

Reinforcement Theory and Behavior Analysis

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Empirical laws in the study of animal and human behavior have been the pursuit of behavior analytic psychologists for at least a century. One of the earliest theoretical, empirical laws in the history of behavior analytic psychology is "the law of effect", credited to E. L. Thorndike at the turn of the 20th century. Behavioral psychology has had quite a history since the law of effect and different directions for the science of human behavior have resulted. In this paper, the response deprivation/disequilibrium hypothesis is traced from its behavioral roots in the law of effect. Skinnerian reinforcement and predictive theoretical accounts of reinforcement are discussed. It is concluded that behavior analysis and the science of human behavior can benefit from theoretical and empirical accounts of reinforcement, further developing our understanding of the circumstances of reinforcement.

Empirical laws in the study of animal and human behavior have been the pursuit of behavior analytic psychologists for at least a century. One of the earliest theoretical, empirical laws in the history of behavior-analytic psychology is "the law of effect." The law of effect, as described by E. L. Thorndike near the turn of the century, is paraphrased below (Thorndike, 1911):

Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation reduced, so that, when it recurs they will be less likely to occur (p. 44).

This statement of the law of effect appears as a rudimentary and cumbersome description of reinforcers and punishers (Skinner, 1938). In addition, the terms used are susceptible to interpretation. However, the revival of the law of effect will serve as a reminder that the event of strengthening (or weakening) a response should be distinguished from circumstances under which strengthening occurs (Hayes, Adams, & Dixon, 1996; Champion, 1960).

Thorndike went beyond the statement of the law of effect as quoted above, by theorizing "satisfiers and annoyers could be defined independently of the learning situation as stimuli which the organism approaches and avoids, respectively" (Champion, 1960, p. 12). Thorndike spent considerable effort in suggesting ways by which these affective states could be independently assessed (Podsakoff, 1982). Thorndike's implicit supposition that "satisfiers are strengtheners and annoyers are weakeners has been tested empirically and proves to have more limited application than he might have hoped" (Champion, 1960, p. 12). In 1938, Muenzinger conducted experiments in Colorado showing that Mr.

Thorndike's statement of the facts is correct, but incomplete (Muenzinger, 1938, p. 217).

Skinner's Atheoretical Account of Reinforcement

Shortly after Thorndike's initial and incomplete description of reinforcement and punishment, an entirely atheoretical approach to reinforcement dominated applied, experimental, and scholarly activities of behavior analysts. More specifically, B. F. Skinner's description of the law of effect (Skinner, 1938):

The operation of reinforcement is defined as the presentation of a certain kind of stimulus in a temporal relation with either a stimulus or a response. A reinforcing stimulus is defined as such by its power to produce the resulting change. There is no circularity about this; some stimuli are found to produce the change, others are not, and they are classified as reinforcing and non-reinforcing accordingly. A stimulus may possess the power to reinforce when it is first presented (when it is usually the stimulus of an unconditioned respondent) or it may acquire the power through conditioning (p. 62).

Skinner's account of reinforcement, "the empirical law of effect," is purely pragmatic and a post-hoc classification of observed events. Decades of research have revealed the limited utility of reinforcement conceptualized in this manner in obtaining (or advancing) the scientific goal of predicting reinforcement effects a priori. This does not discount the extremely valuable utility of operant conditioning and the application of radical behaviorism in a wide variety of contexts. The intent is to point out the limitations as a theory and for predicting instrumental performance.

The empirical law of effect has been criticized as (Postman, 1947; Timberlake & Allison, 1974) circular, meaning it cannot be falsified or disproved by experiment. Skinner was aware of this criticism (or perhaps saw the potential circular interpretation), given the quote regarding reinforcement cited earlier. To illustrate the circularity criticism, "if a particular consequence is associated with an increase in the probability of the instrumental response, then it is a reinforcer; otherwise it is not" only defines a reinforcer; it is not a law (Timberlake & Allison, 1974, p. 146).

Based on these findings, some of the behavior analytic community began to look for alternative accounts of reinforcement, others decided to treat problems such as satiation and hunger "as boundary conditions in the application of the empirical law of effect" (Timberlake & Allison, 1974, p. 147). Paul Meehl (1950) attempted to salvage the empirical law of effect (or at least recognized that the circularity criticism would be mute) by introducing the "transitional hypothesis."

The Transituational Hypothesis

The circularity of the empirical law of effect (not falsifiable, experimentally disproved) could be avoided if stimuli identified as reinforcers or punishers would function to increase or decrease, respectively, the probability of behavior (Meehl, 1950). However, the observation that stimulus function (as reinforcer, neutral stimulus, or punisher) can change depending upon a multitude of variables, eliminates the possibility of "transituational" stimulus function. The simple observation that food will not function as a reinforcer for a satiated rat illuminates this transitory stimuli. Timberlake and Allison (1974) say, "this result is so intuitively obvious that little has been made of it" (p. 147). The lack of "transituational" reinforcers and punishers when applied by the layperson is perhaps the most popular, yet unfounded claim against the behavior analytic tradition. When a "reinforcer" does not "work" for someone, a common reaction is "reinforcement does not work". This is obviously a misrepresentation of the facts, brought about by confusion regarding the definition of reinforcement.

Although Meehl may not have developed a long-standing theory of reinforcement, he opened the door for other approaches to dealing with 'the inadequacy of the empirical law of effect as a predictor of instrumental performance' (Timberlake & Allison, 1974, p. 146). In Meehl's defense, the primary behaviors and reinforcers discussed in the behavior analytic literature at the time were bar pressing, key pecking, and food pellets, respectively. Although as Muenzinger (1938) points out, "the theoretical principles of behavior which we want to invent must be the same for rats and human beings" (Muenzinger, 1938, p. 215).

The Premack Principle

The probability-differential hypothesis of David Premack (1959, 1965) is the most cited progression in the pursuit of empirical laws predicting instrumental performance. Probably the most significant change in Premack's hypothesis was the radical departure from the typical methodology in experimental analyses of behavior. The change was from a focus on a stimulus consequence (reinforcer, punisher) following a behavior, to a focus on the relative probability of two known reinforcing responses. In one attempt to provide a comprehensive empirical framework for explaining instrumental performance, Premack (1965, 1971) has suggested that both the instrumental response and the contingent event be considered in terms of their behavioral characteristics (Heth & Warren, 1978). "Premack's approach marks an important change in the conception of reinforcement. In the traditional view, reinforcement is produced by a stimulus. In Premack's view, reinforcement is related to access to a response" (Timberlake & Farmer-Dougan, 1991, p. 381).

Premack boldly moved away from traditional notions of reinforcement (stimulus-response, linear) toward a response-response conception of reinforcement. "Most importantly, though, Premack's approach predicts outcomes that violate the assumptions of the transituationality approach" (Timberlake & Farmer-Dougan, 1991, p. 381). However, researchers quickly discovered that Premack's conception of reinforcement was

also incomplete. Eisenberger, Karpman, and Trattner (1967) conducted experiments with results in conflict with Premack's postulation. They found that a lower-probability behavior could also serve as a contingent (reinforcing) response if the behavior is reduced (suppressed) below its baseline level. A related conception of reinforcement resulted from "a reanalysis and extension of research by Premack" (Timberlake & Farmer-Dougan, 1991, p. 383) called the response deprivation hypothesis (Timberlake & Allison, 1974).

Response Deprivation Hypothesis

Using the probability-differential hypothesis framework, Timberlake and Allison (1974) proposed an "adaptive-model" of instrumental performance, with the central concept of response deprivation. "The condition of response deprivation is defined to occur if the animal, by performing its baseline amount of the instrumental response, is unable to obtain access to its baseline amount of the contingent response" (Timberlake & Allison, 1974, p. 152). As Timberlake and Allison point out, "many of the contingencies that satisfy the response-deprivation condition satisfy the probability-differential condition as well" (Timberlake & Allison, 1974, p. 152). However, the major difference between the two theories of reinforcement is Premack assumed reinforcement to be the result of a probability differential between two responses, Timberlake and Allison assume reinforcement to be determined by the response-deprivation condition. Allison and Timberlake (1974) conducted experiments that demonstrated the probability-differential condition was not necessary for instrumental performance (an increase in instrumental responding above baseline) in schedules meeting the response deprivation condition requirements.

There are two major assumptions of the model. First, it is assumed that "instrumental performance is a result of the conflict between the freely occurring behavior of the animal and the restrictions of a schedule" (Timberlake & Allison, 1974, p. 150). The second assumption of the model is "that resolution of the conflict between the determinants of free behavior and the requirements of the schedule is based on the biological equipment and capacities of the animal involved. An adaptive outcome is not necessarily most efficient (profitable) in obtaining access to the contingent response" (Timberlake & Allison, 1974, p. 151). In short, if the conflict situation occurs or can be arranged by the scientist or practitioner, instrumental performance (increased instrumental responding relative to baseline) is predicted. The amount of increase in instrumental responding relative to baseline is not predicted, only increases (and decreases) in instrumental responding.

Disequilibrium Account of Reinforcement

Timberlake's most recent iteration of the response deprivation hypothesis introduces the "disequilibrium approach" to incorporate conditions of two types. The two types are "response deficit (originally referred to as response deprivation) and response excess" (Timberlake & Farmer-Dougan, 1991, p. 383). Response deficit conditions predict increased instrumental performance (positive reinforcement) and

response excess conditions predict decreased instrumental responding (punishment; Timberlake, 1980).

Timberlake provides a convincing argument for adopting the response deprivation/disequilibrium approach to predicting instrumental performance. "In sum, relative to the probability-differential model, the disequilibrium approach is both more specific and less limited in its application. Rewards are not restricted to higher probability responses, units of measurement are not limited to duration, and long-term denial of access is not required. In addition, rules for the specification of schedule terms are provided" (Timberlake & Farmer-Dougan, 1991, p. 385). At this point seems appropriate to point out that it is not the author's position that the goal or aim of behavior analysis should necessarily be the prediction and control of instrumental performance. However, the author certainly values the pursuit of empirical laws of prediction and control of behavior through scholarly pursuits regarding reinforcement theory and experimental methodology.

CONCLUSION

Almost 100 years after Thorndike's 1911 publication on the law of effect, it is clear that stimuli identified to function as reinforcers (or punishers) in one situation are not transituational. Furthermore, the circumstances under which reinforcers are utilized can enhance, hinder, reverse, and/or change the reinforcing effect of previously identified reinforcers. "Responses, no matter what their probability, have no absolute or pairwise value as reinforcers. Any directional reinforcement value must begin with the disequilibrium condition resulting from the degree of conflict between baseline responding and the requirements of the schedule" (Timberlake & Farmer-Dougan, 1991, p. 384). In addition, "there are not unique classes of reinforcers or punishers, sets of stimuli, or responses that have transituational reinforcement effects. Neither are there unique combinations of baseline response probabilities that produce reinforcement" (Timberlake & Farmer-Dougan, 1991, p. 384).

The majority of comments provided in this historical trace of reinforcement theory in behavior analysis, from the law of effect to the disequilibrium approach to reinforcement, are exact quotes or close approximations to statements made by many scientists, many times before. However, their import seems almost ignored in the majority of current experimental, applied and theoretical publications in behavior analytic psychology. Evidence for this ignorance is manifested in accounts of reinforcement without acknowledging alternatives and accepting without question, an atheoretical approach to reinforcement as conceptualized by Skinner and others early in the progression of behavioral accounts of psychological behavior.

The public proclamation of and empirical evaluation of theories of reinforcement in behavior analysis are important for a variety of reasons. The primary reason in the current instance is to remind behavior analysts of the potential to increase our "conceptual analysis of the circumstances of reinforcement" (Timberlake & Farmer-Dougan, 1991, p. 379). Furthermore, revisiting theoretical accounts of reinforcement is an attempt to highlight their utility, in both applied and basic settings. Regardless of the reader's opinion regarding the contents of the current manuscript and/or the

goal of predicting instrumental performance, it is the author's intent to perpetuate the pursuit of theoretical accounts of reinforcement in behavioral psychology.

The applied utility of the atheoretical application of the law of effect, the probability-differential hypothesis and the response deprivation/disequilibrium approach to reinforcement and behavior control have been clearly established and as stated earlier, this has not been an attempt to discount these tremendous accomplishments. However, I have tried to make obvious to behavior analysts that the ability to predict the reinforcement effect of disequilibrium conditions would lead to a more complete understanding of the circumstances of reinforcement and is reason alone to pursue predictive, theoretical, empirical accounts of reinforcement. The results of these investigations will provide further information regarding a number of central and important aspects of both a theoretical and predictive conceptualization of reinforcement. Furthermore, it is a pursuit worthy of scholarly effort as behavior analysis continues efforts to advance the psychological science of behavior.

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