“I Can Figure It Out”

Teaching Children with Disabilities Problem-Solving Skills to Master Advanced Communication, Social, and Academic Skills

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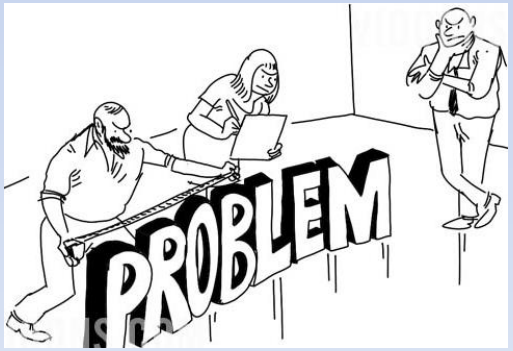

MassABA

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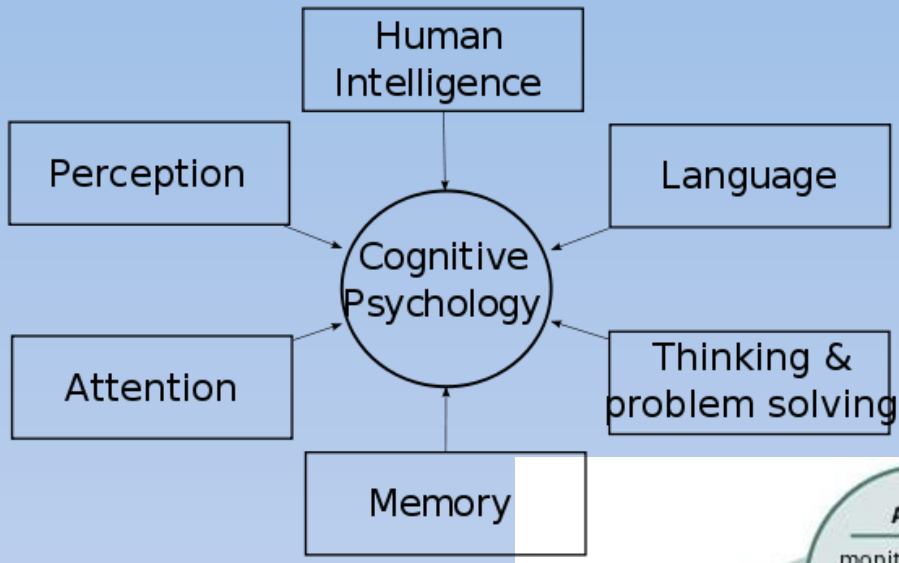


Three Parts of the Mind

Cognitive

Thinking

IQ
Skills
Reason
Knowledge
Experience
Education

Conative

Doing

Drive
Necessity
Innate Force
Instinct
Mental Energy
Talents

Affective

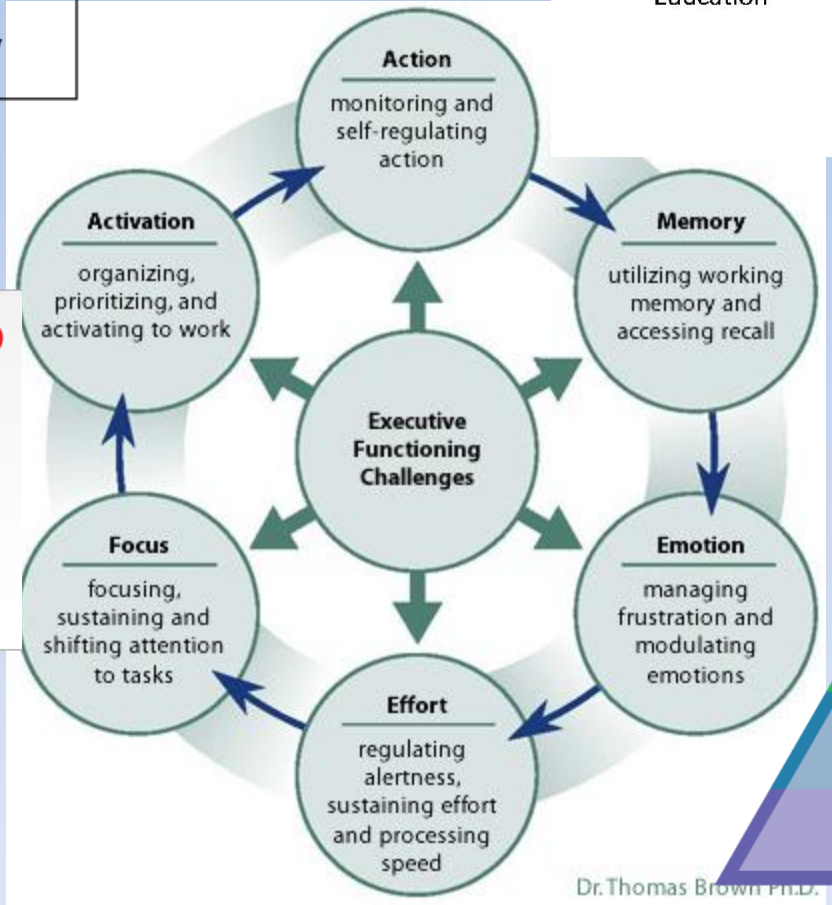
Feeling

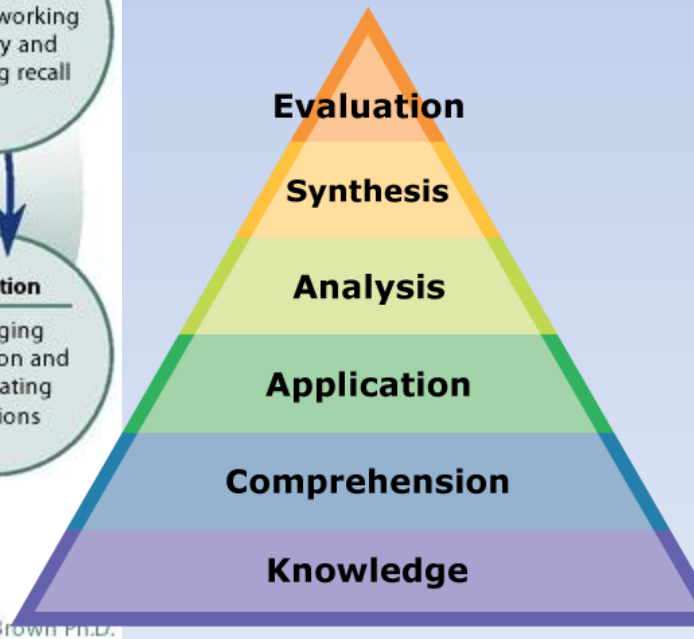
Desires
Motivation
Attitudes
Preferences
Emotions
Values

To Think Critically, Think RED

Keys to CRITICAL THINKING

- **R**ecognize Assumptions
- **E**valuate Arguments
- **D**raw Conclusions





Why Problem Solving is Important

Current problem-solving standards for math curricula demonstrates:

‘‘a shift from a behaviorist approach of teaching rote learning of facts and procedures to a constructivist approach’’

(Butler et al., 2001, p. 20; cited in Neef et al., 2003)

Why Problem Solving is Important

Current problem-solving standards for math curricula demonstrates:

‘‘a shift from a behaviorist approach of teaching **rote learning of facts** and procedures to a constructivist approach’’

(Butler et al., 2001, p. 20; cited in Neef et al., 2003)

Agenda

1. Conceptualizations of problem-solving
2. Applied studies on problem-solving
3. Clinical applications of problem-solving
4. Let's discuss and share ideas

Conceptualizations of Problem Solving

1. Problems
2. Problem solving and examples
3. Response strength and the repertoire
4. Multiple control and joint control
5. Problem solving strategies

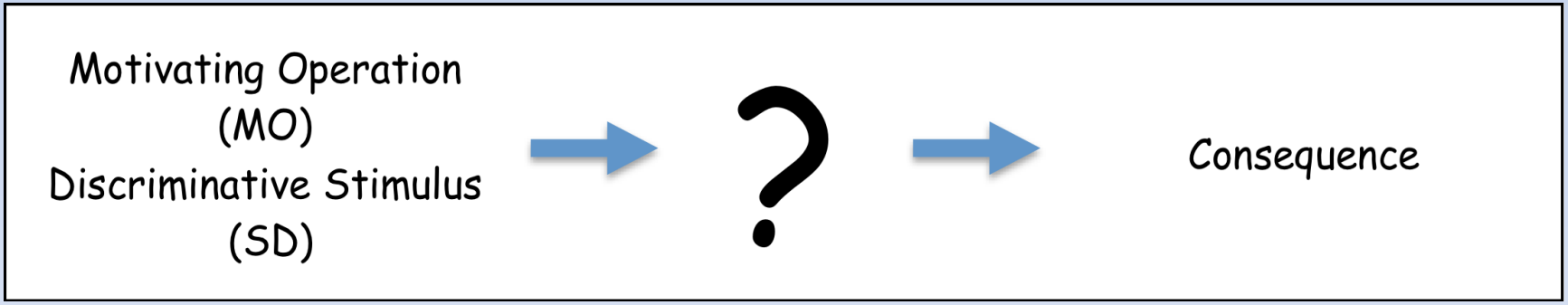
What's your problem?

What are some problems you face?

How do you define a "problem"?

Skinner's Definition of a "Problem"

"In the true 'problem situation' the organism has no behavior immediately available which will reduce the deprivation or provide escape from aversive stimulation" (Skinner, 1953)



Three Criteria of a Problem

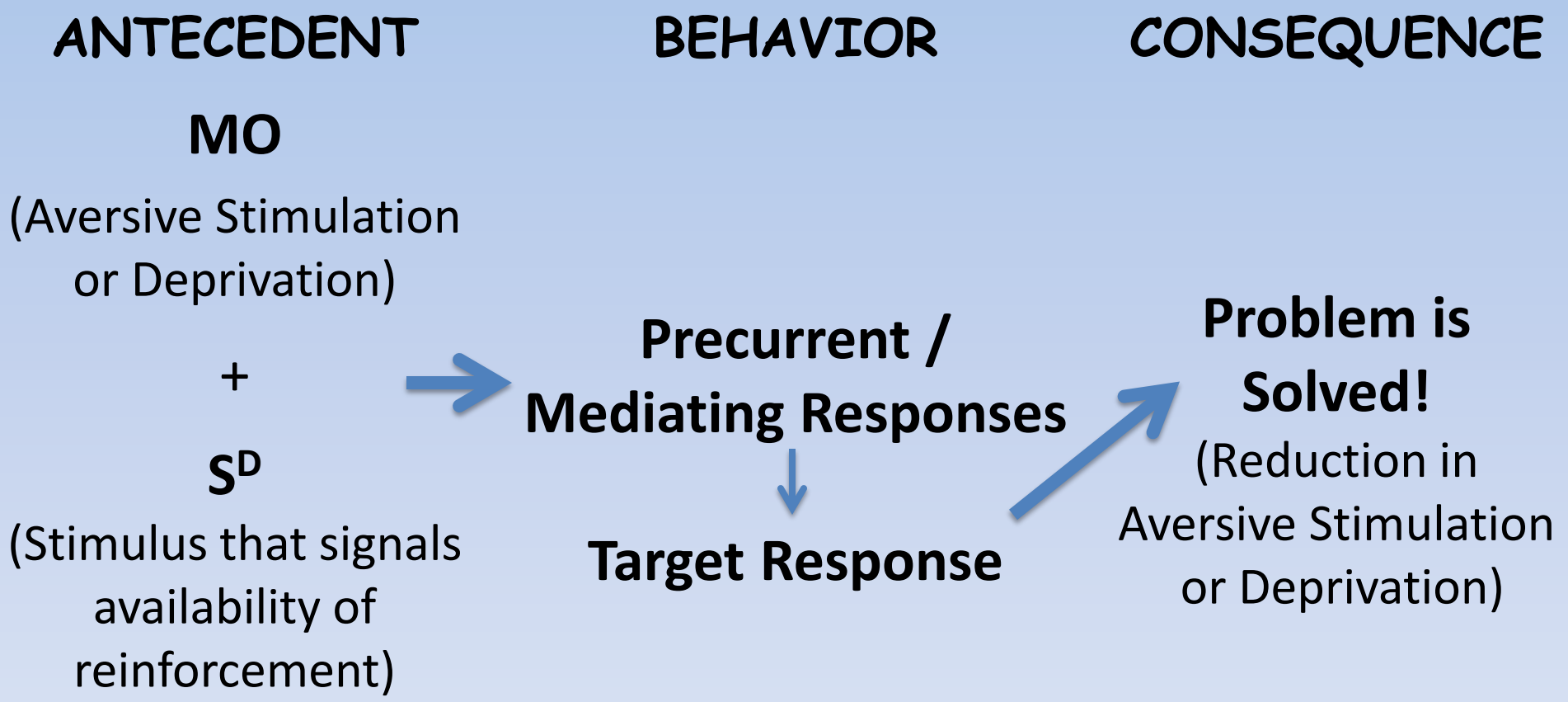
(Donahoe & Palmer, 1994)

1. The target response is in your repertoire
2. The target response is scheduled for reinforcement
3. The current S^D and environmental context are not enough to directly evoke the target response

Solving a Problem

How did you **solve** (or attempt to solve) your problem?

The Behaviors of Problem Solving



FINDING YOUR KEYS

ANTECEDENT	BEHAVIOR	CONSEQUENCE
MO Need to go to work, no keys + **S^D** Clock with time to leave for work	**Precurrent / Mediating Responses** Looking around Picking things up **Target Response** Looking at the keys	**Reinforcer** Presence of the keys

RECALLING THE PAST

ANTECEDENT	BEHAVIOR	CONSEQUENCE
MO Current value of listener's response + **S^D** "What did you do last weekend?"	**Precurrent / Mediating Responses** Intraverbal ("Saturday it was raining") Self-Questioning ("Where did I go? Who did I see?") Visualization (close eyes and picture the rain, your house, your friends) **Target Response** "I watched a movie"	**Reinforcer** Verbal Response "Which one?"

Definition of Problem-Solving

“Problem-solving may be defined as any behavior which, through the manipulation of variables, makes the appearance of a solution more probable” (Skinner, 1953)

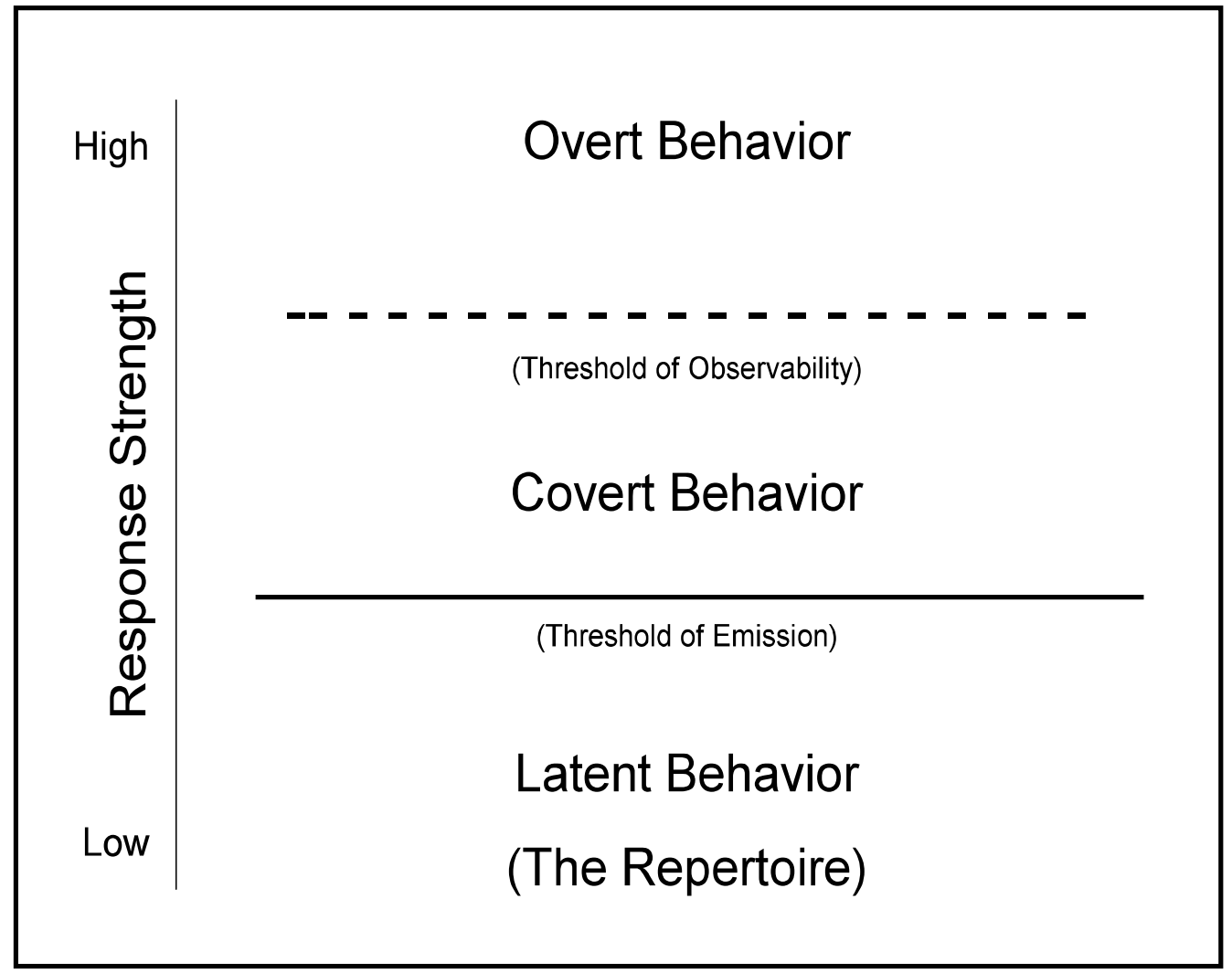
Definition of Problem-Solving

"The behavior of supplementing or manipulating discriminative stimuli until a particular response in the organism's repertoire becomes prepotent over many other responses that are changing in probability. These manipulations are terminated when the original contingency (the problem) is satisfied." (Donahoe & Palmer, 1994)

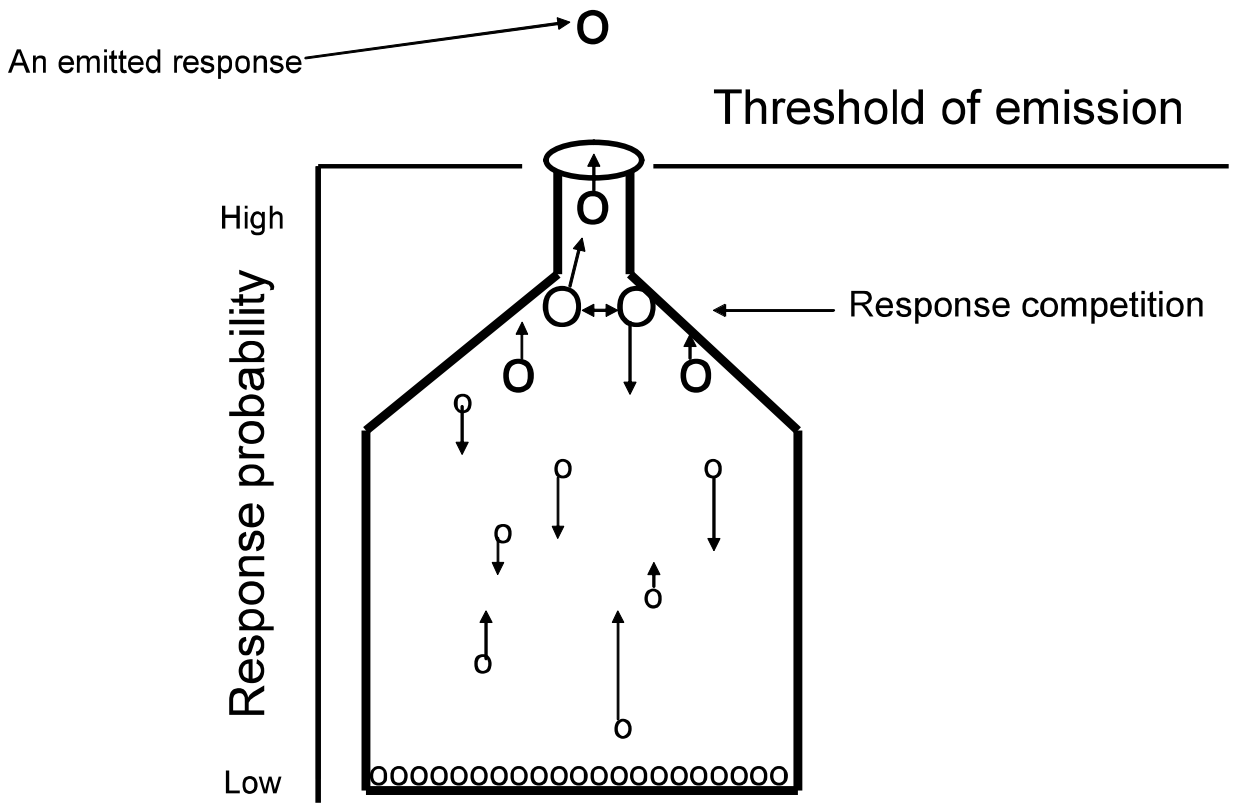
1. Response Strength

"The behavior of supplementing or manipulating discriminative stimuli until a particular response in the organism's **repertoire** becomes **prepotent** over many other responses that are **changing in probability**. These manipulations are terminated when the original contingency (the problem) is satisfied." (Donahoe & Palmer, 1994)

Response Strength (Palmer, 2009)



Response Strength (Palmer, 2009)



Multiple Control

(Palmer, 2009; Palmer, 2014)

What antecedent variables evoke your behavior?

Example: What antecedent variables evoke the behavior of ordering food in a restaurant? S^D: What would you like?

- Audience: who you're eating with
- MOs: how long since you ate particular foods?
- Contextual stimuli:
  (1) How much $ you have (4) What foods are on the menu
  (2) Type of restaurant (5) Presence of waiter/waitress
  (3) What others are ordering

Joint Control (Lowenkron, 1991)

Find a dog, horse, and rat

in the following array

Joint Control (Lowenkron, 1991)








Joint Control (Lowenkron, 1991)

How did you solve that?

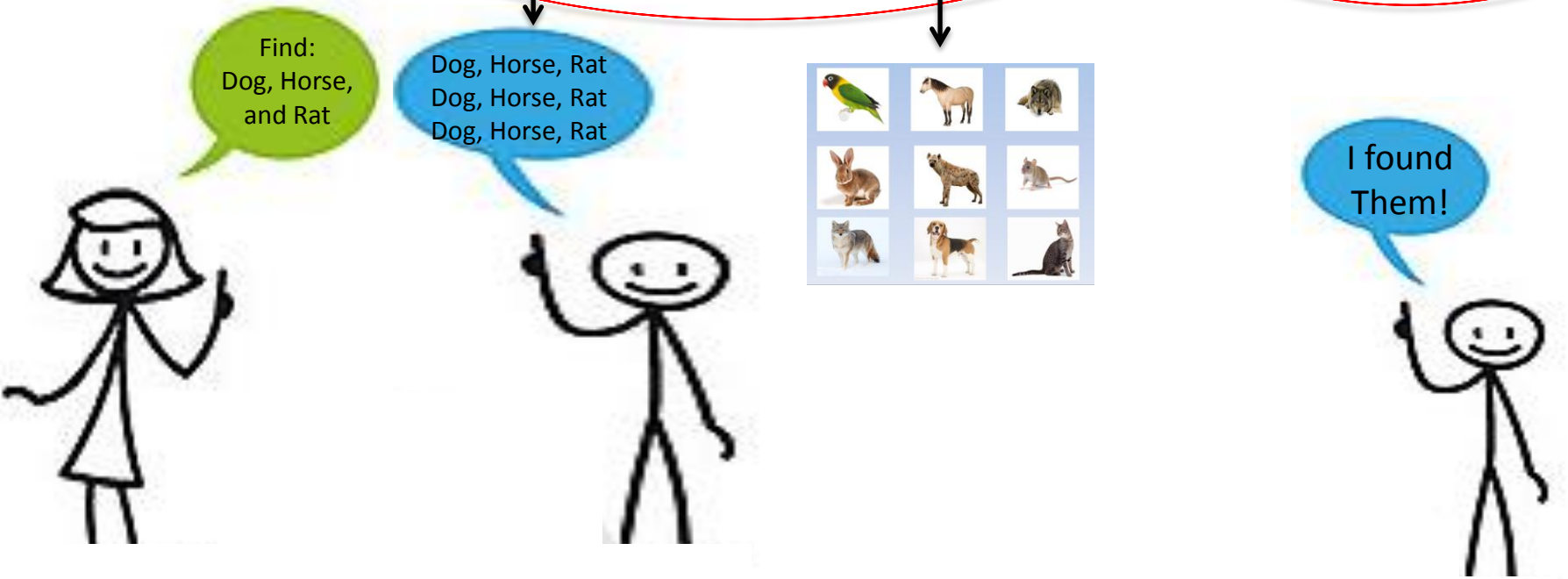
What verbal operants did you engage in?

- Echoic
- Tact

Joint Control (Lowenkron, 1991)

Precurrent Behavior → Target Response

Echoic + Tact = Selection Response



2. Supplementing & Manipulating

"The behavior of **supplementing or manipulating discriminative stimuli** until a particular response in the organism's repertoire becomes prepotent over many other responses that are changing in probability. These manipulations are terminated when the original contingency (the problem) is satisfied." (Donahoe & Palmer, 1994)

How do we supplement or manipulate discriminative stimuli?

Donahoe & Palmer (1994)

- Change our orientation
- Physically manipulate the environment

How do we supplement or manipulate discriminative stimuli?

Donahoe & Palmer (1994)

- Ask for advice
- Look for instructions
- Means-end analysis
- Working backward
- Breaking a problem into parts

LaFrance & Miguel (2014)

- Engage in intraverbal behavior

Skinner (1953)

- Engage in conditioned seeing

Five Problem Solving Studies

Domain	Skill	Strategy
Math	Solving word problems	Solving component parts
Social Skills	Initiating social interactions	Rules
Communication	Manding using PECS	Recombining behavioral units
Communication	Intraverbal categorization	Rules
Communication	Intraverbal categorization	Visual imagining

Common in all 5 Studies

No prompting, prompt fading, reinforcement – no direct training – on **target behavior/skill**

Prompting, prompt fading, and reinforcement on **precurrent behaviors** that students had to use to emit target/current behavior

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2003, **36,** 21–33 NUMBER 1 (SPRING 2003)

ANALYSIS OF PRECURRENT SKILLS IN SOLVING MATHEMATICS STORY PROBLEMS

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2 students with DD

19 and 23 years old

IQs: 46 and 72

We conducted an analysis of precurrent skills (responses that increase the effectiveness of a subsequent or "current" behavior in obtaining a reinforcer) to facilitate the solution of arithmetic word (story) problems. Two students with developmental disabilities were taught four precurrent responses (identifying the initial value, change value, operation, and resulting value) in a sequential manner. Results of a multiple baseline design across behaviors showed that the teaching procedures were effective in increasing correct performance of each of the precurrent behaviors with untaught problems during probes and that once the precurrent behaviors were established, the number of correct problem solutions increased.

DESCRIPTORS: precurrent behavior, problem solving, mathematics, story problems, developmental disabilities

1. How many hot dogs did Jan start out with if she ate 3 hot dogs and had 5 left?

(? – B = C)

2. If Bob had 2 books and bought 7 more, how many did he have in the end?

(A + B = ?)

3. If Sam had 10 pens and then lost 8, how many did he have left?

(A - B = ?)

4. If Ann started out with 6 sodas and had 2 left, how many did she drink?

(A - ? = C)

5. How many coins did Mary start with if she found 5 and ended up with 9?

(? + B = C)

Figure 1. Example of a typical worksheet. Formulas (in bold) are included only for illustrative purposes and were not part of the worksheet.

Table 2

Prompts, Correct Responses, and Incorrect Responses for the Five Problem Components

Initial set	
Prompt	"How many objects did (name) start out with?"
Correct	Appropriate words underlined; number in first box if known or X over box if unknown
Incorrect	Incorrect underline, number, or X; no response in 10 s
Change set	
Prompt	"What happened next?"
Correct	Appropriate words underlined; number in second box if known or X over box if unknown
Incorrect	Incorrect underline, number, or X; no response in 10 s
Operation	
Prompt	"Was that number added or subtracted from the first number?"
Correct	Finger placed under words indicating the operation; correct symbol in circle
Incorrect	Incorrect pointing or symbol; no response in 10 s
Resulting set	
Prompt	"How many objects did (name) end up with?"
Correct	Appropriate words underlined; number in third box if known or X over box if unknown
Incorrect	Incorrect underline, number, or X; no response in 10 s
Solution	
Prompt	A question pertaining to the unknown, as in "How many objects did (name) (start out with, end up with, get, lose, etc.)?"
Correct	Correct answer placed in box with the unknown (indicated by X)
Incorrect	Incorrect answer; no response in 10 s

- Trainer trained each component one at a time
- One word problem per trial; 10 trials per session
- Modeling and praise for training

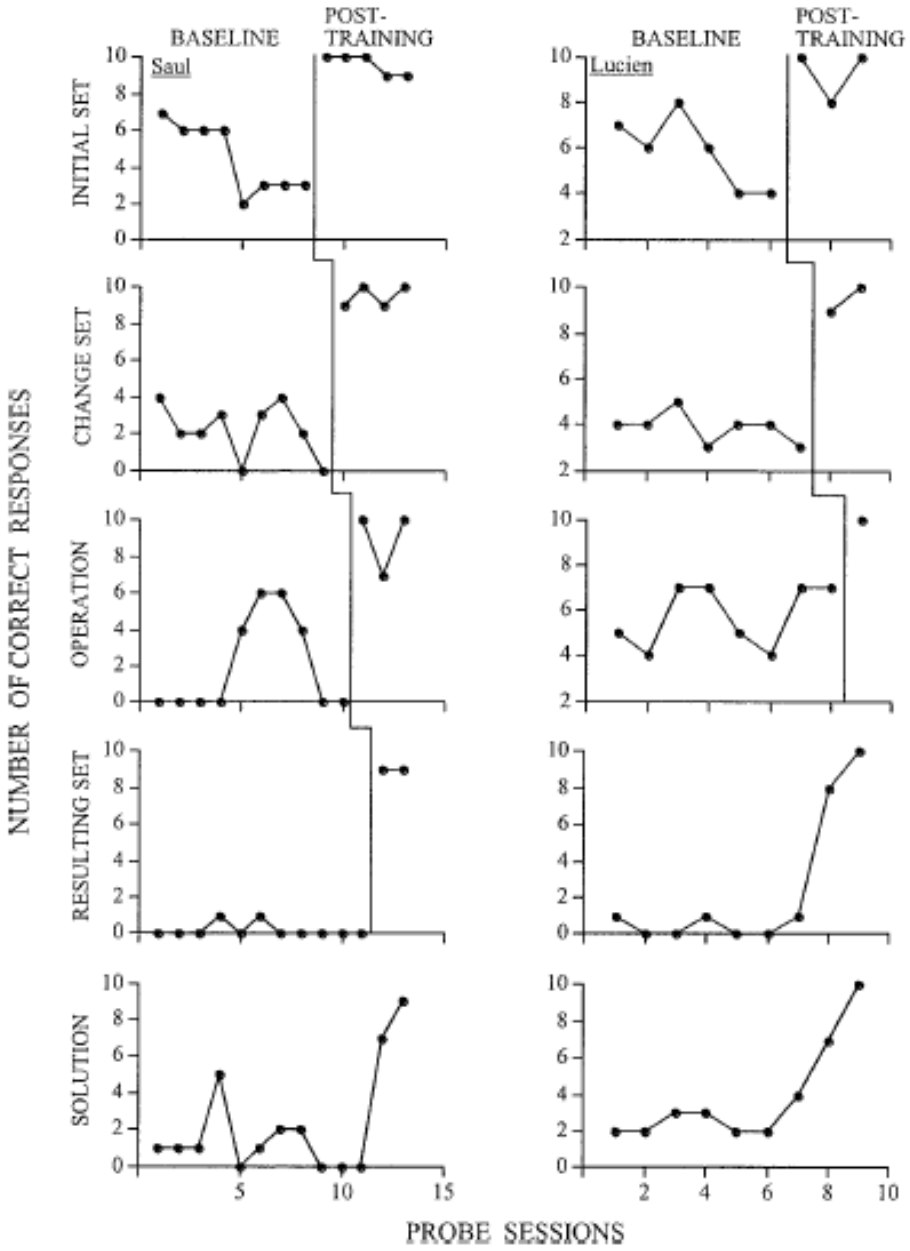

Figure 3. The number of correct responses during mathematics probes across baseline and posttraining conditions.

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2009, 42, 361–367 NUMBER 2 (SUMMER 2009)

THE EFFECTS OF TEACHING PRECURRENT BEHAVIORS ON CHILDREN'S SOLUTION OF MULTIPLICATION AND DIVISION WORD PROBLEMS

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We examined the effects of teaching overt precurrent behaviors on the current operant of solving multiplication and division word problems. Two students were taught four precurrent behaviors (identification of label, operation, larger numbers, and smaller numbers) in a different order, in the context of a multiple baseline design. After meeting criterion on three of the four precurrent skills, the students demonstrated the current operant of correct problem solutions. These skills generalized to novel problems. Correct current operant responses (solutions that matched answers revealed by coloring over the space with a special marker) maintained the precurrent behaviors in the absence of any other programmed reinforcement.

DESCRIPTORS: mathematics, precurrent behaviors, problem solving, word problems

- Younger students: autism, typical
- Multiplication and division
- Self-checking procedure
- Assessed without spaces

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1989, 22, 373–380 NUMBER 4 (WINTER 1989)

A PROBLEM-SOLVING APPROACH TO SOCIAL SKILLS TRAINING IN EMPLOYMENT SETTINGS WITH MENTALLY RETARDED YOUTH

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ROBERT GAYLORD-ROSS

SAN FRANCISCO STATE UNIVERSITY

The present study examined two approaches to teaching social behaviors to 3 developmentally disabled youths in work contexts. In one approach, a problem-solving procedure was learned and transferred to different materials. Conversational probes monitored interactions between disabled employees and their co-workers and customers. A multiple baseline design demonstrated that the training produced generalization and maintenance of the targeted social behaviors to the work settings. A second approach based on a role-playing intervention produced no substantial generalization in the work setting. A social validation questionnaire administered to co-workers supported the efficacy of the problem-solving training procedure. The efficacy of social problem-solving training was discussed in terms of sufficient exemplars, common stimuli, and self-mediations.

DESCRIPTORS: social skills training, problem solving, supported employment

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- 3 students with intellectual disability
- Ages: 18, 16, 18
- IQs: 58, 65, 45

- Work: dishwashing
- Work: break

Dependent Variables

- Initiations: begin conversation, change topic
- Expansions: continue conversation
- Terminating: appropriately end conversation
- Mumbling: non-understandable utterance

Procedures

Baseline: audiocassettes recording for 30 min

Role-Playing Training

- Instructor showed a picture of a situation
- Example: A client approaches you at work. What are you supposed to say?
- Correct (greet) → praise, rationale, role play
- Incorrect → explain, rationale, modeling, role play

Problem-Solving Training

Show picture, explaining, modeling, praise (30 min)

Rule 1: decoding – “What’s happening?”

Rule 2: decision – describe 3 available choices

Rule 3: test each alternative – “What might happen if?”

Rule 4: decision – “Which is better?”

Rule 5: select the behavioral response

Rule 6: emit the behavioral response

Rule 7: evaluate – “How did I feel about how it went?”

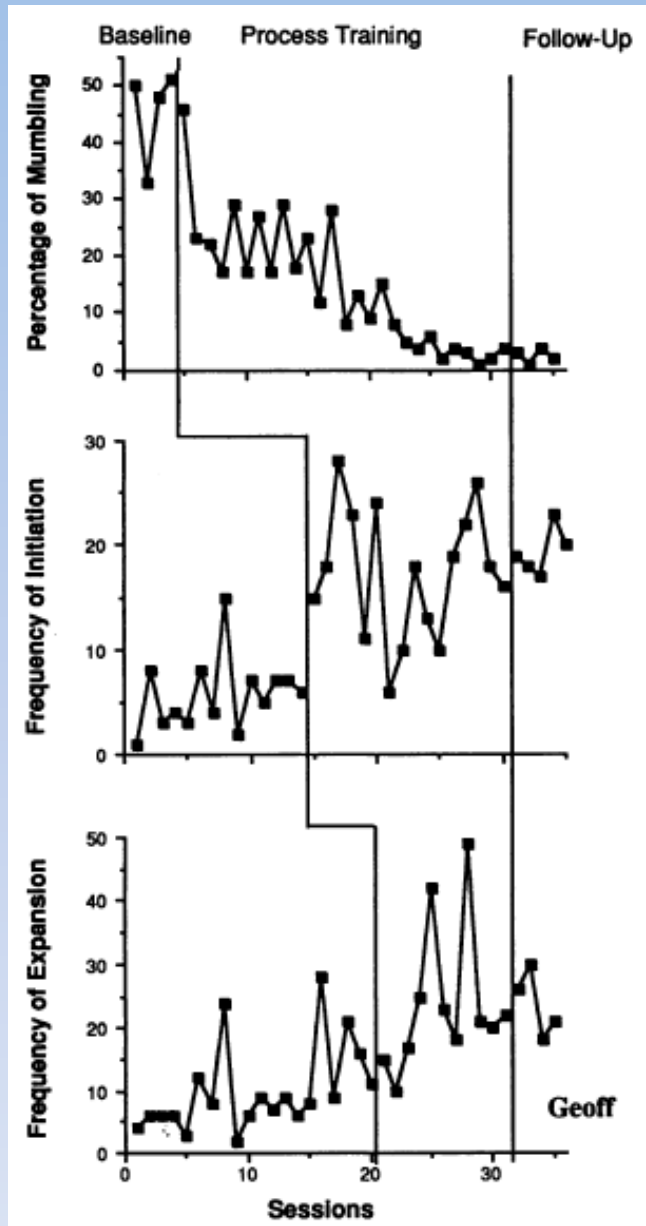
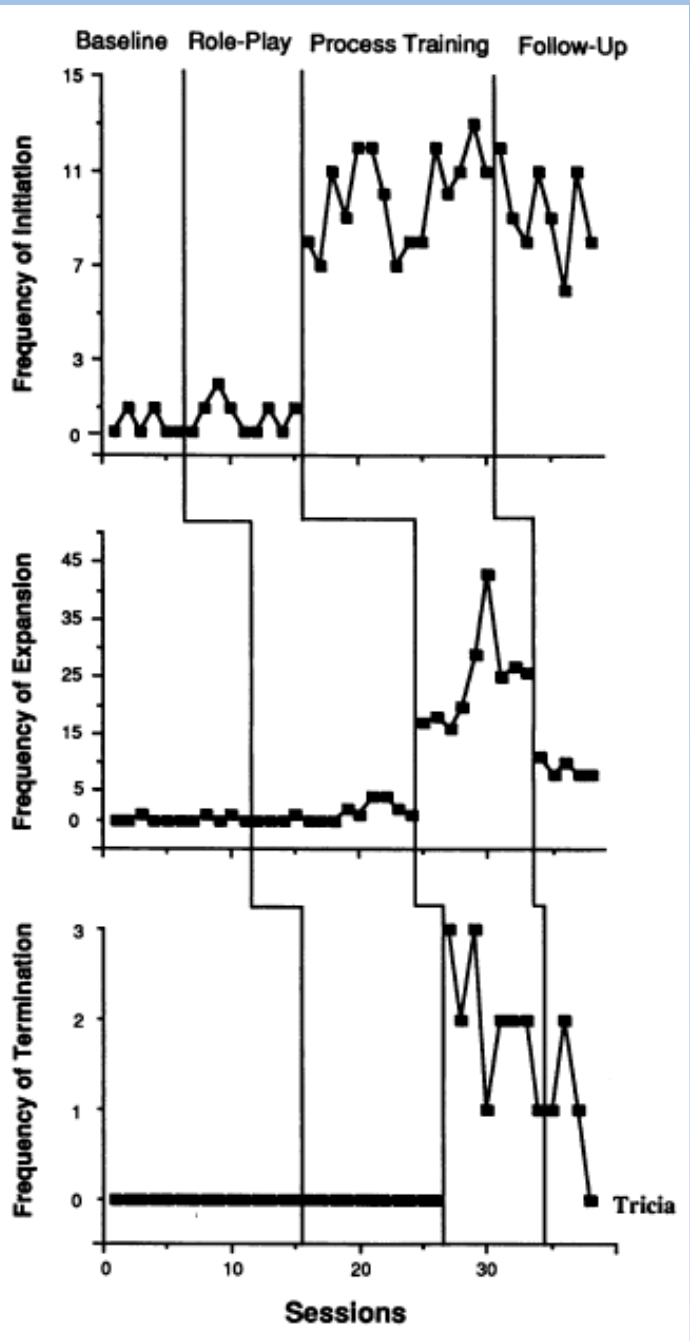


Figure 1. The generalization of social behaviors for Geoff.



JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2006, **39,** 109–115 NUMBER 1 (SPRING 2006)

A PRELIMINARY ANALYSIS OF TEACHING IMPROVISATION WITH THE PICTURE EXCHANGE COMMUNICATION SYSTEM TO CHILDREN WITH AUTISM

JULIE M. MARCKEL, NANCY A. NEEF, AND SUMMER J. FERRERI

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Two young boys with autism who used the picture exchange communication system were taught to solve problems (improvise) by using descriptors (functions, colors, and shapes) to request desired items for which specific pictures were unavailable. The results of a multiple baseline across descriptors showed that training increased the number of improvised requests, and that these skills generalized to novel items, and across settings and listeners in the natural environment.

DESCRIPTORS: improvisation, problem solving, picture exchange communication system, augmentative and alternative communication, autism

- 2 boys with autism (ages 4 and 5)
- Prerequisite: MTS color, shape, action
- Prerequisite: use PECS

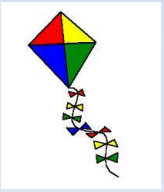
Marckel, Neef, & Ferreri (2006)

Table 1
Descriptors and Examples of Improvised Requests

	Ike	Khan
Functions	Eat, drink, play	Eat, drink, read, watch, listen
Colors	Red, blue, green, pink, orange, purple, black, white, brown, yellow, gray	Red, blue, green, pink, orange, purple, black, white, brown, yellow
Shapes	Circle, square, triangle, rectangle, heart, moon, star, oval, line, diamond, hexagon	Circle, square, triangle, rectangle, heart, moon, star, oval, line
Preferred stimuli	Crackers, chips, pretzels, water, sandwich, cookie, granola bars, cantaloupe, toys, balloon, books, balls, CDs, tapes	Sausage, cupcakes, milk, bread, pancakes, waffle, chicken nuggets, banana, hot dogs, french fries, water, videos, CDs, books
Examples of trained requests	"I want eat white square" for a sandwich	"I want watch green rectangle" for a video
Examples of untrained requests	"I want play green circle" for toy coins	"I want eat brown rectangle" for sausage





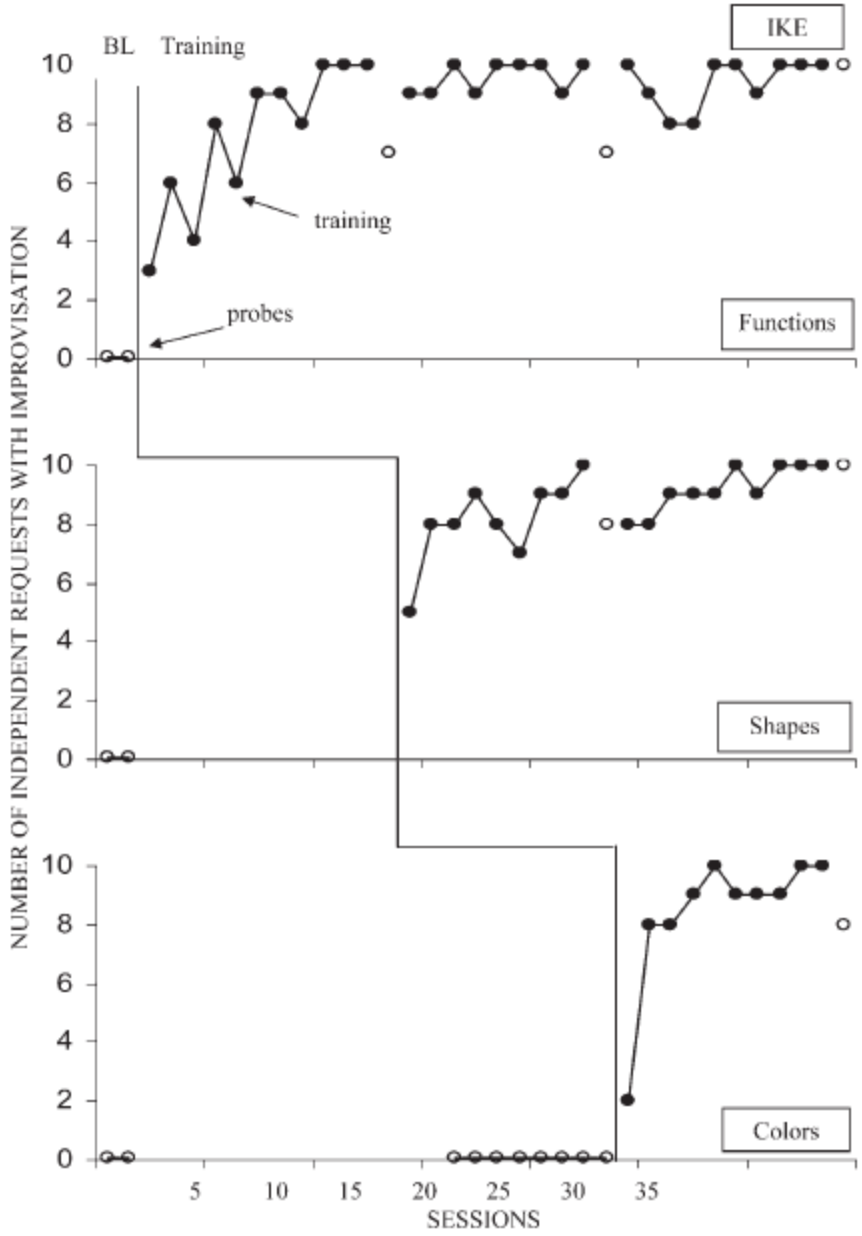
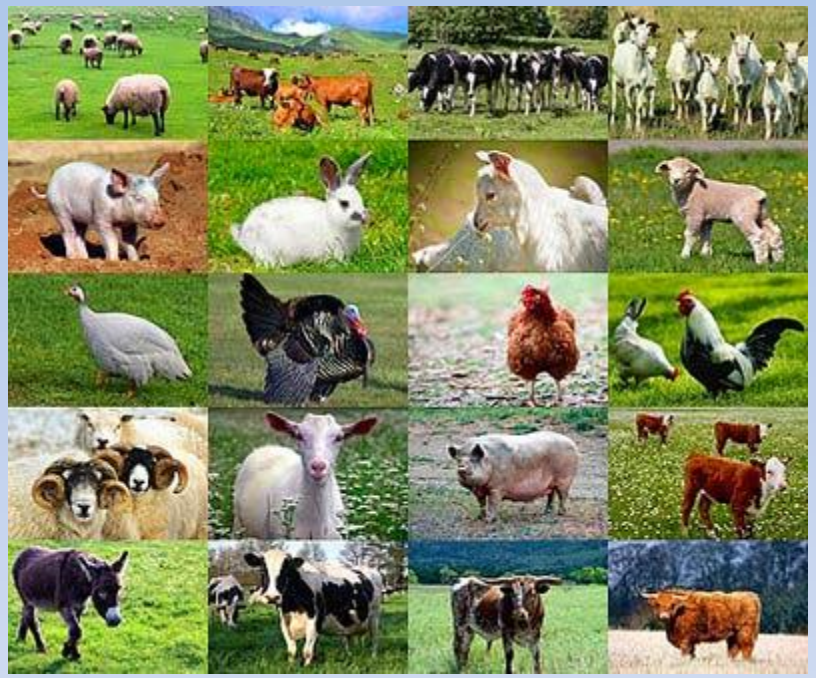



Figure 1. The number of independent improvised requests in the multiple probe across classes of descriptors for Ike. Filled data points represent trained exemplars. Open data points represent untrained requests during baseline and generalization probes.

"when presented with a problem (the unavailability of a single specific graphic symbol to communicate a request for a desired item), the children used a novel synthesis of responses or precurrents (selecting descriptors from different stimulus classes) that generated a reinforceable (current) response (a mand that produced the desired item)." (p. 112)

Discrimination and generalization are required

Tell me some animals!



Both studies: 4 typically developing preschoolers

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2011, **44,** 227–244 NUMBER 2 (SUMMER 2011)

THE ROLE OF PROBLEM SOLVING IN COMPLEX INTRAVERBAL REPERTOIRES

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We examined whether typically developing preschoolers could learn to use a problem-solving strategy that involved self-prompting with intraverbal chains to provide multiple responses to intraverbal categorization questions. Teaching the children to use the problem-solving strategy did not produce significant increases in target responses until problem solving was modeled and prompted. Following the model and prompts, all participants showed immediate significant increases in intraverbal categorization, and all prompts were quickly eliminated. Use of audible self-prompts was evident initially for all participants, but declined over time for 3 of the 4 children. Within-session response patterns remained consistent with use of the problem-solving strategy even when self-prompts were not audible. These findings suggest that teaching and prompting a problem-solving strategy can be an effective way to produce intraverbal categorization responses.

Key words: categorization, intraverbal, meditating response, multiple tact training, problem solving

Sautter, LeBlanc, Jay, Goldsmith, & Carr (2011)

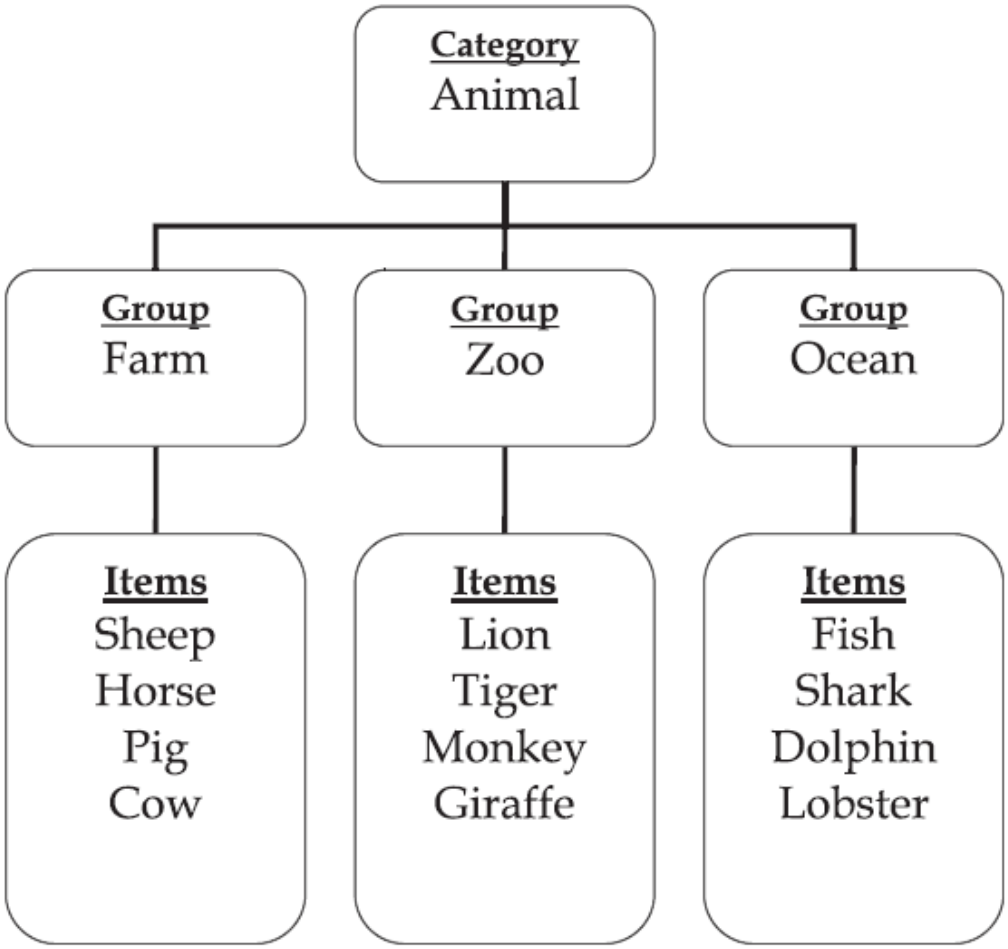

Figure 1. Items and groups of one target category.

2 more categories:

Vehicles

- Land
- Water
- Air

Kitchen items

- Appliances
- Dishes
- Utensils

Test: “Tell me some animals”

Prompts: Use your rules…next rule

<u>Training</u>

- **Multiple tact training 1**: item + group (sheep & farm)
- **Multiple tact training 2:** group + cat. (farm & animal)
- **Intraverbal training 1:** Tell me some farm animals
- **Intraverbal training 2:** Tell me the groups of animals
- **Med. response training 1:** What are your 4 rules?
  - Say 3 groups, pick a group, pick another, say the last
- **Med. response training 2:** What’s your 1st rule? 2nd?
- **Med. response training 3:** Exp. modeled rule use

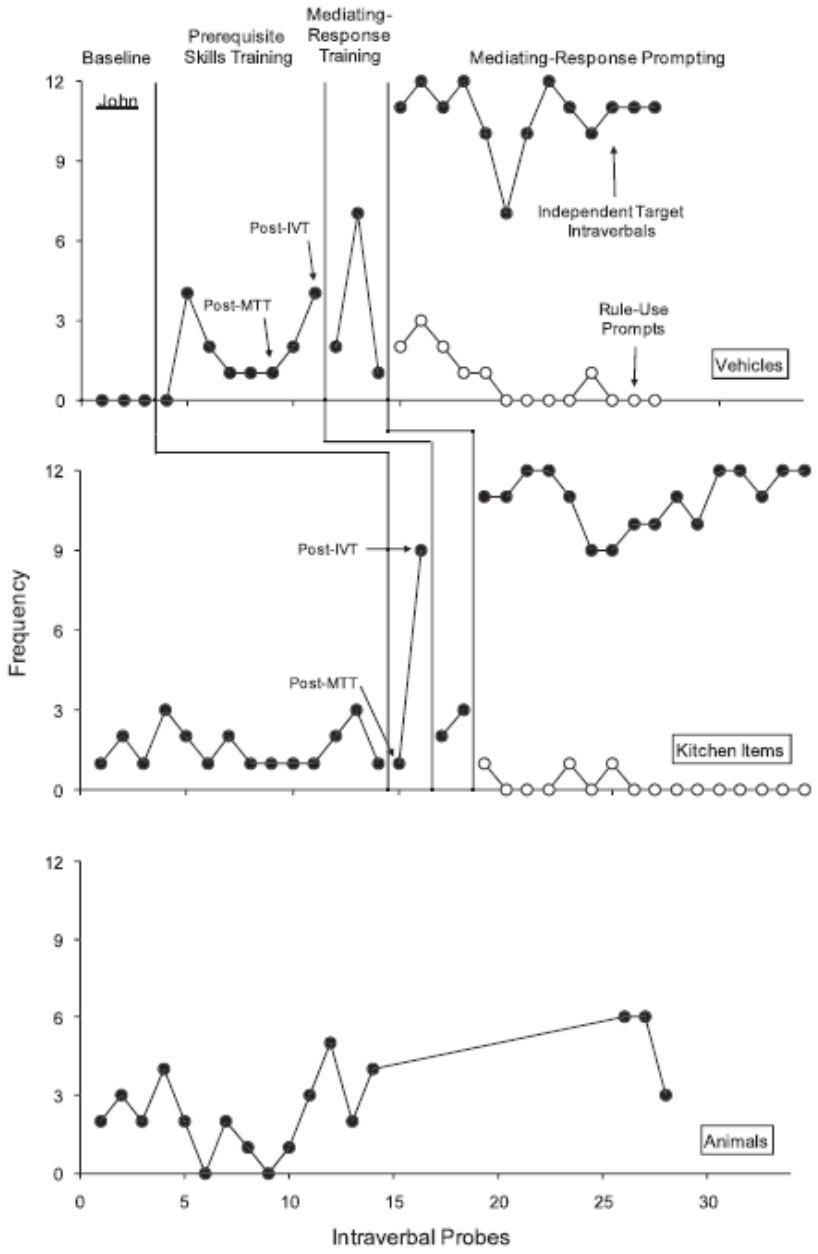

Figure 3. Correct target responses (filled circles) and number of experimenter prompts to use the rules (open circles) during intraverbal probes across categories for John. MTT = multiple-tact training; IVT = intraverbal training; MRT = mediating-response training.

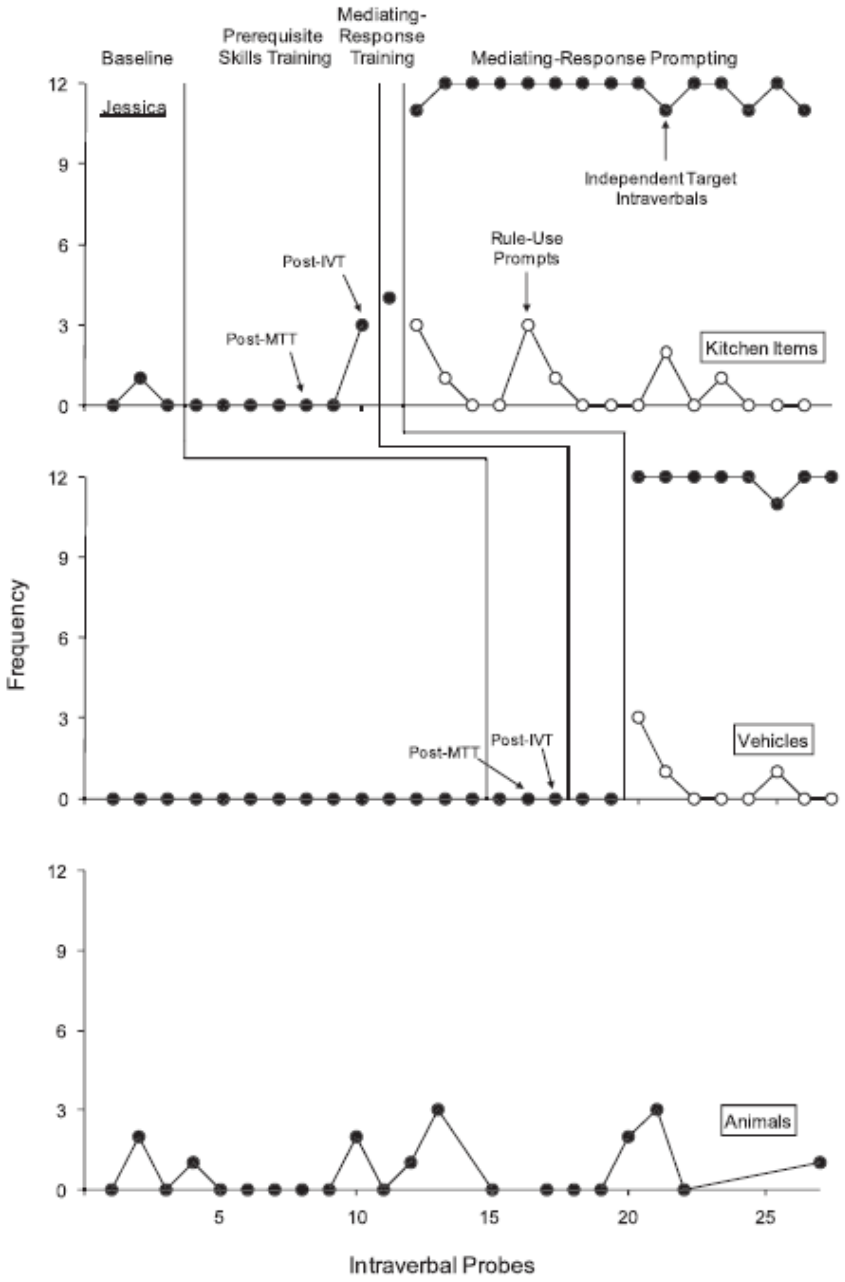

Figure 4. Correct target responses (filled circles) and number of experimenter prompts to use the rules (open circles) during intraverbal probes across categories for Jessica. See Figure 3 for definitions.

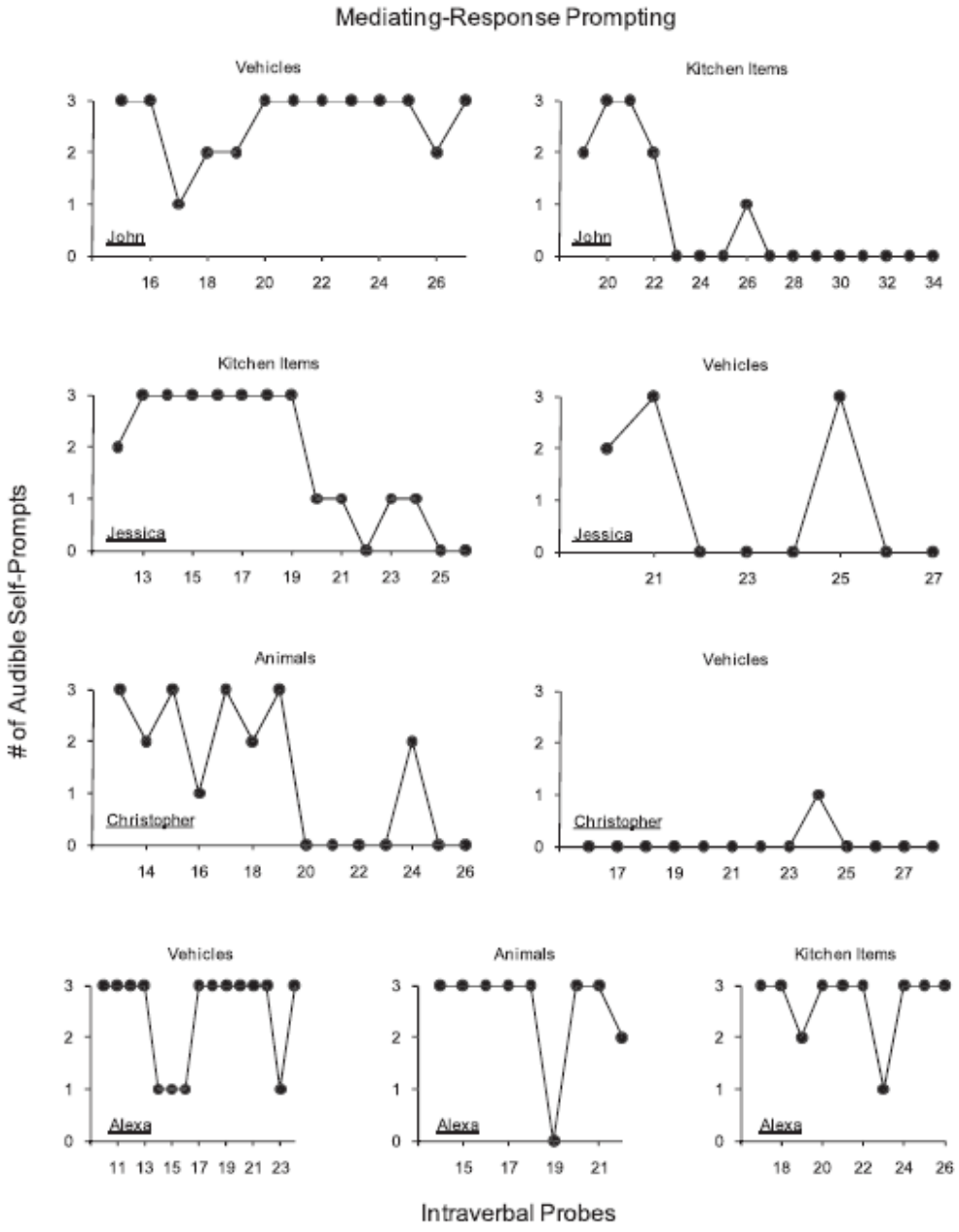

Figure 7. Number of audible self-prompts during MRP phases for each target category across participants.

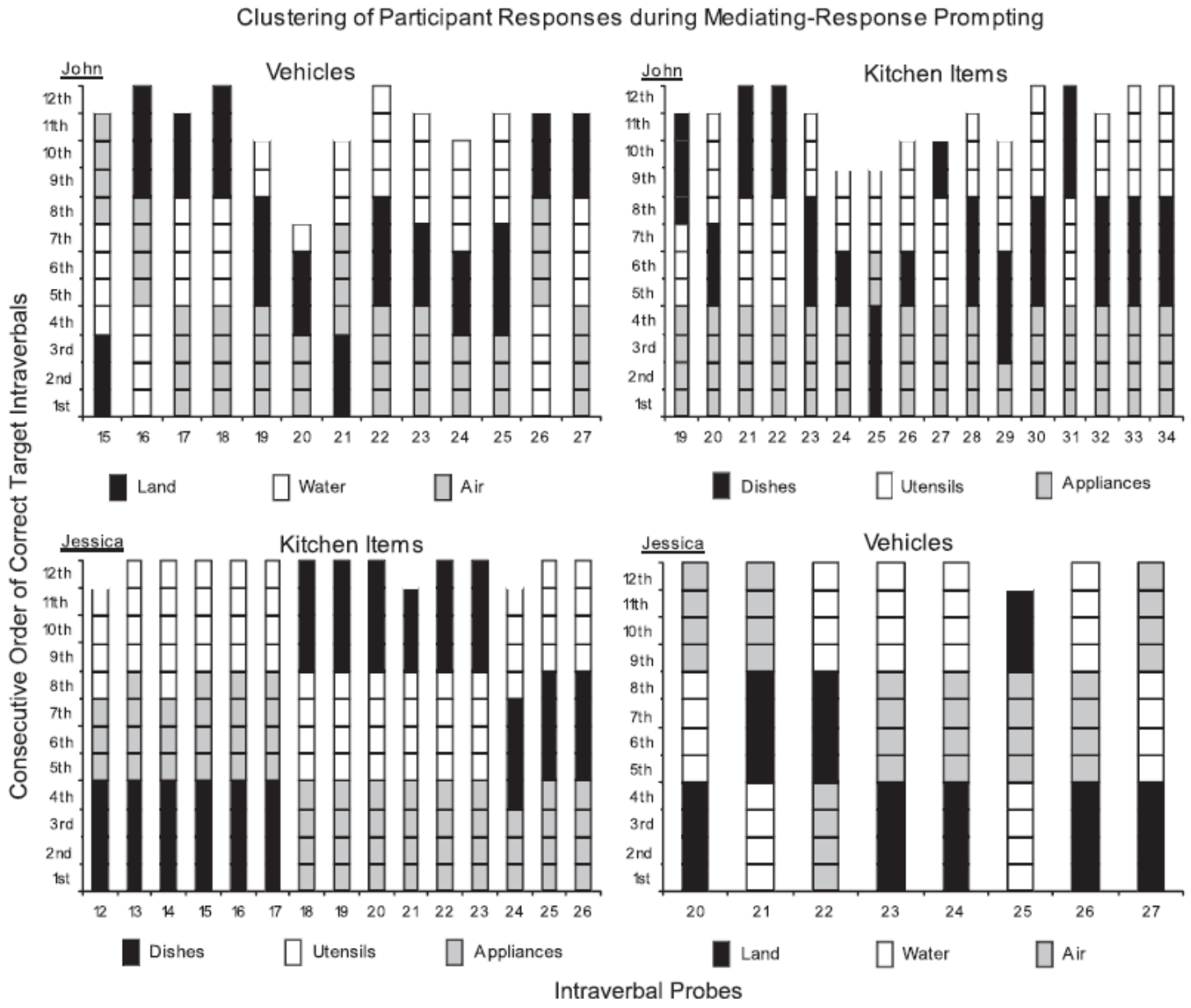

Figure 8. Within-session response patterns depicting the order (from first to 12th) and group membership of correct target intraverbals during MRP phases for each target category for John (top) and Jessica (bottom).

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TRAINING PRESCHOOL CHILDREN TO USE VISUAL IMAGINING AS A PROBLEM-SOLVING STRATEGY FOR COMPLEX CATEGORIZATION TASKS

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It has been suggested that verbally sophisticated individuals engage in a series of precurrent behaviors (e.g., covert intraverbal behavior, grouping stimuli, visual imagining) to solve problems such as answering questions (Palmer, 1991; Skinner, 1953). We examined the effects of one problem solving strategy—visual imagining—on increasing responses to intraverbal categorization questions. Participants were 4 typically developing preschoolers between the ages of 4 and 5 years. Visual imagining training was insufficient to produce a substantial increase in target responses. It was not until the children were prompted to use the visual imagining strategy that a large and immediate increase in the number of target responses was observed. The number of prompts did not decrease until the children were given a rule describing the use of the visual imagining strategy. Within-session response patterns indicated that none of the children used visual imagining prior to being prompted to do so and that use of the strategy continued after introduction of the rule. These results were consistent for 3 of 4 children. Within-session response patterns suggested that the 4th child occasionally imagined when prompted to do so, but the gains were not maintained. The results are discussed in terms of Skinner's analysis of problem solving and the development of visual imagining.

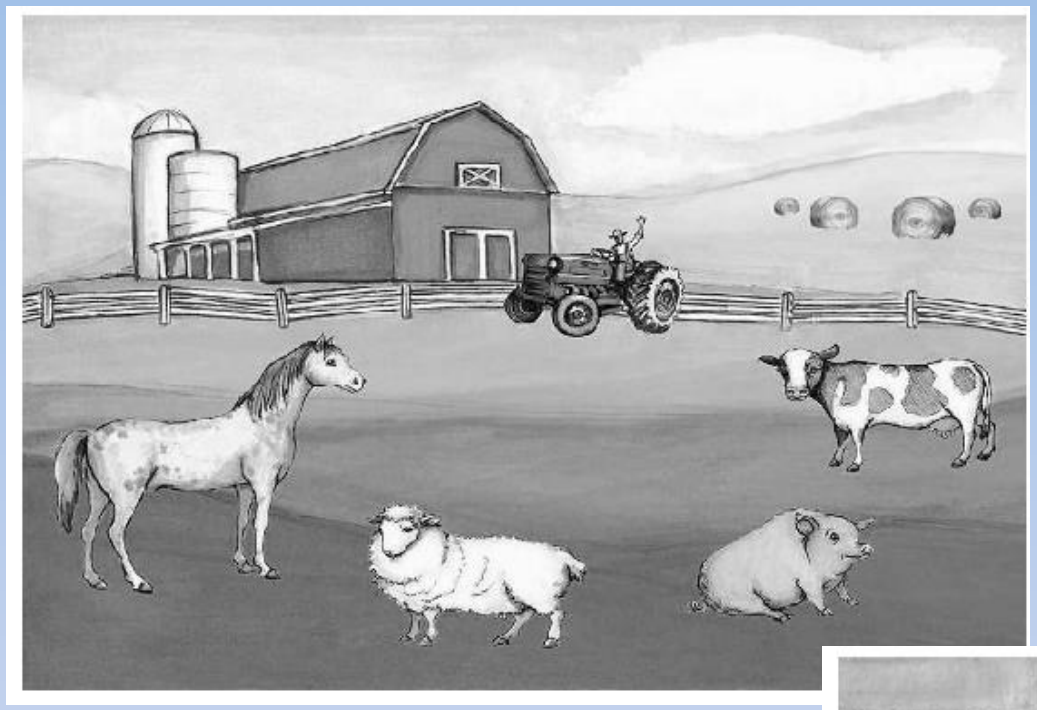
Key words: intraverbals, mediating response, tact training, problem solving, visual imagining

Kisamore, Carr, & LeBlanc (2011)

Table 1

Training Categories, Subcategories, and Items

Animals		
Farm	Ocean	Zoo
cow	dolphin	giraffe
horse	fish	lion
pig	lobster	monkey
sheep	shark	tiger
Furniture		
Bedroom	Living room	Office
bed	coffee table	bookshelf
dresser	couch	desk
mirror	foot stool	desk chair
nightstand	TV stand	lamp
Kitchen items		
Appliances	Dishes	Utensils
dishwasher	bowl	fork
microwave	glass	knife
refrigerator	mug	spatula
stove	plate	spoon
Vehicles		
Land	Water	Air
bus	canoe	airplane
car	jet ski	hang glider
motorcycle	kayak	helicopter
truck	ocean liner	hot air balloon



Kisamore, Carr, & LeBlanc (2011)

- Tact training → "put it in the picture"
- Subcategory IVT: e.g., "What are some places animals go?"
- Multiple tact training: item + place, place + category
- Visual imagining training
  - Show scene and tell child to "look at the place"
  - Experimenter closed eyes and made screen go gray
  - "I see an [item]" and that item appeared on the screen, and the others
  - "Now your turn. Close your eyes. Imagine the place. What do you see?"
  - Fading of screen
- Visual imagining prompts: "Remember, you can imagine," tact prompts
- Visual imagining prompts + rule ("I can imagine places and say what I see")

"SEE IN THE ABSENCE OF THE THING SEEN" (SKINNER, 1953)

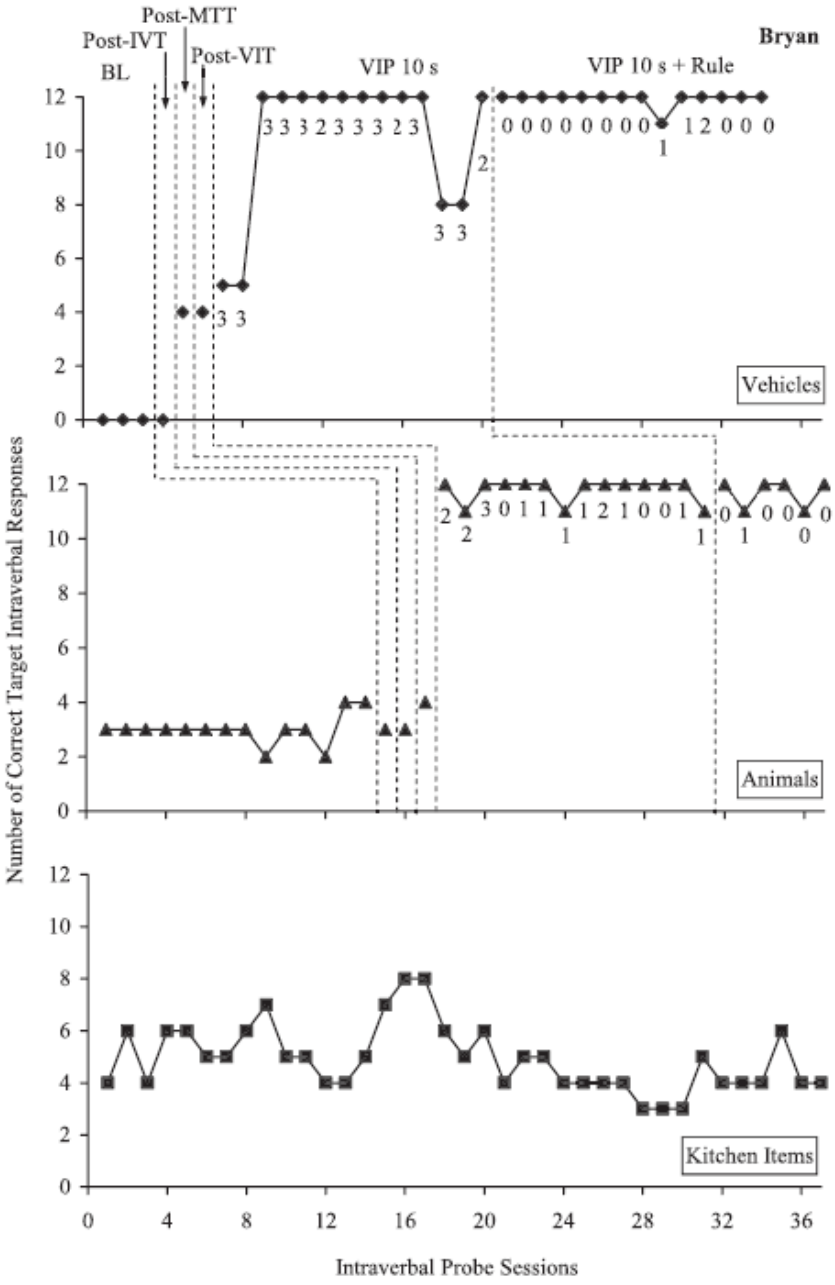


Figure 2. Number of correct independent target responses across training phases and stimulus categories for Bryan. Numbers = number of visual imagining prompts, BL = baseline, IVT = intraverbal training, MTT = multiple-tact training, VIT = visual imagining training, VIP = visual imagining prompting.

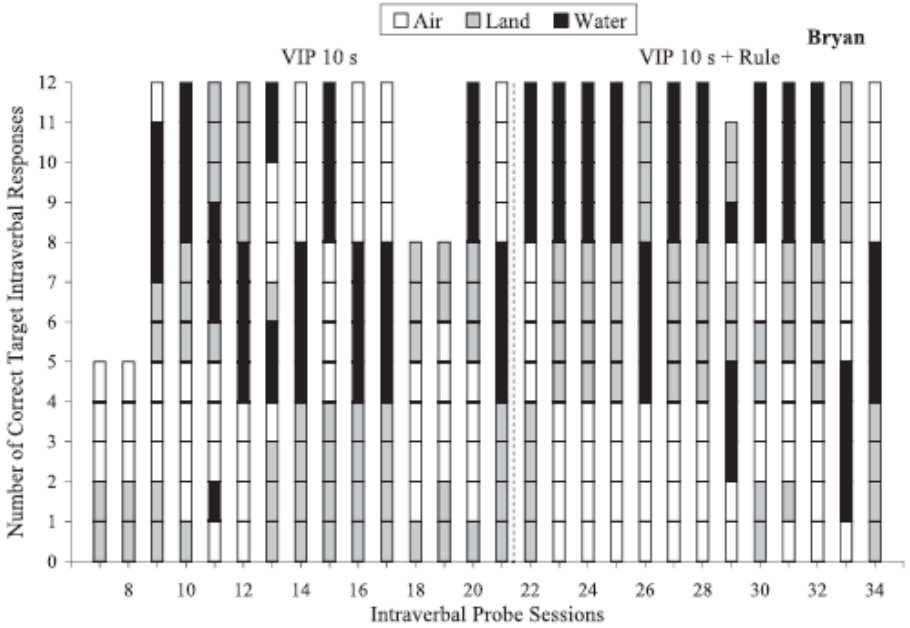


Figure 6. Number of correct target independent intraverbal probe responses in clusters during the prompting phases for Bryan. The data for vehicles are in the top panel, and the data for animals are in the bottom panel. See Figure 2 for definitions.

Problem Solving Matrix

	Math – Story Problems	**Social Behaviors**	**Communication** – Manding PECS	**Communication** – Intraverbals	**Communication** – Intraverbals	**???**
	(Neef et al., 2003)	(Park & Gaylord-Ross, 1989)	(Marckel et al., 2006)	(Sautter et al., 2011)	(Kisamore et al., 2011)	
Teaching Precurrent Behaviors	**X**					
Rules		**X**		**X**		
Recombining Minimal Units			**X**			
Visual Imagining					**X**	
???						

Clinical Applications - Communication

Skill: Initiating Conversations

Problem-Solving Strategy: Intraverbal Self-Questioning

First Ask: Who am I talking to?

What does he or she like?

I know!

Ask a question about what he or she likes

I don't know

What is today's date?

Is a holiday coming up or did one just happen?

Yes

Ask about the holiday

No

Ask about the person's plans for the weekend

Look Around Me

Ask a question or talk to the person about something that I see

Clinical Applications – Communication

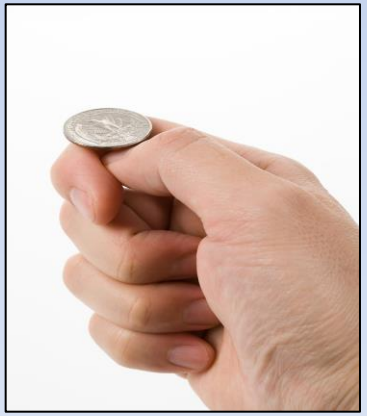
Skill: Answering Questions and Recalling Past Events

Problem-Solving Strategies: Visual Imagining or Keeping a Diary

Clinical Applications – Social Skills

Skill: Deciding Who Goes First in a Game

Problem-Solving Strategy: Fair Decider Strategies



Clinical Applications – Academic Skills

Skill: Writing an Essay

Problem-Solving Strategy: Brainstorming

Discussion

What other skills could be taught with a problem-solving approach?

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