DIAGRAMMING SCHEDULES OF REINFORCEMENT

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A schedule of reinforcement can be represented on the coordinates of an imagined cumulative curve showing number of responses (y) as a function of time (x). If we imagine that the curve begins at the origin, then we can draw a line on the graph and reinforce a response whenever the curve reaches it. A line parallel to the x axis at y=50 means that we reinforce the response which brings the curve to y=50 regardless of position on the x axis. This is fixed-ratio reinforcement; specifically, it is FR 50.

Figure 1 shows 20 schedules defined in Ferster and Skinner, Schedules of Reinforcement, as follows: (1) Continuous reinforcement (crf) is simply FR 1. (2) If no line is drawn, the schedule is extinction (ext). (3) The fixed-ratio (FR) case already mentioned. (4) The diagonal stroke means a variable ratio with mean of 50. (5) Fixed-interval (FI). The imagined curve will meet the line at 5 minutes, regardless of responses emitted, and the next response will be reinforced. (Note that this additional specification is necessary.) Scales are selected so that the ratio of time (in minutes) to number of responses is 10:1. A roughly logarithmic scale will cover the usual range of time and number. (6) The diagonal stroke means variable interval with mean of 5 minutes.

The system is especially helpful in diagramming such schedules as (7) to (12). In (7) the imagined curve will meet either the horizontal line at 100 or the vertical line at 10, and the organism will be reinforced on either FR 100 or FI 10, whichever is satisfied first--an alternative schedule. (8) The line is reached only when 50 responses have been emitted and 5 minutes have elapsed (the conjunctive schedule of Morse and Herrnstein). If the line has a slope, number and time are not independent. These are interlocking schedules. In (9) rapid responding is penalized, for reinforcement then occurs on a relatively large ratio. At lower rates the number is smaller. A single response will be reinforced after 10 minutes. (10) The slope makes this basically a ratio schedule. The lower the mean rate, the larger the number of responses emitted before reinforcement. (11) Basically an interval schedule. The slower the responding, the quicker the reinforcement. (12) Curved lines generate many interesting possibilities to be tested.

Lines which do not join the axes may be completed with an indication of alternative consequences. In (13) reinforcement is obtained on FR unless the mean rate is so low that the curve misses the short horizontal straight line; in that case, as shown by the waving line, a time out (TO) follows. In (14) a minimum rate is required for FI; a lower rate yields a subsequent time out. Tandem schedules are diagrammed by drawing an arrow from the reinforcement line to the origin of a second set of coordinates. (15) Represents a tandem FIFR where FI is the substantial member. (16) In tandem FRFI, where the second schedule is substantial,

J. exp. anal. Behav. 1958, 1 (1).

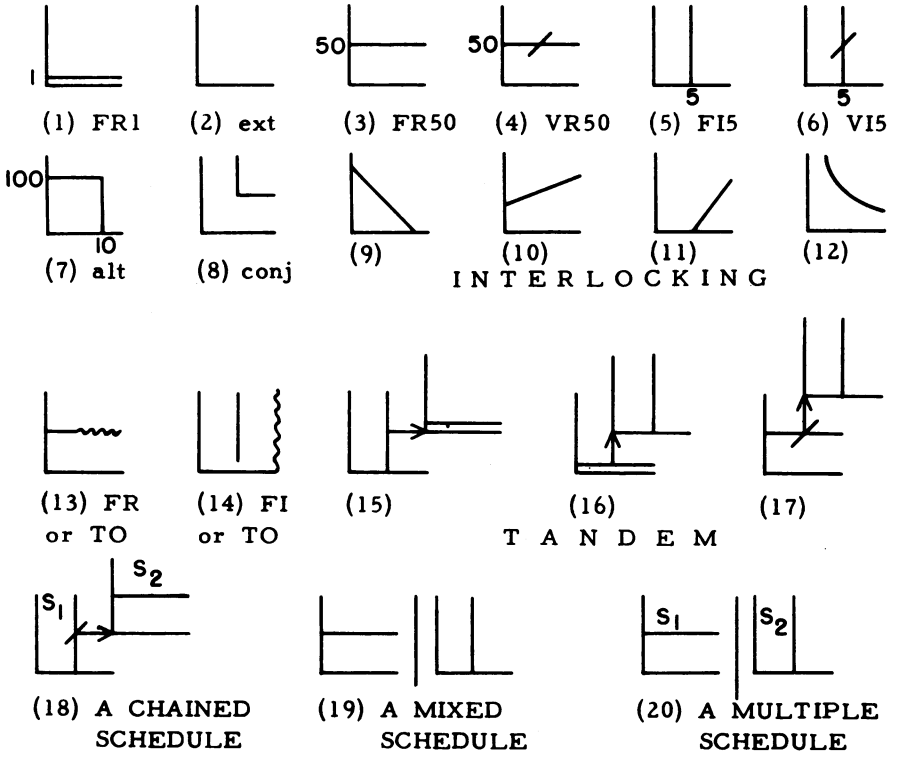

Fig. 1. Schedule diagrams.

second set of coordinates. (15) Represents a tandem FIFR where FI is the substantial member. (16) In tandem FRFI, where the second schedule is substantial, the requirement of a short ratio (possibly only 1 response) before the interval timer starts opposes the development of an interval pause. (17) Tandem VRFI. (18) Chained schedules look like tandem except that the stimulus changes when the schedule changes (S_1, S_2). Vertical lines as in (19) and (20) indicate that one of two (or more) schedules is in force at a given time. Stimuli identify multiple schedules.

The diagrams probably have little value in representing more complex cases, such as interpolated, concurrent, and adjusting schedules. However, notations could profitably be developed for aversive schedules (in escape and avoidance behavior) and for punishment.