Stimulus Control and its Role in Errorless Learning

August 9, 2018
National Autism Conference
David Roth

PaTTAN's Mission

The mission of the Pennsylvania Training and Technical Assistance Network (PaTTAN) is to support the efforts and initiatives of the Bureau of Special Education, and to build the capacity of local educational agencies to serve students who receive special education services.

PDE's Commitment to Least Restrictive Environment (LRE)

Our goal for each child is to ensure Individualized Education Program (IEP) teams begin with the general education setting with the use of Supplementary Aids and Services before considering a more restrictive environment.
Men act upon the world, and change it, and are changed in turn by the consequences of their actions.
-B.F. Skinner

What Does Animal Research Have to Do with Human Behavior?

The Operant

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental event</td>
<td>Activity of individual</td>
<td>Environmental event</td>
</tr>
<tr>
<td>Immediately before response</td>
<td>Observable</td>
<td>immediately after response</td>
</tr>
<tr>
<td>Momentarily changes probability response to occur</td>
<td>Measurable</td>
<td>Changes probability of response to occur in future</td>
</tr>
</tbody>
</table>
## Reinforcement

- A consequence of response
- Increases future probability of response (class)
- Can be positive (+) or (-)

## Unlearned and Learned Reinforcement

**Unconditioned reinforcement:** effective without prior learning

**Conditioned reinforcement:** effective only after a history of being paired with other reinforcement

## Skinner on the Importance of Reinforcement
Reinforcement in Action

The “Facts in the Bag”

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivating Operation (MO)</td>
<td>Response</td>
<td>Specific Reinforcement</td>
</tr>
<tr>
<td>Discriminative Stimulus (S₀)</td>
<td>Response</td>
<td>Generalized Conditioned Reinforcement</td>
</tr>
<tr>
<td>Stimulus Delta (Sₜ)</td>
<td>Response</td>
<td>(Extinction)</td>
</tr>
<tr>
<td>Neutral Stimulus (Sᵢ, Sᵢ', or Sᵢ&quot;)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Discriminative Stimulus for Punishment (Sₚ)</td>
<td>Response</td>
<td>Punishment</td>
</tr>
</tbody>
</table>

Non-Verbal Behavior

Behavior in which the reinforcement is not mediated by other individuals
**Verbal Behavior**

Behavior in which the reinforcement is mediated by other individuals (i.e. listeners) who had been trained to do so.

See Palmer (2008) for more in-depth discussion on Skinner’s definition.

**The Beauty of Skinner’s Definition**

- **Functional vs. Formal**
- **Includes all forms of “communication”**
  - Talking
  - Signing
  - Writing
  - Gesturing
  - Morse Code
  - Smoke Signals

**The Verbal Operants**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivating Operation</td>
<td>MAND</td>
<td>Specific Reinforcement Mediated by a Listener</td>
</tr>
<tr>
<td>Non-Verbal Discriminative Stimulus</td>
<td>TACT</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
<tr>
<td>Verbal Discriminative Stimulus</td>
<td>ECHOIC</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
<tr>
<td></td>
<td>SIGNED Imitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTRAVERBAL</td>
<td></td>
</tr>
</tbody>
</table>
**Motivational Control**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivating Operation (MO)</td>
<td>Response</td>
<td>Specific Reinforcement</td>
</tr>
</tbody>
</table>

**Motivational Control**

<table>
<thead>
<tr>
<th>Motivating Operation</th>
<th>Behavior</th>
<th>Specific Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Changes the value of something</td>
<td>• Response</td>
<td>• Item/Event made valuable by MO</td>
</tr>
<tr>
<td>• Changes probability of behavior b/c of past history</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“No matter how much one has read about a behavioral process, it is always a surprise to see it at first hand.”

--B.F. Skinner
Experimental Analysis of Behavior

Meet Ebby

Motivational Control for Turning
Definitions Revisited

<table>
<thead>
<tr>
<th>Motivating Operation (MO):</th>
<th>Behavior</th>
<th>Specific Reinforcement:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Food deprivation</td>
<td></td>
<td>• Bacon</td>
</tr>
<tr>
<td>• Establishes the value of bacon as a reinforcer</td>
<td>Turning Around</td>
<td>• Specifically reinforcing because of food deprivation</td>
</tr>
<tr>
<td>• Evokes/strengthens turning around because of history of accessing bacon (when available)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Motivational Control for Pecking

Definitions Revisited

<table>
<thead>
<tr>
<th>Motivating Operation (MO):</th>
<th>Behavior</th>
<th>Specific Reinforcement:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yerba Mate deprivation</td>
<td></td>
<td>• Yerba Mate</td>
</tr>
<tr>
<td>• Establishes the value of Yerba Mate as a reinforcer</td>
<td>Pecking</td>
<td>• Specifically reinforcing because of Yerba Mate deprivation</td>
</tr>
<tr>
<td>• Evokes/strengthens pecking because of history of accessing Yerba Mate (when available)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Motivational Control and Verbal Behavior

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivating</td>
<td>MAND</td>
<td>Specific Reinforcement Mediated by a Listener</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Mand

- SPECIFIES to a listener the reinforcement that is currently valuable to the speaker
- Types of consequences that are specified by manders:
  - Items present
  - Actions
  - Assistance
  - Removal of unpleasant stimuli
  - Missing items
  - The attention of another
  - Items with specific properties
  - Items in specific locations
  - Information

Stimulus Control
What is a stimulus?

An item or event in one’s environment that directly affects his or her senses.

What is Stimulus Control?

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminative Stimulus (S₁)</td>
<td>Response</td>
<td>Generalized Conditioned Reinforcement</td>
</tr>
<tr>
<td>Stimulus Delta (S₂)</td>
<td>Response</td>
<td>Extinction</td>
</tr>
<tr>
<td>Neutral Stimulus (S⁺, S₀, or S⁻)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Discriminative Stimulus for Punishment (S₃ₚ)</td>
<td>Response</td>
<td>Punishment</td>
</tr>
</tbody>
</table>
Stimulus Control

Thought Experiment

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminative Stimulus (S\textsuperscript{D})</td>
<td>“What's the kanux, man!”</td>
<td>Generalized Conditioned Reinforcement</td>
</tr>
<tr>
<td>Stimulus Delta (S\textsuperscript{Δ})</td>
<td>“What's the kanux, man!”</td>
<td>Extinction</td>
</tr>
<tr>
<td>Neutral Stimulus (S\textsuperscript{0}, S\textsuperscript{+}, or S\textsuperscript{-})</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Discriminative Stimulus for Punishment (S\textsuperscript{Dp})</td>
<td>“What's the kanux, man!”</td>
<td>Punishment</td>
</tr>
</tbody>
</table>

“The Will Smith Effect”

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminative Stimulus (S\textsuperscript{D})</td>
<td>“What's the kanux, man!”</td>
<td>Generalized Conditioned Reinforcement</td>
</tr>
</tbody>
</table>

8/5/18
## Discriminative Stimulus (S^D) Control

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminative Stimulus (S^D)</td>
<td>Response</td>
<td>Generalized Conditioned Reinforcement</td>
</tr>
</tbody>
</table>

- **Discriminative Stimulus (S^D):**
  - Item/Event
  - Historically preceded availability of reinforcement
  - Momentarily evokes/strengthens particular behavior due to historical successes

- **Response**

- **Generalized Conditioned Reinforcement (GCR):**
  - Item/event
  - Increases future probability of behavior
  - Effective because of its previous pairings with many other reinforcers
  - Relatively independent of current states of MO

## Discriminative Stimulus Control for Turning

- **Discriminative Stimulus (S^D):**
  - Item/Event
  - Historically preceded availability of reinforcement
  - Momentarily evokes/strengthens particular behavior due to historical successes

- **Response**

- **Generalized Conditioned Reinforcement (GCR):**
  - Item/event
  - Increases future probability of behavior
  - Effective because of its previous pairings with many other reinforcers
  - Relatively independent of current states of MO

---

8/5/18
Discriminative Stimulus Control

<table>
<thead>
<tr>
<th>Discriminative Stimulus (S\textsuperscript{D}):</th>
<th>Behavior</th>
<th>Generalized Conditioned Reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Historically preceded availability of “clicking” sound (GCR)</td>
<td>Turning Around</td>
<td>- “Clicking” sound</td>
</tr>
<tr>
<td>- Momentarily evokes/strengthens turning around due to historical successes following response</td>
<td></td>
<td>- Increases future probability of behavior because of past pairings with bacon, girlfriends, yerba mate tea, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Relatively independent of food/yerba Mate/social/etc. deprivation</td>
</tr>
</tbody>
</table>

Conditioned Reinforcement

The Reflex

(U) +

(NS) “CLICK” (presented prior)

(UR): Salivating
**Conditioned Reflex (Reinforcement)**

(CS) "CLICK" → (CR): Salivating

**Generalized Conditioned Reinforcement**

(US) → + (UR): Salivating

(NS) "CLICK"

**Generalized Conditioned Reinforcement**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminative Stimulus (S^0)</td>
<td>Turning Around</td>
<td>Generalized Conditioned Reinforcement: &quot;CLICK&quot;</td>
</tr>
</tbody>
</table>
Conditioned Reinforcers as Conditioned Stimuli or Discriminative Stimuli?

As a result of the generalized reinforcement conditioning history, the response is more heavily influenced by the antecedent stimulus than it is by any current states of motivation.

The more reinforcers that are paired with a conditioned reinforcer, the stronger the antecedent stimulus control will be in evoking the behavior. For example, look at, but don’t read, the following slide...
Generalized Conditioned Reinforcement

Stimulus Delta ($S^\Delta$) Control

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus Delta ($S^\Delta$)</td>
<td>Response</td>
<td>Extinction</td>
</tr>
</tbody>
</table>

Eventual result is a weakening of that response in the presence of the $S^\Delta$.

“The Cillian Murphy Effect”

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus Delta ($S^\Delta$)</td>
<td>“What's the kanux, man!”</td>
<td>Extinction</td>
</tr>
</tbody>
</table>

"The Cillian Murphy Effect"
Stimulus Delta Control

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus Delta ($S^\Delta$):</td>
<td>(eventually weakened)</td>
<td>Extinction:</td>
</tr>
<tr>
<td>• Item/Event</td>
<td>Response</td>
<td>• Absence of Reinforcement</td>
</tr>
<tr>
<td>• Historically preceded UNavailability of reinforcement</td>
<td></td>
<td>• Decreases future probability of behavior</td>
</tr>
<tr>
<td>• Momentarily weakens particular behavior due to historical lack of success</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stimulus Delta ($S^\Delta$) Control for Turning

The Importance of Extinction

• Increases strength of momentary behavior

• Sharpens stimulus control

• Evokes variability of previously successful behavior
Definitions Revisited

<table>
<thead>
<tr>
<th>Stimulus Delta (S^δ):</th>
<th>Behavior</th>
<th>Extinction</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Historically preceded the unavailability of reinforcement following <em>turning</em> behavior</td>
<td>(eventually weakened tendency) <em>Turning Around</em></td>
<td>• Absence of clicks, bacon, yerba mate, and lady-pigeons following <em>turning</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• led to an overall weakening of the future behavior.</td>
</tr>
</tbody>
</table>

Stimulus Control

Stimulus and Response Generalization

• **Stimulus Generalization**: After an individual has learned a response to a stimulus, the same response is made to a new (but physically similar) stimulus without any additional training.

• **Response Generalization**: After an individual has learned a response to a stimulus, a new (but physically similar) response form is made to the same stimulus.
Discriminative Stimulus ($S^D$)
Control for Pecking

Stimulus Delta ($S^A$)
Control for Pecking

Definitions Revisited

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
</table>
| **Discriminative Stimulus ($S^D$):**  
The green disk has been historically correlated with the availability of generalized conditioned reinforcement and evokes or strengthens pecking behavior | **Pecking** | **Generalized Conditioned Reinforcement:**  
The sound of the click increases the future probability of pecking in the presence of the green disk as a result of its previous pairings with bacon, girlfriends, yerba mate tea, etc. |
Definitions Revisited

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stimulus Delta (S^\Delta)</strong>: The blank disk has been historically correlated with the unavailability of reinforcement following pecking and weakens the behavior as a result of extinction</td>
<td><strong>Pecking</strong></td>
<td><strong>Extinction</strong>: The absence of bacon, yerba mate, and lady pigeons following pecking has led to an overall weakening of the pecking behavior</td>
</tr>
</tbody>
</table>

Stimulus Control

![Fake Pigeon Pecking Data]

Bringing the Stimulus Control Pieces Together
Stimulus Control
Outside the Skinner Box

- Behavior: Approaching your boss at work

Stimulus Control
In the Classroom

- Behavior: Approaching the instructor

Stimulus Control and
Verbal Behavior
<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Verbal Discriminative</td>
<td>TACT</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
<tr>
<td>Verbal Discriminative</td>
<td>ECHOIC, SIGNED IMITATION, INTRAVERBAL</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
</tbody>
</table>

Non-Verbal vs. Verbal Stimulus Control

Response vs. Response Produced Stimulus

- **Response**: Any action performed by an individual
- **Response Produced Stimulus**: The sensory product (i.e. sound or sight) of that action
Verbal Response vs. Verbal Stimulus

- **Verbal Response**: Any action of an organism that is
  the result of and maintained by reinforcement
  mediated by a listener
  - Vocal manding “water” to a host
  - Manding by sign “candy”
  - Knocking on a door to be let in
- **Verbal Stimulus**: The sensory product of a verbal
  response
  - The sound of the vocal mand “water”
  - The sight of the signed mand “candy”
  - The sound of someone knocking on the door

Verbal Stimulus vs. Non-Verbal Stimulus

- **Verbal Stimulus**: The sensory product of a verbal
  response
  - The sound of the vocal mand “water”
  - The sight of the signed mand “candy”
  - The sound of someone knocking on the door
- **Non-Verbal Stimulus**: The sensory product of a non-
  verbal response and other properties of the non-
  verbal environment
  - The sight of a glass of water
  - The taste of a candy bar
  - The sight of a door
  - The sound of someone’s footsteps

Verbal Stimulus Control

- **Verbal Stimulus Control**: When a verbal stimulus
  evokes or strengthens a response

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing someone ask for where the door is</td>
<td>Pointing to the door</td>
<td>GCR</td>
</tr>
<tr>
<td>Feeling the braille pattern for the word CAR</td>
<td>Saying “car”</td>
<td>GCR</td>
</tr>
<tr>
<td>Hearing someone knock on the door</td>
<td>Opening the door</td>
<td>GCR</td>
</tr>
</tbody>
</table>
**Non-Verbal Stimulus Control**

**Non-Verbal Stimulus Control:** When a non-verbal stimulus controls a response.

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeing a door knob</td>
<td>Turning and opening the door</td>
<td>GCR</td>
</tr>
<tr>
<td>Seeing a wrapped birthday</td>
<td>Unwrapping the gift</td>
<td>GCR</td>
</tr>
<tr>
<td>Seeing a wrapped birthday</td>
<td>Unwrapping the gift</td>
<td>GCR</td>
</tr>
<tr>
<td>Hearing a truck drive by</td>
<td>Saying “truck”</td>
<td>GCR</td>
</tr>
<tr>
<td>Seeing a red light turn</td>
<td>Stepping on gas pedal</td>
<td>GCR</td>
</tr>
</tbody>
</table>

**Non-Verbal Stimulus Control and the Tact**

**Non-Verbal Discriminative Stimulus**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Verbal Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Verbal Discriminative</td>
<td>TACT</td>
<td>Generalized</td>
</tr>
<tr>
<td>Non-Verbal Discriminative</td>
<td></td>
<td>Conditioned</td>
</tr>
<tr>
<td>Non-Verbal Discriminative</td>
<td></td>
<td>Reinforcement</td>
</tr>
<tr>
<td>Non-Verbal Discriminative</td>
<td></td>
<td>Mediated by a</td>
</tr>
<tr>
<td>Non-Verbal Discriminative</td>
<td></td>
<td>Listener</td>
</tr>
</tbody>
</table>

• SPECIFIES for a listener the discriminative stimulus that controls the response (as opposed to the mand that specifies the reinforcer)
Stimuli that are Tacted

• Items
• Others’ Actions
• Our Own Actions
• Properties of Items (parts, features)
• Stimuli in different sense modes
• Private Events

Verbal Stimulus Control and the Echoic

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Verbal Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory Verbal Discriminative Stimulus</td>
<td>ECHOIC (vocal response whose form matches antecedent)</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
</tbody>
</table>

Echoic Skills

• Simple Sounds
• Words
• Phrases
• Novel Arrangements of Words
• Rehearsal of Complex Utterances
• Volume
• Tone/Pitch/Prosody
**Verbal Stimulus Control and the Intraverbal**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Verbal Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Discriminative Stimulus</td>
<td>INTRAVERBAL (verbal response whose form does NOT match antecedent)</td>
<td>Generalized Conditioned Reinforcement Mediated by a Listener</td>
</tr>
</tbody>
</table>

**Intraverbal Skills**

- Simple Fill-Ins
- Chains (Songs, Poems, Speeches)
- Complex Intraverbal Control:
  - Conversation
  - Recalling Past Events
  - Telling Stories

**Stimulus Control or Motivational Control??**

- Experiencing hunger pangs and telling your significant other “I’m really hungry” when in the kitchen and he/she is near the food.
- Telling your friend (who lives 3,000 miles away) on the phone “I’m really hungry” after hearing your stomach growl.
- Driving past a neighbor’s house and telling your significant other, “That grass sure is tall.”
“Gee, the grass sure is getting tall.”
- Very Observant Wife

Pure Stimulus Control?
- Lying
- Exaggerating
- Misperceptions
- Pseudo-Sciences
- Ulterior Motives
- Recall
- Multiple Control

The Multiple Control of Verbal Behavior
“Skinner’s discussion of multiple control is easily overlooked. Readers sometimes fail to recognize that pure forms of the respective verbal operants are rare outside the laboratory or instructional contexts, and a common preoccupation of students is to try to classify utterances as one or another verbal operant on the assumption that the example must be exclusively one type.” (Michael, Palmer, and Sundberg, 2011)
Conditional Discrimination Defined

“In conditional discrimination, the effect of a discriminative stimulus depends (or is conditional upon) on other stimuli.”

(Michael, Palmer, and Sundberg 2011)

Conditional Discrimination for Turning

In a conditional discrimination, reinforcement for stepping on the gas is conditional upon a clear path in front of your car.
**Verbal Conditional Discrimination**

... in a **verbal** conditional discrimination (VCD), the effect of a discriminative stimulus depends (or is conditional upon) on other **VERBAL** stimuli.

---

**Verbal Conditional Discrimination**

“Simon says, clap your hands”

---

**Simon Says that “Clap Your Hands” is an S^D**

- **VCD**: The effect of the verbal stimulus “clap your hands” as an S^D depends upon the verbal stimulus: “Simon Says”
Conditional Discrimination
Simplified*

Simple Discrimination:
If X-Then Y
(because reinforcement has followed in the past)

Conditional Discrimination:
If X, and If Y - then Z
(because reinforcement has followed in the past)

* Credit goes to Dr. Mark Sundberg for this description

Simon Says

• IF you hear someone say “Simon says” and
• IF you hear him say “clap your hands,”
• THEN clap your hands

Examples of Conditional Stimulus Control

• Putting on a folded undershirt rather than one in the dirty hamper

• When you are at the gas station but you drive past the pump with an orange cone in front of it, and pull up to the one without a cone

• Tactling an item loudly for someone at a crowded party, but quietly for someone in a library
Instructional Verbal Conditional Discriminations

- What is it?
- What color?
- What shape?

Other Multiple Control Topics

- Joint Stimulus Control
- Stimulus Equivalence
- Understanding Literature
- Listening to a Speaker (e.g. your behavior during this talk)
- Engaging in a Conversation
- Recalling Events from Your Past

Transfer of Stimulus Control
Transfer of Stimulus Control

As a result of reinforcing a previously established response to a discriminative stimulus ($S^D$) in the presence of a neutral stimulus ($S^+$), the $S^+$ eventually acquires $S^D$ control over that response.

- TURN  
- PECK  

Transfer of Stimulus Control
Revisit the Definition

As a result of reinforcing turning in response to the red color (S^D), and in the presence of the neutral textual pattern TURN (S^*), the textual pattern (S^*) eventually acquires discriminative stimulus (S^D) control over that response.

———

Transfer of Stimulus Control and Teaching

———

Error-“less” Learning

———
The History of Errorless Learning

Terrace (1963): Discrimination learning with and without “errors”

SD

SA

Trial-and-Error Learning

SD

SA

The History of Errorless Learning

Mistakes Made with Errorless Learning vs. Trial-and-Error

Data Adapted from Terrace (1963)
Participant Names Invented for Presentation
“There should be statues of Terrace’s pigeons in front of every school of education.”
—Murray Sidman

Errorless vs. Trial-and-Error Learning

Marsh and Johnson (1968): Discrimination reversal learning without “errors”

<table>
<thead>
<tr>
<th>Errorless Group</th>
<th>Trial-and-Error Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S^D$</td>
<td>$S^A$</td>
</tr>
<tr>
<td>$S^D$</td>
<td>$S^A$</td>
</tr>
</tbody>
</table>

“Out with the Old and In with the New”

After discriminations were acquired, the researchers reversed the stimuli to measure rate of unlearning the “old” and learning the “new” discriminations

<table>
<thead>
<tr>
<th>Errorless Group</th>
<th>Trial-and-Error Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S^D$</td>
<td>$S^A$</td>
</tr>
<tr>
<td>$S^D$</td>
<td>$S^A$</td>
</tr>
</tbody>
</table>
Results

- **Errorless Learning Group:** Persisted in responding to the “old” S^D despite extinction being scheduled for pecking.

- **Trial-and-Error Learning Group:** Rapidly adapted to changing conditions and learned new discriminations.

Errorless vs. Trial-and-Error Learning

- **Errorless Learning:** Best for circumstances that are relatively unchanging (e.g., 2 + 2 always equals 4, crossing the street)
  - Reinforcement occurs more frequently
  - Learning is more enjoyable
  - Best for developing foundational skills

- **Trial-and-Error Learning:** Best for circumstances that are relatively unstable and require problem-solving for accurate responding (e.g., finding items at a grocery store, complex social skills)
  - Necessarily involves extinction schedules
  - Learning can be more frustrating
  - Best for skills requiring problem solving

Palmer’s Definition of a Problem

1) A target response (or set of responses) is part of the organism’s repertoire under one or more stimulus conditions.

2) Discriminative stimuli are present indicating that the response is scheduled for reinforcement.

3) The response is not under direct control of current discriminative stimuli.
How is a Problem Solved?


Chapter 11

A Behavioral Interpretation of Memory

David C. Palmer
University of Massachusetts

Errorless Learning

vs.

Problem Solving

When Does Helping Help?

Watching myself with Lisa, I have been more impressed by this point. In my concern for helping a child, I destroy the contingencies which would teach her to behave. I save her from annoyances and destroy the contingencies which would teach her to save herself. For example, I push branches aside which are getting against her face and deprive her of the chance to learn how to avoid branches. I pull on a sock and deprive her of the chance to learn to do it herself.

(From Skinner’s Personal Notebooks, 1968)
Extinction: When “Errors” Help

- After problem behaviors have been successfully controlled by S-Deltas (e.g. blank disks)

- ...and when many different adaptive behaviors have been strengthened in the presence of a stimulus condition (i.e. divergent control)...

Then, errorless teaching is no longer the preferred method of instruction

Instead: Instructional environment is systematically set up to evoke extinction-induced problem-solving skills

A failure is not always a mistake, it may simply be the best one can do under the circumstances. The real mistake is to stop trying.

— B Y. Shuman —
Bottom Line
When teaching basic foundational skills to learners, errorless learning will result in:

- Faster rates of acquisition
- Higher likelihood of independent instructional settings and stimuli being paired with reinforcement
- Stronger repertoires of building blocks toward complex tasks that require problem-solving

Applied Research in Errorless Learning

Applied Research in Errorless Learning
Applied Research in Errorless Learning

Terms for Errorless Procedures

- **Neutral Stimulus (S⁺ or S⁰)**: Stimuli targeted for Sᵅ or Sᵅᵅ

- **Prompt Stimulus**: Discriminative Stimuli used to pair with S⁺ and eventually fade out

Types of Errorless Learning

*Meuller, Palkovic, and Maynard (2007):*

- Response Prevention
- Delayed Prompting
- Stimulus Shaping
- Stimulus Fading
Response Prevention

**Definition:** In a discrimination procedure, blocking access to selecting the targeted $S^+$ ($S^0$) and ensuring an undisrupted path only to the targeted $S^0$ ($S^+$).

Delayed Prompting

**Definition:** After presenting a targeted stimulus ($S^+$), the prompt stimulus ($S^D$) is presented at gradually increasing intervals allowing time for:

<table>
<thead>
<tr>
<th>Targeted Time Interval</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Seconds</td>
<td>Picture of a leaf + “What is it?” + “Leaf”</td>
</tr>
<tr>
<td>1 Second</td>
<td>Picture of a leaf + “What is it?” + 1 Second Pause + “Leaf”</td>
</tr>
<tr>
<td>2 Seconds</td>
<td>Picture of a leaf + “What is it?” + 2 Second Pause + “Leaf”</td>
</tr>
<tr>
<td>3 Seconds</td>
<td>Picture of a leaf + “What is it?” + 3 Second Pause + “Leaf”</td>
</tr>
</tbody>
</table>

Stimulus Shaping

**Definition:** Systematically making changes to an established prompt stimulus $S^D$ until it is transformed into a targeted $S^D$ ($S^+$).
Stimulus Shaping

• Definition: After reinforcing a response to prompt stimulus (S^p) that is paired with the neutral stimulus (S^+), the prompt stimulus is systematically faded away.

Stimulus Fading

• Definition: After reinforcing a response to prompt stimulus (S^p) that is paired with the neutral stimulus (S^+), the prompt stimulus is systematically faded away.
“A constantly experimental attitude toward everything—that's all we need.”

-B.F. Skinner

Thank You.

References
