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CONCURRENT FIXED-RATIO FIXED-INTERVAL PERFORMANCES IN ADULT HUMAN SUBJECTS[1]

RICHARD M. SANDERS

SOUTHERN ILLINOIS UNIVERSITY

Two undergraduate males worked for money on a button-pressing task associated with concurrent fixed-ratio fixed-interval schedules of reinforcement. Manipulations of the fixed-ratio requirement produced an interaction between the various fixed-ratio and fixed-interval performances. When the fixed ratio was small, more fixed-interval responding occurred per interval than when the fixed ratio was large. In general, the data were similar to those obtained with lower organisms except that no post-reinforcement pause or ratio strain was seen.

Two or more schedules of reinforcement independently arranged and simultaneously available are called concurrent schedules (Ferster and Skinner, 1957, p. 724). Catania (1966) described a number of local performance interactions of lower organisms resulting from concurrently arranged schedules of reinforcement. One local interaction describes the effect of concurrent fixed ratios (FR) and fixed intervals (FI). This experiment investigated further the local interactions produced by each of a number of FR parameter values and a concurrently scheduled FI 3-min performance using human subjects.

METHOD

Subjects

Two male undergraduates in their late teens were hired to work one session per day for a period of 2 hr, two to four sessions per week. It was explained to each subject that his pay depended upon how he performed during any particular session. Subjects were paid in cash immediately after each session. Before the present experiment, these subjects had had between 20 and 30 hr experience with concurrent schedules of reinforcement in the experimental situation, working with VI, FI, and differential reinforcement of low rate (DRL) schedule components.

The apparatus was described to each subject only in terms of its operations. They were told that they could earn money by pressing the buttons and that the light cell above each response button referred to that button only. The operation of the start and timeout buttons and the method by which reinforcement would be presented were described in detail.

Apparatus

The subject chamber was a small, well-lighted and well-ventilated room. A 30-db white noise source and a 30-db continuous music source masked noise outside the chamber.[2]

Figure 1 is a diagram of the subject's console, which rested on a table and sloped toward the subject at an angle of 30°. The start button had to be held down during the course of a session to keep the apparatus turned on. If this button was released, the apparatus was turned off for 15 min. The start light cell showed a white circle when the apparatus was ready to be operated. This white circle disappeared when the apparatus was started.

Response buttons 1 and 2 required a force of approximately 40 g to produce an electrical impulse to the scheduling equipment; they were placed 14 in. apart. Signal cells 1 and 2 displayed to the subject the discriminative

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[2]The music source was supplied without charge by the Woody Hayes Music Service, Raleigh, North Carolina.

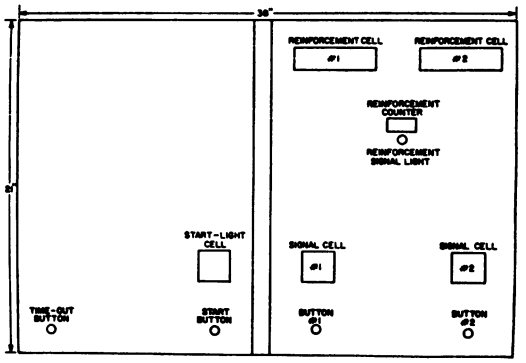

Fig. 1. The subject's view of the apparatus.

stimuli for the respective response buttons: a white horizontal line for the FR schedule and a white vertical line for the FI schedule.

Procedure

The operation of the timeout button was scheduled so that a subject could leave the experimental situation temporarily during the 2-hr session. So long as the subject returned to the console before the end of the timeout, he found the start light on and could continue the experimental session merely by depressing and holding down the start button. This put the subject back into the experiment exactly where he had left it; *i.e.*, his status on the schedules of reinforcement was the same as that which obtained when he began his self-imposed timeout. If a subject failed to return to the experiment before the 5-min timeout was over, the apparatus would turn off for an additional 15 min.

To avoid a position bias, the discriminative stimuli and their associated schedules were switched back and forth from the left to the right key and *vice versa* every 5 to 9 min. Warning stimuli, diagonally oriented white crosses of similar dimensions to the discriminative stimuli, were superimposed upon the discriminative stimuli for 1.5 sec before the switching event to warn the subject of the pending change in position of the schedules.

During the reinforcement cycle, the relevant discriminative stimulus was replaced by a green circle. This stimulus remained on until no responses occurred for that schedule for 3 sec. Therefore, the subject had to stop responding for 3 sec on the manipulandum that had produced reinforcement in order for the reinforcement cycle to be terminated. During the reinforcement cycle, the monetary equivalent of the point on the counter was displayed in the appropriate reinforcement light cell. At the end of the reinforcement cycle, the counter recorded the point, the signal light flashed, and the discriminative stimulus returned to the light cell in place of the green circle.

Data were recorded on separate cumulative recorders for each of the two schedule components.

A wide range of FI and FR parameters was employed during the sessions over a period of 40 subject hours for each subject. In each session in which manipulations were planned, they occurred after 30 min of performance under a non-changing condition. The parameter chosen for manipulation stayed in effect for a minimum of another 30 min. For all data presented below, a minimum of two such 30-min periods constitutes the basis of the calculations. Manipulations were randomized over sessions to prevent more large or small FR values from being scheduled early or late in the history of the subject.

RESULTS

Figure 2 shows the effect of various FR parameter values on both the FR rate and the FI 3-min rate. As the FR parameter value was increased, no systematic effect was seen on the FR rate; however, the FI 3-min rate decreased. Figure 3 shows sample cumulative record segments of the FI and FR performances of the two subjects. As can be seen, the subjects switched to the FI key and emitted a short burst of responses when FR reinforcement occurred.

It can be seen from the data of Fig. 4 that Subject 1 emitted many FI responses at times

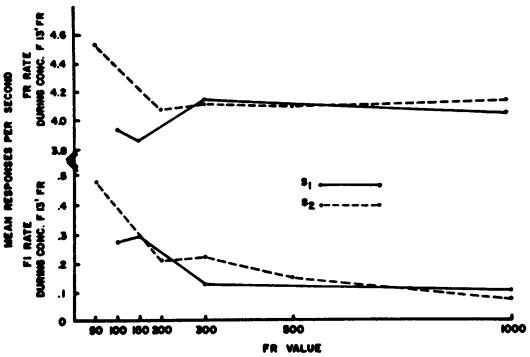

Fig. 2. The mean number of responses per second under each condition specified.

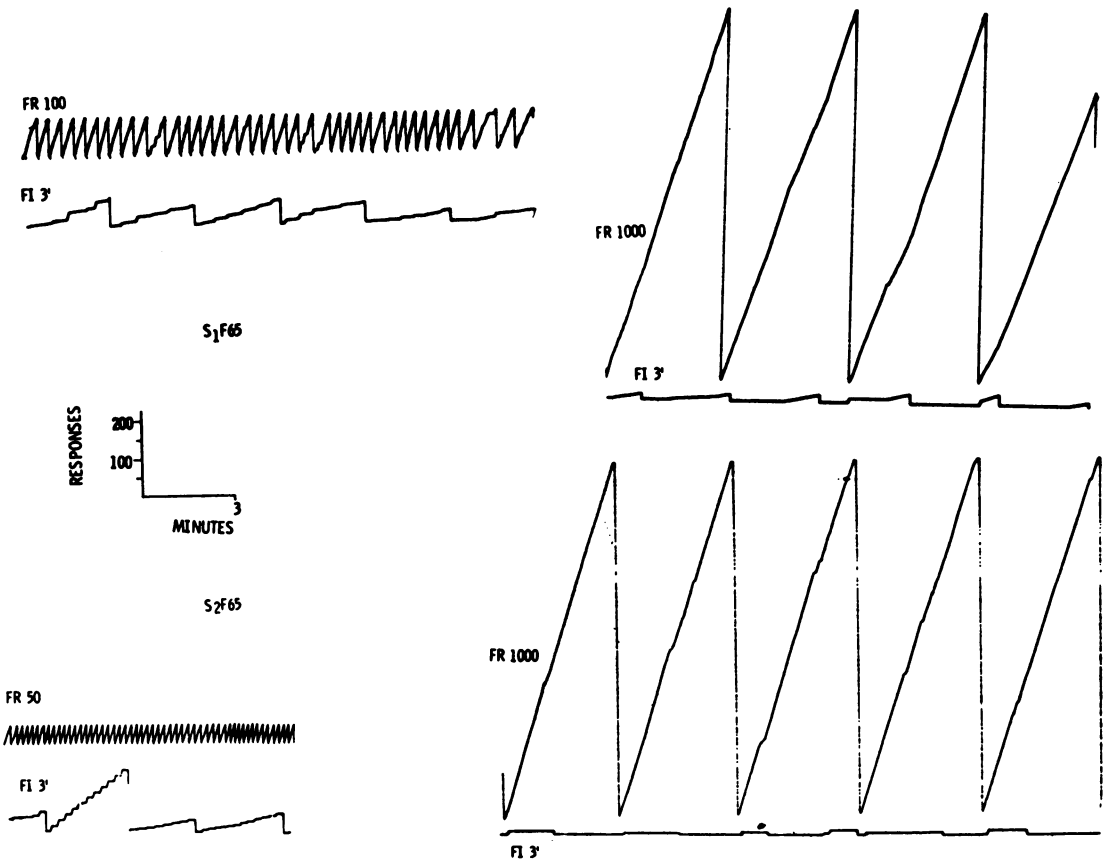

Fig. 3. Sample cumulative record segments for Subjects 1 and 2 showing some of the effects of FR value manipulations on the concurrent FI 3-min performance. Pen reset marks reinforcement.

other than during the FR reinforcement cycle. A tendency to scallop is seen in the performance of Subject 1 for both brief and long FI durations. It was unclear from the cumulative record segments for Subject 2 whether or not there was a tendency to scallop during the FI, because there was so little FI responding.

DISCUSSION

Laties and Weiss (1963) used human subjects on a task similar to the one reported here. They used an FI performance baseline against which to view the effect of a concurrent subtraction task. Subjects were required to perform successive verbal subtractions of the numbers 17, 16, 15, 17, 16, 15, 17, *etc.*, starting at 1000. When this subtraction task was required, the subject's FI performance changed, "generally increasing the pattern's resemblance to that of lower organisms". This low rate in the FI performance, which made it look more like the FI performance of lower organisms, was not as low as that seen in the present data. However, the concurrent subtraction task did not have as great a response requirement as did the concurrent FR. Further, the concurrent subtraction could be performed simultaneously with the FI key pressing, whereas the concurrent FR could not be simultaneously performed with the FI key presses.

The data of Catania (1966) on *Conc* FI FR in lower organisms were very similar to the present data from human subjects. In both instances, fixed-ratio responding persisted for a number of successive reinforcements before the fixed-interval schedule was completed, and the organisms often switched to the fixed-interval schedule just after fixed-ratio reinforcement to emit a short burst of responses before switching back to the fixed-ratio schedule. During this burst on the FI key, the data obtained from lower organisms showed a short

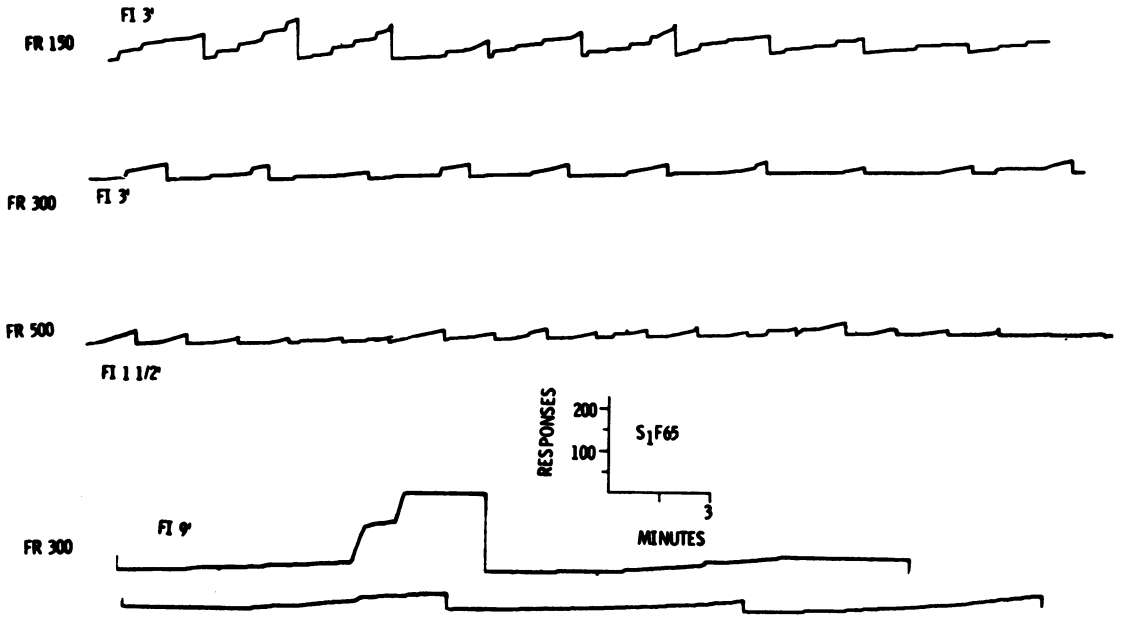

Fig. 4. Sample cumulative record segments of FI performance for Subject 1 showing a tendency to scallop. The value of the concurrent FR is indicated but no FR record segments are presented. Pen reset indicates reinforcement.

pause after reinforcement in the fixed-ratio performance. No such pause after reinforcement was seen in the present data from human subjects during the burst of responses in the FI component, because the humans were able to respond during the FR reinforcement cycle but the pigeons were presumably eating during their FR reinforcement cycle.

No evidence of ratio strain or post-reinforcement pause was seen in the cumulative record segments shown even after 1.5 hr of FR 1000 (Fig. 3). At no time during the course of the research, which covered approximately 80 hr of subject performance, was ratio strain or post-reinforcement pause seen. These data therefore extend the generality of Weiner's (1966) conclusion that "what characteristically occurs with animals under ratio contingencies may not characteristically occur in humans."

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