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This Week's Citation Classic

Terrace H S. Discrimination learning with and without "errors."
J. Exp. Anal. Behav. 6:1-27, 1963. [Columbia University, New York, NY]

Discrimination of color can be learned without responses to S- ('errors') if training begins early in conditioning, with S + and S-differing with respect to brightness, duration, and wavelength. The brightness and duration differences are faded out progressively leaving only the difference in wavelength. [The Social Sciences Citation Index® (SSCI®) indicates that this paper has been cited over 185 times since 1966.]

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"Watching a pigeon learn to discriminate two colors without making any errors came as a rude but pleasant surprise during my first graduate school project on animal learning. I was actually pursuing a different problem based on work I had done during the previous summer for H.M. Jenkins (then at Bell Labs, Murray Hill, New Jersey). Jenkins speculated that, during discrimination learning, errors functioned as a source of intermittent reinforcement. He tested this hypothesis by comparing resistance to extinction after three types of training: continuous reinforcement, intermittent reinforcement, and successive discrimination. For each subject given intermittent reinforcement, non-reinforcement occurred on those trials in which a matched subject from the discrimination group made an error. Jenkins's hypothesis was clearly confirmed: the continuous reinforcement group showed significantly less resistance to extinction than the intermittent reinforcement and discrimination groups.[1]

"When I returned to Harvard I began to study this effect parametrically by varying the number of errors that occurred to S-. Quite arbitrarily I decided first to minimize (as opposed to maximize) the number of errors needed to learn a successive red-green discrimination. I started training with a simple discrimination (red vs. no color) shortly after the pigeon was trained to peck the response key, and faded slowly to the more difficult red-green discrimination. The first three subjects made no errors during their first session. To my amazement they continued to perform perfectly, that is, to respond to S+ and not respond to S-, during 30 subsequent sessions.

"I decided that 'errorless discrimination learning' was a more interesting dissertation topic than a parametric variation of a well-documented phenomenon. My dissertation research, the basis of my article 'Discrimination learning with and without "errors," ' opened a new area of research stimulus control. Originally, this work was cited because it challenged a widely held assumption that 'extinction is the hallmark of discrimination learning.'[2] Subsequent research showed that certain widely observed 'by-products' of discrimination learning do not occur following errorless learning, for example, behavioral contrast, the peak shift, inhibitory stimulus control, drug induced responding to S-, and escape from S-. I hypothesized that these phenomena were direct consequences of the frustration caused by emitting unreinforced responses to S-.[3]

"Because the 'fading' procedure I used to establish errorless learning was conceptually similar to the programs used in teaching machines and because pigeons who learned to discriminate without errors seemed less frustrated than those who learned with errors, B.F. Skinner, my dissertation advisor, cited my results as evidence for the efficacy of programmed instruction. Other researchers demonstrated that the fading techniques I introduced proved successful in training children as well as animals.[4] However, my theory that errorless learning resulted in a neutral S-, one that evoked no conditioned inhibition, turned out to be an oversimplification. As is the case with so many interesting phenomena in psychology, multiple causation, involving factors that I did not anticipate, proved to be the rule."

1. Jenkins H M. The effect of discrimination training on extinction. J. Exp. Psychol. 61:111-21, 1961.
2. Keller F S & Schoenfeld W N. Principles of psychology; a systematic text in the science of behavior. New York: Appleton-Century-Crofts, 1950. 431 p.
3. Terrace H S. By-products of discrimination learning. (Bower G H, ed.) The psychology of learning and motivation. New York: Academic Press, 1972. Vol. 5. p. 195-265.
4. Schreibman L & Koegel R L. A guideline for planning behavior modification programs for autistic children. (Turner S M, Calhoun K S & Adams H E, eds.) Handbook of clinical behavior therapy New York: Wiley, 1981. p. 500-26.