

This Week's Citation Classic

Staddon J E R & Simmelhag V L. The "superstition" experiment: a reexamination of its implications for the principles of adaptive behavior. *Psychol. Rev.* 78:3-43, 1971. [Duke Univ., Durham, NC and Scarborough Coll., Univ. Toronto, Canada]

The paper describes two kinds of behavior of hungry pigeons given periodic brief access to food: interim activities, that occur just after food, and the terminal response, that occurs in anticipation of food. The paper offers a view of reinforcement as selection to account for them and for a number of other anomalous results. [The Social Sciences Citation Index® (SSCI™) indicates that this paper has been cited over 200 times since 1971.]

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January 20, 1981

"The experimental part of this paper was based on Virginia Simmelhag's University of Toronto MA thesis. The experiment, begun in 1966, was strictly of the 'what if?' variety normally regarded as unfundable by any responsible granting agency. The experiment was originally done to see if pigeons exposed to aperiodic (i.e., variable-time) food deliveries would show the same kinds of stereotypy as that demonstrated with periodic (i.e., fixed-time) food by B.F. Skinner in 1948.¹ (They do.)

"Skinner's famous account was anecdotal and had never been formally replicated—possibly because of behavioristic distrust of observational data. Virginia and I were familiar with ethological methods of recording behavior in one-second time bins and decided that this might be an appropriate method here. The results were strikingly reliable: pigeons (and, in later work, rats² and golden hamsters³) partition the fixed time between food deliveries into two periods, an interim period just after food, when food is never available, and a terminal period, when food is probable. During the interim period they engage in vigorous but non-food-related activities, during the

terminal period they engage in food-related activities which, for pigeons at short interfood intervals, usually include pecking. The terms interim and terminal have passed into general use.

"Our results nicely complemented experiments by Brown and Jenkins and Williams and Williams which showed that key pecking in pigeons (the prototypical operant response) could be induced and maintained by a classical conditioning procedure, even in the face of opposing instrumental contingencies (autoshaping and automaintenance).^{4,5} These results, and others on so-called 'schedule-induced' behaviors, had been the cause of a 'crisis' in the field. Our paper provided a unified account which pointed out the two-part nature of reinforced learning: a process of behavioral variation that generates behavior and allows animals to sample their environment, and an opposed process of selection that picks out effective variants. The conventional concept of 'reinforcement' corresponds only to the second, selective process. Autoshaping involves the first process, hence it is not surprising that it fails to fit the usual reinforcement account. The timeliness of the paper in explaining these anomalies probably accounts for its success.

"We argued that the partitioning of the interfood interval into interim and terminal periods is a result of built-in processes for the efficient allocation of behavior. Optimality analyses of operant behavior are now an active research area.⁶

"The first version of the paper was a short, mostly experimental report. A couple of paragraphs in the Discussion appeared cryptic to reviewers and their interest prompted me to greatly expand the theoretical part to explain the numerous anomalies to which I have alluded. Virginia's levelheaded criticism restrained and simplified these theoretical excursions."

1. Skinner B F. "Superstition" in the pigeon. *J. Exp. Psychol.* 38:168-72, 1948.
2. Staddon J E R & Ayres S. Sequential and temporal properties of behavior induced by a schedule of periodic food delivery. *Behaviour* 54:26-49, 1975.
3. Anderson M C & Shettleworth S J. Behavioral adaptation to fixed-time food delivery in golden hamsters. *J. Exp. Anal. Behav.* 25:33-49, 1977.
4. Brown P L & Jenkin H M. Auto-shaping of the pigeon's key-peck. *J. Exp. Anal. Behav.* 11:1-8, 1968.
5. Williams D R & Williams H. Auto-maintenance in the pigeon: sustained pecking despite contingent non-reinforcement. *J. Exp. Anal. Behav.* 12:511-20, 1969.
6. Staddon J E R, ed. Limits to action: the allocation of individual behavior. New York: Academic Press, 1980. 320 p.