

This Week's Citation Classic®

Reynolds G S. Behavioral contrast. *J. Exp. Anal. Behav.* 4:57-71, 1961.
[Harvard University, Cambridge, MA]

A pigeon's rate of pecking during one stimulus was modified by changing only the schedule of reinforcement associated with a different stimulus. Response rate during the stimulus, correlated with the unchanged schedule, was increased by reducing the rate of reinforcement during the alternative schedule, independent of whether response rate during the alternative schedule was changed or unchanged. [The *SCI*® and the *SSCI*® indicate that this paper has been cited in more than 455 publications.]

How Relative Value Controls Behavior

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August 21, 1990

When my deceased colleague, George Reynolds, published his famous paper on behavioral contrast in 1961, the field of operant conditioning had only recently emerged as a distinctively different approach to experimental psychology. Its nascence occurred in the late 1950s when a critical mass of the students of B.F. Skinner and Fred Keller conspired to rebel against the strictures of the prevailing experimental customs, which had frequently hindered the publication of their analyses of the behavior of individual organisms. The result was the creation of the *Journal of the Experimental Analysis of Behavior*, which published its first issue in 1958.

Reynolds was a graduate student at Harvard University during the late 1950s when this enthusiasm was at its peak, and he was one of the leaders of a band of Young Turks who published a number of seminal research articles in the early 1960s that challenged orthodox wisdom and provided the intellectual fuel to propel operant conditioning into the ascendant approach to animal learning during the next decade. His paper on behavioral contrast was among the most important papers of this period.

Previous studies of discrimination learning had been dominated by the Pavlovian concepts of excitation and inhibition, particularly as they had been combined with the concept of stimulus generalization by Kenneth Spence in the 1930s. These basic concepts served as the core of virtually all subsequent theoretical analyses of conditioning. They persist today in a variety of successful theories of conditioning, notably the Rescorla-Wagner model¹ that has dominated research on Pavlovian condi-

tioning for the past two decades. A basic prediction of this approach is that separate reinforcement during an S+ (e.g., red) and nonreinforcement during an S- (e.g., green) should result in some degree of generalization between the two stimuli, so that the excitatory/inhibitory properties of one should transfer to the other. Thus, when reinforcement during red is alternated with nonreinforcement during green, the response rate controlled by red should be lower than when it was reinforced in isolation. But throughout the 1950s there were sporadic reports of just the opposite finding. Nonreinforcement of the S- elevated response to the S+. This directly challenged the basic concepts of incremental learning theory and continues to do so still today.

In his doctoral dissertation, which resulted in his 1961 paper, Reynolds showed for the first time that this elevation in response rate was due to changes in the relative rate of reinforcement associated with the S+. By a variety of techniques, he demonstrated that it was not simply that the response rate during the S- had been decreased (or altered in other ways) or that the subject had suffered the frustrative effects of extinction, since these manipulations without changes in the relative rate of reinforcement had little effect. Conversely, changes in the relative rate of reinforcement in the absence of these other manipulations produced major changes in responding. The result was that the concept of relative rate of reinforcement was elevated into a fundamental concept of conditioning.

The basic idea underlying the relative rate of reinforcement as a controlling variable is that the value of a given reward contingency, as indexed by the response rate that it maintains, is relative to the context in which it occurs. Much of the subsequent history of operant conditioning has been closely tied to providing a theoretical basis for why "relative value" is a dominant controlling variable. Behavioral contrast continues to be a heavily investigated topic,² but is now only one of many settings in which relative value is a critical explanatory concept. Richard Herrnstein has extended the idea to both choice behavior and simple response strength,³ and it serves as the underlying concept for the most influential account of conditioned reinforcement effects as well.⁴ Its kinship to the notion of "contingency" in the domain of Pavlovian conditioning has also been widely recognized. The issue raised by all such concepts is the mechanism by which these effects of reinforcement context are mediated. In 1961 Reynolds clearly demarcated the issue for the first time, and in doing so inspired a huge amount of subsequent research.

1. Rescorla R A & Wagner A R. A theory of Pavlovian conditioning: variations in the effectiveness of reinforcement and nonreinforcement. (Black A H & Prokasy W F, eds.) *Classical conditioning II: current research and theory*. New York: Appleton-Century-Crofts, 1972. p. 64-99. (Cited 325 times.)
2. Williams B A. Another look at contrast in multiple schedules. *J. Exp. Anal. Behav.* 39:345-84, 1983. (Cited 45 times.)
3. Herrnstein R J. On the law of effect. *J. Exp. Anal. Behav.* 13:243-66, 1970. (Cited 640 times.) [See also: Herrnstein R J. Citation Classic. (Smelser N J, comp.) *Contemporary classics in the social and behavioral sciences*. Philadelphia: ISI Press, 1987. p. 111.]
4. Fantino E. Conditioned reinforcement: choice and information. (Honig W K & Staddon J E R, eds.) *Handbook of operant behavior*. Englewood Cliffs, NJ: Prentice-Hall, 1977. p. 313-39. (Cited 60 times.)