Joint Control

Review of Listener/Speaker Responding

- Skinner’s (1957) analysis of verbal behavior offered an alternative to the prevailing structural conceptions of language in which words and sentences (i.e. formal properties of language) were considered the important units of analysis.

- Whereas structural accounts emphasized the topography of language (e.g. syntax, grammar, morphemes, mean length of utterance, etc.), Skinner’s behavior analytic account identified the functional relation between a response and its controlling variables, or the verbal operant, as the important unit of analysis.

- This behavior analytic account of language suggests important implications for the treatment of children with autism and other developmental disabilities (Sundberg & Michael, 2001) and a growing body of clinical work and research has documented the value of including this taxonomy in language training programs (see Sautter & LeBlanc, 2006 for a review).
• Much of this literature, however, has focused on the application of Skinner’s analysis to teaching speaker behavior, with less work dedicated to a thorough analysis of the contingencies operating on the behavior of the listener (Schlinger, 2008).

• Possibly due to this lack of attention, cognitive explanations that describe the listener as a “passive receptacle” (Schlinger, 2008, p. 149), “recipient” (Lowenkron, 1998, p.339), or “processor” of information (Sidner, 2006) have persisted.

• Although Skinner’s (1957) analysis emphasized speaker behavior, he did not ignore the listener. Skinner suggested that the control exerted by verbal stimuli was at least partially dependent upon the listener having an existing verbal repertoire of speaker behavior.

• He stated, “...some of the behavior of listening resembles the behavior of speaking, particularly when the listener understands what is said” (Skinner, 1957, p. 10).

• Schlinger (2008) extended Skinner’s analysis of listener behavior and refined the difference between listener behavior as a repertoire of discriminated operants (i.e., mediation of reinforcement for a speaker) and “listening.”

• Schlinger asserted that listening is behaving verbally. He stated, “...the behavior of listeners and speakers may be inseparable, especially when we say the listener listens, pays attention to, or understands the speaker” (p.148).
• Schlinger argued that, in fact, listening and speaking may not be functionally different, “In other words, the listener also behaves verbally when he or she is said to be listening” (Schlinger, 2008, p.150).

• All of this suggests that listening may be predicated upon a complex verbal repertoire that mediates listener responses.

**Joint Control**


• Lowenkron (1998) defined joint control as “the effect of two (discriminative stimuli) S0’s acting jointly to exert stimulus control over a common response topography” (p.328-329).

• Lowenkron (1998) stated: “Joint control occurs when the currently rehearsed topography of a verbal operant, as evoked by one stimulus, is simultaneously evoked by another stimulus. This event, the onset of joint stimulus control by two stimuli over a common response topography, then sets the occasion for a response appropriate to this special relation between the stimuli” (p.327).

In other words, one verbal response is simultaneously emitted under two distinct sources of stimulus control.

For example, two possible sources of control are: (1) a verbal stimulus that evokes an echoic or self echoic and (2) a nonverbal antecedent S0 that evokes a tact.
• The emission of a single verbal response under two joint sources of stimulus control is a unique event that then exerts control over a third response, typically a selection response which is mediated by the verbal responses.

• Palmer (2006) refers to joint control as a discriminable jump in response strength when two or more concurrent SDs control a response of a common topography. It is an example of multiple control.

**EXAMPLE**

**Italian Example**

• Let’s look at an example of joint control in everyday life on the next slide.

**Joint Control Example**
Stimuli Produced by the Task

- The distinction between unmediated and mediated stimulus selection accounts present important implications for the arrangement of language training programs for children with autism.
- For example, if a child with autism was to be taught to select two items from a larger field (e.g., “Give me the crayon and the ball” when presented with a field of 10 items), an unmediated stimulus selection account would require that each set of two items be specifically trained and reinforced.
- Conversely, according to the [joint control] account, ... the child’s responses may be brought under the control of the stimuli produced by the task itself and not the specific sample and comparison stimuli used, thus facilitating generalized responding.

---Causin, Albert, Carbone & Sweeney-Kerwin (2013, p. 999)

Experiment 1

Experiment 2
Pigeon Analogue Experiment

- Blough (1959) demonstrated something very similar to this with pigeons in a delayed match to sample experimental preparation.

- During the delay period the pigeons which engaged in differentiated stereotypical behavior (analogous to invented gestural signs) were more likely to emit correct matching responses than those which failed to engage in specific topographical responses during the delay.


**EXPERIMENTAL PREPARATION**

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>SAMPLE</strong>  ON - 1 sec (flicker or steady)</td>
</tr>
<tr>
<td>2</td>
<td><strong>DELAY</strong>  e.g., 0-5 sec (all stimulus lights off)</td>
</tr>
<tr>
<td>3</td>
<td><strong>CHOICE</strong>  (side keys on) Bird pecks stimulus that appeared in 1</td>
</tr>
<tr>
<td>4</td>
<td><strong>REINFORCEMENT</strong>  (keys red) Bird eats if peck in was correct</td>
</tr>
<tr>
<td>5</td>
<td><strong>REST</strong>  5 sec (keys red)</td>
</tr>
</tbody>
</table>

Vary from trial to trial:
- sample stimulus (flicker or steady)
- matching key (left or right)
- delay (typically 0, 1, 2, or 5 sec)

*Figure 1. The sequence of events in a single delayed matching trial.*
Figure 2. Matching performance of Bird 5 as a function of delay. The different curves correspond to different periods during the experiment. Each point represents mean data from 5 to 10 sessions. (See text.) The inset indicates the bird’s delay behavior at the time when the data shown in the upper curve were collected.

Blough, 1959 (p. 152)

Following the “superstition” paradigm, it is assumed that at some point during the early sessions of Birds 5 and 1, two behavior chains were related at a better-than-chance level to the two sample stimuli. This having happened, another reinforcement contingency began to operate. For, to the extent that the superstitious chains were correlated with the sample stimuli, they themselves provided discriminative stimuli for the matching responses. Pecks on the flickering key were always reinforced following one of the superstitious chains, and never reinforced following the other chain. The opposite was true of pecks on the steady key. This differential reinforcement strengthened the correct response in the presence of the appropriate chain and ultimately strengthened the chain itself and its association with one of the sample stimuli.

Blough, 1959 (p.157)
Joint Control Research

• In a series of studies investigating the use of sample-coding to teach matching-to-sample, Lowenkron (1984, 1988, 1989), provided empirical support for the role of mediated responding in the occurrence of generalized relational matching.

• In the first study of this type, Lowenkron (1984) demonstrated that generalized responding was dependent upon the occurrence of a coding response.

• In a later study, Lowenkron and Colvin (1995) taught generalized relational matching to preschool children with vocal verbal behavior in the form of tacts and intraverbals as the mediating responses.

• Gutierrez (2006) taught adult women to acquire a generalized sequencing repertoire using an unfamiliar language by establishing mediating responses

• DeGraaf and Schlinger (2012) replicated and extended the findings of Gutierrez (2006) by comparing the effectiveness of joint control training and prompt fading procedures in teaching sequencing responses.

Joint Control Research with Children with Autism
• Presently, there are only two published and one unpublished applied studies on the benefits of joint control training for children with autism.

• Tu (2006) examined the importance of joint control when teaching responses to experimenter vocal requests to both vocal and non-vocal children.

• She found that tact and echoic training were insufficient to produce listener selection responses.

• Only after joint control training did the participants improve their selection response.
In an unpublished dissertation, Delgi Espinosa (2011) examined the effects of a teaching procedure derived from a joint control analysis on the selection of picture sets composed of color and item combinations for three children with autism.

The joint control teaching procedures required that participants simultaneously emitted self-echoic and tact responses prior to emitting selection responses.

Causin, Albert, Carbone & Sweeney-Kerwin (2013), published the most recent study on the application of joint control to teaching complex listener behavior to children with autism.

A complete description of that research follows.
METHOD

Participants and Setting

• There were three participants in this study.

• All participants demonstrated echoic/mimetic, tact and intraverbal repertoires that fell within the 18-30 month level of the VB-MAPP (Sundberg, 2008).

• All participants were enrolled at a private clinic that provides one-on-one instruction that was guided by the principles of applied behavior analysis and incorporated Skinner’s (1958) analysis of verbal behavior.

• Bobby
  – Six-year-old male diagnosed with autism who was enrolled for about 15 hours per week.
  – Non-vocal learner who used manual sign language as his primary means of communication.

• Connor
  – Fourteen-year-old male diagnosed with Pervasive Developmental Disorder (PDD) and Attention Deficit Hyperactive Disorder (ADHD) who was enrolled at the clinic for about 8 hours per week.
  – Vocal learner

• Andre
  – Seventeen-year-old male diagnosed with autism who was enrolled for about 15 hours per week.
  – Vocal learner
Stimulus Sets

- Choice of stimulus sets of pictures of items was the dependent variable in this study. Therefore, a pool of 12 previously mastered tacts and listener selection responses were combined to form 50 stimulus sets containing three or four pictured items in each set. The number of pictured items within each set varied for each participant based on pre-baseline assessment of skill levels.

Experimental Design

- A multiple probe design across participants was used to examine the effectiveness of joint control training on teaching listener responding (Horner & Baer, 1978).
Response Definitions and Data Collection

- Two dependent variables in this study:
  - Cumulative frequency of untrained stimulus sets acquired (baseline and generalization).
  - Cumulative frequency of trained stimulus sets acquired (based on daily first trial probes in the training condition).

- **Correct response**: Selecting all pictured items that correspond to the spoken items named by the instructor (i.e., vocal stimulus), in the same order in which they were presented by the instructor; the response was completed within 20 seconds of the presentation of the vocal stimulus and included a full 1 second pause following the selection/delivery of the final item.

- For example, the experimenter said “Give me A, B and C”. A correct response was the child handing A, B and C to the teacher in that order within 20 secs that included no attempt to hand over another stimulus for 1 sec after the response.

- **Incorrect response**: Selecting pictured items that did not correspond to the vocal stimulus OR selecting the incorrect number of pictured items OR selecting pictured items that correspond with the vocal stimulus in a different order than which they were presented OR emitting a response beyond the established time criteria (20 seconds) OR initiating a response before the completion of the vocal stimulus OR failing to respond.

- IOA and treatment fidelity measures were all within acceptable ranges.
Experimental Conditions

1. Baseline – probes of all 50 sets were conducted during each day of baseline according to the probe procedures described in the next slide. A correct response during any probe during baseline was the criterion for acquisition and the set was removed from the group of 50.

2. Probes for trained and untrained sets occurred each day during treatment. A correct response on the first presentation of a stimulus set was the criterion for acquisition. During training probes acquisition required two consecutive daily probes to meet acquisition criterion.
General Procedures

- Each time acquisition criteria were met for a trained stimulus set, a probe of all remaining untrained stimulus sets was conducted until all the sets were recorded as either trained or untrained.

- What follows are video illustrations of each of the phases of the experiment.
**Experimental Conditions**

- **Baseline Conditions**
  - Baseline Procedures (*Bobby Video*)

- **Treatment Conditions**
  - Joint Control Training Condition
    - Vocal Learner Teaching Procedures (*Andre Video*)
    - Non-Vocal Learner Teaching Procedures (*Bobby Video*)
    - Error Correction Procedures (*Connor Video*)
  
  - Joint Control Training with Rehearsal Condition
    - Vocal Learner Rehearsal Training Procedures (*Andre Video*)
    - Non-Vocal Learner Training Procedures (*Bobby Video*)

**Results**

- In total, Billy acquired 22 trained stimulus sets and 28 untrained stimulus sets across 120 joint control training condition sessions.

- In total, Cole acquired 20 trained stimulus sets and 30 untrained stimulus sets across 96 joint control training sessions.

- Across 206 joint control training sessions, Abe acquired 26 trained stimulus sets and 24 untrained stimulus sets.
Private Nature of Responses

- The private nature of the jointly controlled responses block direct observation and therefore leads to an interpretive analysis of the role of joint control.

- In this experiment, the children were not required to emit overt tact responses and therefore, the additive effects of the tact response can only be inferred.

- In prior studies however, blocking of one of the responses necessary for joint control substantially degraded correct responding suggesting that covert responses appear to be playing a role in the additive effects of more than one stimulus leading to listener response errors.

- Throughout this study there were instances in which the child emitted the overt response with no requirement or when he failed to emit an overt tact response appeared to interfere with responding leading to response errors.

- Video demonstrations of this follow.
• Frequently during both daily first trial probes and untrained stimulus set probes, Bobby was observed to respond intraverbally to the teachers vocal stimulus and presence the stimulus through self-mimetic behavior even when he was not explicitly required to do so.

  Bobby Example (Bobby Video- one rehearsal)

• Prior to beginning training with rehearsal, Connor did not emit an overt self-echoic response during final trial and untrained probes. Following training with rehearsal, Connor always engaged in a self-echoic rehearsal, even when he was not required to do so by the experimental contingency (i.e. during untrained probes).

  (Connor Video)

• Andre engaged in a self-echoic rehearsal during both training and untrained probe conditions. When Andre engaged in the correct self-echoic rehearsal to correct stimulus set, suggesting that the self echoic rehearsal contributed to the correct selection response.

  (Andre Video)

Clinical Applications

• In this experiment the emission of a single response topography occurring under two different sources of control (i.e. echoic and tact or mimetic and tact) occasioned selection responses.

• Given this analysis, the onset of joint control was a generic event consisting of the simultaneous control of two discriminative stimuli over a single response.

• The results of this study indicated that joint control training was effective in increasing trained and untrained listener responses for the three participants involved.

• Typical children may acquire this repertoire through exposure to every day contingencies, however, children with autism may require precise teaching to acquire jointly controlled responses.
• A number of authors have expounded upon the advantages of a joint control analysis, not only as an explanation for complex human behavior (Lowenkron, 1998), but as a means by which to design language training programs for individuals with language deficits and delays. (Causin, Albert, Carbone, Sweeney-Kerwin, 2013; delgi Espinosa, 2011; Michael et al., 2011; Sidener, 2006; Tu 2006).

• As an example of mediated stimulus selection joint control training provides an efficient method of teaching generalized responding to children with autism that would require a virtually impossible number of trials to achieve the same outcome. (Sidener, 2006).

• Within autism treatment programs, skills that are often acquired under the title of “auditory and visual memory” or cognitive skills may actually be acquired through the unwitting effects of the type of verbal mediation that was explicitly taught in this study.

The list of skills that may be taught using methods derived from a joint control analysis include:
• delayed match to sample
• completing a complex pattern of items,
• finding a previously displayed item within a large array,
• identifying what is missing from a previously displayed array of items,
• following multiple step instructions,
• answering yes or no,
• counting out a specific number of items from a larger set.  

Videos of Clinical Applications

Future Research

• In general, when mediating responses (self-echoic, self-mimetic and tact responses) were overt, correct selection of the stimulus set was more likely. Similar to the studies performed by Gutierrez (2006), Lowenkron, (2006b), DeGraaf and Schlinger (2012), future research should experimentally investigate the individual roles of echoic, self-echoic, and tact responses to provide additional empirical evidence in favor of a joint control analysis.
REFERENCES


THE END

Palmer on Joint Control
http://autism.outreach.psu.edu/archive/conference-schedule-2013
Find Presentation # 9 by Palmer and Select the title
Download the ppt and then select Dave Palmer to view the video

Francesca degli Espinoza on Joint Control
http://autism.outreach.psu.edu/archive/conference-schedule-2014
Find Presentation # 44 and select the title
Download the ppt and then select Advanced and then select the paper on “Teaching Generalized Multiply Controlled Verbal Behavior”.

Vincent Carbone on Joint Control
http://autism.outreach.psu.edu/webcasting
Scroll down this page and select presentation # 37
Then, scroll down and to download the ppt and handout readings
Then at the bottom of the page select the webcast