For verbal skills of children with disabilities to be functional and effective, their use needs to become spontaneous\(^{(1)}\), to occur in a variety of non-training situations\(^{(2)}\), include complex linguistic structures\(^{(3)}\), and to extend beyond directly taught statements\(^{(4)}\).

Behavior analysts and speech-language pathologists have complementary expertise and evidence.
Agenda

- Summarize the linguistic perspective of language
- Tutorial on Skinner’s analysis of verbal behavior
- Introduce notion of “transfer of stimulus control”
- Example of research drawing from both Applied Behavior Analysis and Speech-Language Pathology
- General summary of ABA and SLP language intervention research

SLP Definition: Language

- Humans, unlike animals, communicate complex thoughts, feelings, and ideas through language.
- Language is a code. It is defined as follows:
  - “Socially shared code or conventional system for representing concepts through the use of arbitrary symbols and rule-governed combinations of those symbols” (Owens, R.E., 2008)
  - “A code whereby ideas about the world are represented through a conventional system of arbitrary signals for communication” (Bloom, 1988)
Key Ideas for Defining Language

- Arbitrary symbols (code)
- Convention (a mutually agreed upon code by members of a community)
- Rules (how to combine the coded symbols, what order, what situations)
- The number of rules is finite for each language.
  - Once these rules are learned, we can produce an infinite number of expressions (productivity)

Structure of Language

- Form
  - Phonology
  - Morphology
  - Syntax

- Content
  - Semantics

- Use
  - Pragmatics

Verbal Behavior

Behavior that is reinforced through another person.

Socially-mediated behavior.
**VB Defined**

Verbal Behavior
- I ask you to turn off the light and you turn off the light
  - *Antecedent*: The light is on and I need it off
  - *Verbal Behavior*: "Please turn off the light"
  - *Consequence*: You turn off the light (reinforced through another person)

Not Verbal Behavior
- I turn off the light
  - *Antecedent*: The light is on and I need it off
  - *Behavior*: I turn off the light
  - *Consequence*: The light goes off (not reinforced through another person)

---

**FORM**
what the behavior looks like

**FUNCTION**
why the behavior occurs

---

**Same Form Different Function**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Behavior</th>
<th>Consequence</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sees a book</td>
<td>&quot;book&quot;</td>
<td>Attention/ praise</td>
<td>Label TACT</td>
</tr>
<tr>
<td>&quot;What do you read?&quot;</td>
<td>&quot;book&quot;</td>
<td>Attention/ praise</td>
<td>Answering Questions INTRAVERBAL</td>
</tr>
</tbody>
</table>
Plain English Definitions of Basic Verbal Operants

<table>
<thead>
<tr>
<th>Operant</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAND</td>
<td>Asking for reinforcers - things that you want. Saying shoes because you want shoes.</td>
</tr>
<tr>
<td>TACT</td>
<td>Naming or identifying objects, actions, events, etc. Saying shoes because you see shoes.</td>
</tr>
<tr>
<td>INTRAVERBAL</td>
<td>Answering questions or having conversations in which your words are controlled by other words. Saying shoes when someone else says, “What do you wear on your feet?”</td>
</tr>
</tbody>
</table>

Motivating Operations (MO)

- Antecedent variables that temporarily alter the reinforcing effectiveness of consequences
  - Establishing Operations (increase value)
  - Abating Operations (decrease value)

Controlling Variables for the MAND

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Verbal Behavior</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 hours without water and salty snacks</td>
<td>says, “water please”</td>
<td>cup of water</td>
</tr>
<tr>
<td>room is quiet</td>
<td>signs music</td>
<td>music is turned on</td>
</tr>
<tr>
<td>several non-preferred task demands</td>
<td>says, “all done”</td>
<td>demands stop</td>
</tr>
<tr>
<td>wandering the room without toys</td>
<td>exchanges picture of slinky</td>
<td>gets to have the slinky</td>
</tr>
</tbody>
</table>
Controlling Variables for the TACT

<table>
<thead>
<tr>
<th>Antecedent (non-verbal stimulus)</th>
<th>Verbal Behavior (tacts)</th>
<th>Consequence (generalized reinforcement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a cup</td>
<td>says, &quot;cup&quot;</td>
<td>approval/attention</td>
</tr>
<tr>
<td>sunny outside</td>
<td>points to the sun in PECS book</td>
<td>approval/attention</td>
</tr>
<tr>
<td>stop sign</td>
<td>says, &quot;stop&quot;</td>
<td>approval/attention</td>
</tr>
<tr>
<td>a picture of socks</td>
<td>signs socks</td>
<td>approval/attention</td>
</tr>
</tbody>
</table>

Controlling Variables for the INTRAVERBAL

<table>
<thead>
<tr>
<th>Antecedent (verbal stimulus)</th>
<th>Verbal Behavior (intraverbal)</th>
<th>Consequence (generalized reinforcement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;E, I, E, I,...&quot;</td>
<td>says, &quot;O&quot;</td>
<td>approval/attention</td>
</tr>
<tr>
<td>&quot;How old are you?&quot;</td>
<td>points to 6 in PECS book</td>
<td>approval/attention</td>
</tr>
<tr>
<td>&quot;Name some animals!&quot;</td>
<td>says, &quot;dog, pig, duck&quot;</td>
<td>approval/attention</td>
</tr>
<tr>
<td>&quot;On your feet you wear...&quot;</td>
<td>signs socks and shoes</td>
<td>approval/attention</td>
</tr>
</tbody>
</table>

Organization of Communicative Functions

Speech-Language Pathology
- Behavior Regulation
  - Requesting objects/action
  - Protesting
- Social Interaction
  - Request social/comfort
  - Greeting
  - Calling
  - Showing off
- Joint Attention
  - Commenting
  - Request information
  - Provide information

Applied Behavior Analysis
- Mands
  - All requests
  - Showing off / greeting
  - P - B - specific reinforcer
- Tacts
  - All commenting
  - Providing information
  - P - B - general reinforcer
- Intraverbals
  - Verbal exchanges
  - A - B - general reinforcer
**FORM**
SLPs are experts

**FUNCTION**
Behavior analysts are the experts

---

**Stimulus Control** is established when a response is reinforced in the presence of an antecedent stimulus and that antecedent stimulus reliably evokes/cues the behavior.

*The stimulus is said to **control** the response.*

---

**Trial = opportunity for response**

$$A_N \quad - \quad B \quad - \quad C$$

- **N** = Naturally occurring
- **A** = 4 hours w/o water & salty snacks
- **B** = “water please”
- **C** = given water

---
**AN + AP - B - C**

- 4 hours w/o water & salty snacks
- Cup of water is put in front of child but out of reach
- “water please”
- Given the water

*N = Naturally occurring; P = Programmed prompt*

**AP - B - C**

- Cup of water is put in front of child but out of reach
- “water please”
- Given the water

*N = Naturally occurring; P = Programmed prompt*

**AN - B - C**

- Room is quiet
- Sign music
- Music gets turned on

*N = Naturally occurring*
A_N + A_P - B - C

- Room is quiet
- Manually guides hands to sign music
- Signs music
- Music gets turned on

N = Naturally occurring; P = Programmed prompt

-----------------------------------------------

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-----------------------------------------------

-----------------------------------------------

A_P - B - C

- Manually guides hands to sign music
- Signs music
- Music gets turned on

N = Naturally occurring; P = Programmed prompt

-----------------------------------------------

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-----------------------------------------------

A_N - B - C

- See a cup
- Says, “cup”
- Attention & approval

N = Naturally occurring

-----------------------------------------------

-----------------------------------------------

-----------------------------------------------

-----------------------------------------------
A_N + A_P - B - C

sees a cup
model “cup”
says, “cup”
attention & approval

N = Naturally occurring; P = Programmed prompt

A_P - B - C

model “cup”
says, “cup”
attention & approval

N = Naturally occurring; P = Programmed prompt

A_N - B - C

“Name some animals”
says, “dog, pig, duck”
attention & approval

N = Naturally occurring
A_N + A_P - B - C

“Name some animals.”
shows pictures of a dog, a pig, and a duck

says, “dog, pig, duck”
attention & approval

N = Naturally occurring; P = Programmed prompt

The goal of verbal behavior instruction (and language intervention) should be to transfer control from the programmed stimuli (prompts) to naturally occurring stimuli.

*Prompting is a teaching procedure to help children make the correct response until the response has come under the control of naturally occurring stimuli.
Transfer of Stimulus Control

Using transfer of stimulus control technology to promote generalization and spontaneity of language

Trina D. Spencer & Thomas S. Higbee, 2012

Background

- **Spontaneous**: language emitted under the control of stimuli that occur naturally in the environment as opposed to stimuli presented or controlled by an adult/instructor.
- **Generalized Use**: varying trained skills in meaningful ways and emitting them in a variety of contexts (e.g., stimulus and response generalization).
To promote the spontaneous and generalized use of language in conversation, researchers have systematically engineered the transfer of stimulus control from programmed prompts (e.g., scripts) to more natural features of the context (e.g., activity schedules, toys, routines, conversation partners, etc).

Script fading following script training is a common mechanism for accomplishing this transfer.

### Systematic Review of Script Training Interventions

#### Identifying Current Best Evidence

1. Appraising Methodological Quality
2. Examining Intervention Effect
3. Determining the Adequacy of the Evidence

- 5 single subject design studies
- 3 researchers and locations
- 20 different participants

---


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<table>
<thead>
<tr>
<th>Researchers</th>
<th>Participants</th>
<th>Setting/Location</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Quality Score</th>
<th>PND</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown, Krantz, McClannahan, &amp; Poulson, 2007</td>
<td>3 boys ages 7–13</td>
<td>Small classroom; New Jersey</td>
<td>Written scripts with fading</td>
<td>Verbal responses separated from prior verbal responses from the conversation partner</td>
<td>19</td>
<td>I = 86% G = 91%</td>
<td></td>
</tr>
<tr>
<td>Krantz &amp; McClannahan, 1993</td>
<td>3 boys &amp; 1 girl, ages 9–12</td>
<td>School and research center; New Jersey</td>
<td>Written scripts with fading</td>
<td>Responses or questions unprompted by an adult</td>
<td>20</td>
<td>I = 97% M = 75%</td>
<td></td>
</tr>
<tr>
<td>Krantz &amp; McClannahan, 1998</td>
<td>3 boys ages 4–5</td>
<td>Classroom; New Jersey</td>
<td>Written scripts with fading</td>
<td>Words said within 1 m of recipient and separated from verbal response made by recipient</td>
<td>19</td>
<td>I = 82% G = 100%</td>
<td></td>
</tr>
<tr>
<td>Matson, Sevin, Box, Francis &amp; Sevin, 1993</td>
<td>3 boys ages 4–5</td>
<td>University clinic; homes; Classroom; Louisiana</td>
<td>Written script on visual cue cards with fading</td>
<td>Target phrase within 10-s after presentation of nonverbal stimulus cue and before verbal model</td>
<td>20</td>
<td>I = 96% G = 100% M = 100%</td>
<td></td>
</tr>
<tr>
<td>Reagon &amp; Higbee, 2009</td>
<td>3 boys ages 3–6</td>
<td>Homes; Utah</td>
<td>Audio scripts with fading</td>
<td>Unprompted contextually appropriate statements or questions</td>
<td>20</td>
<td>I = 83% G = 89% M = 95%</td>
<td></td>
</tr>
<tr>
<td>Wichnick, Vener, Keating, &amp; Poulson, 2010</td>
<td>2 boys &amp; 1 girl, ages 4–6</td>
<td>Small classroom; New York</td>
<td>Audio scripts with fading</td>
<td>Word, phrase, sentence or question independent of instructor prompts</td>
<td>19</td>
<td>I = 91% G = 78%</td>
<td></td>
</tr>
</tbody>
</table>

---

Note.

I = intervention; G = generalization; M = maintenance; PND = percentage of non-overlapping data points.
Purpose

To investigate the effect of script training (without script fading) and generalization procedures on the spontaneous and generalized use of complex language targets.

<table>
<thead>
<tr>
<th>Generalization Procedures</th>
<th>Complex Language Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural contingencies of reinforcement</td>
<td>Prepositions</td>
</tr>
<tr>
<td>Multiple exemplars</td>
<td>Coordinating Conjunctions</td>
</tr>
<tr>
<td>Train loosely</td>
<td>Subordinating conjunctions</td>
</tr>
<tr>
<td>Train common stimuli</td>
<td></td>
</tr>
</tbody>
</table>

Research Design/Participant

- Fran: 5-year-old female with an ASD
- Fran attended a university-based preschool for children with ASD.
- Multiple baseline across behaviors
- Prior to the intervention condition, language samples were gathered while Fran painted with her instructor, her mother, and a typical peer (baseline).
- The samples were transcribed and analyzed.
- Three classes of language targets were identified.
  - Prepositions - with, in, on
  - Coordinating Conjunctions - and, but
  - Subordinating Conjunctions - because, when

Setting/Materials

- Settings
  - Fran’s instructional area at the university-based preschool.
  - Fran’s home at the kitchen table.
  - Fran’s Kindergarten classroom.
- A table and two chairs
  - Conversation partners sat across from Fran.
- Four types of art materials were used during the study.
  - Color Wonder and Color Wonder paper
  - Dot paints and art paper
  - Squeeze paints and art paper
  - Stamps and art paper (generalization)
Script Sheets

- To the left of each line was a picture of the participant (icon) and between each line was a red circle signaling a pause.
- Each line included a language target
  - “The colors are pretty on the paper.”
  - “Your picture is pretty and colorful.”
  - “It’s messy when it gets on my hands and fingers.”
- For each target there were 3 versions—the same phrases presented in a different order.

General Procedures

- Test sessions preceded training sessions every day.
- Fran selected from an array of three art activities (Color Wonder, Dot paints, & Squeeze paints) before each test session and each training session.
- Three undergraduate instructors worked with Fran during the study and served as conversation partners during test and training sessions.
- Test sessions lasted 3 minutes.
- Training sessions ended when Fran read all five scripts aloud (about 5 min).
Generalization and Maintenance

- Three types of stimulus generalization probes were conducted during baseline and following the intervention.
  - With Fran’s mother at her home
  - With typical peers
  - With materials not used during training
- One maintenance probe was conducted after 4 weeks.
  - With a typical peer in Fran’s Kindergarten classroom.

Intervention

1. Script Training
   - What to say (language structures)
   - Response prompt
2. Generalization Training
   - Under what conditions should she say it
   - How to say it differently with the same effect

1-Teaching the Script

- Before scripts were introduced in the conversation context while painting, Fran was taught to read the set of 5 scripts (note cards).
- She practiced them until she could read all five lines with only a few errors and then they were introduced into the conversation context (usually one day).
- Scripts were reviewed outside the conversation context at least once a day during Fran’s typical instructional activities.
2- Training Session (Conversation Context)

- The session began when the conversation partner put the materials and script sheet (in a rectangular container) on the table.
- Fran unpacked the script sheet with the materials and placed it to the side of the table.
- A prompter, standing behind Fran, manually guided her to unpack her script sheet and to use it.
- The prompter never spoke.

2- Training Session (Conversation Context)

- Conversation Partner
  - Placed container on table
  - Waited for Fran to start the conversation
  - Spoke naturally, modeled good talking, and replied to and restated Fran’s comments.
  - When Fran had read all her lines, said “It’s time to clean up. Thanks for playing.”
- Prompter
  - Waited 20 seconds for Fran to begin the conversation independently before prompting the first line.
  - Once started, waited for 10 seconds of no talking to prompt Fran toward the next line.
  - Gently oriented Fran’s head toward partner as needed.

Test Session Procedures

- The session began when the conversation partner put the materials (in a rectangular container) on the table.
- Both Fran and the partner unpacked the materials and began painting.
- The conversation partner did not talk until after Fran began the conversation.
- The conversation partner was instructed to speak naturally, model good talking, and reply to or restate anything Fran said.
- After 3 min., the conversation partner said, “It’s time to clean up. Thanks for playing.”
- Scripts were never present during test sessions—Icons were introduced for subordinate conjunctions.
Dependent Variable

- Each transcription was analyzed for the inclusion of language targets.
  - Number of language targets Fran used in 3 min.
    - Prepositions
    - Coordinating Conjunctions
    - Subordinate conjunctions
  - FYI: Typical SLP measurement strategy.
Generalization and Maintenance

• Three types of stimulus generalization probes were conducted during baseline and following the intervention.
  • With Fran’s mother at her home
  • With typical peers
  • With materials not used during training

• One maintenance probe was conducted after 4 weeks.
  • With a typical peer in Fran’s Kindergarten classroom.

Results

Stimulus Generalization

19% trained responses

22% trained response

84% trained responses

Response Generalization

19% trained responses

22% trained response

84% trained responses
Spontaneity Analysis

Results

29% in baseline

86% in intervention

Conclusions

- Programming for Generalization
  - Natural maintaining contingencies
  - Training sufficient exemplars
  - Train loosely
  - Program common stimuli

- Pairing non-specific discriminative stimuli (icons) with both the programmed discriminative stimuli (scripts) and the naturally-occurring stimuli (unspecified dimensions of context) may enhance the transfer of stimulus control.

VB Analysis of Conversation

<table>
<thead>
<tr>
<th>A_N</th>
<th>A_N</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>art materials, conversation partner, table and chairs</td>
<td>conversation partner talking</td>
<td>Fran describes her painting</td>
<td>attention from conversation partner</td>
</tr>
</tbody>
</table>

Non-verbal Verbals Generalized Reinforcement

part intraverbal part tact


**VB Analysis of Conversation**

<table>
<thead>
<tr>
<th>A</th>
<th>+</th>
<th>B</th>
<th>-</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>art materials, conversation partner, table and chairs</td>
<td>preposition</td>
<td>attention from conversation partner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-verbal</td>
<td>verbal</td>
<td>Reinforcement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Transfer of Stimulus Control**

<table>
<thead>
<tr>
<th>A</th>
<th>+</th>
<th>B</th>
<th>-</th>
<th>C</th>
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<tr>
<td>art materials, conversation partner, table and chairs</td>
<td>preposition</td>
<td>attention from conversation partner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-specific discriminative stimulus</td>
<td>subordinating conjunction</td>
<td>reinforce picture verbal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that color done?</td>
<td>preposition</td>
<td>attention from conversation partner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Transfer of Stimulus Control**

<table>
<thead>
<tr>
<th>A</th>
<th>+</th>
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<td>that color done?</td>
<td>preposition</td>
<td>attention from conversation partner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fran uses subordinating conjunction attention from conversation partner.

Can stimulus control be transferred from scripts to more naturally-occurring stimuli in the absence of formal script fading?

- Yes, if you program for it!
- Merged knowledge from ABA and SLP to be the most effective for Fran.
  1. Spontaneous
  2. Non-training situations
  3. Complex linguistic forms
  4. Beyond trained statements

**GENERAL Summary of Evidence**

**Applied Behavior Analysis**
- Young children with autism
- Many systematic reviews of comprehensive ABA — strong
- Thousands of studies on teaching procedures (DRO, time delay, self monitoring, functional assessment)

**Speech Language Pathology**
- Young children with language impairment
- Few systematic reviews of language interventions
- Thousands of studies describing characteristics of children with language disabilities (focus on form)
Recommendations for Team Decision Making

• Every BA needs an SLP buddy (with a password) and every SLP needs a BA buddy.
• Know the other disciplines research, jargon, and approaches and know your own.
• Surrender your ego for the best interest of the child.
• Explicitly use the EBP framework as a guide.
• Respect and explicitly identify the contributions that each professional can make to the team.
• Use data to drive decisions – Empiricism wins!

Thank you!

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References


