

This Week's Citation Classic

Catania A C & Reynolds G S. A quantitative analysis of the responding maintained by interval schedules of reinforcement. *J. Exp. Anal. Behav.* 11:327-83, 1968.
[New York Univ., Bronx, NY and Univ. California San Diego, La Jolla, CA]

By studying how pigeons' pecking depended on varying times between peck-produced food deliveries, we were able to design schedules that generated relatively constant rates of pecking over extended periods. Such schedules provide useful baselines for assessing how drugs and other variables affect behavior. [The *Social Sciences Citation Index*[®] (SSCI[™]) indicates that this paper has been cited over 210 times since 1968.]

A. Charles Catania
Department of Psychology
University of Maryland Baltimore County
Catonsville, MD 21228
and
George S. Reynolds
Department of Psychology
University of California
La Jolla, CA 92037

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"George Reynolds and I began this research while we were both graduate students working in B.F. Skinner's pigeon laboratory at Harvard University. Ferster and Skinner¹ had developed the subject matter of reinforcement schedules there. Responding is maintained by its reinforcers or consequences, as when a pigeon's pecking persists if it occasionally produces access to grain. Rate of responding and its patterning in time depend on the schedule, an arrangement determining which responses produce reinforcers. We systematically examined variable-interval (VI) schedules, in which responses become eligible to produce reinforcers at varying times after some event. This schedule is important because responding need not interact with the delivery of reinforcers: as long as response rate exceeds some minimum value, response rate does not affect reinforcement rate. The implications were practical as well as theoretical, in that VI schedules had become schedules of choice for generating behavioral baselines.

"We set up two experimental chambers

using available electromechanical equipment. The successive occasions on which responses could produce VI reinforcers were usually arranged by punched tapes driven past a sensing switch. Our main technical innovations were substituting a stepping motor for the continuous tape drive, so we could synchronize our recording circuitry with the intervals on the punched tape, and designing our schedules explicitly in terms of reinforcement probability as a function of elapsed time. Because session durations varied with schedule parameters, one of our more difficult problems was that of ordering the values studied for different pigeons so that all could be run within the available time. Daily sessions, from June 1960 through May 1962, included weekends and holidays. "We submitted and then withdrew our first manuscript in 1961, after deciding that one comprehensive paper was preferable to several short ones. In successive drafts, we condensed theory and expanded empirical content, and several revisions and editorial reviews culminated in the published monograph supplement. Most citations were probably to the second of two appendices, which provided a rationale and a simple formula for constructing VI schedules that generated constant response rates. Our schedule finitely approximated the output of a random generator. As solid-state devices and dedicated computers gradually replaced electromechanical equipment, the instrumentation of such schedules became routine. Our monograph also demonstrated how momentary and overall response rates were jointly determined by momentary and overall reinforcement rates. Those functional relations have entered into a variety of mathematical accounts of reinforced behavior. We acknowledge that our technical appendices are fast becoming obsolete, but are pleased by the continuing citation of our empirical findings. Skinner had left us free to select our own research directions, and we regard those opportunities to conduct our own research as crucial aspects of our early careers. We mainly regret that few such rewarding laboratory environments exist these days for us and for our students."

1. Ferster C B & Skinner B F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957. 741 p.