

Competitive DRL performance in humans: Differential reinforcement of short poststimulus pausing

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Pairs of human subjects were trained to press a lever according to 5-sec and 12-sec DRL reinforcement schedules. Subjects initially responded independently of one another during baseline sessions and then competed against one another on the same schedule parameters. Results indicated that poststimulus pause durations during competitive sessions were shorter and more closely approximated the schedule value than did poststimulus pause durations under independent conditions. Competition as a means of establishing optimal sensitivity to schedule requirements is discussed.

Early investigations of competitive behavior emphasized differential reinforcement of speed of responding in laboratory animals (e.g., Bayroff, 1940; Lepley, 1937; Winslow, 1940). Although most studies failed to demonstrate response facilitation because discrepant performance differences characterized opponents' behavior, Church (1961, 1962) was able to show orderly changes in competitive behavior when reinforcement was made contingent on specific response topographies.

Among the dependent measures in the analysis of human competitive behavior is performance on standard schedules of reinforcement. For example, Buskist, Barry, Morgan, and Rossi (1984) exposed subject pairs to a fixed-interval (FI) schedule of reinforcement, in which lever-presses occasionally produced points on a game console. During initial sessions, subjects' responding was reinforced according to their individual proficiency on the reinforcement schedule. Next, subjects were exposed to a contingency in which the first person to meet the FI schedule requirement received points for that interreinforcement interval (IRI). Subjects' responding under competitive conditions increased relative to rates under independent conditions. Moreover, although responding under the independent conditions resembled the varieties of behavior of human subjects under typical FI contingencies (see Lowe, 1979), each subject responded with a consistent break and run pattern during competitive FI conditions.

The present experiment examined competitive human performance under a different temporally based reinforcement schedule, a differential reinforcement of low rate (DRL) schedule.

METHOD

Subjects

Two pairs of male Auburn University undergraduates volunteered to serve as subjects in exchange for class credit in their introductory psychology class. No subjects reported any previous experience with behavioral research.

Apparatus

Subjects were seated individually before either of two identical response consoles housed in separate sound-attenuated and darkened cubicles. Each console measured 55 × 31 × 44 cm and sat on a 70-cm-high table. The front portion of the console slanted upward at an angle of 45°. Mounted on the center of the console was a four-unit LED counter. Directly above the counter, at distances of 4 cm and 16 cm, respectively, were two lights, an amber "session" light and a green reinforcement-feedback light. Directly below the counter, at a distance of 4 cm, was a red "loss" light. Located in the upper left-hand corner of the console was a row of three small lights, each measuring 1.2 cm in diameter. From left to right, the colors of the lights were blue, white, and red. In front of each console was a small wooden box (10 × 10 × 10.5 cm) which contained a standard Gerbrands primate lever. Housed in a room adjacent to the cubicles was a TRS-80 Model I microcomputer that controlled all experimental conditions and data collection.

Procedure

Experimental sessions were conducted at the same time daily, Monday through Friday. Prior to the initial session, each subject was read the following instructions:

By depressing this lever you may earn points on this counter (experimenter pointed to corresponding lever and counter). Every lever press, however, may not result in accumulating points on the counter. The amber light is a signal that the experimental session has begun; when it goes off permanently, the session is over. Every time you receive points on the counter, the amber light will go off for a few seconds and the green light will come on. Each illumination of the green light will indicate that you have earned 25 points. These points will be added to any other points you may have already earned. Responding while the green light is on will not affect your point earnings. The red light will not be operative during this part of the experiment.

Subjects were also told that the lights in the upper left-hand corner of the console would, in some way, aid them in responding on the lever. Questions regarding the experimental procedure were answered by

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rereading the appropriate section(s) of the instructions. A set of typed instructions remained in each booth throughout the experiment. Watches were not worn by subjects, and a clock was not present in either cubicle.

Training

During initial experimental sessions, subject pairs were exposed to gradually increasing values of a DRL schedule of reinforcement (e.g., 2-min session durations at DRL 2, then 3-min session durations at DRL 3, etc.), until eventually reaching two terminal values, 5- and 12-sec. During each session, either the blue or red stimulus light was illuminated for the entire session. For one pair of subjects, the blue stimulus light signaled the DRL 5-sec schedule and the red light signaled the DRL 12-sec schedule; for the second subject pair, these stimuli and schedules were reversed.

Independent sessions

Next, subject pairs were randomly exposed to four sessions of each DRL schedule parameter (with the stipulation that no schedule parameter occurred more than twice in succession). Subjects' responses had no programmed effect upon one another's point earnings and contributed only to each one's own point tally. After each session, the experimenter entered each subject's cubicle to inform him of his coactor's total point tally for that session.

Competition

After the independent condition, subjects were instructed as follows:

Starting today you will be competing against one another for the points. Whenever the red light comes on in your booth, your opponent has earned the 25 points, and you have not. As before, whenever you receive the points, your green light will come on briefly. At the end of each session, I'll come into your booth to inform you of your opponent's final score.

Subject pairs then were randomly exposed to four sessions of each schedule parameter.

During competitive sessions, the first pair member to satisfy the DRL schedule requirement received 25 points, and his green reinforcement light illuminated. During this same period, the other subject received only illumination of the red "loss" light. Termination of point delivery started the next IRI. During competition, if a subject responded before the programmed IRI had elapsed, the interval was automatically reset for that subject only. The other subject's interval was not reset, and reinforcement became available as scheduled. Delivery of points to either subject automatically reset the IRI for both subjects. The experimenter entered each subject's booth at the finish of each competitive session to inform him of the final score of that competitive bout. Independent and competitive sessions were 9 min long.

RESULTS AND DISCUSSION

The DRL schedule delivers reinforcement contingent on a response only if the response follows a period of non-responding as defined by the schedule value. For this reason, the critical datum with respect to DRL schedule performance would seem to be the duration of the post-stimulus pause rather than the absolute response rate. The poststimulus pause (PSP) is the time elapsed between the offset of the green light (during independent sessions) or the red or green light (during competitive sessions) and the first response in the subsequent IRI. PSP durations are equal to postreinforcement pause durations and are used in the present case since both subjects received correlated stimuli but only one subject received reinforcement during each IRI. It would be expected that the competitive DRL contingency would differentially select for

PSPs closer to the schedule value than during independent conditions.

Figure 1 shows PSP data for subject pairs AL-KW and MN-JJ for all independent and competitive sessions. Data points represent median PSP durations, and vertical lines indicate PSP range for each session. Unfilled circles represent independent responding, and filled circles represent competitive responding. Data for subject pair MN-JJ are missing for some sessions due to computer malfunction.

For all subjects, PSP durations under competitive conditions more closely approximated the programmed IRI than during independent sessions (i.e., PSPs were longer during independent than competitive conditions). In addition, PSP ranges generally were reduced under competitive conditions, though exceptions to this were evident. The most striking aspect of the range data were the

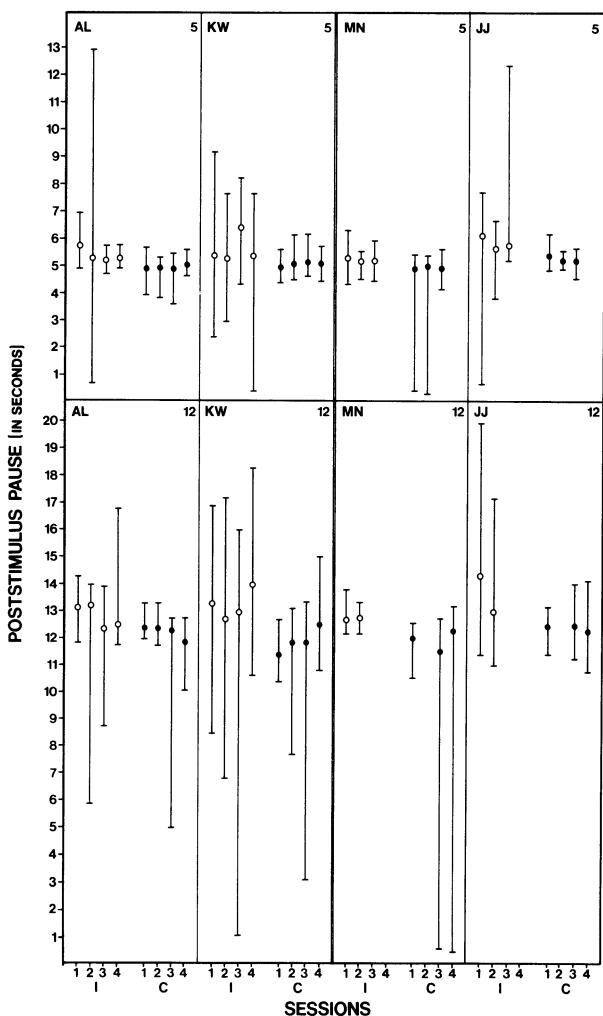


Figure 1. Median and range of poststimulus pause (PSP) durations for subject pairs AL-KW and MN-JJ for independent and competitive sessions. Open circles represent independent sessions, and closed circles represent competitive responding.

PSP upper boundaries; in no case did the upper PSP boundary under competitive conditions exceed the independent upper PSP boundary.

These data demonstrate the control exerted by the competitive contingency over the poststimulus pause, a central attribute of DRL responding. The competitive DRL schedule, in effect, imposes a limited hold contingency on responding such that the reinforcement probability declines as the pause exceeds the schedule value. Consequently, pauses that closely approximate the schedule value are more likely to be reinforced than longer pauses. Pauses that were shorter than the scheduled IRI never met with reinforcement but resulted in resetting of the interval for that subject. It is interesting, therefore, that median poststimulus pause duration was frequently less than the scheduled DRL parameter (see Figure 1). This finding reveals that, while the effect of the competitive contingency produced an adjustment in the temporal pattern of responding, the adjustment to be made was often a very fine one, and overadjustment, defined by pauses less than the minimal interval value, was common.

The present experiment extends the analysis of human social behavior to include the performance of competitors under a DRL schedule of reinforcement. The primary effect of the competitive contingency was to enhance temporal discrimination; competitive responding can be said to have more closely approximated "optimal" schedule performance than did performance under independent conditions. These results, in agreement with Church's (1961,

1962) response facilitation work with animals and Buskist et al.'s (1984) research on human competitive FI performance, reveal that competitive contingencies act in concert with reinforcement schedules to select for specific properties of operant responding.

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