Establishing behavioral persistence with schedules of reinforcement.

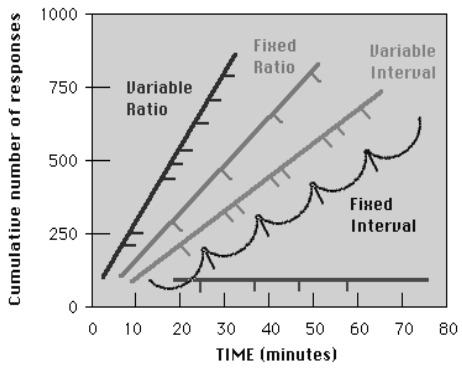
Free operant vs. discrete trials

- Free operant procedures: the individual can respond repeatedly without constraints.
- Discrete trials procedures: a stimulus is presented prior to the opportunity for a response to occur and be reinforced; e.g. a trainer saying, “do it now.”

Schedules of Reinforcement

	FIXED	VARIABLE
RATIO	FR	VR
INTERVAL	FI	VI
DURATION	FD	VD

SCHEDULES OF REINFORCEMENT



Schedules of Reinforcement

- *Continuous reinforcement* – every response gets reinforced
- *Extinction* – no instance of the response is reinforced
- *Intermittent reinforcement* – maintenance of a behavior by reinforcing it only occasionally

Ratio Schedules

- *Ratio Schedules* – there is a direct relationship between the *amount* of the behavior put out and the amount of reinforcement obtained.
- The harder or faster you work, the more strongly or frequently you are reinforced.
- For this reason, ratio schedules tend to generate hard work up to a certain point.
- If a ratio schedule is increased too rapidly or requires too many responses to earn a reinforcer, *ratio strain,* or deterioration in responding, occurs.

Ratio Schedules

- Use ratio schedules when you want to generate a high rate of responding and when you can closely monitor (i.e. count) each response.
- Some real-world ratio schedules have a *reset function*. When the organism makes an error, any accumulated responses toward completion of the ratio are taken away, and the organism must begin again. This results in the organism being more careful as the ratio builds, and more disappointed when an error occurs further into the ratio.

Ratio Schedules

- *Fixed Ratio (FR)* – reinforcement occurs each time a set number of responses of a particular type are emitted.
- Examples: FR 10 – a student gets a star on his paper for each 10 math problems he completes
- FR 1000 – a "piece-worker" in a factory gets paid for every 1000 items he assembles

Ratio Schedules

- Effects of a FR schedule: it normally produces a high a steady rate of responding and a pause in responding following reinforcement.
- The length of the post reinforcement pause depends of the value of the FR.
- The higher the FR value, the longer the pause.

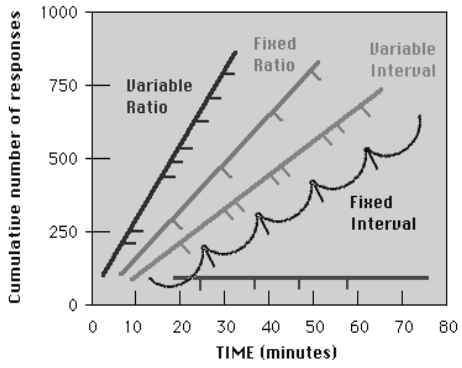
Ratio Schedules

- *Variable Ratio (VR)* – the number of responses required to produce reinforcement changes unpredictably from one reinforcement to the next.
- Examples: VR 10 – on average, a salesman makes a sale to every 10th person he makes a sales pitch to, but it varies unpredictably
- Slot machine- the number of pulls of the handle to obtain a jackpot varies unpredictably between one reinforcement to the next, but can be averaged over time.

Ratio Schedules

- Effects of a VR schedule: this schedule produces the highest rate of responding and eliminates the post-reinforcement pause seen in the FR schedule.
- VR also produces behavior which is highly resistant to extinction.

SCHEDULES OF REINFORCEMENT



Interval Schedules

- *Interval Schedules* – the opportunity for reinforcement is independent of the organism's effort.
- The rate of responding is lower than the ratio schedules.
- They are typically not used for behavior modification programs.
- They require continuous monitoring of behavior after the end of each interval until a response occurs.

Interval Schedules

- *Fixed Interval (FI)* – the first response after a fixed period of time following the previous reinforcement is reinforced and a new interval begins.
- Note that passage of time is not the sole factor.
- FI does not mean that reinforcement will occur every 5 minutes, for example. The desired response must still occur sometime after the specified period of time.

Interval Schedules

- Example: FI 1 day – going to the mailbox will be reinforced with finding mail there, but only once daily
- The behavior of "shopping" at store that is open from 10AM to 9PM is only reinforced if you go there after 9:59 AM and before 8:59 PM.
- Your plane is scheduled to arrive at precisely 9:06 PM. Any response of looking for that plane or attempting to board that plane prior to that time will not be reinforced.

Interval Schedules

- Effects of a FI schedule: this schedule produces a scalloped effect.
- There is an increase in the rate of responding gradually throughout the interval until reinforcement, and then a post-reinforcement pause.
- Again, the higher the value of the FI, the longer the pause.

Interval Schedules

- *Variable Interval (VI)* – the length of the interval changes unpredictably from one reinforcement to the next, but will vary around some mean
- Example: checking your e-mail or answering machines. Individuals could leave messages at any time; however, study of the number of messages left over time would reveal some average.
- Waiting for a taxi to arrive.

Interval Schedules

- *Interval Schedules with a Limited Hold* – there is only a finite time after an interval passes during which reinforcement will remain available and a response will earn that reinforcer.
- Example: FI 1 minute / LH 2 seconds – after a minute has passed since the last reinforcement, reinforcement will again be available, however a response must occur within a two-second time period to earn that reinforcer.

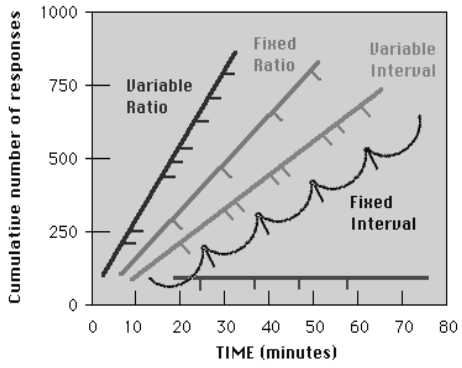
Interval Schedules

- Benefits: the addition of a LH to an interval schedule produces a rate of response that mimics a ratio schedule as long as the limited hold is small.
- FI / LH schedules produce responses which are like FR and VI / LH schedules produce responses which are like VR schedules.
- Use limited hold when you want to produce a high rate of responding, but you can only monitor the behavior periodically or at irregular intervals (e.g. a teacher in the classroom)

Interval Schedules

- Examples in the natural environment: FI / LH bus schedule – the bus arrives more or less on a schedule, but will not wait for you if you're not there
- VI / LH calling someone whose phone is busy – you don't know how long your friend may be on the phone, and once they're off, they may leave, get on the Internet, or get a call from someone else before long.

SCHEDULES OF REINFORCEMENT



Duration Schedules

- *Duration Schedules* – reinforcement occurs after the behavior has been engaged in for a continuous period of time
- Duration schedules are useful for behavior modification programs only when the target behavior can be measured continuously and reinforced on the basis of its duration.

Duration Schedules

- *Fixed Duration (FD)* – the behavior must be engaged in for a fixed amount of time in order to receive reinforcement
- Example: an hourly employee
- *Variable Duration (VD)* - the interval of time the behavior must be engaged in varies
- Example: waiting to cross a busy intersection

Duration Schedules

- Duration schedules can produce long periods of behavior.
- VD produce higher rates of responding and greater resistance to extinction.
- FD produce post-reinforcement pauses while VD do not.

Concurrent Schedules of Reinforcement

- In most situations, we can engage in a variety of different behaviors at any particular moment, each of which may be operating on a different schedule of reinforcement.
- Herrnstein (1961) proposed the *matching law* to explain which behavioral option we are likely to choose.
- "The time devoted to an activity in a concurrent situation is proportional to the rate of reinforcement of that activity, relative to the rates of reinforcement on the other concurrent activities."

Concurrent Schedules of Reinforcement

- In other words…
- we choose to engage in the behavior with the highest probability of reinforcement or "pay-off."