Vet Clin Exot Anim 24 (2021) 1–16 https://doi.org/10.1016/j.cvex.2020.08.002 vetexotic.theclinics.com 1094-9194/21/ª 2020 Elsevier Inc.

DRAFT

Exotic Animal Behavior: Support from Applied Behavior Analysis

Susan G. Friedman, PhD, Cynthia E. Stringfield, DVM, Marion R. Desmarchelier, DVM,

Introduction

For the last twenty years, the coauthors of this chapter have collaborated after first meeting as members of the California Condor Recovery Team. While it is standard operating procedure for veterinarians to consult with specialists within the larger veterinary field, this partnership between a skilled veterinarian and an experienced applied behavior analyst has led to uniquely successful behavioral solutions much greater than the sum of their parts. Clearly, a behavior problem that is diagnosed as a symptom of an underlying physical dysfunction or disease process requires the specialized training of medical practitioners. However, behavior problems resulting from an ill-fit environment and maladaptive learning history are the specialized purview of behavior analysis, the science of behavior change. We believe that it takes collaboration among experts from these very different levels of analysis to fully account for the physical and behavioral wellness of the animals in human care.

Of course, there is the human element. As Stanovich (1) boldly wrote in his book, *How to Think Straight About Psychology*, "We must give up the idea that personal recipe knowledge of human behavior is adequate, that this is the only psychology we need." Indeed, the same words must be said for personal recipe knowledge as it relates to non-human animal behavior. One mystery that often surrounds problem behavior is its very persistence. Clients may have a litany of failed

behavior-change programs by the time they turn to you for help. As they wade through the personal recipes of one Internet charlatan after another, clients don't realize that with each failed attempt at behavior change, the window of opportunity closes a little bit more as animals learn to ignore changes in their environment that would otherwise facilitate behavior change.

Training the next generation of animal care professionals is another consideration. Both authors have spent much of their careers teaching their respective science and application to students. These students need teachers who model the interdisciplinary collaboration required to truly facilitate the least intrusive effective behavioral solutions for animals. This chapter is intended to inspire readers to seek out specialists from different related fields with whom to work shoulder to shoulder, as we have done, to improve behavioral outcomes for all animals.

Understanding Behavior

The governing principles revealed by the experimental analysis of behavior has widespread applicability across species and has produced an applied technology for teaching, training and managing behavior. The technology is called applied behavior analysis (ABA). Within this field, learning is defined as behavior change due to changes in the environment. The ability to learn is itself part of every animal's biological endowment, the result of natural selection. Learning is the mechanism by which individuals cope with the demands of an ever-changing environment during their lifetime. It is evolved modifiability that "takes up where reflexes, fixed action patterns, and general behavior traits leave off." (2).

Common misunderstandings about ABA should be dispelled. The central interest and main contribution of ABA is the behavioral level of analysis, i.e., how behavior-environment relations account for the behavior we observe. Behavior is never wholly independent of conditions. Therefore, the goal of any behavior intervention is to arrange the environment so that behavior problems are irrelevant, inefficient and ineffective, and new skills are learned (3). Behavior analysis does not discount the existence of animals' thoughts or feelings. However, thoughts and feelings are private events, which make them difficult to measure directly. More importantly, they too are influenced by environmental events. To clarify, consider this common explanation for biting behavior: "The animal bit its caregiver because it was afraid." This causal account of biting is problematic because it is based on circular reasoning. If we ask, "Why did the animal bite?" The answer is, "Because it is fearful." If we ask, "How do you know the animal is fearful?" We are told, "Because it bites." The more useful question asked by behavior analysts is, *what environmental events account for both the biting and fear behaviors?*

For an explanation to qualify as a valid, scientific account of behavior, we must identify the physical (measurable) events that reliably produce it. As Skinner said,

> "It is does not help in the solution of a practical problem to be told that some feature of [an individual's] behavior is due to frustration or anxiety; we also need to be told how the frustration or anxiety has been induced and how it may be altered." (4).

As to the how frustration or anxiety is induced, we look to the environmental conditions for things we can change, on behalf of the learner. This is a critically important piece of every behavior puzzle.

Contingencies

The concept of contingency is central to understanding, predicting and changing behavior. A contingency describes a dependency between two or more events. Behavior never occurs in a vacuum. It depends on events that precede it, called antecedents, and outcomes, called consequences. The complete unit – antecedents, behavior, and consequences are the behavior ABCs. No smaller unit of analysis is meaningful.

Antecedents are the stimuli, events and conditions that precede behavior and set the occasion for the behavior to occur. Antecedents don't cause the behavior; rather they signal the contingency ahead: W*hen* antecedent A is present, *if* behavior B occurs, *then* consequence C will follow.

Behavior is a power tool, part of every animal's biology, used to control the environment. Behavior is defined as what an animal does that can be measured. All analyses start with an unambiguous, measurable description of overt behavior and conditions. Hypothetical, psychological constructs and diagnostic labels do not describe specific behaviors in context and are, therefore, be too vague and ambiguous for effective intervention. For example, a dog doesn't take food gently from a stranger because it is friendly; rather, the dog takes food gently and we call it friendly. Friendliness is not a cause; it is a label for the gentle behavior in the context of a stranger offering food. In fact, we can accurately say that the behavior causes the label.

Consequences are the engine that drives future behavior. Antecedents are the signposts that signal the behavior–consequence (BC) contingency immediately ahead. For example, an offered hand (A), may set the occasion for a parrot to step up (B), which results in caregiver attention (C). Over time, stepping up may increase as a function of attention, in the presence of an offered hand. For another parrot, an offered hand (A), may signal a different BC contingency—stepping up (B), which results in confinement in a cage (C). For this second parrot, stepping up may decrease as a function of confinement in the cage. Behavior is selected by consequences and the value placed on any particular outcome is very individual, truly a study of one. For any individual, behaviors that produce desired outcomes are repeated; behaviors that produce aversive consequences are modified or suppressed.

Assessing the ABCs is also known as functional assessment. It is key to understanding what environmental events maintain behavior. Then, to change behavior we change conditions. Changing an animal's functional behavior is not a casual or cavalier process. If the outcomes of the problem behavior weren't important to the animal, it would not behave in this way. Thus, the ultimate goal of any behavior change program is to protect the rate and quality of valued outcomes an animal behaves to get. This is best achieved by replacing the problem behavior with a desirable alternative behavior and teaching new skills, rather than solely suppressing a problem behavior.

Key Questions for Functional Behavior Assessment

Functional assessment requires observation skills that clients can quickly develop. The following key questions help focus their observations on the ABCs (3):

- What does the problem look like in terms of actual behavior, i.e., what do you see?
- Under what conditions does your animal do this behavior, i.e., what events predict it?
- What does your animal get, or get away from, by emitting this behavior?
- Under what conditions does your animal not do this behavior, i.e., when is it successful?
- What do you want the animal to do instead?
- What prerequisite skills does the animal need to succeed?
- How will you teach the prerequisite and alternative behaviors to your learner?

CONTROL

It is a small step from observing that behavior is what we do to achieve functional outcomes and realizing that control over outcomes matters in the lives of all animals. Control is reasonably classified as primary reinforcer, i.e., an innate and necessary requirement for survival and behavioral health. As discussed by Leotti, et al (5), "Converging evidence from animal research, clinical studies and neuroimaging work suggest that the *need for control is biological imperative for survival*, and a corticostriatal network is implicated as the neural substrate of this adaptive behavior."

When an animal's control over outcomes is blocked as a lifestyle, maladaptive behaviors often increase (6) including depression, learning disabilities, emotional problems (7), and suppressed

immune system activity (8). Restriction of behaviors, particularly those that are highly valued by a species, produces behavioral and physiological stress (9).The restriction of motion (i.e., restraint) results in increased heart rate, increased norepinephrine and cortisol release, and the production of gastric ulcers (10). Additional research evidence suggests lack of control is a major cause of abnormal stereotypic behaviors, failure to thrive, and impaired reproduction commonly observed in animals raised in captivity (11).

In a study with 90 day-old babies, the group that controlled the onset of the mobiles over their cribs (by raising their heads and closing a switch under their pillows) were more active and happier than the group of babies with the same amount of moving mobile time but no control over the onset of their devices (12,13). Further, the contra-freeloading research, which has been replicated with dozens of species and shows that animals in general, prefer contingent access to commodities such as food, water and lighting rather than free access, i.e., they prefer to work for outcomes (14,15,16,17). In addtion, when control is provided, animals make effective use of it (18,19).

Of course, control is a continuum, not a dichotomy. It is unnecessary and counterproductive to work in the extremes (no control versus total control). No cat should be allowed to scratch a keeper and no alligator should be allowed to eat a bucket. However, if an error is to be made in either direction, it is better to fall on the side of providing more control. This can be achieved by arranging stimulus-rich environments that foster many more choices than restrictions.

Least Intrusive Ethical Standard

Just because we can change behavior, doesn't mean we should. And, when we decide it is necessary, it is the process by which we change behavior that is most critical from a welfare point of view. Effectiveness is not enough when it comes to choosing and applying behavior-change interventions (20). Borrowing from the field of applied behavior analysis with human learners, an expanded hierarchy of procedures (21) is proposed that adds a second criterion to effectiveness: relative intrusiveness. Intrusiveness refers to both the social acceptability of a procedure, and, most importantly, the degree to which a learner controls its own outcomes (22). Without this ethical standard, interventions are likely to be selected on the basis of convenience, familiarity, speed, or blind authority, and may inadvertently produce the detrimental side effects of punishment and learned helplessness in our animals (see below). The commitment to using the most positive, least intrusive, effective interventions allows us to think before we act, so that we make choices about the *means* by which we accomplish our behavior goals. In this way, we can be both effective and humane. This is the minimum standard of care we should stretch to meet on behalf of the welfare of learners and caregivers alike. Figure 1 below depicts the suggested hierarchy of behavior change procedures.

Veterinarians will note that the first "stop" on the hierarchy is to assure "Wellness: Nutritional and Physical." Medical problems will not be solved with learning solutions (and vice versa). For example, a problem such as a cat urinating in inappropriate places may well be a medical issue. It would be unethical and ineffective to proceed with a learning solution before determining if the behavior is symptomatic of an underlying medical problem. Likewise, intervening with a medical solution with be neither ethical nor effective in the long run, when the cause of the

behavior problem is ill-fit environment or skill deficit. And then there are those behavior challenges in which both the medical and behavioral models must join forces to provide an ethical, effective intervention, requiring the very collaboration described in this chapter.

EMOTIONS

It's useful to differentiate between the emotional behavior we do and the emotional feelings we perceive. Emotional behavior (e.g., tail wagging, ears back, and fleeing) is easily accounted for by both classical and operant learning processes. Respectively, new elicitors of innate responses are learned though the process of classical conditioning (e.g., raised hackles elicited by a passing vehicle); and new behaviors are selected by consequences via the process of operant learning (e.g., hiding in a kennel during a thunderstorm, i.e., negative reinforcement).

However, private emotions are a different matter. A behavior analysis perspective on emotions can be very empowering. As Layng (23) explains, "…emotions neither cause behavior nor are caused by behavior; they are instead part of consequential contingencies." In other words, as with overt behavior, emotions are not independent of environmental influence. It is the behavior-consequence contingency that emotions closely reflect. Said another way, happy is a function of a positive reinforcement contingency, fear is a function of an escape contingency, anxiety is a function of an avoidance contingency, and frustration is a function of an extinction contingency.

To further make this point, consider the twenty different kinds of aggression listed in Barrows (24), "Animal Behavior Desk Reference: A Dictionary of Animal Behavior, Ecology, and

Evolution." They are anti-predatory, aversion induced, behavioral, defensive, direct, displaced, dominance, ecological, frustration-induced, intrasexual, intraspecific, moralistic, parental, parental disciplinary, predatory, redirected, sexual, territorial, weaning. However, on closer inspection notice that it is actually different conditions, not different behaviors, that is described by this list. For any given species and individual, the behavior pattern (topography) described as "aggressive" is fairly consistent.

Lewon and Hayes (25) contend, "When we conceive of emotions and hunger not as *things* but as verbal descriptions of environment-behavior relations, we are able to see important similarities between humans and nonhumans". The empowering bottom line is then, to change emotions, change conditions (antecedent events and consequences). Changing the conditions in which animal live is often in the caregivers' control.

Trust

One emotion often evoked as a key to successful relationships is trust. A critical thinker will ask, what does this construct really mean? What does trust look like? And, how can we build it? We can operationalize trust as the level of sureness that approaching and interacting with another individual (human or conspecific) will produce safe and reinforcing outcomes. With this description we can generate both the measures of trust and the path to create it. When caregivers provide a preponderance of safe and positively reinforcing outcomes, animals approach and interact more. The label trust is the emotion that reflects those experiences (contingencies) for both parties.

A great metaphor to make this point to clients is to describe their Trust Account at the Bank of Relationships. To build big trust accounts, it is important to provide animals with control through choice situations and to ensure that the frequency of positive interactions far exceed the frequency of negative interactions. Resilient animals bounce back after an occasional aversive event, but we must be sure to keep the overall ratio of positive interactions to negative interactions really big. That's the way to keep trust accounts "in the black."

Behavior Change Strategies

Applied behavior analysis offers a practical model of behavioral support to help clients prevent and resolve behavior problems with their animals. It's often helpful to think of behavior problems as falling into one of two general categories – either not enough of the "right" behavior or too much of the "wrong" behavior. Depending on which of the two problems we face, our goal will be to teach caregivers how to work with their animals to increase desirable behaviors and replace undesirable behaviors. Most often we do both. Understanding the functional relations between behavior and environmental events is key to accomplishing these goals. Behavior is never independent of the strong influence of conditions and in the case of animals in human care, where we provide so many of the conditions (antecedents and consequences), this is good news for knowledgeable caregivers.

Reducing problem behaviors is not the only goal when planning an intervention. A good plan is one in which the physical and social context of the environment is redesigned to provide the

animal with an opportunity to preserve the function served by the problem behavior with an acceptable alternative behavior and to allow the animal to learn new skills that make the problem less likely to occur (3). The focus on preserving the function of a problem behavior with an appropriate alternative is fundamental to understanding behavior and respecting behaving organisms: if the behavior didn't matter to the animal, it wouldn't keep doing it. For example, the function typically served by biting is to remove someone's hand—that is, to say no. Since all animals have a right to say no, our first goal should be to replace biting with an acceptable way to say no—for example, moving away. Our second goal is teaching the learner that saying yes, by approaching calmly, yields even better outcomes.

Changing Behavior with Antecedent Strategies

Antecedents are the signposts that give order to our behavior in the sense that they tell us what to do when. There are three general types of antecedents: Cues, setting events, and motivating operations. Each type of antecedent can be an important tool for changing problem behavior.

Add or Remove the Cue ˆ

When clients report a behavior problem, ask, what cues the behavior? A stimulus becomes a cue (discriminative stimulus) for a particular behavior if it is repeatedly present when the behavior is reinforced. A ringing telephone can become a cue for raucous vocalizations if raucous vocalizations result in attention when the phone rings. An offered hand can become a cue for lunging if lunging removes the hand when the hand is offered. The strength of a stimulus

to cue a particular behavior is related to the strength of the reinforcer that follows the behavior. To build strong cues, deliver strong reinforcers in the presence of the cues.

Removing the stimulus that cues a problem behavior is one way to reduce it. For example, with companion parrots, buttons and jewelry often cue chewing because chewing results in social and sensory reinforcers in the presence of those buttons and jewelry. By removing the cues (wearing T-shirts and removing jewelry) chewing necessarily decreases. Adding a cue for an alternate behavior is another way to reduce the frequency of a problem behavior. For example, opening the food door may cue lunging because lunging has been reinforced with the delivery of food. Teaching an animal to station on a distant perch when cued prevents lunging.

Increase or Decrease Effort with Setting Events

When clients report a problem behavior, ask, how can the setting be changed to make the right behavior easier than the wrong behavior? Setting events are the context, conditions or situational influences that affect behavior. For example, we can make coming out of the cage easier by selecting cages with large doors, which may ultimately reduce biting. We can make chewing the window frame harder by locating the play-tree in the middle of the room. The relations between setting events and problem behavior should be considered carefully as the setting is often one of the easiest things to change.

Strengthen or Weaken Motivation

When clients report a problem behavior, ask, what's the motivation, i.e., what consequence does the behavior produce? Motivating operations (also known as establishing operations) temporarily alter the effectiveness of consequences. For example, a few carrots may be a highly motivating consequence to an animal that rarely has access to them but not motivating at all to an animal that has unlimited access to them every day. An iguana may be more motivated to go to a warm rock on a cool day and chasing a conspecific may be less reinforcing after an energetic training session.

Antecedent behavior-change strategies are often preventative management solutions rather than learning solutions. As a result, antecedent strategies can be the most positive, least intrusive, effective behavior-change procedures.

Decreasing Behavior with Consequences

When clients report a problem behavior, ask, what purpose does it serve the animal, i.e., what does the animal get, or get away from, by doing the behavior? Reinforcement is the process by which behavior is maintained and increased. It is a natural process that, like gravity, is in effect whether we realize it or not. Behavior is repeated because it results in reinforcement – even problem behavior. Clients often look in the wrong place, inside the animal, for answers to why animals do what they do (e.g., the animal lunges because it is hormonal, dominant, or neurotic). By focusing on the functional relations between observable behavior and consequences, clients consider the actual causes for behavior that they can do something about, namely changing the antecedent conditions and consequences they provide.

Extinction

Once the reinforcer for a problem behavior is identified from a functional assessment, the maintaining reinforcer can be permanently withheld to reduce the behavior. When the contingency between a behavior and its consequence (if B then C) is removed, the behavior serves no function and eventually diminishes. This process is called extinction. There are really very few problem behaviors that are well suited to extinction due to the problems with the procedure, described below. Extinction is most effective the very first time a problem behavior occurs, i.e., don't give the behavior function in the first place.

- Extinction can be a slow process, especially with behaviors maintained on an intermittent reinforcement history (usually the case with problem behaviors).
- There is often an intolerably sharp increase in the frequency and intensity of the problem behavior before it eventually decreases (extinction burst) that may result in clients reinforcing even less desirable behavior.
- Extinction can result in frustration-elicited aggression.
- Uncontrolled or inadvertent reinforcement can undermine the procedure (bootleg reinforcement).
- Behaviors that were previously extinguished in the past can resurge when a new extinction procedure is started.
- Over time, the problem behavior can recover, and the extinction procedure will need to be implemented again.

- Other animals may imitate the problem behavior.

All told, extinction as a sole procedure for reducing problem behaviors is usually insufficient. It is a difficult strategy to implement well and, more importantly, animals should have the opportunity to learn new skills to replace undesirable behavior.

Punishment

Punishment is the process by which consequences decrease and suppress behavior. It is rarely necessary to use this approach because 1) there are less intrusive, effective alternative teaching approaches, and 2) punishment occasions detrimental side-effects, discussed further below.

Behavior can be punished by contingently adding an aversive stimulus, called positive punishment (or “discipline” or “corrections" in lay terms), or by contingently removing positive reinforcers, called negative punishment (“fines” or “penalties” in lay terms). For example, while the handler arranges the jesses with her ungloved hand (A), if the raptor throws a foot at the handler (B), then the handler shakes her arm sharply (C). In this scenario footing may decrease (punishment) given the addition (positive) of the sharp shake of the arm. Alternatively, as a handler raises the food hand (A), if the raptor lunges at the hand (B), then the handler intentionally drops the food back into his pouch. (C). Lunging at the handler may decrease (punishment), given the removal (negative) of the food (the reinforcer).

Decades of scientific studies demonstrate the problems with positive punishment listed below. As a result of these problems, and the efficacy with which alternate strategies can be used, positive punishment should only be used to solve behavior problems when more positive, less intrusive procedures have failed (indeed, an uncommon occurrence among experienced practitioners).

- Punishment is associated with four detrimental side effects:
    - Increased aggression
    - Generalized fear
    - Apathy
    - Escape avoidance behaviors

- Additional Considerations Before Using Punishment:
    - Punishment doesn't teach learners what *to do* instead of the problem behavior.
    - Punishment doesn't teach caregivers how to teach alternate behaviors.
    - Punishment is really two aversive events – the onset of a punishing stimulus and the forfeiture of the reinforcer that has maintained the problem behavior in the past.
    - Punishment requires an increase in aversive stimulation to maintain initial levels of behavior reduction.
    - Effective punishment reinforces the punisher, who is therefore more likely to punish again in the future, even when antecedent arrangements and positive reinforcement would be effective.

Time Out from Positive Reinforcement

Time out from positive reinforcement ("time out") is a negative punishment procedure that can effectively reduce problem behavior with fewer detriments than positive punishment but, like extinction, it is a difficult procedure to effectively implement. Time out is the temporary reduction of access to positive reinforcers contingent on a problem behavior. For example, when a client installs a food cup through a cage door (A), if the animal swipes at the cage bars (B), then the client temporarily removes food cup (C). Swiping cage bars will likely decrease due the process of negative punishment in which the food cup, a positive reinforcer, was removed. Time out can be a relatively unintrusive behavior-change procedure if it is implemented correctly. It should be implemented consistently, with close contiguity (immediacy) between the behavior and the consequence; it should be short (only a few seconds is usually effective with many individuals); the animal should be quickly brought back into the situation to do it again better and earn positive reinforcement; and the client should let the procedure do the job (no emotional responses necessary).

A New Standard of Best Practices

The use of any behavior reduction technique should be rare in the course of a caregiver's work. By strengthening alternative desirable behaviors and teaching new skills, punishment is rarely, if ever, necessary. When an animal doesn't behave according to expectations, their "missed behavior" is important data that something needs to change in the training program and/or the

environment in which the animal behaves (26,27). We change environments, the animal changes its behavior.

This is not an easy call to action. Many of us use punishment reflexively as it is most assuredly our legacy society wide. Laying down the old tools of force and coercion and replacing them with tools of choice and cooperation will require learning new information and building different skills. It is a commitment we must make for the animals (human and non-human alike) in our care. Doing so will pay big dividends for animal welfare.

Increasing Behavior with Consequences

Without question the two sharpest behavior change tools are variations of differential reinforcement. Differential reinforcement is the process of reinforcing one class of behaviors and not others. Differential reinforcement of alternate behavior (DRA) is used to replace problem behavior with a more appropriate behavior. Differential reinforcement of successive approximations (shaping) is used to teach new skills. Both procedures avert the problems and side effects of positive punishment and also result in the high rates of positive reinforcement vital to behavioral health. This is why both procedures are preferred, i.e., less intrusive, on the ethical hierarchy of effective behavior-change procedures.

A crux training move is selecting the goal behavior to replace problem behavior with or the new skill to teach a learner. Lindsley (28) wrote that goal behavior should pass the "dead-man's test": If a dead man can do it (e.g., be still, be quiet) it isn't going to make a good target behavior. This

amusing (or shocking) criterion is important to consider. Behavior targets should specify active, over, measurable behavior to the greatest possible extent. Animals are built to behave.

Differential Reinforcement of Alternative Behavior

When clients report a behavior problem, ask, what behavior does your animal already know that you would like it to do instead? With differential reinforcement of alternate behavior (DRA), a desirable replacement behavior is reinforced (increased) while the problem behavior is extinguished (not reinforced). For example, vocalizing for attention can be replaced with chewing an enrichment item for attention. To use DRA, a functional assessment is necessary to identify the reinforcer that has been maintaining the problem behavior in the past, in order to withhold it. There are three things to consider when selecting an alternate behavior. First, although the behavior targeted for reduction is a problem to people, it serves a legitimate function for the animal or it would not continue to exhibit the behavior. The function is either to gain something of value, e.g., vocalizing to gain attention (positive reinforcement); or, the function is to remove something aversive, e.g. lunging to remove intruding hands (negative reinforcement). An alternative or incompatible behavior should be selected that replaces the function served by the problem behavior but in a more appropriate way. If the alternative behavior is incompatible with the problem behavior, (i.e., if both behaviors can't physically be performed at the same time) the behavior change program can proceed more quickly. This variation of DRA is called differential reinforcement of an incompatible behavior, DRI. For

example, chewing is incompatible with vocalizing, and standing on a far perch is incompatible with lunging at the food door.

Second, the alternate behavior should produce even more reinforcement than the problem behavior in order to successfully compete with and replace it. According to the principle called the matching law, "... the distribution of behavior between alternative sources of reinforcement is equal to the distribution of reinforcement for these alternatives."[1] Thus, given a choice between two alternative behaviors, animals tend to exhibit the behavior that results in the greater reinforcement. The matching law is itself a powerful tool for managing behavior. For example, if staying on a perch produces double the reinforcement as flying off, birds tend to stay on the perch. Third, the alternative behavior should be one the animal already knows how do. During extinction of the problem behavior, a well-established alternative behavior is more likely to be performed than one that is newly acquired. When alternative behaviors are strengthened and maintained, differential reinforcement can provide long-lasting results. As this method relies on both positive reinforcement (to teach animals what *to do)*, in addition to extinction of the undesirable behavior, DRA and DRI offer a less intrusive and practical approach to managing animal's problem behavior than do punishment strategies or extinction alone.

Shaping

When clients report a behavior problem, ask, what skill does your animal need to learn?

Differential reinforcement of successive approximations, also known as shaping, is another type of differential reinforcement procedure. Shaping is used to teach new behaviors by the process of

successively reinforcing subtle variations in responses (approximations) along a continuum that leads to the final goal behavior.

Shaping starts by reinforcing the closest approximation the animal already does. Next, an even closer approximation is reinforced, at which time reinforcement for the first approximation is withheld. Once the second approximation is performed without hesitation, an even closer approximation is reinforced while withholding reinforcement for all previous approximations. In this way, the criterion for reinforcement is gradually shifted incrementally closer and closer to the goal behavior. Finally, every instance of the final behavior is reinforced. For example, to teach an animal to interact with an enrichment item, the following approximations can be reinforced in turn: Looking at toy, leaning toward toy, moving a foot in the direction of toy, taking one step toward toy, taking several steps to arrive beside toy, touching toy with foot, holding toy with foot while manipulating it in mouth, and reinforcing longer durations of engagement with item. If the learner experiences difficulty at any approximation, the teacher can back up and repeat the previous successful step or reinforce even smaller approximations. Ultimately it is the learner who determines the pace, number of repetitions, and size of the approximations in a shaping procedure.

Implementing a shaping procedure requires keen observation of the subtle, natural variation in the way behaviors are repeatedly performed. For example, each time an animal lifts its foot, it is naturally done differently than the last time (e.g., left or right; high or low; fast or slow, with toe movement or without, etc.). In daily life, these variations are unimportant and simply classified as one behavior, or operant class, called “lifting a foot.” However, this subtle variation in foot

lifting is exactly what allows us to shape new behaviors such as offering a steady foot for nail trims.

With shaping we can theoretically teach any behavior within the biological constraints of the learner. Husbandry, medical and enrichment behaviors can be shaped to reduce stress and increase physical and mental stimulation. Animals can learn such behaviors as going in and out of crates, staying calm wrapped in towels, flying to designated perches, and even playing basketball. Shaping can also be used to change different dimensions of existing behaviors such as duration, rate, intensity, topography (specifically what the behavior looks like), and latency (response time).

A Final Word

Each behavior intervention should start with a careful functional assessment and the intervention should be designed to meet the needs of the individual learner using the most positive, least intrusive effective methods. The plan should also be feasible for the client to implement. The greater our knowledge of the scientific principles and procedures of learning and behavior, the more effectively will meet these goals and improve the welfare of the animals in our care.

Far from "carrot and stick" strategies or "mechanistic reflex-arc stuff," applied behavior analysis harnesses animals' innate, biological flexibility to change their behavior based on experience, i.e., the past outcomes of behaving. If not for this extraordinary, inherent adaptability, animals would not survive this ever-changing world. It is the nature of all animals to learn. Together with other behavior sciences and technologies, such as ethology and medicine, connecting the

dots from science to practice provides patients and clients with a much better future. It is the authors' earnest hope that the information provided here will help forge such a path.

References

1. Stanovich K. How to Think Straight About Psychology. Needham Heights, MA: Allyn & Bacon; 2001.
2. Chance P. Learning and behavior. Belmont, CA: Thomson/Wadsworth; 2003. p. 24.
3. O'Neill RE, Horner RH, Albin RW, et al. Functional assessment and program development for problem behavior: A practical handbook. Pacific Grove, California: Brooks/Cole. 1997.
4. Skinner BF. Science and Human Behavior. New York, NY, The Free Press. 1953. p.167.
5. Leotti LA, Iyengar SS., Ochsner KN. Born to Choose: The Origins and Value of the Need for Control. Trends in Cognitive Science 2010; 14(10): 457-463.
6. Brown GE, Hughes GD, Jones AA. Effects of shock controllability on subsequent aggressive and defensive behaviors in the cockroach (Periplaneta americana). Psychological Reports 1988; 63: 563-569.
7. Maier SF, Seligman, MEP. Learned Helplessness: Theory and evidence. Journal of Experimental Psychology: General 1976; 105: 3-46.
8. Laudenslager ML, Ryan SM, Drugan RC, et al. Coping and immunosupression: Inescapable but not escapable shock suppresses lymphocyte proliferation. Science 1983; 221: 568-570.
9. Friend TH. Recognizing behavioral needs. Applied Animal Behaviour Science 1989; 22: 151–158.

10. Glavin GB, Paré WP, Sandbak T, et al. Restraint stress in biomedical research: an update. Neurosci Biobehav Rev.1994; 18: 223–249.
11. Clubb R, Mason G. Animal welfare: captivity effects on wide-ranging carnivores. Nature 2003; 425: 473–474.
12. Watson, JS. Memory and "contingency analysis" in infant learning. Merrill-Palmer Quarterly 1967; 13: 55-76.
13. Watson, JS. Cognitive-perceptual development in infancy: Setting for the seventies. Merrill-Palmer Quarterly 1971; 12: 139-152.
14. Coulton, LE, Warren, NK, Young, R J. Effects of foraging enrichment on the behavior of parrots. Animal Welfare 1997; 6: 357-363.
15. Gilbert-Norton, L. Captive birds and freeloading: The choice to work. Research News 2003; 4(1).
16. Inglis IR, Ferguson, NJK. Starlings search for food rather than eat freely available food. Animal Behaviour 1986; 34: 614-616.
17. Osborne SR. The free food (contrafreeloading) phenomenon: A review and analysis. Animal Learning & Behavior 1977; 5 (8): 221-235.
18. Cerutti D and Catania AC. Pigeons' preference for free choice: Number of keys versus key area. Journal of Experimental Analysis of Behavior 1997; 68: 349-56.
19. Carlstead K, Seidensticker J,Baldwin R. Environmental Enrichment for Zoo Bears. Zoo 1991; 10: 3-16.
20. Friedman SG. What's wrong with this picture? Effectiveness is not enough. Good Bird Magazine 2008; 4(4): 12-18.

21. Alberto, PA, Troutman, AC. Applied Behavior Analysis for Teachers. NJ: Merrill Prentice Hall; 1999.

22. Carter SL, Wheeler JJ. Considering the intrusiveness of interventions. The International Journal of Special Education 2005 ; 20: 132-142.

23. Layng, TVJ. Private emotions as contingency descriptors: emotions, emotional behavior, and their evolution. European Journal of Behavior Analysis. 2017; http://dx.doi.org/10.1080/15021149.2017.1304875

24. Barrows, EM. Animal Behavior Desk Reference: A Dictionary of Animal Behavior, Ecology, and Evolution. Boca Raton, FL: CRC Press; 2001.

25. Lewon M, Hayes, L. Toward an analysis of emotions as products of motivating operations. Psychological Record 2014; 64: 813-825.

26. Rosales-Ruiz J. Teaching dogs the clicker way. 2007; Retrieved from http://stalecheerios.com/blog/wp-content/uploads/2011/07/Teaching-Dogs-the-Clicker-Way-JRR.pdf

27. Friedman SG. Tsk, No, Eh-eh: Clearing the Path to Reinforcement with an Errorless Learning Mindset. Paper Presented at the Annual Conference of the Animal Behavior Management Alliance 2016, Tampa, FL.

28. Lindsley OR. From technical jargon to plain English for application. Journal of Applied Behavior Analysis 1991; 24(3): 449-458.

Figure 1. Suggested hierarchy of behavior change procedures according to the least intrusive, effective intervention guideline.