BEHP 1016

Why People Often Make Bad Choices and What to Do About It: Important Features of Combined Schedules of Reinforcement

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Overview

- Brief review of simple and combined schedules of reinforcement
- Important features of combined schedules
  - Behavioral contrast
  - Behavioral momentum
  - The matching law
  - Self-control
  - Contingent reinforcement in context—an updated model of the discriminated operant

Simple Schedules of Reinforcement

- Ratio Schedules
  - Fixed (FR)
  - Variable (VR)
- Interval Schedules
  - Fixed (FI)
  - Variable (VI)
- Time Contingent Schedules
  - Fixed (FT)
  - Variable (VT)
- Differential Reinforcement Schedules
  - DRH
  - DRL
  - DRO

Important Features of Combined Schedules of Reinforcement

- Behavioral contrast
- Behavioral momentum
- The matching law
- Self-control
- Contingent reinforcement in context—an updated model of the discriminated operant

Combined Schedules of Reinforcement

- Mixed and Multiple Schedules
- Concurrent and Conjunctive Schedules
- Chained and Tandem Schedules
- Conjoint Schedules
- Alternative Schedules

A little learning is a dangerous thing; 
Drink deep, or taste not……

--Alexander Pope
Behavioral Contrast

- Demonstrated first by Reynolds (1961)
- First phase, a Multiple VI VI schedule
- Second phase: EXT in one component, second component remains unchanged
- What pattern of responding is observed?
- What could account for this?

ASR # 1

In Reynolds (1961) experiment, behavioral contrast was demonstrated in what schedule of reinforcement?
1. Multiple VI VI, Multiple VI EXT
2. Concurrent VI VI
3. Alternative VI VR
4. A chained schedule
5. None of the above

ASR # 2

What is the counterintuitive finding in behavioral contrast?
1. Extinction does not occur
2. A change in conditions does not result in a change in behavior
3. Responding in the unchanged component increases despite no increase in rate of reinforcement
4. The choice between components shows a preference for the lower reinforcement rate

ASR # 3

Reynolds (1961) study on behavioral contrast illustrates:
1. how choice can be studied in multiple schedules
2. an interaction between schedule components
3. extinction will not occur when other sources of reinforcement are available
4. extinction can induce aggression

ASR # 4

In behavioral contrast, the change in behavior in the unchanged schedule component can be seen as what kind of behavior?
1. retaliatory
2. rational
3. compensatory
4. steady state
Behavioral Momentum

• Metaphor developed by John A. (Tony) Nevin
• Refers to the tendency for a pattern of behavior, once established, to persist despite some opposition to the response-reinforcer relationship
• Physical momentum is the tendency for an object in motion to continue at the same velocity unless opposed by a physical force.
• Momentum = mass \times velocity

Behavioral Momentum

• In the behavioral momentum metaphor, behavioral momentum is the product of behavioral mass and behavioral velocity
• Behavioral velocity is equal to (baseline) response rate
• Behavioral mass is the resistance of the baseline response rate to change when the response-reinforcer relationship is disrupted

Response-Reinforcer Disruptors

• Extinction
• Satiation
• Dark key food (periods between components)
• Punishment
• Alternative reinforcement
  • DRA
  • FT or VT reinforcement
• Distraction

Nevin, Mandel, & Atak, JEAB, 1983

• Multiple VI VI baseline
• 1-min components, SR+ = 4 s access to grain
• Following stable baseline, EXT or dark key food delivered at different rates

Table 1

<table>
<thead>
<tr>
<th>Schedule and Order of Conditions</th>
<th>Group-1</th>
<th>Group-2</th>
<th>Group-3</th>
<th>Group-4</th>
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</tr>
</tbody>
</table>

Note: Distinction perceptual, grain sacs presented at the base
Nevin, Mandel, & Atak, JEAB, 1983

• Experiments contained an important confound
• What was it?
• Response-reinforcer contingencies perfectly confounded with stimulus (color)-reinforcer contingencies
• Unclear whether momentum is a function of response-reinforcer (operant) or stimulus-reinforcer (Pavlovian) contingencies

Nevin et al. JEAB, 1990

• Purpose—to determine whether momentum is a function of S-S or R-S contingencies
• Multiple concurrent schedule baseline
• Momentum tests—extinction and satiation

ASR # 5

John (Tony) Nevin’s work is most closely related to whose work?
1. B. F. Skinner
2. A. Charles Catania
3. Israel Goldiamond
4. Isaac Newton
5. none of the above

ASR # 6

Behavioral momentum is:
1. The product of behavioral mass times behavioral velocity
2. The tendency for a pattern of behavior to persist despite some opposition to the response-reinforcer relationship
3. A useful concept for clinical interventions
4. First developed by John A. Nevin
5. All of the above

ASR # 7

Which of the following is not a response-reinforcer disruptor:
1. Extinction
2. Satiation
3. Punishment
4. DRA
5. A change from a VI 60-s schedule of reinforcement to a VR 60 schedule
In which of the following baseline schedules would behavior be more resistant to change?
1. VI 60-s
2. VI 120-s
3. VI 240-s
4. Conjunctive VI 60-s, VT 30-s
5. VR 500

Nevin et al. JEAB, 1990

- Purpose—to determine whether momentum is a function of S-S or R-S contingencies
- Multiple concurrent schedule baseline
- Momentum tests—extinction and satiation
- Findings: G = W > R; momentum is a function of stimulus-stimulus contingencies

Mace et al. JEAB, 1990

- Purpose—to test the species generality of Nevin’s findings

Experiment 1
- Sorting on a multiple VI 60s VI 240s baseline
- Preferred video introduced following stable baseline
- Replicated Nevin et al 1983

Species Generality of Behavioral Momentum

Concurrent Schedules
- 2 or more components independently available at the same
- Each component is correlated with a distinct stimulus
- Provides a procedure for studying choice and the variables that affect choice
Concurrent Schedule Procedure

- Choice between green, red or both
- 3-s LH, 2-s COD
- B1 = response rate on green
- B2 = response rate on red
- r1 = obtained SR+ rate on green
- r2 = obtained SR+ rate on red
- 4 x more SR+ on green
- What is the pigeon likely to do?

Schedule

<table>
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<tr>
<th>Schedule</th>
<th>VI 60s</th>
<th>VI 240s</th>
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<tbody>
<tr>
<td>SR+ rate</td>
<td>60/hr</td>
<td>15/hr</td>
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<td>r1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>r2</td>
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</tbody>
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ASR # 9

Nevin et al. 1990 demonstrated that behavioral mass is a function of what kind of contingencies?
1. stimulus-stimulus
2. stimulus-response
3. response-response
4. response-stimulus
5. None of the above

ASR # 10

What is the most significant applied implication of the answer to the previous question (9)?
1. Adding reinforcement to an environment in which problem behavior occurs can increase the persistence of problem behavior
2. Positive reinforcement of desirable behavior is the best way to treat problem behavior
3. The higher the rate of contingent reinforcement, the more persistent behavior is
4. Behavioral velocity is the most important component of behavioral momentum
5. None of the above

ASR # 11

Behavioral mass is:
1. How much momentum a behavior has
2. The resistance of baseline response rate to change
3. The opposite of behavioral velocity
4. The tendency for behavior to persist
5. All of the above

ASR # 12

Which of the following is true about behavioral momentum?
1. it is a positive function of stimulus-reinforcer contingencies
2. it is a positive function of response-reinforcer contingencies
3. it has only been demonstrated in rats and pigeons
4. it is a metaphor about choice

ASR # 13

The Nevin, Mandel & Atak (1983) experiments on behavioral momentum had what major limitation?
1. there were only two response-reinforcer disruptors studied
2. the findings were not replicated for most pigeons
3. Response-reinforcer contingencies were confounded with stimulus-reinforcer contingencies
4. resistance to change was not a positive function of baseline rates of reinforcement
What was the main purpose of Nevin et al.’s 1990 paper?
1. to determine whether momentum is a function of stimulus-reinforcer or response-reinforcer contingencies
2. to extend study of the range of response disruptors to extinction and satiation
3. to determine whether momentum is a function stimulus-response contingencies
4. to replicate Nevin et al. (1983) with a greater number of subjects

Nevin et al. 1990 employed what baseline procedure to study resistance to change?
1. a concurrent schedule
2. a multiple schedule
3. a concurrent chain schedule
4. a multiple concurrent schedule

Nevin et al. 1990 found that alternative reinforcement:
1. increased baseline response rates for the target response
2. increased resistance to change during extinction and satiation tests
3. did not affect resistance to change
4. resistance to change was not a positive function of baseline rates of reinforcement

The principal finding from Nevin et al. 1990 was that resistance to change is a function of what kind of contingencies?
1. stimulus-stimulus
2. stimulus-response
3. response-response
4. response-stimulus

The principal purpose of Mace et al. (JEAB, 1990) was:
1. to demonstrate that the high-p treatment works because of behavioral momentum
2. to replicate Nevin et al. (1990) using extinction and satiation as response disruptors
3. establish the species generality of Nevin et al. (1990)
4. challenge previous research findings on behavioral momentum

The response disruptor in Mace et al. (1990) was:
1. Extinction
2. Extinction and satiation
3. Distraction
4. Alternative reinforcement
Mace et al. (1990) replicated:
1. Nevin et al. (1983) only
2. Nevin et al. (1983) and (1990)
3. Nevin et al. (1990) only
4. Mace et al. (1988, on the high-p treatment)

\[ \text{The Matching Law (Herrnstein, 1970)} \]

- Summarized the findings from 41 sets of experiments over 12 years
- Showed that relative response rate was a function of relative rate of reinforcement
- Mathematical expression of the allocation of responses across available alternatives in relation to obtained reinforcement
- It simply states, “relative response rate will match relative reinforcement rate”
- The relationship also holds for time allocation

**Herrnstein (JEAB, 1961)**

**Procedure**
- Pairs of Concur VI VI
  - VI 3 VI 3
  - VI 2.25 VI 4.25
  - VI 1.5 EXT
  - \( B_1 / B_2 = r_1 / r_2 \)

**Findings**
- Relative response rate matched relative reinforcement rate
- Yields a straight-line regression function where the slope = 1.0 and intercept = 0

**Chung (1966)**

**Procedure**
- Single alternative VI schedule—different rates of reinforcement in different conditions
  - Formula for the function known as Herrnstein’s hyperbola
  - \( R = k / (r + re) \)
  - \( k \) = total response rate
  - \( r \) = rate of reinforcement on VI
  - \( re \) = rate of all over reinforcement

**Findings**
- Function shows an asymptotic curve
- Single alternative arrangement produces less sensitivity to variations in reinforcement

**Catania (JEAB, 1963)**

**Procedure**
- Conc VI VI
- Findley procedure
- Time each stimulus key illuminated measured—expression of relative time allocation

**Findings**
- Relative response allocation approx equalled relative time allocation
How do choices differ?

- How often each choice is rewarded (rate of reinforcement)
- How valuable the consequence is (quality of reinforcement)
- How soon the reward is delivered after the behavior occurs (delay to reinforcement)
- How much effort is required to obtain the reward (response effort)

Rate of Reinforcement

- Reflected in the schedule of reinforcement
- How many responses are required to produce each reinforcer (ratio schedules)
- How much time must pass until the first response is reinforced (interval schedules)
- In general, people distribute their behavior in proportion to relative rate of reinforcement (behavior matches reinforcer)
- For example, every 5th disruptive behavior vs. completion of a 20-item worksheet produces teacher attention—which would you do to get teacher attention?

Quality of Reinforcement

- Reflected in the relative preference an individual has for different reinforcers
- Can be identified via a reinforcer preference assessment (Fisher et al., 1992, JABA)
- In general, people distribute their behavior in relation to relative quality of reinforcement
- For example, disruptive behavior produces a reprimand vs. worksheet completion produces praise—which would you do to get teacher attention?

Delay to Reinforcement

- Reflected in relative delay required to receive reinforcement
- Reflects the susceptibility one has to impulsive behavior
- In general, people distribute their behavior in relation to relative delay to reinforcement
- For example, the 5th disruptive behavior produces immediate attention vs. worksheet completion produces praise when returned the next day—which would you do to get teacher attention?

Response Effort

- Reflected in relative effort the response requires to receive reinforcement
- Reflects the relative caloric expenditure or cognitive activity required to produce reinforcement
- In general, people distribute their behavior in relation to relative response effort
- For example, swearing requires minimal caloric expenditure to produce attention vs. math worksheet completion requiring considerable cognitive activity to produce praise—which would you do to get teacher attention?

ASR # 21

What schedules of reinforcement did Herrnstein (1961) use to formulate the Matching Law?
1. multiple schedules
2. alternative schedules
3. concurrent VR VR schedules
4. concurrent VI VI schedules
ASR # 22

Herrnstein’s (1961) Matching Law states:
1. Response time will match reinforcement time
2. Relative response time will match reinforcement time
3. Organisms prefer matching to non-matching
4. Relative response rate will match relative reinforcement rate

ASR # 23

A changeover delay:
1. Discourages adventitious reinforcement of schedule switching
2. Imposes a brief delay to reinforcement when an organism switches from one concurrent schedule component to another
3. Can be necessary to make relative response rate sensitive to relative reinforcement rate
4. 1 and 2
5. All of the above

ASR # 24

Herrnstein’s (1961) Matching Law examined choice using which schedules?
1. Pairs of concurrent VI VI schedules
2. One concurrent VI VI schedule
3. Pairs of concurrent VR VR schedules
4. Pairs of multiple concurrent schedules

ASR # 25

Herrnstein (1970):
1. replicated Herrnstein (1961)
2. summarized findings from a large number of experiments confirming the matching relation
3. formed the basis of the Generalized Matching Law
4. conducted the first applied research on the Matching Law

ASR # 26

What statistical analysis is used to quantify parameters of the Generalized Matching Law?
1. simple linear regression
2. t-tests
3. multiple regression
4. analysis of variance

ASR # 27

Which of the following variables do not affect choice?
1. Reinforcer quality
2. Reinforcer rate
3. Ratio strain
4. Response effort
5. Reinforcer delay
Matching Equations

**Basic equation (of proportions)**

\[
\frac{B_1}{B_1 + B_2} = \frac{r_1}{r_1 + r_2}
\]

**Example**

\[
\frac{400}{400 + 100} = \frac{60}{60 + 15}
\]

Matching Equations

**Generalized matching equation**

\[
\frac{B_1}{B_1 + B_2} = \frac{r_1}{r_1 + r_2}
\]

Taking the reciprocal of both sides

\[
\frac{B_1}{B_1 + B_2} = \frac{r_1}{r_1 + r_2}
\]

Reducing the quotients to 1

\[
\frac{B_1}{B_2} = \frac{r_1}{r_2}
\]

Equation of ratios

**Generalized Matching Law Example**

\[
y = 0.7808x + 0.0964
\]

\[R^2 = 0.2764\]

The Bias and Sensitivity Parameters

**Bias**

- Regression intercept (a)
- If \( a \neq 0 \) reflects a bias toward B1 or B2 that is independent of \( r_1/r_2 \)
- Variables known to influence bias:
  - Reinforcer quality
  - Reinforcer delay
  - Response effort

**Sensitivity**

- Regression slope (b)
- If \( b > 1 \) reflects overmatching; if \( b < 1 \) reflects undermatching
- A measure of how sensitive the organism is to relative rates of reinforcement

Effects of Reinforcing An Alternative Response
ASR # 28

Rate of reinforcement is reflected in:
1. the response requirements necessary to produce reinforcement
2. the qualitative differences in different frequencies of reinforcement
3. how many times reinforcers are delivered when target behaviors do not occur
4. the schedule of reinforcement

ASR # 29

One parent reprimands a child’s disruptive behavior and the other parents offers to play with the child following disruptive behavior. These different forms of attention reflect differences in:
1. reinforcer rate
2. reinforcer quality
3. Preference
4. relative rate of reinforcement

ASR # 30

A student has the choice to work on an assignment or engage in disruptive behavior. This choice differs with regard to:
1. reinforcer rate and response requirements
2. reinforcer rate and reinforcer quality
3. reinforcer delay
4. reinforcer quality and delay, and response requirements

ASR # 31

In the Generalized Matching Equation, bias (a) reflects:
1. the sensitivity to relative rates of reinforcement
2. asymmetries in alternatives
3. preference for one rate of reinforcement over another
4. the slope of the regression line
ASR # 32

Overmatching refers to:
1. engaging in higher rates of responding than necessary to maximize reinforcement
2. the bias parameter in the Generalized Matching Equation exceeding 1.0
3. allocating more responses to the richer of two concurrent schedules
4. the effects of reinforcer quality

Concurrent Chain Schedule

FIGURE 11-3 Schematic diagram of a concurrent-chain procedure as it might be arranged for a pigeon's key pecks. Initial links, both keys are white (W) and equal but independent schedules (usually VI) operate for both keys. According to its schedule, pecks on the left key produce terminal link A, in terminal link A, the left key is green (G). The right key is dark, and pecks on green produce reinforcers according to schedule A. Similarly, according to its schedule, pecks on the right key produce terminal link B, in terminal link B, the right key is red (R), the left key is dark, and pecks on red produce reinforcers according to schedule B. The relative rates of pecking the two initial links define preferences for the respective terminal links. For example, if a pigeon pecked the right white key more often than the left white key, it would be appropriate to say that the pigeon preferred schedule B to schedule A.

Contingent Reinforcement in Context

How key developments in behavior analysis accommodate a dynamic and complex model of human behavior in natural environments

- Motivating operations
- The Matching Law
- Response class hierarchies
- Behavioral momentum
Defining the Basic Unit of Analysis

• It is our working definition of what behavior is
• The first step toward an understanding of complex human behavior in natural environments
• Can then study the wide range of variables that affect behavior

What is the unit of analysis?

Discriminated operant

Components of the Discriminated Operant

- $S^D$ What signals the availability of reinforcement?
- $R$ What responses have a common effect on the environment? What are the probabilities of each?
- $S^{R+,R-,P+,P-}$ What reinforces behavior? What schedule of reinforcement is operative?

Discriminated Operant

Comprised of 3 Components
- Discriminative stimulus ($S^D$)
- Response ($R$)
- Reinforcer or Punisher ($S^{R+,R-,P+,P-}$)

So then....

I conduct a functional behavioral assessment (FBA) and determine that:
- In the presence of the father ($S^D$)
- A child engages in severe tantrums several times per day ($R$)
- In order to gain access to a preferred activity ($S^{R+,R-,P+,P-}$)
Q: Can I predict that the child will tantrum when father comes home from work?

A: Probably not—most human behavior is more complicated than that

Q: If I can’t predict when or whether tantrums will occur, will I be able to change the behavior?

A: Probably not—being able to predict behavior is often prerequisite to changing it through non-aversive means

How did the development of the MO conceptual framework change our view of the discriminated operant?

Example of a Response Class

**Different Ways of Getting Attention**

- Asking a question
- Complimenting someone
- Smiling
- Asking for help
- Shouting, knocking over furniture, pushing someone, kicking, hitting, throwing things, breaking things, using profanity, running away, pulling hair, etc. etc. etc.

Updated Discriminated Operant

\[ S^D \rightarrow R \rightarrow S^{R+,R-,P+,P-} \]
Components of the Discriminated Operant

• **MO**
  - What motivates behavior?
  - What evokes behavior?

• **SD**
  - What signals the availability of reinforcement?

• **R**
  - What responses have a common effect on the environment?

• **SR+**
  - What reinforces behavior?
  - What schedule of reinforcement is operative?

What does the MO affect?

\[ MO \]

\[ SD \rightarrow R \rightarrow SR^+ \rightarrow R^- \rightarrow P^+ \rightarrow P^- \]

ASR # 33

A preference assessment would identify what variable that affects choice?
1. rate of reinforcement
2. quality of reinforcement
3. delay to reinforcement
4. response effort

ASR # 34

According to the Matching Law, if an inappropriate behavior is reinforced on a VI schedule, what reinforcement schedule for appropriate behavior will produce increases in appropriate behavior at any schedule value?
1. VI
2. VR
3. DRO
4. VT

ASR # 35

According to the Matching Law, if an inappropriate behavior is reinforced on a VR schedule, what reinforcement schedule for appropriate behavior will produce increases in appropriate behavior at any schedule value?
1. VI
2. VR
3. DRO
4. VT

The Matching Law

• Individuals always have multiple choices at any given point in time
• Behavior 1, Behavior 2, Behavior 3, Behavior 4, etc.
• Engage in school work, look out the window, talk to peers, swear at the teacher
The Matching Law has BIG implications for conceptualizing the Discriminated Operant

**Concurrent Discriminated Operants**

*Choices, choices, so many choices*

\[ SD \rightarrow R \rightarrow SR^+, R^-, P^+, P^- \]

\[ SD \rightarrow R \rightarrow SR^+, R^-, P^+, P^- \]

\[ SD \rightarrow R \rightarrow SR^+, R^-, P^+, P^- \]

**Components of the Discriminated Operant**

- **MO**
  - What motivates behavior?
  - What evokes behavior?
- **SD**
  - What signals the availability of reinforcement?
  - What are the probabilities of each?
- **R**
  - What responses have a common effect on the environment?
  - What are the relative reinforcement rates?
  - What are the relative reinforcer qualities?
  - What are the relative reinforcer delays?
  - What are the relative response efforts?
- **SR**
  - What reinforces behavior?
  - What schedule of reinforcement is operative?
  - What reinforcers and schedules are concurrently available?

**Nevin & Grace**

Brain and Behavioral Sciences, 2000

- Unifying theory of choice and momentum
- Demonstrated that the variables that affect choice also affect momentum
  - Relative reinforcement rate
  - Relative reinforcer quality
  - Relative reinforcer delay
  - Relative response effort

These variables combine to determine Behavioral Mass

**Reinforcer Quality and Behavioral Momentum**

- Increase
- Decrease

**Whole-Session Analysis**

**Projection of Baseline Extinction**

**Subjects**
Reinforcer Quality and Behavioral Momentum

Concurrent Discriminated Operants Considered in the Context of Behavioral Mass

Of what possible relevance is this?!

- Contexts have histories of reinforcement that affect how persistent desirable and undesirable behavior is
- Train pro-social behavior in new contexts with new interventionists
- It offers a tremendous opportunity to build a new history that will strengthen the persistence of desirable behavior
- Your first objective in working with the students is to establish yourself as a source of positive reinforcement

ASR # 36

Which schedule is most commonly used to study self-control?
1. Concurrent schedule
2. Concurrent chain schedule
3. Multiple schedule
4. Multiple concurrent schedule
5. Time delay schedule

ASR # 37

An organism is said to behave impulsively when:
1. They make quick choices
2. They choose a less valued reinforcer with a shorter delay over a more valued reinforcer with a longer delay
3. They choose more valued reinforcers despite a longer delay
4. They prefer larger reinforcers over smaller reinforcers

ASR # 38

Which of the following factors affect whether an organism shows self-control?
1. The value of the initial link schedule
2. The time from completion of the initial link to the onset of the terminal link
3. The relative delay to reinforcement
4. The availability of a commitment response
5. All but “1”
ASR # 39

A commitment response is made when?
1. a person agrees to do the right thing
2. a person agrees to accept a smaller reinforcer for more work
3. a person chooses to place himself/herself in a situation without the impulsive choice alternative
4. a person chooses the larger delayed reinforcer

ASR # 40

According to Nevin and Grace (2000):
1. The factors that affect choice affect behavioral mass
2. History of reinforcement affects behavioral mass
3. Choice and persistence are a function of relative rate of reinforcement among other factors
4. A discriminated operant’s behavioral mass changes over the life of the individual
5. All of the above