal and visual cues, they always followed the visual cue rather than the verbal cue. These findings suggest that, if the goal is for a dog to respond to a verbal cue alone, visual cues should not be present during training, and that owners should pay attention to their body language to avoid unintentional visual cues.

Other studies have focused on factors that may disrupt performance after a verbal cue has been taught. Braem and Mills (2010) found that dogs made significantly more errors when a well-known verbal cue was preceded by a novel word ("banane sit") than when the cue was given alone ("sit"), preceded by the dog's name ("Rover, sit"), or preceded by the dog's name and a two second pause ("Rover……sit"). The dogs also made more errors when a recently learned verbal cue was preceded by a novel word or their name and a two second pause, compared to the recently learned cue alone or preceded by their name with no pause.

Fukuzawa, Mills, and Cooper (2005b) found that dogs were significantly less likely to respond to altered versions of known verbal cues ("sit" became "chit," "sat," and "sick," while "come" became "tome," "ceme," and "cofe"), compared to the original cues. In addition, some changes had more of an effect than others — dogs were significantly less likely to sit when given the cue "chit" than when given the cue "sick," indicating that certain types of phonetic alterations or alterations at different points in a cue (beginning or end) may have greater effects than other alterations. Generally, this suggests that trainer should be careful to always pronounce verbal cues the same way.

In another study, Fukuzawa, Mills, and Cooper (2005a) found that dogs were significantly less likely to respond to known verbal cues delivered by a tape recorder behind the trainer's back than when the trainer spoke the cues, and this effect was even worse when the

trainer was wearing dark sunglasses. Simply changing posture or wearing dark sunglasses by speaking the cues did not result in a decrease in correct responding. In addition, Fukuzawa, et al. found that dogs were significantly less likely to respond to cues given by a trainer who was partially out of sight, and that the trainer turning their back on the dog resulted in significantly fewer responses to a "sit" cue but not to a "come" cue. Taken together, this suggests that dogs use some amount of visual cues in the form of facial movements while the trainer is speaking in addition to the verbal cue when responding, unless they have been trained otherwise (as is likely the case with a "come" cue that may be used when the dog is out of sight or looking away from their owner).

While all of these studies provide interesting and useful information about what to avoid when teaching and using verbal cues, there are two issues with many of these studies, namely the use of a small group design when there are likely to be individual differences that could be better assessed with a single-subject design, and a lack of detail when describing the training procedures used.

The majority of the studies (Braem & Mills, 2010; Fukuzawa, Mills, & Cooper, 2005b; Skyrme & Mills, 2010) used group designs, with six to twelve participants, and compared the group averages when analyzing their results. Unfortunately, this type of group design will mask any individual differences that may be important to dog trainers — for example, it is possible that dogs with a specific learning history might have very different results than dogs with a different learning history, but a group design would hide this potential finding. In fact, Fukuzawa, Mills, and Cooper (2005b) found that there was a significant difference in performance between individual dogs, but did not examine the dogs' individual data to show

what, exactly, this difference was. In contrast, Fukuzawa, Mills, and Cooper (2005a) and McConnell (1990) used small groups of dogs (between six and fourteen) but in a within-subjects design where each dog's data was compared to itself. In this case, it was possible to see more individual differences, although the studies still focused on the overall differences between conditions rather than each participant's performance. Murrey (2007) used a multi-element design with a single participant that allowed a much more detailed examination of that participant's performance and the effects of the training methods than was possible with any of the other studies.

Another issue with these studies is that there was very little description of the training methods used. Aside from Murrey (2007), none of the studies were focused on the training method, so it is understandable that they went into less detail than Murrey did. However, what information they did give was severely lacking. While they all used dogs that had been trained to respond to verbal cues, often during the course of the study, only one (McConnell, 1990) gave enough information for the training procedure to be replicated. In McConnell's study, the trainer observed the dog and, when the dog was beginning to perform the desired behavior, gave the cue. If the dog then completed the behavior, the trainer pet and fed the dog, otherwise the trainer waited until the next time the dog began to perform the behavior. After every fifth time the dog completed the desired behavior following a cue, the trainer gave the cue while the dog was doing something else to test if the dog would respond correctly. The other studies in which a response to a verbal cue was trained gave varying amounts of information on the training procedure, ranging from simply stating "dogs were trained to their two commands using positive reinforcement" (Braem & Mills, 2010, p. 52), to noting the

schedule of reinforcement used (Skyrme & Mills, 2010), to giving a detailed description of the number of trials per session and the number of session per day (Fukuzawa, et al., 2005a). This lack of information on the training procedure used suggests that either the authors are assuming that everyone will teach a verbal cue the same way, or that the method of teaching the response will not affect the dog's later performance during the remainder of the study, and therefore the lack of information will not affect those wishing to replicate their procedures. Given Murrey (2007)'s findings that the training methods can have a significant effect on performance and the frequency of errors, it seems unlikely that every method to train a response to a verbal cue will produce the same sort of performance. Furthermore, it is unlikely that everyone will use the same training methods — even experienced professional dog trainers use a variety of methods to train responses to verbal cues, and the same trainer may recommend different methods depending on the behavior being trained.

The number of possible training methods suggested by dog trainers is quite large, but these methods can be broken down into broad categories. In all cases, the desired final performance is that the dog performs the desired behavior following a verbal cue. What varies is how (and if) the dog trainer uses additional nonverbal cues, such as food lures or previously trained hand signals, that will later have to be eliminated, and when the trainer introduces the verbal cue.

Of the methods that use an additional cue, the most popular seems to be using a lure to get the dog to start moving and giving the verbal cue just as the dog completes the desired movement or just as the dog reaches the desired position (Cantrell, 2004; Dodman, 2008; George & Port, 2016; Rosengarten, 2004; Taylor, 2006). A typical example of this method would

be positioning a food lure in front of the dog's nose and moving it up and back over the dog's head. The dog's back legs will bend as it follows the food lure, and the trainer says "sit" at the exact moment that the dog's hindquarters touch the ground. The trainer then allows the dog to eat the food lure.

Another method is to use a lure to get the dog to complete the desired behavior, and then give the verbal cue (Frankel, 2000; Geller & Grotenstein, 2010). A typical example is positioning a food lure in front of the dog's nose and moving it up and back over the dog's head so the dog moves into a sitting position. Once the dog has sat, the trainer says "sit" and allows the dog to eat the food lure. In practice, there may be little difference between this method and the previous, although proponents of the previous method emphasize giving the cue at the exact moment that the dog reaches the desired position, while proponents of this method are less concerned about a small pause between the dog being in position and the cue. Other trainers specifically recommend against giving a cue after the dog has reached the desired position (Laurence, 2013), noting that the action of, for example, sitting is what needs to be labeled. Cues given after the dog has finished that movement may instead become cues for whatever the dog happens to be doing at the moment the cue is given, such as remaining motionless.

Other trainers suggest using a lure to get the dog to move, but giving the verbal cue while the dog is moving, rather than after the dog has completed the behavior (Landsberg, Hunthausen, & Ackerman, 2013; McConnell & Scidmore, 2010; McMillan, 2016; Stillwell, 2007). In this case, the trainer would position a food lure in front of the dog's nose and move it up and back over the dog's head. As the dog's nose follows the lure up, but before the dog's

hindquarters touch the ground, the trainer would say “sit.” As soon as dog’s hindquarters touch the ground, the trainer would allow the dog to eat the food lure. One trainer, McMillan, combines this method with the first — he suggests giving the cue as the dog begins to follow the lure, then praising and repeating the cue (“good SIT,” p. 92) at the moment the dog’s hindquarters touch the ground.

Still other trainers suggest giving the verbal cue before a lure (Dunbar, 2004; McConnell & Scidmore, 2010). For example, a trainer might say “sit,” then position a food lure near the dog’s nose and move it up and back until the dog moves into a sitting position. Once the dog is sitting, the trainer would allow the dog to eat the food lure.

Finally, a very similar method to the previous uses a previously trained cue as the additional cue (Laurence, 2003; Pryor, 1984). In this case, if the dog already knows to sit following a specific hand signal, the trainer would say “sit,” then give the hand signal. After the dog has sat, the trainer would provide reinforcement, and in future trials would gradually fade out the use of the hand signal cue.

When working with additional nonverbal cues, some trainers (Cantrell, 2004; Landsberg, et al., 2013; Laurence, 2003; McConnell & Scidmore, 2010; Pryor, 1984; Stillwell, 2007) recommend having the dog practice the behavior with the cue (either a lure or another cue) alone first. After the dog is quickly and reliably responding to the additional cue, the verbal cue can be introduced. However, other trainers (Dodman, 2008; Frankel, 2000; Geller & Grotenstein, 2010; George & Port, 2016; McMillan, 2016; Rosengarten, 2004; Taylor, 2006) introduce the verbal cue and the additional cue (usually a food lure) simultaneously.

While additional nonverbal cues are very commonly recommended when introducing a verbal cue to dogs, other training methods do not use them. These methods rely on either noticing and giving a verbal cue for naturally occurring behavior, or training the behavior until it occurs frequently and then introducing the verbal cue (although the trainer is using the contextual cues in the training environment to increase the likelihood that the dog will perform the correct behavior, these types of cues are present across all of the possible training methods and a trainer will need to test for control by these cues no matter what training method they use — the fact that the trainer does not use additional movements or food lures as cues puts these training methods in this category of not using additional cues). Like the other methods, opinions vary on when and how the cue should be given.

One common strategy when introducing a verbal cue for a naturally occurring behavior is to give the cue as the behavior is happening (Cantrell, 2004; Dodman, 2008; Rosengarten, 2004; Stillwell, 2007). As an example, a trainer might observe that their dog is going to sit (perhaps because they got lucky or perhaps because they were waiting in a situation in which the dog is likely to sit), say "sit" as the dog is moving into position, and then reinforce using food or praise. Rosengarten notes that this method is easy to implement throughout the day, but slower than training with lures.

Other trainers use a similar method, but give the verbal cue just as the dog is beginning to perform the behavior or even moments before the dog begins, if it can be predicted (Landsberg, et al., 2013; McConnell & Scidmore, 2010). A trainer using this method might notice that the dog's back legs are just starting to bend, or that the dog is shifting its weight, or whatever that particular dog's very beginning of sitting looks like, and say "sit." Once the dog is

sitting, the trainer would reinforce that behavior with food or praise. Landsberg, et al., indicate that either this method or the previous can be used, but giving the cue earlier is more effective. Both of these two methods are commonly suggested for potty training, in order to train the dog to eliminate on cue (a behavior that would be quite hard to lure or prompt!).

Still other trainers suggest the even simpler method of noticing that the dog is doing the behavior and saying the cue (Geller, 2010). In this method, a trainer might look over and notice the dog is sitting, say "sit," and praise the dog. Geller suggests that effectively narrating what the dog is doing throughout the day will help the dog to learn to associate those words with the behaviors. There are some trainers who recommend against this, however. Rosengarten (2004) notes that the cue should only be given while the dog is in motion, as the goal is to teach the dog to perform that motion when the cue is given. If the trainer gives the cue while the dog is in position, the dog may instead associate the cue with other behaviors, such as licking itself, which it happens to be doing while in the desired position.

Rather than simply waiting for the behavior to occur, some trainers suggest training the behavior without a cue first, so that the behavior is very likely to occur in the training environment, then introducing the verbal cue. Pryor (1999) suggests first training the dog, using a clicker and positive reinforcement, to perform the desired behavior. Once the dog has learned the behavior and is frequently performing the behavior in front of the trainer, the trainer can introduce the cue. When the dog is about to perform the behavior, the trainer gives the cue, waits for the dog to complete the behavior, then delivers the reinforcer. After several repetitions, the trainer should not give the cue, let the dog perform the behavior, then not provide reinforcement. Pryor notes that this method of teaching a cue is initially slow (she

suggests trying eight to ten repetitions a day for a week), but that once the dog has learned several cues using this method, subsequent cues will be learned more quickly.

Alexander (2003) and Spector (1999) suggest a similar method with more steps. As before, the trainer should begin by teaching the desired behavior using a clicker and positive reinforcement. Once the dog is consistently performing the behavior during the training session, the trainer should say the cue just before the dog completes the behavior (for example, saying “sit” just as the dog’s hindquarters touch the ground), then click and deliver the reinforcer after the behavior is completed. After several repetitions, the trainer can begin to gradually move the cue earlier and earlier in the sequence leading up to the behavior, until they are saying the cue before the dog even begins to move (saying “sit” just as the dog begins to bend their hind legs, then before the dog begins to bend their legs). Once the dog will consistently perform the behavior following the cue, the trainer should stop reinforcing the behavior if it is not preceded by the cue. Alexander recommends repeating each step about 50 times before testing to see if the dog will respond to the verbal cue.

With all of these different methods available for teaching verbal cues to dogs, it might be difficult to decide what method to use. Unfortunately, the behavior analytic research on stimulus control does not focus on the timing of the cue relative to the desired behavior. However, there is some evidence that may be helpful. The most commonly recommended training methods rely on using an additional nonverbal cue, such as a food lure or a previously trained hand signal, to get the dog to perform the desired behavior. This method requires a transfer of stimulus control at some point from the additional cue to the verbal cue. There is some research to suggest that using additional cues that are not related in some way to the

desired final cue results in more errors and a greater chance of the learner failing to learn the desired behavior than using only the desired cue (Strand & Morris, 1988). This may be especially problematic when using nonverbal cues with dogs, given Skyrme and Mills' (2010) findings that visual cues seem to overshadow verbal cues when dogs are exposed to both simultaneously. Using an additional visual cue, such as a hand signal or the movement of a lure, may make transferring stimulus control to the verbal cue especially difficult. Dog trainers tend not to give explicit instructions for how to accomplish this transfer of stimulus control, and instead suggest that the trainer simply stop using the additional cue after repeatedly practicing with both cues (Frankel, 2000). Rather than just stopping using the additional cue and hoping for the best, trainers may want to consider using a delayed cue procedure, in which the additional and desired cues are at first introduced simultaneously, then the desired cue is followed by the additional cue with a longer and longer delay between the two cues (Touchette, 1971). Eventually, the dog should begin to respond to the desired verbal cue before the additional cue is given (and if the dog does not, this method would allow the trainer to clearly see that the dog is only responding to the additional cue and develop an alternative training plan).

One subset of training methods using additional cues warrants special mention — the methods that involve giving a verbal cue before the additional cue. These methods lend themselves well to using a delayed cue procedure to transfer stimulus control to the verbal cue, and also prevent a visual additional cue from overshadowing the verbal cue by presenting the visual cue after the verbal cue. While there has not been research specifically with dogs, there is substantial support for these procedures in applied behavior analytic research (see for

example Carroll, Joachim, St. Peter, & Robinson, 2016; Grow, Kodak, & Carr, 2014; Vedora & Barry, 2016), which suggests that these methods may also be useful when working with dogs.

Theoretically, the training methods that do not involve adding an additional cue should be simpler, because there is no need to remove the additional cue and transfer the stimulus control to the verbal cue. Unfortunately, there is very little evidence to support or call into question any of these methods. One study, McConnell (1990), successfully taught dogs to respond to cues by giving the cue right when the dog began to perform the behavior naturally, then providing reinforcement if the dog completed the behavior. Other than that, there do not seem to be any studies examining these training methods.

The purpose of this study is to begin to fill in some of this missing information. This study focuses on the training methods with the least support but best theoretical chance of working, namely those that do not involve an additional cue. For the sake of consistency, this study will focus on the subset of methods in which the dog is initially trained to perform the behavior without a cue before introducing the verbal cue, using a single-subject design to control for any possible effects of the learner's history. The goal of this study is to determine what methods of introducing the verbal cue, if any, are effective — giving the cue just at the beginning of the behavior, in the middle of the behavior, or after the behavior is completed.

METHOD

Participant

The participant was an adult, 15 pound, spayed female dog, believed to be an Italian greyhound/Chihuahua mix. At the beginning of the study she was three years old, and she had just turned four at the end of the study. She was adopted from a rescue when she was about a year old, and lived with her family as a pet dog before, during, and after the study — the experimenter/trainer was not someone she was familiar with prior to the study.

She was selected for this study partly due to convenience (she lived near the trainer and training times could be easily scheduled), but also because she had a history of responding to a handful to verbal cues and hand signals that had been taught using lures and shaping.

Setting and Materials

Setting

The study took place on the area rug in the living room of the dog's apartment. The rug was bordered on two sides by couches forming an L shape.

The trainer sat, cross legged, on the floor in front of one couch, with a coffee table to her right side to hold the treats, notebook, and other equipment used during the session, and a tripod holding a video camera to her left side.

Three different apparatus that the dog could sit on or in were used in this study: a carrier, a hoop, and a platform. The dog's only exposure to these apparatus was during the study sessions. The apparatus could be placed in front of and to the right of the trainer (Position 1), in front of and to the left of the trainer (Position 2), or directly in front of and about 18-24 inches away from the trainer (Position 3). See Figure 1.

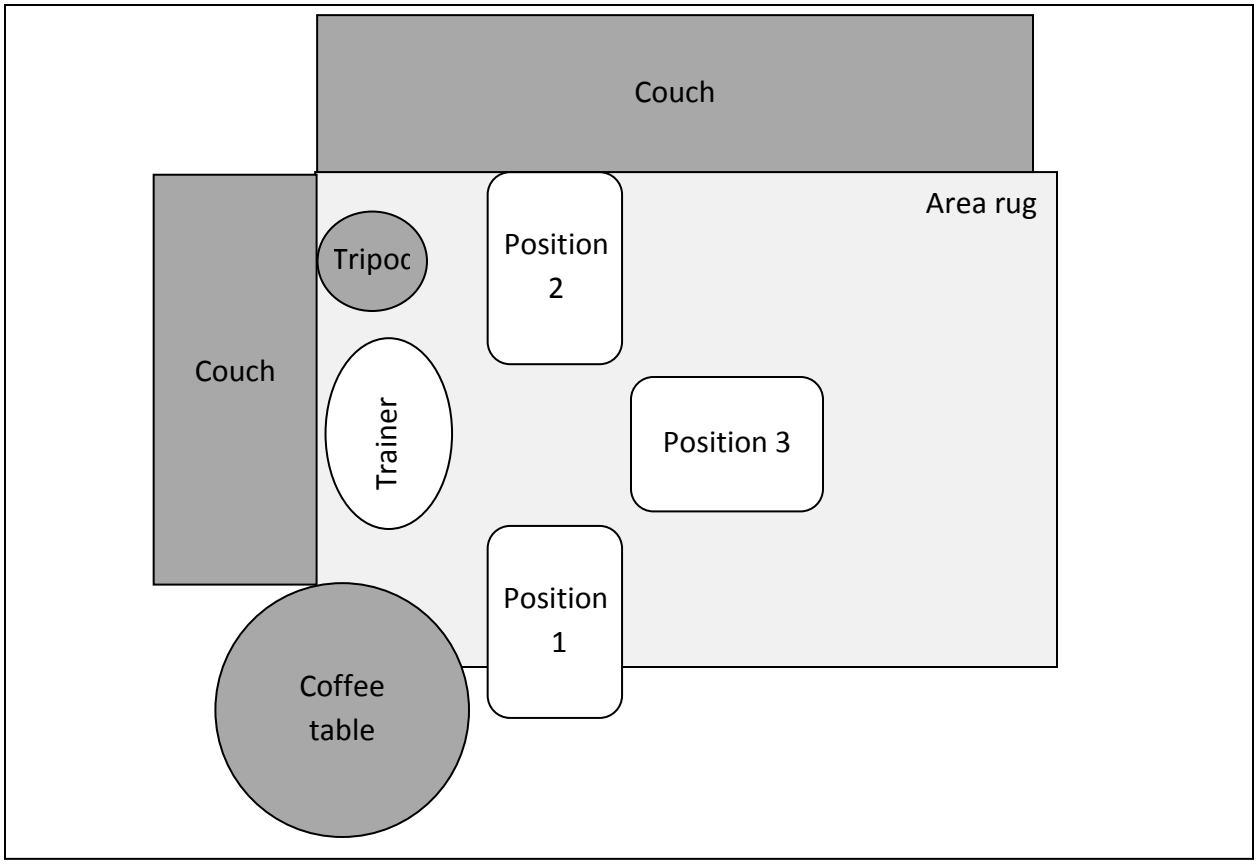

Figure 1. Diagram of training area (not to scale).

During sessions, the dog's owner and the other dog in the household were in another room with the door shut. The household cat was usually shut in another room as well, but would occasionally wander through the training area if she had been missed when preparing for the session (if she avoided the training area, the session continued, but if she attempted to interact with the trainer, dog, or training apparatus, the session was paused so she could be removed). Over the course of the study there were some minor changes around the room, such as plants brought inside for the winter, lights turned on or off, or dog toys left lying around. None of these changes affected the immediate training area, and the dog did not show any interest in them during the sessions.

Apparatus

The carrier was a commercial soft-sided dog carrier with a top opening, yellow sides with black mesh panels, and a black plastic floor. It measured 12 by 16 inches, with sides about four to six inches tall, depending on how far they had been compressed. During the study, the top was flipped to one side and out of the dog's way.

The hoop was a rectangular ring of white foam board pieces taped together. It measured 13 by 17 inches, with sides just over two inches tall.

The platform was constructed from the top of a standard brown cardboard shipping box which had been cut down in height and braced on the underside with a grid of cardboard to ensure it would hold the dog's weight. It measured 13 by 19 inches and was about 3.25 inches tall.

Other Supplies

A variety of semi-soft commercial dog treats served as edible reinforcers. Treats were cut into small pieces approximately 3-5 mm square and 2 mm high. The flavors were rotated every few weeks as observations from prerequisite training and reports from the dog's owner indicated that she would become bored and refuse to work if a single flavor was used too long. During training sessions, the appropriate number of treats were held in a bowl on a table at the trainer's side.

A small hand-held clicker was used as an audible marker.

When cues needed to be given in a certain order during a session, the trainer referred to a prepared list in a notebook located next to the bowl of treats, so she could determine the next cue when picking up the treat for the previous trial.

All sessions were videotaped with a non-SLR digital camera capable of recording video and sound, mounted on a tripod within the trainer's reach.

Measures

The dependant variable for this study was the dog's pattern of responding (correctly or incorrectly) to each of the cues. A correct response was defined as the dog's behavior corresponding to the cue given (so for example, the trainer says "turn" and the dog does a turn behavior, or the trainer says "platform" and the dog does a platform behavior — in the case of the nonsense cues, the corresponding behavior was "no change").

There were seven cues used by the trainer ("carrier," "down," "hoop," "platform," "shake," "turn," and "nonsense" — a nonsense cue was any English word the dog had not learned a specific response for, such as "newt" or "whale"). There were eight corresponding behaviors emitted by the dog (carrier, down, hoop, platform, shake, turn, other behavior, and no change).

Behavioral Definitions

All behaviors began when the dog was sitting (hindquarters on ground, front legs straight and upright) in front of the trainer and the trainer gave one of the cues listed above. Following the cue, the first behavior from the list below that the dog emitted within 4.5 seconds was considered the dog's response. The dog could take longer than 4.5 seconds to complete the behavior as long as she started to move within 4.5 seconds of the trainer saying the cue. The behavior ended when the trainer clicked the clicker, gave another verbal cue, or used hand signals and verbal prompts to reposition the dog in a sitting position in front of her, whichever came first.

If the dog scratched or licked her body, this was completely ignored and not considered part of the behavior — due to seasonal allergies manifesting as itchy skin, the dog would occasionally stop to scratch in the middle of performing another behavior. For example, if the dog started to turn in a circle, briefly stopped and scratched, then completed the circle, that would be considered an instance of the turn behavior (as if the scratching had not occurred).

A *carrier* behavior was defined as the dog moving to the carrier apparatus, stepping or hopping over the side, then sitting with all four feet within the carrier. While not necessary, the dog usually turned to face the trainer once in the carrier before sitting.

A *down* behavior was defined as the dog lowering herself to the ground so her chest and all four legs touched the ground.

A *hoop* behavior was defined as the dog moving to the hoop apparatus, stepping over the side, then sitting with all four feet within the hoop. While not necessary, the dog usually turned to face the trainer once in the hoop before sitting.

A *platform* behavior was defined as the dog moving from in front of the trainer to the platform apparatus, stepping up onto the platform, then sitting with all four feet on the platform. While not necessary, the dog typically turned to face the trainer once on the platform before sitting.

A *shake* behavior was defined as the dog lifting one front paw off the ground, moving the paw towards the trainer's body, and either resting the paw on the trainer's body or returning it to the ground. Contact with the trainer's body was not required. If the dog lifted a paw and moved it towards the trainer's body but got up and performed another behavior rather than remaining sitting and returning the paw to the ground, this was not counted as a

shake and instead was counted as whatever behavior the dog completed after getting up. For example, if the dog lifted her paw, moved it towards the trainer's body, then stood up and turned in a circle, that would be considered a turn rather than a shake.

A *turn* behavior was defined as the dog standing up and turning in a complete clockwise circle, beginning and ending facing the trainer.

An *other behavior* was defined as the dog getting up from a sitting position (hindquarters leaving the ground) but not performing any of the behaviors listed above. Examples include leaving the training area, bowing/stretching, and trying to crawl into the trainer's lap. As noted above, scratching or licking her body was not considered an instance of other behavior.

An instance of *no change* was defined as the dog remaining sitting (hindquarters remained on the ground) from when the trainer said a cue until the trainer clicked or said another cue. The dog could move her head (looking around, yawning, etc) or front paws (any movement that did not meet the shake criteria above) during this time as long as her hindquarters remained on the ground.

Data Collection

Data was collected from videotaped sessions by hand. Prior to data collection, the videos were cut into single trial segments, starting from the dog being in a sitting position in front of the trainer and the trainer giving a cue, and ending when the trainer clicked and delivered a treat or gave the next cue. For each trial, the dog's behavior was scored as one of the eight possible behaviors defined above. If the cue and behavior matched, that trial was then scored as correct ("no change" was considered a match for a "nonsense" cue), while if

they differed the trial was scored as incorrect. The cumulative number of correct responses to each cue was calculated from this data.

Interobserver Agreement

A second observer with behavior analytic training and experience working with dogs independently collected data for 27% of trials with the "carrier," "hoop," and "platform" cues, and for 25% of trials with the "down," "shake," "turn," and "nonsense" cues. The observer was provided with the definitions and a video showing samples of each behavior drawn from videos taken during the prerequisite training, but received no additional training. IOA was calculated by dividing the number of agreements on the behavior the dog performed following a given cue by the number of agreements plus disagreements multiplied by 100.

For trials in which the "carrier" cue was given, agreement was 83.3%. For trials in which the "down" cue was given, agreement was 100%. For trials in which the "hoop" cue was given, agreement was 100%. For trials in which the "platform" cue was given, agreement was 83.3%. For trials in which the "shake" cue was given, agreement was 100%. For trials in which the "turn" cue was given, agreement was 100%. For trials in which a "nonsense" cue was given, agreement was 100%.

Procedures

Prerequisites

Prior to the beginning of the study, the trainer tested whether the dog would respond to the known verbal cues ("down," "shake," and "turn"). If the dog did not reliably respond to the verbal cues alone but did reliably respond to the verbal cue and a hand signal, the trainer

began with the verbal cue immediately followed by the hand signal and gradually faded the hand signal until the dog was responding to the verbal cue alone.

Additionally, the trainer taught the dog to go to and sit on or in each of the three apparatus, using a combination of shaping and prompting by pointing to or tapping on the apparatus. During this training, only one apparatus was available at a time. Before the study began, the dog would consistently complete fifteen loops of starting in front of the trainer, walking to the apparatus, sitting on or in the apparatus, hearing a click, and returning to in front of the trainer to receive a treat for all three apparatus in all three locations.

General Procedures

Training sessions took place in the afternoons, four days a week. Each session was typically between two and three minutes long, although this varied depending on the dog's behavior. Between sessions, the dog and trainer took a six minute break, during which they sat on the couch and the trainer pet the dog, or they played tug and fetch with one of the dog's toys. In a typical day, they completed four or five sessions over the course of 45 minutes to an hour.

The trainer indicated that a session was about to begin by asking the dog "Are you ready?" in an excited tone of voice, then sat down and started the camera. At the end of each session, the trainer raised her hands and said "Okay, time for a break!" before turning off the camera and getting up.

During sessions, the trainer maintained a consistent body posture to avoid inadvertent nonverbal cues. The trainer rested her hands (one hand holding the clicker) on her knees except when delivering a treat or taking notes. The trainer made eye contact with the dog when

possible, or watched the top of the dog's head when it was not, while giving verbal cues and while the dog responded to the cues.

The trainer said the verbal cues in a consistent manner throughout the study. "Carrier" was said quickly, with an emphasis on the initial "c" sound. "Down" was said in a lower tone of voice than the other cues with an emphasis on the "ow" sound in the middle. "Hoop" was said with an emphasis on the "oop" sound at the end (due to the quality of the sound recording, the initial "h" was sometimes inaudible on the recordings). "Platform" was said with a distinct break between the two syllables and with the emphasis on the initial "plat." "Shake" was said with an emphasis on the "sh" sound at the beginning. "Turn" was said with an emphasis on the initial "t" and an "er" rather than "ur" sound in the middle.

The dog was free to move about during the sessions. If she left the area immediately around the trainer and apparatus during training, the trainer would say her name and lightly pat the ground. If the dog returned, the trainer would praise her and continue the session, otherwise the trainer would simply end the session and that session would be continued following a break in which the trainer did not interact with the dog.

Baseline

During baseline, the three apparatus were placed in Positions 1, 2, and 3, with their locations determined randomly. A trial began when the dog was sitting in front of the trainer. The trainer gave a verbal cue, then silently counted "one, two, three, and done."

For all the cues except for the nonsense cues, if the dog performed the correct behavior, the trainer clicked the clicker, then praised the dog and delivered a treat in her hand or on the ground in front of her. After the dog had consumed the treat, the trainer prompted the dog to

sit in front of her again (if necessary) and moved on to the next trial. If the dog performed a behavior that was not the corresponding behavior for that cue, the trainer prompted the dog to sit in front of her again (if necessary) and moved on to the next trial. If the dog had not begun to move by the time the trainer reached "done," the trainer moved on to the next trial.

For the nonsense cues, if the dog had not moved by the time the trainer reached "done," the trainer moved on to the next trial. If the dog performed any other behavior, the trainer prompted the dog to sit in front of her again (if necessary) and moved on to the next trial.

During baseline, the trainer gave fourteen cues. Each of the three previously known cues (down, shake, and turn) was given three times. Each of the novel cues (carrier, hoop, and platform) was given once. Two nonsense cues were also given. The order of the cues was determined randomly prior to the beginning of the session, although the trainer did ensure that no cue occurred more than twice in a row, and cues that were very unlikely to result in reinforcement (the novel cues and nonsense cues) did not occur more than two times in a row.

Hoop — Cue at Beginning of Movement

During hoop training sessions, only the hoop apparatus was present, in either Position 1, 2, or 3. A trial began when the dog was standing or sitting in front of the trainer. The trainer observed the dog closely and, as soon as or just before the dog had begun to perform a hoop behavior, the trainer said "hoop." If the dog completed the hoop behavior, the trainer clicked the clicker, then praised the dog and delivered a treat in her hand or on the ground in front of her. The next trial began as soon as the dog had consumed the treat. If the dog did not

complete the hoop behavior, the trainer prompted the dog to return to standing or sitting in front of her (if necessary) and began the next trial.

After the dog had successfully completed ten hoop behaviors, there was one probe trial — see the Probes section below (p. 26) for details.

Carrier — Cue while Moving

During carrier training sessions, only the carrier apparatus was present, in either Position 1, 2, or 3. A trial began when the dog was standing or sitting in front of the trainer. The trainer observed the dog and waited until the dog began to perform a carrier behavior. As the dog was in the process of getting into the carrier (between one and three paws in the carrier), the trainer said "carrier." If the dog completed the carrier behavior, the trainer clicked the clicker, then praised the dog and delivered a treat in her hand or on the ground in front of her. The next trial began as soon as the dog had consumed the treat. If the dog did not complete the carrier behavior, the trainer prompted the dog to return to standing or sitting in front of her (if necessary) and began the next trial.

After the dog had successfully completed ten platform behaviors, there was one probe trial — see the Probes section below (p. 26) for details.

Platform — Cue after Sitting

During platform training sessions, only the platform apparatus was present, in either Position 1, 2, or 3. A trial began when the dog was standing or sitting in front of the trainer. The trainer observed the dog and waited until the dog performed a platform behavior. As soon as the dog sat on the platform, the trainer said "platform," then clicked the clicker and praised the

dog while delivering a treat in her hand or on the ground in front of her. The next trial began as soon as the dog had consumed the treat.

After the dog had successfully completed ten platform behaviors, there was one probe trial — see the Probes section below (p. 26) for details.

Probes

A probe trial began when the dog had consumed the tenth treat during a training session. The trainer prompted the dog to sit in front of her, then gave the cue that was trained during that session (so, for example, a probe trial following a "hoop" training session would use a "hoop" cue). Following the cue, the trainer immediately began to silently count "one, two, three, and done." If the dog performed the correct behavior corresponding to the cue given, the trainer clicked the clicker and praised the dog while delivering a treat in her hand or on the ground in front of her. After the dog had consumed the treat, the trainer said "Okay, time for a break!" and ended the session. If the dog performed any other behavior, the trainer waited until the dog had completed the behavior, then said "Okay, time for a break!" and ended the session. If the dog did not begin to move by the time the trainer reached "done," the trainer said "Okay, time for a break!" and ended the session.

Final Testing

After the training was complete, there were three testing sessions that were identical to the baseline session. The apparatus were in different positions during each testing session, such that each apparatus appeared in Position 1, 2, and 3 over the course of the three testing sessions.

Experimental Design

A multi-element design was used to compare introducing a verbal cue at different points in time when the dog was performing behaviors originally learned in a free operant procedure. In order to ensure that the dog had equal exposure to all three apparatus in all three possible positions, training was divided into nine-session blocks, during which each apparatus appeared in each position for one session. The order of the positions and apparatus were randomly determined for each nine-session block.

Because only one apparatus was present during training and probe trials, baseline and final testing sessions in which all three apparatus were present were also conducted, to determine if the dog had learned to go to a specific apparatus following a specific verbal cue, or had simply learned to go to any apparatus following the verbal cue. Known cues were included in these sessions to keep the rate of reinforcement high, and nonsense cues were included to determine if the dog had learned that a specific cue meant go to an apparatus or if she would go to an apparatus following any word she didn't know.

The criterion to move from the training sessions to the final testing was 100% correct responses to at least one cue across two blocks of nine sessions. That meant that the dog would have correctly responded to a given cue six times, twice for each position the apparatus could be in.

Baseline, probe trials, and final testing used differential reinforcement rather than testing under extinction or testing under reinforce all conditions because all three possibilities carried the risk of the dog learning during testing. The risk of the dog learning the cues in part or fully due to the probe testing, resulting in a false positive, was deemed preferable to the risk

of the dog learning to ignore the novel cues when sitting because they never lead to reinforcement (if tested under extinction) or learning to remain still following the novel cues when sitting because that was the most efficient way to access reinforcement (if tested under reinforce all), resulting in a false negative.

RESULTS

General

Figure 2 shows the dog's responses to all the cues given when the dog was sitting in front of the trainer over the course of this study. The data point for the first probe of the "hoop" cue is missing due to a camera malfunction.

The x-axis displays the opportunities the dog had to respond to a cue, i.e. every time the dog was given a cue when sitting in front of the trainer. The y-axis displays the possible behaviors the dog could perform, color coded by behavior. Phase change lines mark the change between baseline, the probe trials following training sessions, and the final testing. The previously known and nonsense cues were only given during baseline and testing.

Each data path corresponds to one cue, and the position on the y-axis of each point on that path indicates what behavior the dog performed following that cue. The data paths are color coded to correspond to the behaviors. For example, a dark blue data point (a behavior following a "carrier" cue) that is in the dark blue carrier behavior band indicates that the dog correctly performed a carrier behavior following a "carrier" cue. On the other hand, a dark blue data point in the yellow no change behavior band indicates that the dog incorrectly remained sitting following a "carrier" cue. If the dog were to respond correctly to every cue, the data paths would be in horizontal lines within the corresponding colored bands on the graph.

The cues are further broken down three color-coded categories. The blue cues with solid connecting lines are the cues that were taught during this study. The red cues with dashed connecting lines are previously known cues. Finally, the yellow cue with a dotted connecting line is the nonsense cue that the dog had no prior exposure to.

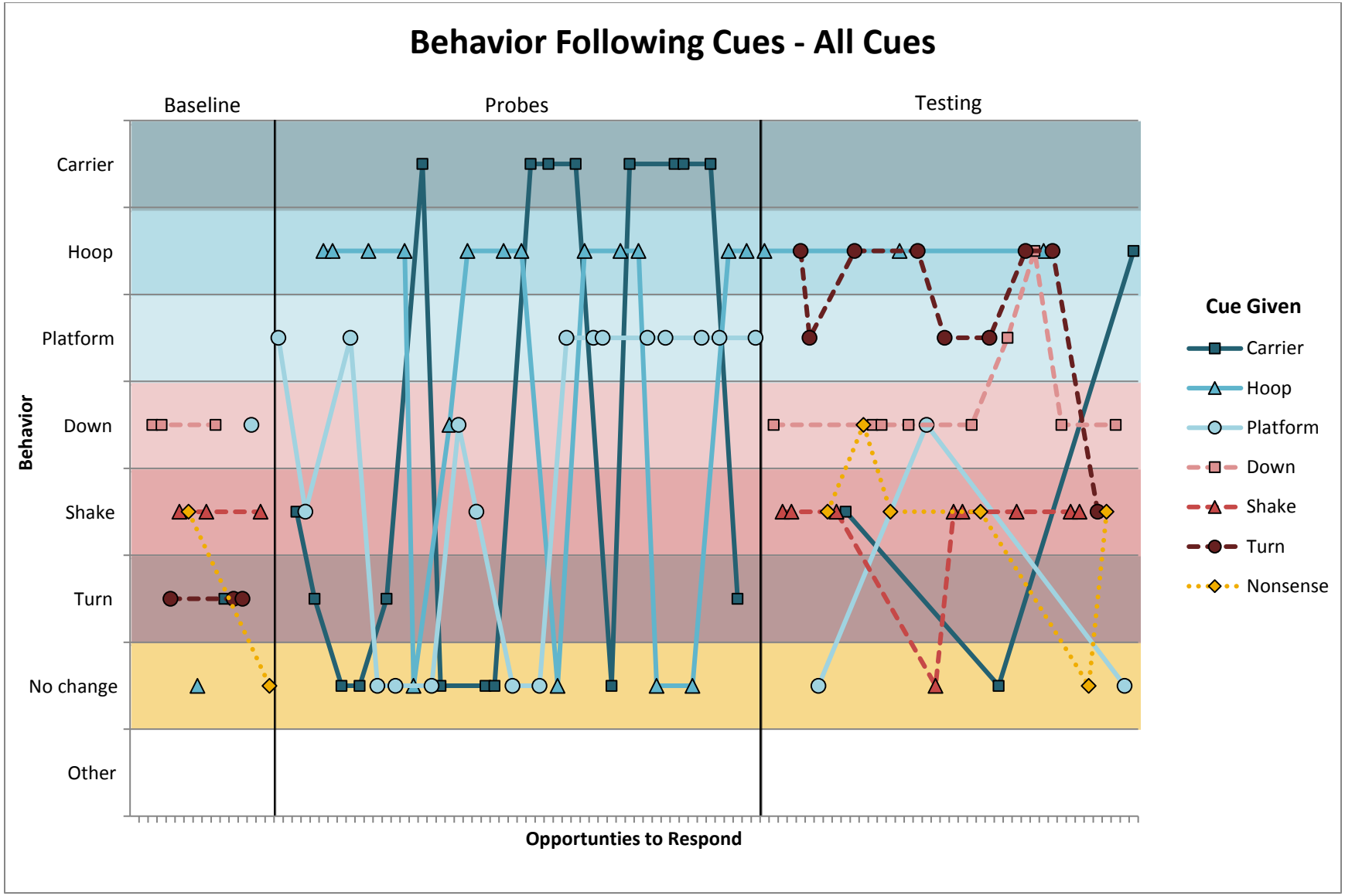

Figure 2. Responses to all cues.

Figure 2 shows how the order of the cues was randomly varied. For ease of viewing, the cues are separated into categories in later graphs: Figure 3 shows the three cues taught during this study, Figure 4 the three previously known cues, and Figure 5 the nonsense cues.

Cues Taught in this Study

Figure 3 (page 32) shows the dog's responses to the cues that were taught over the course of this study. As before, the *x*-axis displays the opportunities the dog had to respond to those cues, while the *y*-axis displayed the behavior the dog performed. The data paths each represent one cue, and are color coded to match the correct response.

For all three cues, the dog did not respond correctly during baseline. In the case of the "carrier" and "platform" cues, the dog offered behaviors that corresponded to known cues (turn and down, respectively). She remained sitting following the "hoop" cue.

During the probe trials at the end of each training session, the dog began responding to all three cues, although the pattern of responses was different for each cue. With the "carrier" cue, which was taught by giving the cue as the dog was stepping into the carrier, she initially did not respond to the cue (her first correct response was in the sixth probe trial), then began to respond intermittently. With the "hoop" cue, which was taught by giving the cue just as the dog began moving, she immediately began to respond intermittently, with overall more correct responses than incorrect. With the "platform" cue, which was taught by giving the cue after the dog sat on the apparatus, she responded intermittently during the first couple of trials, then had a long stretch of not responding (the fourth through the tenth probe trial), and finally began to respond correctly to every cue.

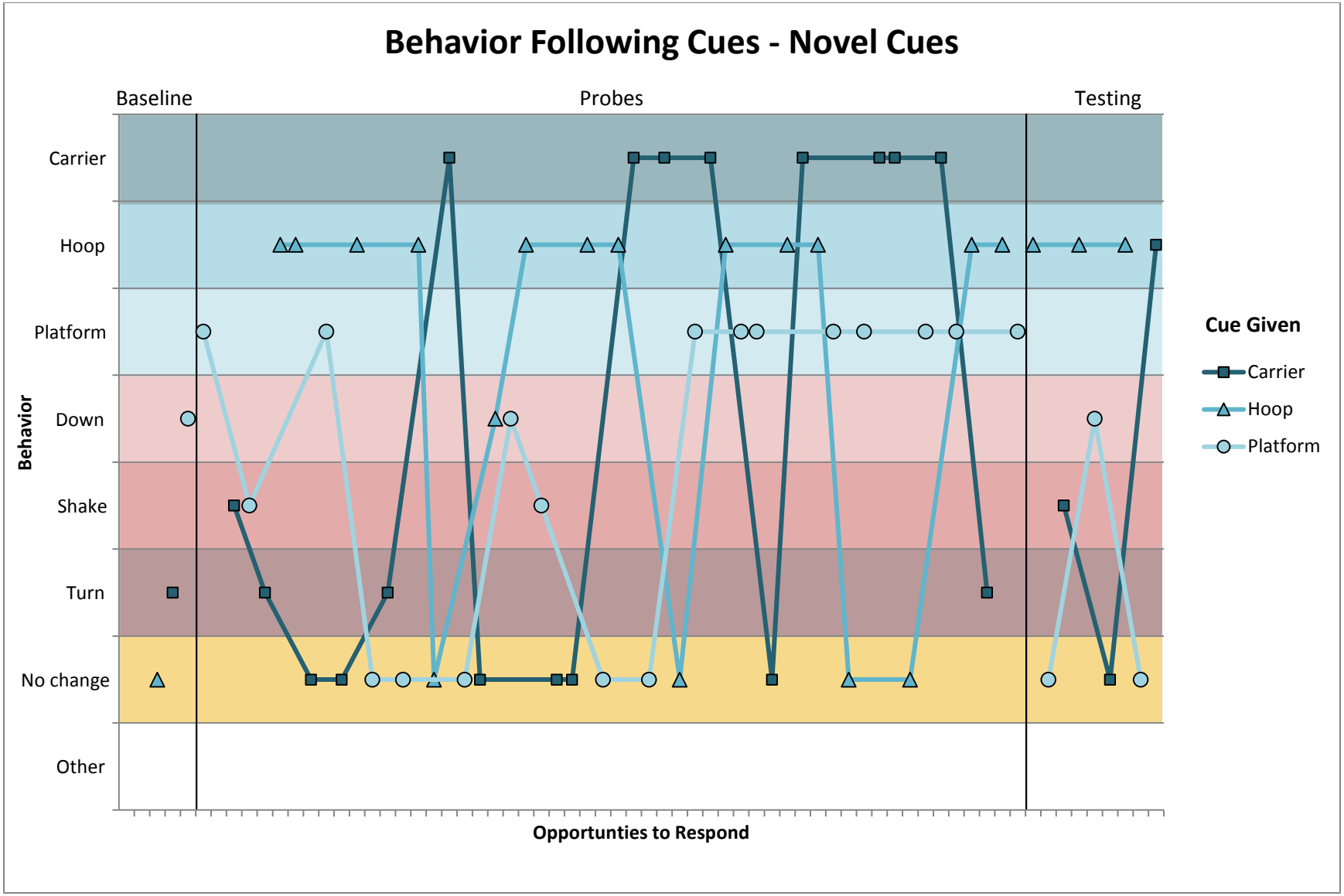

Figure 3. Responses to cues taught during this study.

For all three cues, the majority of errors consisted of the dog remaining sitting (6/10 errors following the “carrier” cue, 4/5 errors following the “hoop” cue, and 5/8 errors following the “platform” cue).

During the test trials, in which all three apparatus were present, the dog did not respond correctly to any of the “carrier” or “platform” cues, but did respond correctly to all three “hoop” cues. Her three errors following the “carrier” cue consisted of a shake behavior, remaining sitting, and a hoop behavior. Following a “platform” cue, she remained sitting twice, and lay down once.

Previously Known Cues

Figure 4 shows the dog’s responses to the cues that she was familiar with prior to this study. As before, the x-axis displays the opportunities the dog had to respond to those cues, while the y-axis displayed the behavior the dog performed. The data paths each represent one cue, and are color coded to match the correct response.

For all three previously known cues, during baseline the dog correctly responded 100% of the time. During the tests, the dog correctly responded to the majority of the “down” and “shake” cues, but did not respond correctly to any of the “turn” cues. Following the “down” cue, she made two errors (out of nine opportunities to respond), going to the platform once and to the hoop once. Following the “shake” cue, she made one error, by remaining sitting. Following all but two “turn” cues, she got up and began to turn, but went to an apparatus rather than completing the turn behavior. She seemed to prefer the hoop apparatus (5/7 errors in which she went to an apparatus) or the apparatus in Position 2, the position she saw first after beginning to turn (4/7 errors).

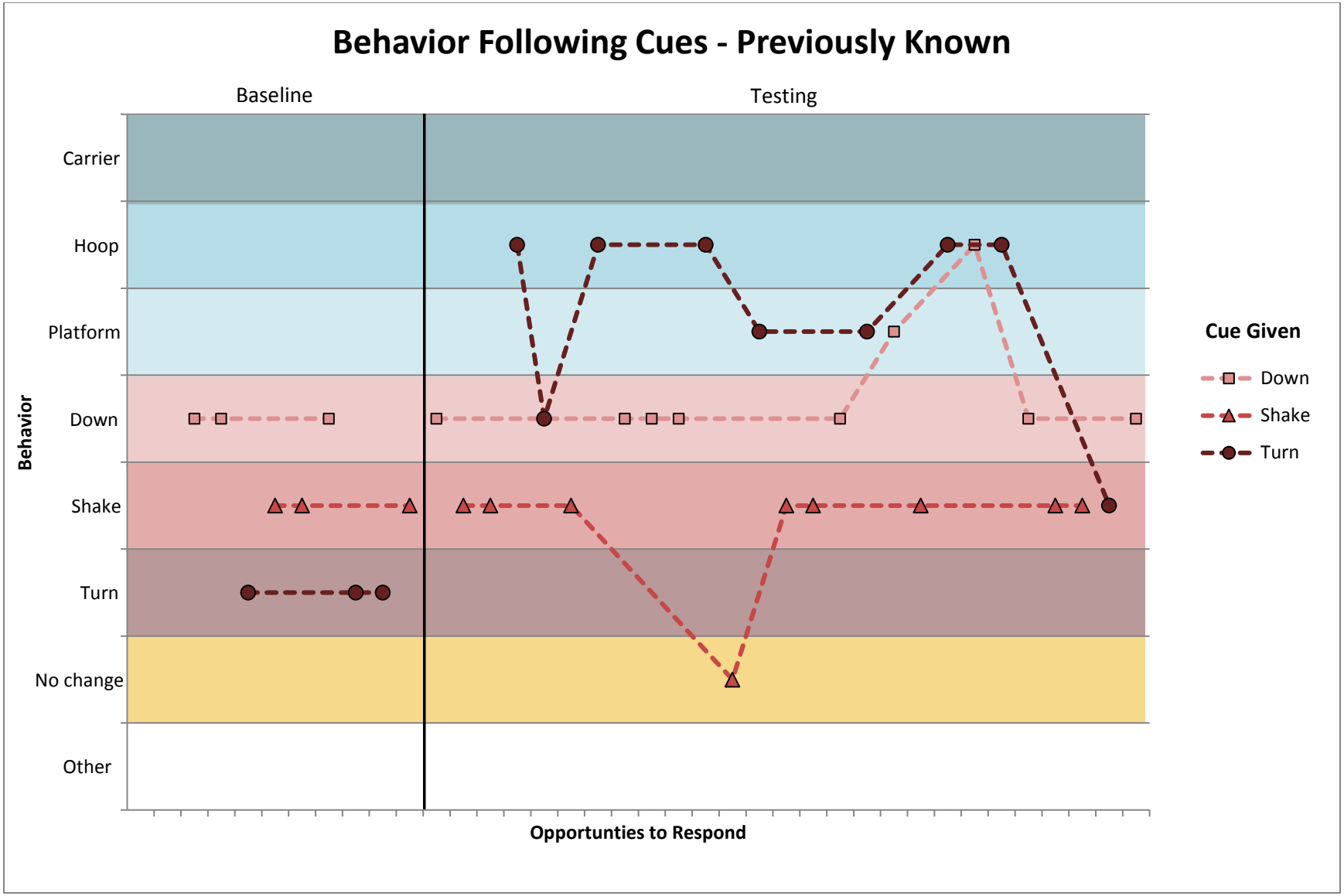

Figure 4. Responses to previously known cues.

Because of the way that the apparatus were positioned across test sessions, the first three apparatus errors consisted of the dog turning past one or more other apparatus to go to the hoop, while the last four involved the dog going to the first apparatus she came to while turning, twice the platform and twice the hoop. The two errors that did not involve going to an apparatus were a down behavior and a shake behavior.

Nonsense Cues

Figure 5 shows the dog's responses to the nonsense cues. As before, the x-axis displays the opportunities the dog had to respond to the nonsense cues, while the y-axis displayed the behavior the dog performed. The dog only responded correctly (i.e. remain sitting until the next trial) following nonsense cues twice, once in baseline and once during testing. The majority of errors (5/6) were a shake behavior, and the remaining error was a down behavior.

Errors

Figure 6 shows a breakdown by percentage of the dog's responses to each cue during the probe trials to make seeing the common errors easier. The cue given is displayed on the x-axis, while the y-axis displays the percentage. Responses to each cue are represented by a bar graph, color coded to match the previous graphs.

During the probe trials, for all three cues, the dog responded correctly the majority of the time. She responded correctly the least to the "carrier" cue (approximately 45% of her responses to the "carrier" were carrier behaviors) and the most to the "hoop" cue (approximately 70% of her responses were correct). The most common error for all three cues was to remain sitting, and there were occasional errors from the previously known behaviors (down, turn, and shake).

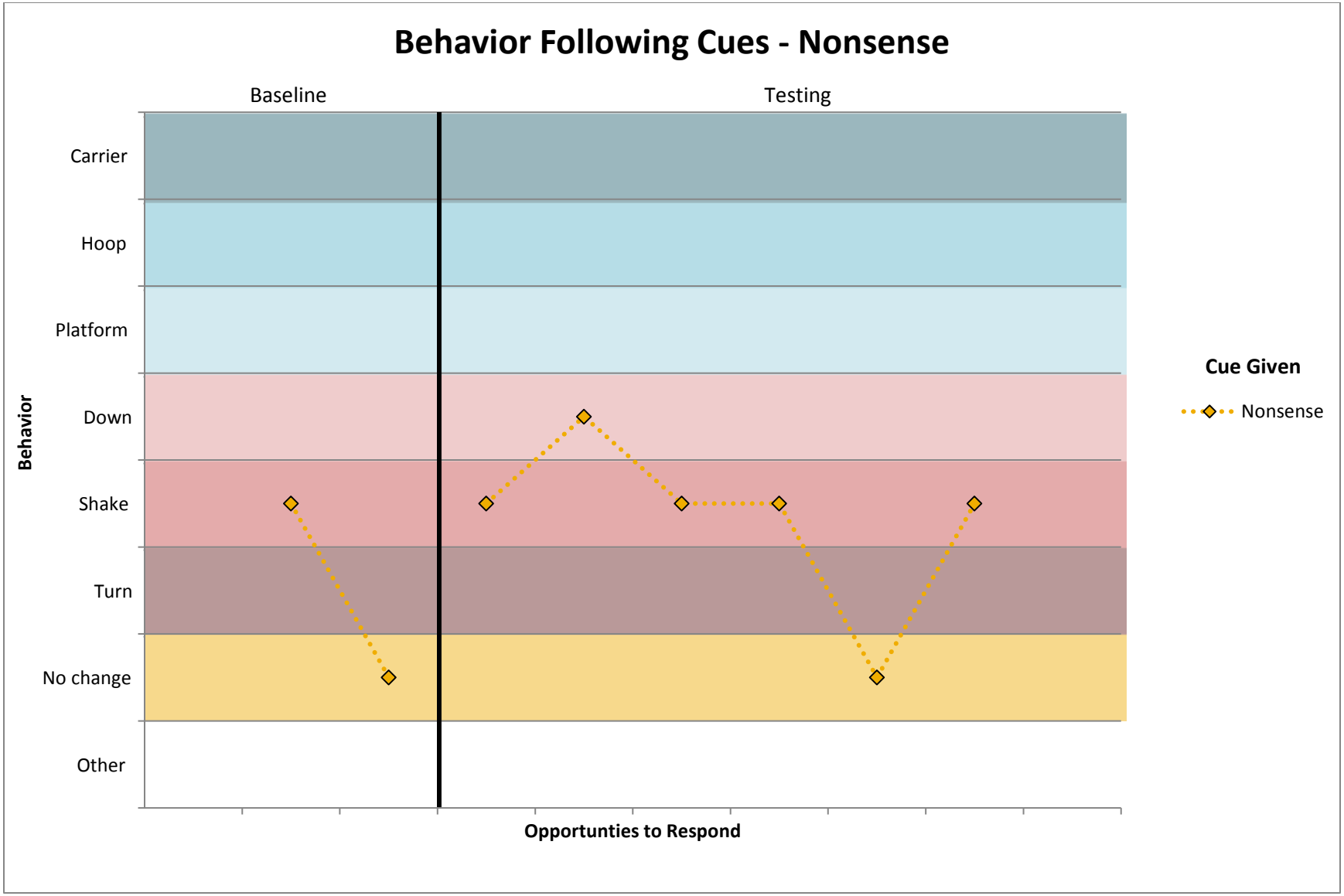

Figure 5. Responses to nonsense cues.

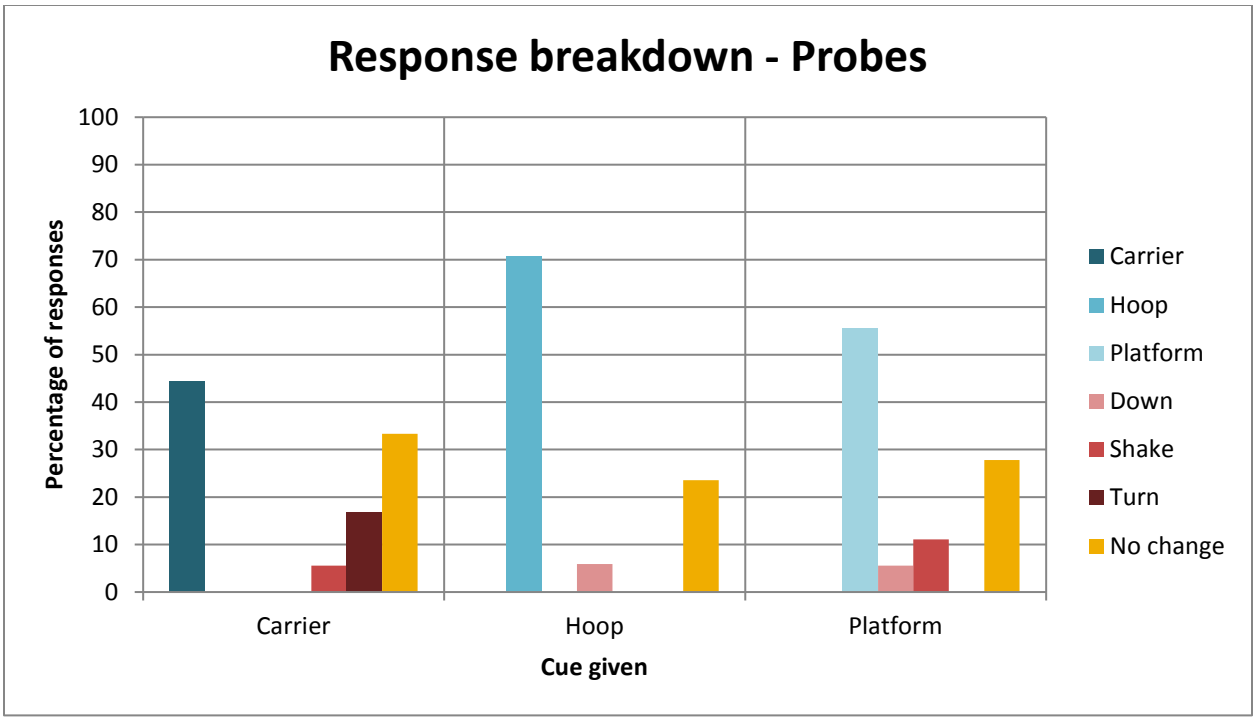

Figure 6. Breakdown of responses during probes.

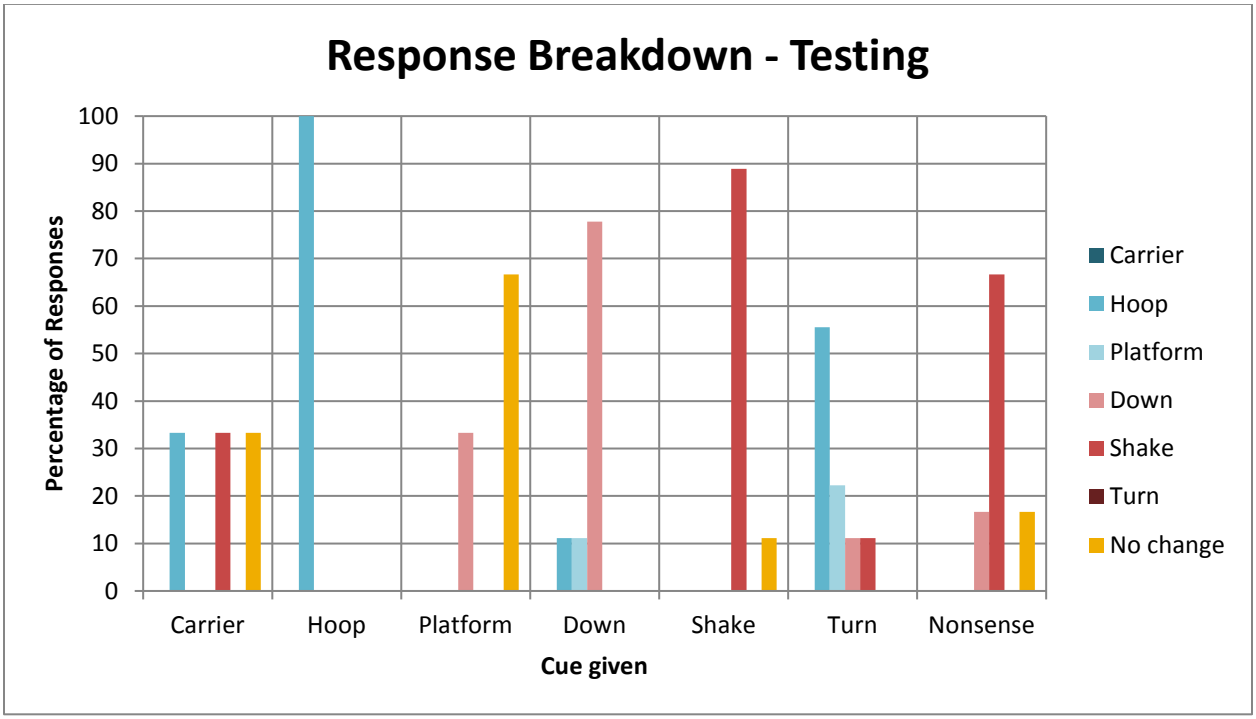

Figure 7. Breakdown of responses during testing.

The dog made no errors responding to the incorrect apparatus because the only the correct apparatus was available during the probe trials.

Figure 7 shows a breakdown by percentage of the dog's responses to each cue during the final testing. The cue given is displayed on the x-axis, while the y-axis displays the percentage. Responses to each cue are represented by a bar graph, color coded to match the previous graphs.

For the cues taught during this study, the majority of errors consist of remaining in place or performing a behavior corresponding to a previously known cue. Only one error involved going to the incorrect apparatus, when the dog went to the hoop following a "carrier" cue.

For the previously known cues, the errors were more variable. Following a "down" cue, there were very few errors and all errors consisted of going to an apparatus. Following a "shake" cue, there were again very few errors, specifically one instance in which the dog did not move. However, following the "turn" cue, every response was an error, and the majority of those errors involved going to an apparatus, most commonly the hoop.

For the nonsense cues, most responses were errors, and the majority of them consisted of shake behaviors. The dog never went to an apparatus following a nonsense cue.

DISCUSSION

This experiment shows that, while the dog was able to perform the desired behavior following the verbal cue using all three training methods when only one apparatus was present, only the method in which the cue was given just as the dog began to move (the "hoop" cue) resulted in the dog learning to perform the behavior when multiple apparatus were present. This is consistent with McConnell's (1990) findings that giving a cue as the dog begins to move does result in learning, but also shows for the first time that giving a cue at other times in the behavior is not effective.

It is important to note that, during the probe trials, the dog just had to go to the only apparatus present following a verbal cue, while the final testing involved a conditional discrimination in which the dog had to select the correct apparatus following a verbal cue. This more complex task, which was never trained, was deliberately chosen to test whether a training method used in one setting would result in generalization to a much more complex setting. In the case of the cue that was introduced just as the dog began to move ("hoop"), this was indeed the case. However, it is premature to conclude that the other training methods are not at all effective. It is possible that the dog's correct performance during the probe trials for the cues that were introduced as the dog was moving ("carrier") or after the dog was sitting on the apparatus ("platform") were simply the result of being in the training context following a training session, and the dog was not responding to the verbal cues at all. However, it is also possible that the dog had learned the cues, but only in the training environment, and did not generalize to the conditional discrimination task in the final testing. It is unclear from the present study which of these possibilities is the case. One way to test if the dog was responding

solely to the training context would be to give a nonsense cue (a word the dog had not learned a response to) rather than the “carrier” or “platform” cue during a probe trial. If the dog went to the apparatus, it would suggest that she had learned to go to the apparatus following a word, but the word itself was unimportant. On the other hand, if the dog did not go to the apparatus following the nonsense cue, that would suggest that the dog had learned the “carrier” or “platform” cue, but only in the very narrow context of the probe trials, with just the one, correct apparatus present. For the purposes of this discussion, saying that the dog had learned a cue means that the dog responded correctly to the cue during the final testing, and saying that the dog had not learned a cue means that she did not respond correctly to that cue during the final testing.

This study also revealed some interesting information about taking errors (or their absence) as an indicator of whether or not learning is occurring — both whether errors during the probe trials indicated that the dog had not learned the cue, and whether the pattern of errors during the probe trials provides more information than the number of errors.

For two of the cues, the one that the dog learned (“hoop,” introduced just as the dog began to move) and one of the two that she did not learn (“carrier,” introduced as the dog was stepping into the apparatus), the dog made occasional errors throughout the probe trials. On the other hand, the dog never made any errors during probe trials once she had begun to respond to the “platform” cue (introduced after she was sitting on the apparatus), but completely failed to respond to that cue during testing. This means that the presence or absence of errors was not a good indicator of whether or not the dog was learning a cue. Additionally, the criterion to move from training to testing during this study, 100% correct

responding across two training blocks, was not a good choice, as it assumes that errors indicate a lack of learning. Because this criterion was too stringent, it is impossible to know how many training trials it actually took for the dog to learn the "hoop" cue. It took no more than 18 training sessions, or 180 trials in which the cue was given just as the dog began to move, but that is all that can be determined. This is a substantial number of training trials, and a future study that switches to the testing conditions earlier could determine if all those trials are truly needed, or if a smaller number of training trials would be sufficient. This information would be especially helpful because there is no consensus among dog trainers regarding the recommened number of training trials. Alexander (2003) suggests a total of 150 training trials, during which the cue is introduced as the dog is about to complete the desired behavior and gradually moved back until it is being given just as the dog begins moving. In contrast, Pryor (1999) suggests only 56-70 training trials in which the cue is given just as the dog begins to move.

While the presence or absence of errors during the probe trials did not indicate whether learning had occurred, there was a different pattern of errors between the two cues that the dog did not learn ("carrier," introduced when she was stepping into the apparatus, and "platform," introduced after she was sitting on the apparatus) and the cue that the dog did learn ("hoop," introduced just as she began to move). With both of the cues that the dog did not learn, there was a long period of probe trials (five to six in a row) early on in which the dog did not respond to the cues. In contrast, with the cue that the dog did learn, she immediately began responding correctly to that cue during probe trials (minus the occasional error, but in this condition she never made more than two errors in a row). This suggests that the probe

trials may still be useful for assessing learning, as a pattern of not responding to the probes seems to indicate that the training method is ineffective.

One potential criticism of this research is that the probe trials were tested with differential reinforcement — if the dog responded correctly to the cue, she received food and praise, while if the dog did not respond correctly, she received nothing. It is possible that this, rather than the training trials in which the cue was given as the dog was performing the behavior, was what taught the dog the cue. However, because the dog experienced both the training trials and the probe trials for all three cues, but only one cue was learned, this is unlikely to be true. If the probe trials produced learning, one would expect to see the dog learn all three cues. Instead, she only learned the cue that was given just as she began to move during the training trials ("hoop"), suggesting that when the cue was introduced was the relevant factor. What cannot be determined, however, is whether or not the probe trials assisted in learning that cue. A useful extension of this research would be to compare training in which the dog only experiences the training trials, where the cue is given just as the dog begins to move, to training in which the dog experiences those training trials interspersed with probe trials in which she is asked to sit, the cue is given, and correct responses are reinforced. If the dog only learned to respond to the cue in the second training condition, this would suggest that probe trials using differential reinforcement are a necessary part of learning the cue, while if the dog learned to respond to both cues, this would suggest that the probe trials are irrelevant.

Another potential issue is that this study used very similar behaviors with different apparatus, meaning that the goal was to teach the dog to discriminate between the apparatus.

However, most dog trainers are using these training methods to teach the dog to perform different behaviors. This was chosen for this study to keep the conditions as consistent as possible and so that the trainer could control what behavior the dog could perform by only allowing the dog access to one apparatus at a time during training. However, it is possible that some training methods may be more effective for teaching cues for a visual discrimination task, while others may be more effective for teaching cues for different body movements.

Along those same lines, it may also be an issue that all three behaviors taught during this study begin virtually identically, with the dog standing up and beginning to turn. The only difference was where the apparatus was positioned — if the apparatus was in Position 2 (to the trainer's left) or 3 (in front of the trainer), the dog began by standing up and turning clockwise, while if the apparatus was in Position 1 (to the trainer's right), the dog began by standing up and turning counterclockwise. The dog may have learned that these behaviors are interchangeable in a way that she would not have if the behaviors began with different movements, for example a sit that began by bending the back legs compared to lying down that began by lowering the chest. This may have meant that the behaviors were too similar and difficult to learn during training and testing, and resulted in the dog not correctly responding to the "carrier" and "platform" cues. In fact, this similarity did seem to be an issue with the "turn" cue, the previously known cue that also began with the dog standing up and turning clockwise. During testing, the dog never correctly completed a turn behavior — instead she would begin to turn, and then go to an apparatus. In this case, it seems that the combination of an identical beginning to the behavior and the fact that going to an apparatus had been reinforced much more recently than turning in a circle caused problems and the dog went to what had most

recently been reinforced. Interestingly, three of the first four times the dog was given the "turn" cue during testing, the dog turned past other apparatus and went to the hoop, indicating that perhaps she preferred the hoop or that the hoop behavior was somehow stronger than the carrier and platform behaviors. Four of the last five times the dog was given the "turn" cue during testing, she turned and went to the first apparatus she came to, in Position 2, which was the platform twice and the hoop twice. Unfortunately due to how the apparatus were randomly placed during testing, it's impossible to say if the last two instances were due to her preferring the hoop or preferring Position 2, which required the least effort to move to. The other two errors following a "turn" cue during testing were other previously known behaviors, a down and a shake. If a similar issue was what caused the dog to not respond correctly to the "carrier" and "platform" cues during testing, we might expect to see a similar performance, with the dog mostly going to the hoop apparatus and/or the most easily reached apparatus. However, this was not the case. Of the six errors following either a "carrier" or a "platform" cue, three consisted of the dog remaining sitting, two consisted of the dog offering a previously known behavior (down and shake), and only one involved going to the wrong apparatus (in this case, she went to the hoop, which was also the easiest to reach).

It is also possible that, rather than learning go to the hoop following the "hoop" cue, the dog had learned some sort of general "go to the hoop following any unrecognized word" behavior. The nonsense cues were included to control for this, and as it turned out, the dog never went to any of the apparatus following a nonsense cue, indicating that it was the "hoop" cue that specifically controlled going to the hoop. The fact that the dog did perform some behavior six of the eight times following a nonsense cue suggests that she had learned a

general rule that, when sitting in front of the trainer, a word meant that she was supposed to do something. In those instances, she offered previously known behaviors (five shakes and a down), perhaps because of their long history of reinforcement.

While going to the hoop was not the dog's default behavior following all unknown cues, the fact that she did repeatedly go to the hoop following the "turn" cue during testing is problematic. According to Pryor's (1984) and Spector's (1999) criteria for perfect stimulus control, for a cue to truly control a behavior, four things must be true. The first three criteria were met by the "hoop" cue and behavior during the final testing: the behavior always occurred in response to the cue, the behavior did not occur in the absence of a cue, and no other behavior occurred following the cue. However, the fourth criterion, the behavior must not occur following a different cue, was not met, as the dog went to the hoop multiple times following the "turn" cue and once each following the "carrier" and "down" cues. This indicates that the dog had not fully learned to perform the hoop behavior following the "hoop" cue. However, both Pryor (1984; 1999) and Spector (1999) specifically suggest additional training once the dog has learned to respond to the cue in order to teach the dog not to respond in the absence of the cue and not to perform that behavior following a different cue. This additional training was not included in this study. In fact, most dog trainers do not recommend this additional training, being content with a dog that simply performs the behavior following the cue. By that looser and more common definition of stimulus control, the dog's behavior was under the control of the "hoop" cue. Had the training also included trials in which going to the hoop was not reinforced in the absence of the "hoop" cue and trials in which the other cues used during testing were practiced with the hoop apparatus present (and incorrect instances of

going to the hoop not reinforced), perhaps the testing would have resulted in perfect stimulus control.

Finally, it is also possible that the dog learned the “hoop” cue and did not learn the “carrier” and “platform” cues not because of when they were introduced, but because of some feature of either the apparatus or cue chosen. To control for this, additional dogs could have been used in a counterbalanced design, so that Dog A was given the “hoop” cue as she began to move, the “carrier” cue as she was moving, and the “platform” cue after she was sitting, while Dog B was given the “platform” cue as she began to move, the “hoop” cue as she was moving, and the “carrier” cue after she was sitting, and Dog C was given the “carrier” cue as she began to move, the “platform” cue as she was moving, and the “hoop” cue after she was sitting. If all three dogs learned the “hoop” cue, it would be clear that it was the apparatus or cue used rather than the training method that produced learning, while if all three dogs learned the cue that was introduced when they began to move, it would be clear that the apparatus and cue were irrelevant and the training method was effective.

Despite the lack of additional dogs for counterbalancing, there are some indications that the dog most likely learned the “hoop” cue due to the training method rather than features of the apparatus or cues. There were no noticeable differences in the dog’s affect or behavior with the three different apparatus during training, which might have indicated that she found some more aversive than others or that there was a significant difference between the carrier and platform apparatus compared to the hoop apparatus from her perspective. Additionally, all three are similar to apparatus commonly used in dog training. The sport of agility uses either a pause table, a low table similar to the platform apparatus, or a pause box, a square with low

sides similar to the hoop apparatus, that the dog is required to sit or lie on or in during competition (training@affordableagility.com, 2016), while pet dogs are often trained to voluntarily enter a dog crate or carrier, such as the carrier apparatus (McConnell & Scidmore, 2010). If any of these apparatus were to cause issues during training, one would expect to find references to this in the dog training literature, but this is not the case. Similarly, there was no noticeable difference in the dog's reaction to the cue words themselves, and the words sounded distinct enough from each other and from other cues the dog knew that it was very unlikely that the dog was unable to discriminate between the cues. Pryor (1984) notes that all verbal cues are arbitrary to an animal that does not speak the language, and any word desired can be used as a cue for any behavior with the proper training.

In summary, this study suggests that, if one wishes to bring a behavior that is already occurring in the training context under the control of a verbal cue, the best option is to say the cue just as the learner begins to move. Giving the cue later in the movement, either after the behavior has been completed or while the learner is in the middle of moving, is much less likely to be successful. However, it is important to remember that this is very preliminary research into methods that are commonly used in practice but have little to no support in literature, and further research is needed before general conclusions can be drawn. This study used one dog who already responded to a limited number of verbal cues. It is possible that a dog who had never learned to respond to verbal cues or who already knew hundreds of verbal cues would learn differently. Similarly, because only one dog was used, it is not clear what effect, if any, the dog's learning history might have on what training methods are effective. There may be other idiosyncratic variables that also affect training that cannot be determined from the present

study. Hopefully future research addressing these issues will give dog trainers and others who work with verbal cues a much better guideline for what training methods to use than what is currently available.

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