

Training Animals: The Art of Science

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Presented at ABMA Conference, 2004

Introduction

The word “art” is often used to describe performance at the highest level, the use of skill and imagination in the production of things of beauty. It seems that every profession recognizes its art. We all cook but Paul Prudhomme is an *artist*. Maya Angelou, Mario Andretti, Anika Sorenson – all artists in their respective fields. The word art is often used to describe animal training too, as in the “art of shaping.” In the field of animal training, the modern artist also performs at the highest level, using skill and imagination to produce a thing of beauty – reliable, *cooperative* animal behavior. As with other professionals, we know it when we see it.

Let’s stick with the analogy between cooking and training as the similarities don’t stop with art. Both activities are clearly rooted in natural sciences: Cooking is the application of the laws of physics and chemistry; training is the application of the laws of learning and behavior. Of course, many of us cook without an explicit understanding of the science that makes it possible and the same goes for training too. Still, few of us would argue that technical knowledge doesn’t improve our understanding of how things work. It does! And technical knowledge also greatly improves our ability to solve problems when things don’t work.

It is also true that valid information is more accessible to a greater number of people when science arrives. Science plays a big part in large-scale education because it offers a common language and replicable procedures. There are an astounding number of cookbooks out there to teach even the lamest among us to improve our cooking skills. Karen Pryor first published *Don’t Shoot the Dog! The New Art of Teaching and Training*, in 1984, in which she teaches the *science* of learning and behavior. Since that time, a veritable plethora of animal training books with scientific underpinnings have hit the market. (We are heartened to see that the science of positive reinforcement fills book store shelves!) If you can read, chances are good that you can learn how to cook a soufflé and teach your dog to sit in just a few sessions.

We’ve had many interesting and lively discussions in pursuit of an understanding of the art and science of training. Like a kite tail in the wind we catch it for a moment then it’s jerked out of our hands to dance off beyond our reach once again. What makes an artist different than a technician? How do we operationalize art? Is something lost by focusing exclusively on science or gained by imaginative lay-descriptions? For example, compare the technical term “limited hold schedule of reinforcement” to the more evocative image of a hawk learning fast that it has a short window of opportunity to catch the mouse or it will lose it down the hole! What exactly is it Paul Prudhomme tastes that makes him add

just one more pinch of salt than the recipe calls for? What does that trainer see that makes her hold back the cue because the bird isn't ready to loop the pole? That's what we're after: The art of the science of animal training.

Our discussions haven't led us to all the answers but we have drawn some tentative conclusions:

1. Art is not outside the realm of science; if it was, the artist's training would not be effective.
2. Like spices, behavior comes in many, exquisitely subtle flavors some of which are not even perceptible to the ordinary palate; it is this sensitivity to the endless variations in behavior, tiny movements of an eye, shoulder or feather, which earns the artist our admiration.
3. We don't know what accounts for the artist's extraordinary powers of observation (which Steve calls intuition and Susan calls a latent database), but the inextricable and reciprocal mix of genetics and experience satisfies us for now.
4. You don't get artists by cookbook training alone. Along with technical skills we should reinforce creativity (novel behavior), imagination (novel thought) and inspiration (novel feelings). In other words, we should reinforce *thinking outside box*.

The Art of Science

We have discovered that, although our professional backgrounds have fostered very different ways of talking about learning and behavior, our training strategies are very similar. In hindsight, that shouldn't be surprising as the past 75 years of behavior science has revealed fundamental laws of behavior that describe many of the underlying mechanisms of successful training.

It's true that explicit knowledge of behavior science is neither necessary nor sufficient for training at the highest level, the level of an artist; however, science offers more than just validation for trainers whose artistry brought them to the right conclusions about how behavior works, particularly regarding the efficacy of positive reinforcement strategies. A scientific foundation adds powerful tools to any trainer's toolbox absolutely, clarity that is otherwise not available, and it increases our ability to hold professionals accountable for what they do with animals.

At the same time, the artists in the field of training will continue to contribute to science by forging new ground, pushing the boundaries of what is known. There will always be innovative approaches to be explained by scientific investigation. This makes the current interface between animal training and behavior science a very exciting place to be.

Below are some of Steve's training philosophies and strategies that he developed over three decades of pursuing the art of training, expressed in the lay-language in which they evolved. Susan has briefly annotated each strategy with some relevant science to support them. We think the inclusion of both vernaculars represents the potential for integrating the art and science of animal training to yield a sum that is greater than its parts.

I. What's He Thinking?

Steve: I try to figure out what animals are thinking anytime I work with them. I carefully watch the animal to discover the tiniest sign of what is going on in its mind. My training success has always been closely associated with my ability to know what the animal was thinking. Then, about 15 years ago, I attended an animal behavior workshop. The speaker said that we should “*never* try to figure out what an animal is thinking, only what the animal is doing.” This was a very important moment for me ... an epiphany, I thought. It confirmed my suspicion that the “artistic” approach was valid and these scientists should stay where they belonged: In the lab! How could anyone say I should discount the nervous thoughts of a bird that had just flown away? Ridiculous! I had to be sensitive to what the bird was thinking in order to plan my training strategy, to stop advancing toward it, gain its confidence and ultimately keep it from flying away again.

I have since come to understand that I was indeed focusing on what the bird did. As I approached the bird I observed a slight tightening of the feathers and darting eyes before he flew away. In other words, I was *inferring* thoughts from observable behavior.

*Susan: Thinking is certainly behavior – something an animal **does**. The problem with thinking as a training target (and research variable) is that it's a **covert** behavior, i.e., the private event of the thinker. Therefore, it can't be directly observed or measured. How then do we unambiguously identify what we are training or even know when we've met our goal?*

*When we focus on **overt** behaviors, we can also observe the way in which the environment maintains a behavior (cues and reinforcers). That's exactly what we need to know to train new behaviors and modify existing ones.*

II. Responsibility

Steve: I have learned that the best trainers are usually the ones who accept responsibility for both the good and the undesirable behavior their animals perform. Undesirable behavior in an animal is just as reflective of a trainer's skills as the desirable behavior. Accepting responsibility for the undesirable behavior provides personal incentive for a trainer to affect change in the behavior. Excuses like the animal is “messing with your mind” or “is jealous” or “is mischievous” does not relieve a trainer of responsibility for the animal's behavior. Assigning blame to an animal for its poor behavior only serves to stifle a person's growth as a trainer.

Susan: The animal is never wrong -- you get what you reinforce. All behavior has function, including undesirable behavior. The question is not “Why is the animal behaving this way?” but rather, “What's reinforcing this behavior?”

*Regarding excuses, the terms jealous and mischievous do not describe actual behaviors. They are abstract ideas called **constructs** that label classes of behaviors. The problem with constructs is our tendency to reify them, that is, to treat them as real, as if they exist in a tangible form. We can't observe an animal's jealousy but we can observe its charging or biting behavior. Of course there are also other explanations for why an animal might charge or bite for example protecting a territory, mate or off-spring; ill-health or a negative history with the trainer. So, just like with covert behavior, constructs result in unverifiable targets.*

III. Give Animals Power

Steve: Training free-flight birds has caused me to understand the importance of creating partnerships with animals rather than trying to dominate or control them. For me, the consequence of a poor training decision or shaky relationship with a bird might mean I never see that bird again. This partner approach also worked well for me when I started training mammals some 20 years ago. I allowed all the animals I worked with to have a strong voice in the training session. I would ask them to perform behaviors then wait for their response through their body language. I never commanded, or forced, or made animals do anything. I always allowed them to do things for treats and rewards.

With this relationship I also allowed animals to experience the consequence of their decisions. For instance, if an animal showed aggression toward me, I would often say "Ok, I get it, you don't want me to be in your territory. I'll just take my bucket of goodies and leave now." After a couple minutes I would usually return to give the animal another chance to earn the reinforcement. I would also make sure that when I came back I asked the animal to do something easy so I could get a reinforcer to it and start the animal thinking positive thoughts before the aggression occurred again. Allowing animals the power to influence my behavior strengthened my relationship with them and created a more positive and effective learning environment.

Susan: Research on a construct called learned helplessness suggests that the power to behave in ways that affect one's environment, in particular, the power to escape aversive situations, is basic to behavioral efficacy. This research has been replicated with dogs, cats, monkeys, cockroaches, children and adults (see Maier and Seligman, 1976).

IV. Two-way communication

Steve: There are volumes written on the proper delivery of cues. However, there is comparatively little data written on the importance of observing the animals' response to this communication. The best training occurs when there is an exchange of information that results in both the learner and the teacher achieving something desirable. For this collaboration to occur at the highest-level communication needs to flow in both directions. The trainer delivers the cue and the animal responds in the most natural way possible ... with body language. I have worked hard to develop my skills of observation to help me read an animal's almost imperceptible

body language. The tiny raising of hair on the arm, the subtle glance of the eye, the barely visible shifting of body posture are just a few of the signs that I am sometimes almost intuitively aware of when training animals.

Susan: Both learners and trainers are active operators of their environment (hence the term operant conditioning). In this way, the science of behavior is different than other sciences. We don't "cause" animals to behave in the sense that physicists cause liquid to boil by turning up a flame. We can only set the occasion for particular behaviors; the animal's response to our cues is up to the animal. In the same way, the animals set the occasion for, and reinforce, our behavior in a perpetual feedback loop. Behavior is always the result of interaction with the environment in which all present are a part.

IV. Empowering Questions

Steve: I learned long ago that asking good questions could produce empowering information. The two questions I ask myself most when evaluating behavior situations are:

1. What's the Motivation?

All animals, including humans, evaluate situations from the perspective of "what's in it for me?" When I ask myself, "what's the motivation" when evaluating animal behavior it forces me to view the situation from the animal's perspective ... being very careful to avoid anthropomorphism. I understand animals make decisions based on their experience, motivation and prediction of the possible consequences associated with their actions. Animals are always going toward something or going away from something. We have the power to "make" animals do things or to "let" animals do things. The best results are gained by creating environments where the animal wants to perform the behavior the trainer asks.

*Susan: Careful antecedent arrangement and positive reinforcement (creating an environment where the animal approaches consequences rather than avoids them) should always be our first choice among training strategies. With positive reinforcement the animal learns what **to do** rather than just what **not to do**. And, unlike negative reinforcement and punishment it has no negative side effects (see Azrin, and Holz, 1966).*

2) How does it apply to the behavior of the species in the wild?

This question reminds me that internal forces in an animal sometimes motivate behavior. These innate, or hard-wired, behaviors are often self-reinforcing and therefore might continue no matter how long I ignore them. Understanding that hard-wired behavior accounts for some of the actions I see in animals gives me insight into the motivation for the behavior and helps me plan a strategy for influencing the behavior.

Susan: Innate behaviors are those performed without prior experience. From an evolutionary perspective, they likely serve important survival functions. Knowledge

of species-wide behavior patterns, as well as the environmental conditions which elicit them, increases our ability to predict, interpret and manage many behaviors in captive animals. Ultimately all behavior is flexible.

VI. Set Them Up To Succeed

Steve: Being a bird trainer has heightened my sensitivities to environmental elements that might affect a bird's behavior. The softest breeze blowing from behind a bird, a hawk 2,000 feet in the air, a moving car a half mile away, or even a new trainer standing quietly several feet away, can stop a bird from performing even the simplest behavior. I know I can't eliminate all the distractions in the environment, but the more distractions I remove the more successful the training session will be.

I have also come to understand the importance of knowing what the animal is capable of doing and only asking it to perform behaviors that are relatively comfortable for it to accomplish. If I do ask an animal to perform a difficult behavior, or one that it has less confidence in, I often ask the animal to perform a couple easy behaviors first to get the animal in a working frame of mind.

Susan: Preceding events, conditions and stimuli set the occasion for behavior to occur. Setting events and establishing operations are two classes of antecedents that are often under the control of the trainer and can be used to facilitate behavior. They increase or decrease the likelihood of a behavior occurring.

Regarding difficult behaviors, behavioral momentum is an interesting technique for getting a low-probability behavior (a behavior the animal is likely to resist doing) by first cueing a high probability behavior (a behavior the animal does quickly and easily, see Mace, et al, 1988).

VII. Repetition Builds Confidence

Steve: Slow performance of behavior is often little more than lack of confidence. Repetition is the key ingredient when creating confidence. I have trained hundreds of birds to go inside Vari kennels. At one time I thought just getting the bird inside the box and reinforcing it was enough to train the behavior. Often I was wrong. I later discovered the power of repetition and the strategy of allowing the bird to make the decisions. Now, instead of locking a bird in a crate with a nice reward after the first repetition, I allow the bird to go inside the crate for a reinforcer and then come back out. I also extend the time the bird is in the kennel by delaying the reinforcement or adding a second reinforcer. Once the bird shows signs that it wants to stay in the kennel to earn more reinforcers I begin to make the reinforcer contingent on the door closing. The end result is a bird that is comfortable and confident in the kennel.

I have since used this repetition strategy on many species of animals, especially ones that do not want to shift into cages or holding areas. There is little motivation for an animal to cross the threshold of a doorway if it knows it will be locked inside

till morning. However, if crossing the threshold results in a favorite treat being presented, and the animal is allowed to return to the exhibit yard, the animal is much more likely to perform the behavior in the future. With each repetition of passing through the door-way for a reinforcer the animal's performance of the behavior will likely improve. If the presentation of the food reward is contingent on the door closing for a few seconds, door closing becomes positive instead of negative. With each repetition the animal gains confidence in the door closing. When the door is finally shut for the night a large quantity of favorite foods and the confidence built through the repetitions will often soften the negative impact of being locked in over night.

Susan: Reinforcers are highly individual to each animal and circumstance. The property of being "reinforcing" is not a characteristic that is static or intrinsic to particular consequence. Only the animal's future rate of behavior provides the data as to whether or not a particular consequence is reinforcing at that time. For some animals, coming out of a kennel is an effective reinforcer for going or staying inside it. Similarly, stepping back from a frightened animal can be used to reinforce calm behavior and setting an animal down can reinforce stepping up.

VIII. Short Window of Opportunity

Steve: Animals in the wild learn the value of quick action. When opportunity presents itself, animals respond. If they respond slowly or incorrectly they learn from their mistakes and they go on. If they do not learn from their mistakes they will likely fall victim to their environment and die. In captivity where our highest priority is to protect our animals from harm and stress, the consequence of our animal's poor performance is usually minimal.

The lioness knows she has a very short window of opportunity to perform the behavior of chasing the waterbuck if she is to eat waterbuck tonight. Conversely, the waterbuck knows it has a very short window of opportunity to perform the avoidance behavior if it is to survive. Another analogy is a hawk that is sitting in a tree watching a mouse walk through a meadow. If the hawk waits too long, the mouse will go down the hole and the bird will lose its opportunity to catch the mouse.

I take advantage of this natural tendency to react quickly to environmental stimuli when training animals. I have found this strategy dramatically improves performance of behavior a majority of the time. Here is how I would use it when training an eagle to fly to the glove. First, I raise the glove to cue the behavior. If the bird responds quickly I reinforce the bird with a favorite treat and put her back on the perch for another repetition. If the bird does not respond in say three or four seconds, I lower my glove and put my hands behind my back, closing her window of opportunity to perform the behavior and earn the reinforcement. After just a few seconds I raise my hand, cuing the behavior again. The increase in attention span and performance of behavior is usually apparent after the first repetition.

Susan: Schedules of reinforcement account for predictable patterns of behavior. Limited hold is a contingency that rewards responding within a set interval of time and therefore produces more rapid responding.

IX. Train at the Animals Pace

Steve: Most animals are set up to react quickly to changes in their environment, and to learn from those experiences. This basic survival strategy serves wild animals especially well. It also exists in the animals we house in the safe confines of our exhibits.

Knowing that animals are probably capable of learning faster than I am capable of teaching, my goal is to try and work at the animal's pace. That means train fast. I set very aggressive goals for my training sessions and try to make as much progress as the animal will allow. Where some people might go into a training session hoping to shape a couple approximations, I go into each training session expecting to shape the entire behavior. My goal is to spend one repetition at each approximation of the behavior. If I have gauged my animal's motivation, skill and confidence correctly, she will perform the behavior without hesitation. If she hesitates in her performance, I will invest another repetition at that level. If she hesitates again I may back up to a previous approximation that I know she will perform without hesitation, or I might just end the session and try again later. My criterion for advancing from one approximation to the next is when the animal performs without hesitation. I am careful not to invest too much reinforcement history in any one step because it will send the message to the animal that this level of performance is all that is required for reinforcement. If I make progress with every repetition the message is clearer to the animal that progress is required for reinforcement.

Susan: Pace is related to behavior acquisition. A quick pace can reduce inter-response time which increases the opportunity for a higher rate of behavior and a higher rate of reinforcement. Both conditions are associated with behavioral fluency. A slow pace may in effect hold a learner back and slow down overall acquisition.

IX. The Power of Teamwork

Steve: The most successful animal trainers I have ever known have been part of an effective and skilled team. By sharing resources, planning strategies, and working together, all of the team members benefit at levels that might not be possible if they worked separately. The best teams are the ones where team members benefit from the same positive training strategies they use with their non-human animals. Great team members understand that recognition, praise and support are just a few of the affective motivators for humans. They also understand that negative approaches are poor tools for shaping human behavior.

Susan: All of us are smarter than one of us. The laws of behavior apply to all animals, species bar none.

Conclusion

As the window of opportunity opens ever wider for people to learn the scientifically validated principals of learning and behavior it is important to remember to reinforce creativity, imagination, and inspiration. The translation of sound theory into potent practice by standardizing training protocols, plans and procedures is important to improving our efforts to train well and on a large scale using the most-positive/least-intrusive effective methods. However, taken to the extreme we may reduce chefs to cooks and lose some of the potential for realizing the art of training.

Thinking outside the box is not a call to think outside of science. It is a call to think beyond simple recipes, that is, cookbook or train-by-numbers approaches. As long as we maintain high standards of accountability, there should be no risk, and likely significant gains, in allowing people to experiment and boldly follow their intuitions/latent databases to explore the art of the science of training.

References

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