

GOOD SCIENCE: SKINNER'S FUNCTIONAL RELATIONS AND DOG TRAINING

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The utility and scientific basis for the four quadrants, specifically the distinction between positive versus negative reinforcement and punishment has become a newly revived discussion in dog training. For those of us that train animals, regardless of the discussion's endpoint, it is an opportunity to make us more conscientious in our training and aware of the implicit and explicit lines we draw about our practices. In these new discussions, however, are suggestions questioning the scientific validity of learning theory/behavior analysis/behaviorism (this accusation was levied on the apparent inability to falsify Skinner's system of behavior). This is a serious accusation that requires addressing, given that it is behavior analysis that provides the basis and framework for our ability to train our animals and understand so much of their behavior. Despite the severity of the accusation, it is inaccurate and misguided.

First, the distinction between positive and negative is continually debated within the field by renowned behaviorists, as has been pointed out (Breedon, 2014). However, this does not open the door to a critique of the field as a whole. In other disciplines, specialists disagree about minutiae in their fields. Nevertheless, the overarching tenets of those fields hold. Second, and contrary to previous suggestions, behavior analysis is a scientifically valid field; its approach to identifying behavioral laws is similar to that of physics. The metric of falsifiability does not apply to behavioral principles as they, like the laws of physics, are not hypotheses. Therefore, the accusation of their unfalsifiability is empty. (As an aside, natural selection and evolution have been similarly accused of not being falsifiable and on similar grounds (Thompson, 1981).) The understanding that behavioral principles are functional relations, again, like physical laws has been lost in this most recent conversation and yet is essential in understanding the utility of behavior analysis.

Behavior analysis is "*a comprehensive experimental approach to the study of the behavior of organisms. Primary objectives are the discovery of principles and laws that govern behavior, the extension of these principles over species, and the development of an applied technology*" (Pierce & Cheney, 2003 p. 3). That is, Skinner and other behavior analysts sought and continue to seek to identify the variables that affect behavior. These include current external environmental variables (e.g., social stimuli, setting, and cues or discriminative stimuli), internal environmental variables (e.g., hormone levels, blood glucose levels), past experience (e.g., history of reinforcement or punishment), and individual and species-specific genetic factors. Behavior analysis focuses largely on the environmental determinants of behavior (motivational factors, cues or antecedent stimuli, and consequences) and the past learning history these provide, even while acknowledging and considering species-specific and genetic factors as variables. Moreover, like physical laws, the principles of behavior identified by behavior analysis have wide generality, not only encompassing a huge variety of actions and consequences, but also being evident in a broad range of the animal kingdom, ranging from insects to mammals.

Skinner was greatly influenced by Ernst Mach, a physicist and mathematician, who proposed an analysis of the natural world via functional relations. A functional relation is a more modern take on cause-effect relations - they are "simply correlated changes in two classes of phenomena" (Smith, 1986). The force equation in physics, $F = ma$ is just one example of a functional relation. It states that as mass (m) or acceleration (a) increases or decreases, so does force (F).

How does this apply to behavior, specifically dog training? If I increase how often my dog receives a treat after touching my hand with his nose and his touching behavior then increases in rate, the environmental event (treat delivery) and rate of behavior are correlated. If I no longer give him a treat when he touches my hand and I then see that the rate of nose touching decreases, my claim that treats and nose touching are functionally related is further substantiated.

Additionally, I can go back to delivering treats contingent on nose touches to further confirm this functional relation. In fact, we have done this very experiment (Feuerbacher & Wynne, 2012). Such experimental manipulations conducted within an individual animal are part of what make our science so strong and we can demonstrate functional relations in individuals (and it is the individual, not the "average" dog with which we should be concerned). In fact, there is a push in clinical trials to adopt these types of research methods to improve individualized medicine (Lillie et al., 2011).

We can identify and compile countless functional relations. For example, barking in one dog might increase in frequency when it produces owner attention, in another it might increase when it produces conspecific play, and yet in another it might increase when it produces distance from an aversive stimulus. However, as Poincaré noted, "Merely to observe is not enough. We must use our observations ... The scientist must set in order. Science is built up with facts as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house" (quoted in Moore, 2010). This is just what Darwin and Skinner both accomplished: they found the commonalities in individual instances of natural phenomena and organized them.

Darwin noticed individual instances of morphological differences between various species and inductively posited natural selection as a mechanism that might account for these variations. Similarly, Skinner and other behaviorists noted many instances of similar functional relations and organized them into principles of behavior. Some consequences produced increases in the rate or likelihood of a behavior that they followed (reinforcement) and others produced decreases in the rate or likelihood of a behavior that they followed (punishment). These instances of reinforcement and punishment are simply labels for functional relations between environmental events and behavior. We use these terms as shorthand: I can say more briefly "reinforcement" than "a consequence delivered contingent on behavior that increased the future likelihood of that behavior."

As such, these terms are definitions, which, unlike hypotheses, are not falsifiable. To be

clear, however, once a functional relation is indicated, that relation can be experimentally verified. That is, you can now test whether your environmental event is actually functionally related to your behavior of interest - but this does not bear on the concepts themselves of reinforcement or punishment, only that particular conjectured functional relation.

One criticism sometimes lobbed at behavior analysis is that it involves circular reasoning (explaining a phenomenon with the same evidence that we are trying to explain). Here's one such example that at first glance might appear to be circular: Why did my dog start touching my hand more frequently? Because of reinforcement. How do I know reinforcement occurred? Because the frequency of responding increased. However, these statements are not circular; they simply state a functional relation using the shorthand of "reinforcement." Marc Branch provided a parallel to the previous example using the force equation from physics: "If you see a mass accelerated, then a physicist says a force made it happen. But how do you know there was a force? Because a mass was accelerated! Sounds a lot like the definition of reinforcement" (personal communication, December 8, 2014).

If falsifiability does not apply as a meaningful metric to these functional relations, by what standard should we measure them, and the methods of behavior analysis more generally? We should measure them by whether this formulation of behavior is actually effective. Does it give us a cohesive view of behavior that allows us to effectively change behavior? I should hope as dog trainers that the answer is yes. (*Note:* for an excellent popular summary of the resurgence and success of Skinnerian techniques in society see Freedman (2012))

Lastly, what about the distinction between positive versus negative when referring to reinforcers and punishers? With regard to the terms positive and negative, the issue is two fold: one being the actual bio-behavioral existence of these two entities, and the other in the utility of the distinction. As has been pointed out (Breedon, 2014), the addition (positive) of food could be taken as the removal (negative) of hunger. Does it matter which is the case? From a purely theoretical perspective, it is certainly intriguing. Potentially more refined measures of behavior or neuroscience can point to an answer. While there are no decisive answers on this issue, we can address the utility of the distinction from a training perspective.

Drawing good/bad lines using quadrant lines can bind trainers in one of the four quadrants and certain techniques such as CAT and BAT are dismissed out of hand (Breedon, 2014). (As a side note, any training dealing with fear necessarily involves presentation of an aversive stimulus, including desensitization and counter conditioning, or click/treat for calm behavior). However, it is often how the training is carried out that matters. This suggests, then, that there are measurable ways for assessing the acceptability of our training practices even if using the quadrant system does not demarcate the correct lines for us.

If we were to eschew the nomenclature of positive and negative, we would not be free floating and now allowed to deliver any consequence we want because we have removed

the distinction between what has typically been viewed as "good" (positive reinforcement) and "bad" (negative reinforcement). The reason those types of consequences have been viewed as "good" or "bad" is likely due to their other side effects on behavior. It is these side effects that can be used to judge the consequences and contingencies, without specifically appealing to which quadrant they belong.

An example of how we can define acceptability in training is seen in the work of Alexandra Kurland. While relying heavily on what we would call positive reinforcement, she sometimes makes elegant use of negative reinforcement. Why is her use of negative reinforcement perceived as elegant and acceptable? Because the behavior of the horse, beyond the target behavior, is what we aim to achieve - the animal shows no signs of stress, no signs of avoidance, and the shaping steps she takes are so small that the horse is bound to succeed.

Why, though, is someone else's use of negative reinforcement, such as quickly pulling up on a choke chain to teach sit by only reinforcing the final behavior and not approximations unacceptable? Because the behavior of the dog, beyond the target behavior is not what we aim to achieve. If the dog has not been shaped through small steps to respond to that pressure and thus does not quickly contact reinforcement, the animal would likely show signs of stress along with escape and avoidance behaviors, all of which impede our training. From a purely practical standpoint that training is undesirable, because it would hinder the very learning we are trying to promote. Furthermore, there is a more attractive alternative that produces not just non-avoidance behaviors but actually produces affiliative behavior when training this target behavior: using food, play, or attention as consequences, not just escape from pressure.

This, then, is one of the most important questions we need to be consistently asking ourselves as trainers: are the contingencies we are applying producing the behavior that we, as humane-technique-seeking trainers want? Does the animal come freely to participate in a training session? Will it stay in the training session or would it escape if given the opportunity? Do our consequences elicit other behaviors that might interfere with our training (e.g., the dog will no longer approach the trainer or the dog is so stressed that it cannot learn)?

Perhaps we do need new nomenclature that takes these measures into account, and the positive/negative reinforcement quadrant lines do not wholly encapsulate that distinction. But we can appreciate the attempted drawing of the positive/negative line as a means of capturing a needed distinction of how different contingencies affect our animals. Given the ethics that guide our profession, the distinction between acceptable and unacceptable training, or best, better, good, and bad training still exists, and defining that distinction would mean identifying what we want from our training (effects on our target behavior as well as side-effect behaviors), and systematically evaluating when our training meets those goals and when it does not - and whether that difference falls along positive/negative quadrant lines or not. Perhaps it is time for trainers to meaningfully explore these questions and we can do so by understanding and evaluating environment-behavior relations using the strong science of behavior analysis.

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