Maximizing Stimulus Control: Best Practice Guidelines for Receptive Language Instruction

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Importance of Effective Teaching

• Use the most effective and efficient teaching strategies because
  • Even under optimal conditions we don’t get 40hr/wk for 2-6 years!!
  • Practice doesn’t make perfect!!
    • Perfect practice makes perfect
    • Practicing errors creates entrenched faulty stimulus control and PROBLEM BEHAVIOR
Markers to Evaluate Your Teaching

Effective teaching

• Leads to independent and accurate responding
• Leads to rapid acquisition
• Results in a high probability of reinforcement
• Results in minimal problem behavior

Ineffective Teaching

• Leads to high error rates
• Leads to prompt dependence and passivity
• Results in a low rate of reinforcement
• Results in increasing trends in problem behavior

Stereotypy may persist

Escape function
Stimulus Control and Autism

- **Stimulus control**: a stimulus readily evokes or alters some dimension of a behavior

- Failed/Faulty stimulus control is the norm

- Teaching is about manipulating antecedent stimuli to establish **stimulus control**
  - Stimuli that accompany or precede responses that are reinforced can come to influence those responses in important and complex ways (Skinner)
Incorporating Advances in Stimulus Control Technology

• Many aspects of DTT are based on the original “ME book” protocols

• We have learned so much about stimulus control that suggests other procedures for optimal instructional programming!
  • Murray Sidman
  • Shriver Center and NECC!
  • Green (2001)
Teaching Receptive Language Skills: Recommendations for Instructors

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Why this paper?

• Synthesize the literature in a consumable form

• Generate best practice guidelines and tools

• Publish in a behavior analysis journal for practitioners
Scope of Use

- Listener responding – both simple and conditional discriminations

- Other types of conditional discriminations – V-V matching, picture-based mand training

- MOST important with early learners who are just beginning discrimination training – start right to prevent future problems!!!
Types of Discriminations

- **Simple Discriminations**
  - Discrimination that has three elements:
    - Sd, Bx, Sr+
    - E.g., Oral Naming (tact), Instruction Following, Imitation

- **Conditional Discriminations**
  - **Matching** is basis for many of these responses
  - Require multiple simple discriminations and **conditionality**
    - Reinforce response **if and only if** there is a specific additional stimulus
Recommendations

• Require an observing response
• Minimize unintentional instructor cues
• Arrange the antecedent stimuli and required behaviors
  – Select the appropriate auditory instruction
  – Plan the required behaviors
  – Select the features of the stimuli and behaviors carefully
  – Introduce and teach the targets simultaneously
  – Counterbalance antecedent stimuli
• Use effective prompting and differential reinforcement procedures
• Troubleshoot stimulus control problems
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Require an observing response

- Observing responses (OR)
  - Learner emits a response that results in sensory contact with the stimuli
- Differential observing responses (DOR)
  - Same as OR except learner response varies depending on stimulus
Require an observing response

• The OR or DOR should match the program and learner skills
  • Motor Imitation
    • “Look at me”
  • V-V Matching Trials
    • Scan the array, touch the sample, touch each comparison
  • Listener Responding (A-V)
    • Respond after the stimulus, echo the target

• Only reinforce responses that occur after the antecedents are presented
  • Did not attend to stimulus if it didn’t exist before response
Example of DOR Procedure

Say, “Blue”

Child says, “Blue”

“Blue”

Say, “Blue”

Child says, “Blue”

“Blue”
Recommendations

- **Require an observing response**
- **Minimize unintentional instructor cues**
- **Arrange the antecedent stimuli and required behaviors**
  - Select the appropriate auditory instruction
  - Plan the required behaviors
  - Select the features of the stimuli and behaviors carefully
  - Introduce and teach the targets simultaneously
  - Counterbalance antecedent stimuli
- **Use effective prompting and differential reinforcement procedures**
- **Troubleshoot stimulus control problems**
Minimize Unintentional Cues

• Instructors may unintentionally provide prompts for correct answer

• Examples:
  – Looking at the correct item in the array
  – Placing the correct item in the array first
  – Minor body mannerisms during instruction-following tasks (e.g., posture for stand up)
  – Placing hand near the incorrect ones to block
  – Tone or pitch of voice
Minimize Unintentional Cues

• Stimuli that accompany or precede responses that are reinforced can influence responses in important and complex ways (Skinner)
  • EVEN WHEN WE DIDN’T MEAN FOR IT TO HAPPEN!!
• Increases the likelihood that irrelevant features of the environment will control responding instead of the programmed stimuli
Minimize Unintentional Cues

• Return hand and body to neutral, keep face at neutral, keep eyes on learner, same tone
  • Practice until fluent without unintentional cues
  • Teach instructors to recognize in others (video)

• Periodically check for drift

• Prepare materials out of view – printed arrays in a binder or PowerPoint presentation
Recommendations

• **Require an observing response**
• **Minimize unintentional instructor cues**
• **Arrange the antecedent stimuli and required behaviors**
  – Select the appropriate auditory instruction
  – Select the features of the stimuli and behaviors carefully
  – Introduce and teach the targets simultaneously
  – Counterbalance antecedent stimuli
• **Use effective prompting and differential reinforcement procedures**
• **Troubleshoot stimulus control problems**
Provide Clear and Concise Instructions

• Instructions should:
  – Be brief and clear
  – Contain the relevant information

• Unnecessary information may lead to faulty stimulus control (Green, 2001; Tarbox, Tarbox, & O’Hora, 2009)
  – Example
    • Show me the red one, show me the green one, show me the blue one
Provide Clear and Concise Instructions

<table>
<thead>
<tr>
<th>Program</th>
<th>Avoid</th>
<th>Ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Following instructions</td>
<td>“Ok, let’s stand up”</td>
<td>“Stand”</td>
</tr>
<tr>
<td>Receptive ID: objects</td>
<td>“I’d like you to point to red” or “Point to the truck for me”</td>
<td>“Red”</td>
</tr>
<tr>
<td>Receptive ID: abstract features</td>
<td>“Show me the big one”</td>
<td>“Big”</td>
</tr>
</tbody>
</table>
Arrange the Antecedents and Required Behaviors Carefully

- Carefully program the behaviors and stimuli for the set with care—remember you are discriminating these things FROM each other
  - Start with easier (snake, bird, dog) then move to harder (horse, cow, dog)
- Avoid opposite actions in instruction following target sets—status may evoke the other behavior rather than your instruction
  - Stand up, sit down
  - Arms up, arms down
  - Light on, light off
Arrange the Antecedents and Required Behaviors Carefully

• Introduce multiple targets simultaneously – NO MASS TRIALS!!!
  – Introduce a minimum of three targets at the onset of training and exit them together
    – following 3 different directions
    – identifying common objects from an array of 3 cards

• Minimizes the likelihood of
  • correct responding and reinforcement for “doing what you just did” without listening to the auditory stimulus
  • control by “reject relation” or switching
Arrange the Antecedents and Required Behaviors Carefully

- Faulty stimulus control is so common when you use massed trials that Lovaas (2003) has multiple pages describing the most common error patterns
  - E.g., scrolling, win-stay, lose-shift, side bias

- Absolutely critical that the conditional and discriminative stimuli control responding on every single trial
  - Conditional stimulus must vary every trial with a different required response that is uniquely associated with that auditory stimulus
Sequential vs. Simultaneous Methods

• **Sequential Method (simple to conditional)**
  - Blocked-trial procedure (Saunders & Spradlin, 1989)

• **Simultaneous Method (conditional only)**
  - Green (2001); Grow, Carr, Kodak, Jostad & Kisamore (2011); Grow, Kodak, & Carr (2014)
Step 1: Sequential Method

1. "BLUE"

2. "BLUE"

3. "BLUE"
Step 2: Sequential Method

1. "RED"

2. "RED"

3. "RED"
Step 3: Sequential Method

1. "BLUE"

2. "BLUE"

3. "BLUE"
Step 4: Sequential Method

1. “RED”

2. “RED”

3. “RED”
Step 5: Sequential Method

1. "BLUE"

2. "RED"

3. "RED"
Step 6: Sequential Method

1. "YELLOW"

2. "YELLOW"

3. "YELLOW"
Step 7: Sequential Method

1. "BLUE"

2. "YELLOW"

3. "BLUE"
Step 8: Sequential Method

1. “YELLOW”

2. “YELLOW”

3. “RED”
Step 9: Sequential Method

1. “BLUE”

2. “YELLOW”

3. “RED”
Simultaneous Method

“YELLOW”

“RED”

“BLUE”
Figure 2. Percentage of correct independent correct responses during Erin’s first evaluation. The numbered arrows represent steps in the simple-conditional method.
LAURA L. GROW et al.

Percentage of Correct Independent Responses

Erin (2)

Simple/Conditional Method

Conditional-Only Method

Step 9

Step 9 + RAS+EC

3-week probe
Follow-up

Percentage of Independent Responses During Follow-up

Erin 1  |  Erin 2  |  Erin 3  |  Shane 1  |  Shane 2  |  Shane 3  |  Devin 1  |  Devin 2

* indicates significant difference.
Green (2001)

• Vary sample equally within the block but keep the comparisons the same
  • Minimizes responding to or away from novel distracter

• At least 3 comparisons on every conditional discrimination trial
  • Early mass trials which are simple discriminations can interfere with subsequent conditional discriminations and minimize attending to the auditory stimulus

• Random variation in order of sample presentation within block

• Random variation in placement of comparison stimuli within the block
  • Positional bias
Counterbalance Array

• Without planning, an instructor is likely to present the stimuli in a way that promotes faulty stimulus control
  – Placing the correct item in a particular position disproportionately may result in a side bias
• Create a system to ensure therapists rotate the stimuli correctly
### Counterbalancing

<table>
<thead>
<tr>
<th>Trial</th>
<th>Session Type A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coloring</td>
</tr>
<tr>
<td></td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td>2</td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Coloring</td>
</tr>
<tr>
<td>3</td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Coloring</td>
</tr>
<tr>
<td></td>
<td>Bathing</td>
</tr>
<tr>
<td>4</td>
<td>Coloring</td>
</tr>
<tr>
<td></td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td>5</td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Coloring</td>
</tr>
<tr>
<td>6</td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Coloring</td>
</tr>
<tr>
<td></td>
<td>Bathing</td>
</tr>
<tr>
<td>7</td>
<td>Coloring</td>
</tr>
<tr>
<td></td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td>8</td>
<td>Bathing</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Coloring</td>
</tr>
<tr>
<td>9</td>
<td>Dancing</td>
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<td>Bathing</td>
<td>Dancing</td>
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<tr>
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<td>Dancing</td>
<td>Coloring</td>
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<td>Coloring</td>
<td>Bathing</td>
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<td>Bathing</td>
<td>Dancing</td>
</tr>
<tr>
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<td>Dancing</td>
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<table>
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<tr>
<th>Trial</th>
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<th>Session Type B</th>
<th>Session Type C</th>
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<tbody>
<tr>
<td>1</td>
<td>Coloring</td>
<td>Bathing</td>
<td>Dancing</td>
</tr>
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<td>Dancing</td>
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Recommendations

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• Troubleshoot stimulus control problems
Use Effective Prompts and Fading Procedures

- **Response prompts:** Additional behavior by the teacher that increases the likelihood that the correct behavior will occur
  - Verbal (instruction)
  - Gestural or Model (pointing)
  - Physical (physical guidance)

- **Can go in sequence either way:**
  - Increasing assistance (LTM)
    - Verbal, Gestural/Model, Physical Guidance
  - Decreasing assistance (MTL)
    - Guidance, model, gestural, verbal
Use Effective Prompts and Fading Procedures

• **Increasing assistance (LTM):**
  - Each trial provides an opportunity to respond at each level of prompting
  - Implement higher-level prompt only if no correct response
  - Potential drawbacks: Frequent errors, prompt dependence

• **Decreasing assistance (MTL)**
  - Amount of assistance gradually decreased across trials
  - Fewer errors, more efficient (more rapid learning) than least-to-most prompts - sometimes called “errorless”
  - High rate of reinforcement means you DON’T NEED TO INTERSPERSE maintenance tasks

• **General recommendation (MacDuff et al)**
  - **Assess** skill level with least-to-most probes
  - **Teach** with most-to-least trials
Use Effective Prompts and Fading Procedures

• “Errorless” learning procedures rather than trial and error

• Fade prompts quickly and effectively
  • Probe and teach
  • Time-delay (Touchette & Howard, 1984)
  • DON’T USE POSITIONAL PROMPTS!!

• Benefits
  • Reduces or eliminate errors
  • Decreases overall instruction time
  • Prevents or reduces escape-maintained problem behavior
Grow, Kodak, & Carr (2014)
Errorless Teaching

![Graph showing the number of sessions to mastery for Kenny (1), Kenny (2), and Will using Conditional Only Method and Simple/Conditional Method.](image-url)
# ____ Trial Correct / Error

<table>
<thead>
<tr>
<th>Probe</th>
<th>Session Type A</th>
<th>Prompt Req</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>dog</td>
<td>cat</td>
</tr>
<tr>
<td>2</td>
<td>cat</td>
<td>horse</td>
</tr>
<tr>
<td>3</td>
<td>horse</td>
<td>dog</td>
</tr>
</tbody>
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<tbody>
<tr>
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<td>dog</td>
<td>cat</td>
</tr>
<tr>
<td>2</td>
<td>cat</td>
<td>horse</td>
</tr>
<tr>
<td>3</td>
<td>horse</td>
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<td>horse</td>
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<tr>
<td>9</td>
<td>horse</td>
<td>dog</td>
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</table>

# ____ Session Type A

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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>dog</td>
<td>cat</td>
</tr>
<tr>
<td>2</td>
<td>cat</td>
<td>horse</td>
</tr>
<tr>
<td>3</td>
<td>horse</td>
<td>dog</td>
</tr>
</tbody>
</table>

%
Use Effective Reinforcement

- Use preference assessment to identify effective reinforcers

- Provide higher magnitude reinforcers, higher quality reinforcers or denser schedules of reinforcement for independent responses than for prompted responses
  - Karsten & Carr (2009)
  - Olenick & Pear (1980)
  - Vladescu & Kodak (2010)
Data Analysis and Maintenance

• Analyze for the set!!
  • 100% independent accuracy for probes
  • Also track responding on trial blocks to do error analysis and detect trends once errors can occur

• Combine known sets to new mastery criterion prior to moving into final maintenance
Figure 2. Percentage of correct independent correct responses during Erin’s first evaluation. The numbered arrows represent steps in the simple-conditional method.
Larger Analysis

Receptive Targets

Probes to Criterion Per Target vs. Consecutive X-item sets
Recommendations

• Require an observing response
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  – Plan the required behaviors
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• Use effective prompting and differential reinforcement procedures
• Troubleshoot stimulus control problems
Uh Oh!!! Did I teach a strategy?

- Faulty stimulus control can be established by
  - An instructional history of massed trials
  - Unintentional instructor cues
  - Failing to counterbalance the stimuli
- Error patterns may worsen over time and/or bleed over into other programs
Troubleshoot problems

• Discard corrupt targets unless THAT is the critical stimulus – not just learning to learn
• Add in DOR to ensure attending
• Eliminate instructor cues and maybe even instructor (if SD for attending to other than essential features)
• Conduct error analyses to detect stimulus control issues
Right Side Bias

1. “ORANGE”

2. “RED”

3. “BLUE”
Error Analysis-Side Bias

- Calculate the percentage of responses that are allocated to each position in the array
Stimulus Bias

1. “ORANGE”

2. “RED”

3. “BLUE”
Error Analysis-Stimulus Bias

• Calculate the percentage of responses that are allocated to each stimulus in the array
### Troubleshoot Problems

**Table 2. Examples of Issues That Might Arise During Receptive Language Instruction and Some Potential Solutions**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Potential solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner displays a side bias during receptive language programs</td>
<td>Increase the array size</td>
</tr>
<tr>
<td>Learner responses are influenced by the instructor's behavior</td>
<td>Identify and eliminate the instructor behavior (e.g., looking at the correct visual comparison stimulus)</td>
</tr>
<tr>
<td>Learner engages in switching responses when two targets are similar</td>
<td>Separate targets into two training sets and ensure that the new training sets contain distinction targets</td>
</tr>
<tr>
<td>Learner responds prior to the delivery of the antecedent stimuli</td>
<td>Prevent or block responding prior to the delivery of the relevant antecedents; require a differential observing response; place premature responses on extinction</td>
</tr>
</tbody>
</table>
Recommendations

• Require an observing response
• Minimize unintentional instructor cues
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  – Select the features of the stimuli and behaviors carefully
  – Introduce and teach the targets simultaneously
  – Counterbalance antecedent stimuli
• Use effective prompting and differential reinforcement procedures
• Troubleshoot stimulus control problems
Last words . . .

- Design it well
- Make it easy to present the trials optimally
- Stay on top of the data
- Fix it quickly if it goes off of the rails
Contact me:
lleblanc@tbh.com