Beyond the Elementary Verbal Operants: Teaching Complex Generalized Verbal Behavior to Children with Autism

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Overview

- Three domains, among many, that require complex analyses:
  - Multiple control
  - Intraverbal control
  - Remembering
- Our goal
  - To lay a conceptual foundation for each
  - To show some implications for practice

What is an operant?

- Responses vs. response classes
- Role of controlling variables
  - Responses of the same topography under control of different S^Ds and different MOs are different operants.
    - E.g., *iron, staff, score, can*
  - Stimulus generalization and response induction
    - The antecedents, behavior, and consequences all vary within generalization classes. An operant is a set of correlated classes of antecedents, behavior, and consequences.
- "Elementary" verbal operants
  - Skinner's taxonomy: *Fire* as tact, mand, intraverbali, textual, transcriptive, echoic

Misconceptions about verbal operants

- Pure examples are rare
  - Multiple control is ubiquitous
  - Therefore, classification into types is of little importance (and often impossible) but…
  - Identification of controlling variables is of great importance.

- Example
  - A man in a desert: "Water"
  - A man approaching an oasis: "Water"
  - A man in a restaurant: "I'll just have water, please."

- Saying "bear" in response to a bear track found near an empty picnic table is a metonymical tact. Saying "A bear has been here" is much more. In a normal occurrence, "That animal is a lion" is also more than a tact. The expression contains two tacts: *animal* and *lion*. It also contains additional material serving a function that in my book I call "autoclitic." It includes what linguists call syntax or grammar. If we are to stick closely to demonstrated behavioral processes, only the increased probability of saying *lion* in the presence of a lion is the relation called a tact.
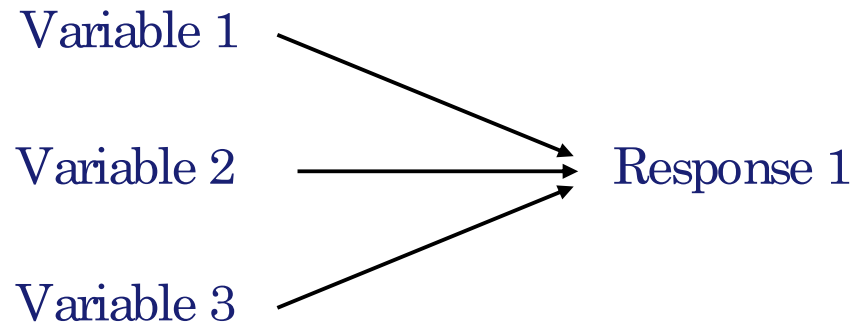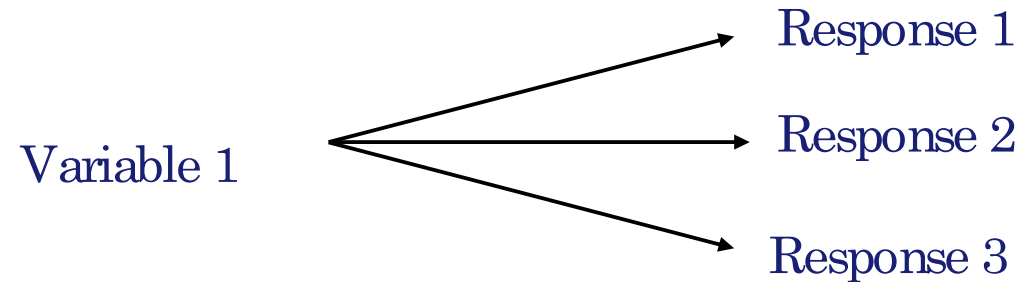
— Skinner, 1984

Multiple Control

- "Two facts emerge from our survey of the basic functional relations in verbal behavior:
  - (1) the strength of a single response may be, and usually is, a function of more than one variable and
  - (2) a single variable usually affects more than one response." (Skinner, 1957, p. 227)

- Stimulus control is continuous
- Stimulus control is additive
- Many competing responses typically vie for dominance

Convergent and Divergent Multiple Control

(1) Convergent multiple control

Variable 1
Variable 2
Variable 3
→ Response 1

(2) Divergent multiple control

Variable 1
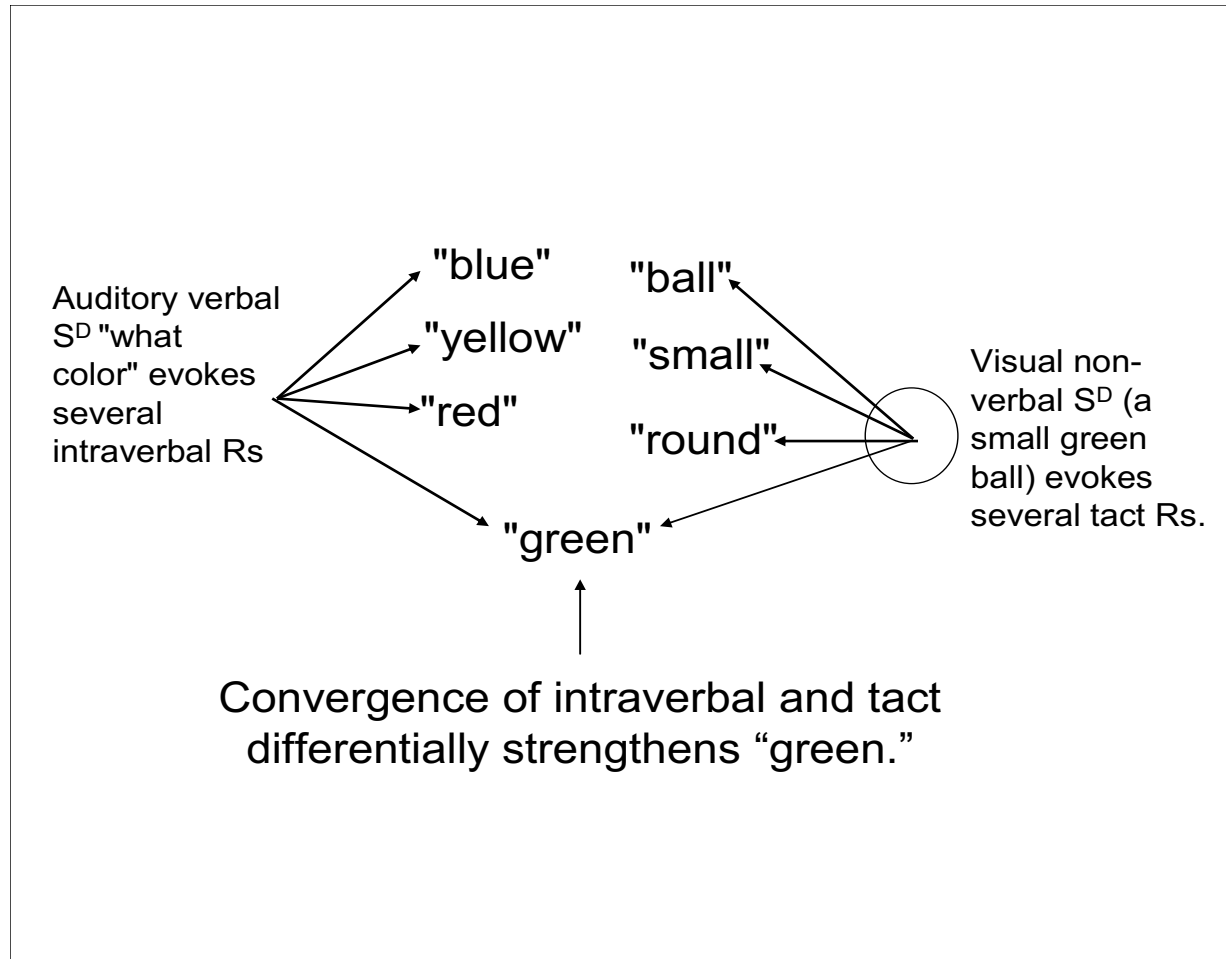→ Response 1
→ Response 2
→ Response 3

Example

- Suppose an adult picks up a small, green, rubber ball and says to a child, "What color is this?"

- The auditory verbal stimulus "color" strengthens a variety of intraverbal responses, such as *blue, yellow, red,* and *green.*

- The visual nonverbal stimulus (the ball) strengthens a variety of tacts, such as *ball, small, round,* and *green.*

- The response *green* is under the control of both variables and is strengthened accordingly.

- That it is actually emitted arises from motivational variables and audience control as well.
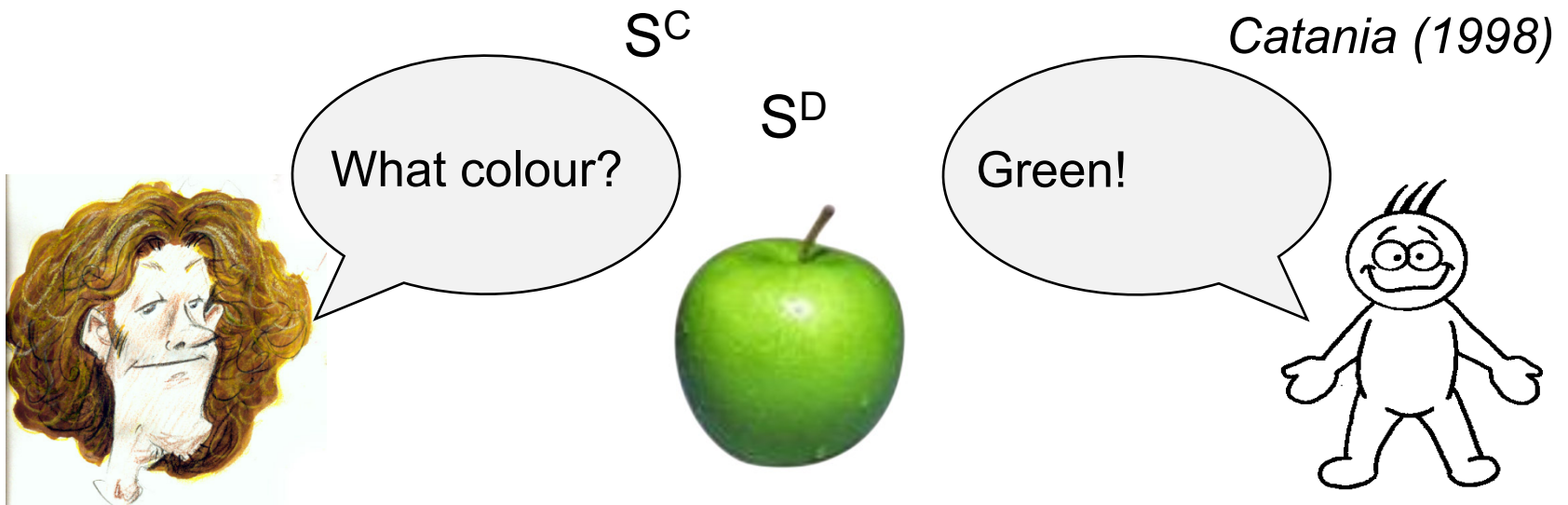
Example of additivity of response strength arising from multiple control

Auditory verbal S^D "what color" evokes several intraverbal Rs

"blue"

"yellow"

"red"

"ball"

"small"

"round"

Visual non-verbal S^D (a small green ball) evokes several tact Rs.

"green"

Convergence of intraverbal and tact differentially strengthens "green."

Note that at any moment many mutually incompatible responses are likely to have some strength. Only the "strongest" will be emitted.

Conditional discrimination in verbal behaviour

Inherent in all verbal operants as probabilities of verbal responses vary with the presence of conditional and discriminative stimuli

S^C

S^D

What colour?

Green!

Catania (1998)

Adapted from Axe (2008)

Applied considerations

- As soon as a basic verbal behaviour repertoire has been established, further explanations (and procedures) become necessary to account for (and teach) the interactions of its parts

- As interventionists, our quest must be to identify the sources of stimulus control (i.e., the controlling variables) in the natural environment and to recreate those contingencies in our teaching–only from procedures derived from a molecular analysis of multiply controlled verbal behaviour can we move beyond teaching specific responses under very restricted stimulus control

Early problems in
multiple stimulus control: objects

- **Colour vs. noun**
  - "What colour is it?" - "Apple"

- **Function vs. noun**
  - "What do you do with it?" - "Apple"

- **Sound vs. noun**
  - "What does it say?" - "Cat"

- **Category vs. sound**
  - "What does a cat say?" vs. "What is a cat?"

Events

- **Agent vs. action**
  "Who is it?" - "Drinking"

- **Object vs. function**
  "What is he drinking?" - "Straw", or
  "What is he drinking with?" - "Juice"

- **Agent vs. object**
  "Who is drinking?" - "Juice", or
  "What is he drinking?" - "Boy" or *"Straw"*

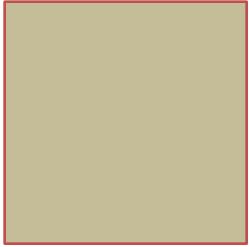# Teaching question discrimination to children with autism

- Procedure based on manipulating relevant conditions to evoke intraverbal control between the word "colour" and a colour name (i.e., the example being presented) and the word "number" and a number name (i.e., the example being presented).

- By training responding to single elements using autoclitic frames it may be possible to bring responding under multiple echoic, intraverbal, and tact control in a tact conditional discrimination without specifically teaching each response.

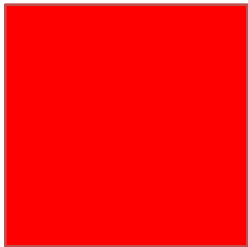*degli Espinosa and Brocchin (2015)*

To protect the identity and interests of the children involved, please do not make recordings or take photographs of the videos about to be shown.
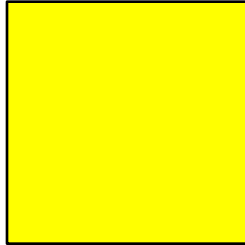
"What colour?"

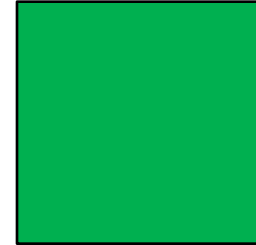*"colour blue"* *"colour red"* *"colour yellow"* *"colour purple"* *"colour orange"*

"What number?"

"number three" *"number one"* *"number five"* *"number two"* *"number four"*

Procedure: teaching steps (run concurrently)

1. **Echoic priming**

   "Colour green", "colour red", "colour blue", etc., and "number 3", "number 5", "number 4", etc., to increase intraverbal control of the verbal stimulus

   "Colour" and the name of a colour, "Number" and the name of a number

2. **Establish tacting of numbers with the autoclitic frame "Number [X]"**

   Stimuli are black numbers on white paper. Ask "What number?" in each presentation. Response is partly an echoic, partly intraverbally controlled, and partly a tact (specific sample), thus establishing multiply controlled responding

3. **Establish tacting of colour swatches with the autoclitic frame "Colour [X]" (in separate trial blocks from Step 2)**

   Ask "What colour?" in each presentation. The response is partly an echoic, partly intraverbally controlled, and partly a tact (specific sample), thus establishing multiply controlled responding

   Video AM

Procedure: testing step

4. **Testing**

   When the above groups of tacts have been established (Steps 1 to 3), begin testing for tact conditional discriminations using a continuous schedule of reinforcement for each correct response

   a) Run echoic trials as a priming session

   b) Present five coloured numbers on the table and randomly ask one of the two questions about a single stimulus (i.e., do not ask two questions about the same stimulus). Use an intraverbal filler, so when you point to the relevant sample and ask "What number?", say "Number…". The child should then say "Number" and the number name together (e.g., "Number three"). *Note*. The intraverbal filler is used to establish intraverbal control over the whole class with the tact as the specific sample, so it does not function as a prompt for the tact. Use the same procedure for the "What colour?" question

Test tact conditional discrimination

What colour?

What number?

What number?

What colour?

What colour?

What number?

1 3 5 4 2

Intraverbal and tact control via autoclitic frames: some examples

- "What number?" "**Number** [number name]""
- "What is it?" – "**It's a** [object name]"
- "What colour?" – "**Colour** [colour name]"
- "What animal?" – "**It's a** cat"
- "What does it say?" – "**It says** meow"
- "Who is it?" – "**It's** mummy"
- "What is **she doing**?" – "**She is** swimming"
- "What do you **eat**?" – "**Eat** spaghetti"
- "What do you eat **with**?" – "**With** fork"
- "When do you eat breakfast?" – "**When** it's morning"

Video

Skill	Description	Example
Simple tacts (non verbal control) – beginner objective	*Says the name of the item presented: noun, colour, number, animal*	*Picture of car "car".* *Red colour swatch "red".*
Tact question discrimination: colour/noun, sound/noun (single object)	Answers two to three questions about a visible single item: colour, noun, number, animal	"What is it?"; "What colour?"; "What number?"; "What does it say?"
Tact Yes and No and conditional questions (single object)	Answers direct questions, yes and no, conditional questions about a single visible item: colour, noun, number, animal	"Is it a car?"; "Is it a car or a chair?"; "Is it green?"; "Is it red or green?"
Tact question discrimination feature (part), function, class (single object) *FFC taught as separate skills first*	Answers direct questions about single visible item: noun, colour, function, class, feature (part), sound	"What is it?"; "What colour?"; "What is a car?"; "What do you with a car/it?"; "What does it/a car have?"
Tact question discrimination feature (part/adjective), function, class: direct questions, yes and no, conditional questions (single object)	Answers direct questions, yes and no, conditional questions: colour, function, class, feature (part), sound	"What is it?"; "What is a car?"; "Does it have wings?"; "Is the car blue?"; "Is it transport or an animal?"; "What do you do with it?"
Tact two-element questions (multiple objects): all question formats	Answers direct questions, yes and no, conditional questions about function, class, feature, adjective when presented with multiple objects in the same visual field	"What does the pen have?"; "Is the chair made of wood?"; "Is the cup empty or full?"; "Where do you find the cup?"; "What do you do with a toothbrush?"; "What colour is the cup?"; "Which is the big animal?"; "Is the dog dirty?"

Excerpt from "Early Behavioural Intervention Intermediate Curriculum Checklist"
(degli Espinosa, 2011)

Objects vs. events: general knowledge vs. experiences

Object

- Non-variable "vocabulary" regarding a given item
- All there is to know about a cat vs. "this" cat

Event

- Variable "vocabulary" about a changing event
- All there is to see about the cat in the picture

The intraverbal as an elementary operant

- Narrow definition (a functional definition):
  - Verbal behavior that has been reinforced in the presence of a verbal antecedent and that comes to strength when that antecedent is presented again.
  - Examples
    - "How are you?"   "Fine, thanks."
    - "Mary had a …"   "Little lamb."
    - "To be or not to be…"   "That is the question."
    - "What's 8 X 8?"   "64"
- So defined, calling something "an intraverbal" serves an explanatory function: The response is emitted because it had been reinforced in the presence of the verbal antecedent in the past.

The intraverbal (cont'd.)

- Loose definition (a structural definition):
  - A verbal response that is scheduled for reinforcement following a verbal antecedent.
  - Examples:
  - "What are you reading?"   "Pride and Prejudice."
  - "What did you do last night?"   "I watched the debate."
  - "I'm bored."   "Me too. Let's go out."
  - "What's 22 X20?"   "Let's see…. uh… 440."
- So defined, the term serves no explanatory function. The responses are primarily under control of additional variables. That is, the verbal antecedent is not sufficient to explain the response: there is no relevant history of reinforcement for the response.
- We prefer the narrow definition, but the loose definition is ubiquitous in our field (and in some cases the boundary is blurry).

"An Intraverbal" vs. "Intraverbal Control"

- Intraverbals, narrowly defined, are relatively trivial:
  - Poems, songs, catch phrases, memorized facts, lists
  - They represent a small proportion of verbal behavior and are easily understood.

- Intraverbal control, as an example of multiple control, is pervasive and important.
  - Verbal behavior almost always has verbal antecedents.
  - So some intraverbal control is almost always present, even if it arises from one's own speech.
  - It is usually just one of many concurrent controlling variables that combine to evoke a verbal response.

Intraverbal control in grammar

- "Grammar" refers to structural regularities in verbal behavior. Structural regularities can be explained as examples of intraverbal control.

- E.g., autoclitic frames
  - Strings, repeatedly heard and echoed in a context, with some elements fixed, some variable. The fixed elements are the frame, and each element exerts intraverbal control over subsequent elements of the frame.
  - E.g., "The X gave the Y to the Z."
    - "X promised Y that Z"
    - "On top of the X"
    - "Look at the X"

Autoclitic frames and "sentences"

- A is wearing a B.
- The A is on top of the B
- A promised B that C.
- A sent the B to the C.
- The (boy) has a (blue) (wagon).
- (Joe) is taller than (Sue).

- Intraverbal control is responsible for the "structure" of such utterances and is therefore fundamental to a behavioral account of language.

Applied considerations

- The trap of teaching intraverbal responses through an echoic/tact to intraverbal transfer **<u>before</u>** a repertoire of tact conditional discriminations has been established
  - "What do you **eat**?" - "Fork" ("What do you eat with?")
  - "What is a **cat**?" - "Miao" ("What does a cat say?")
  - "What do you do with **food**?" - "Pizza" ("What is a type of food?")
- Using such procedures risks turning a response that should occur under multiple control (i.e., a conditional discrimination) into one that occurs under simple discriminative control alone (i.e., a pure intraverbal). Because it has temporal contiguity, by definition, a pure intraverbal cannot be a variable response.

Learning how to learn

- Because EIBI aims to equip children with autism with skills necessary for independent functioning across a wide range of real-world contexts:
  - Interventions that focus on teaching every single requisite response for a given situation cannot be optimal, or, indeed, often even efficient
  - Instead, clinicians must focus on developing procedures for intervention that enable children to acquire novel responses in the absence of any teaching subsequent to intervention

Continuum: tact and intraverbally controlled conditional discrimination - object

Nouns	Colours	Sounds	Category	Parts	Prepositions Locations	Function
	"What colour?"	"What colour?"	"What colour?"	"What colour?"	"What colour?"	"What colour?"
	"What is it?"	"What is it?"	"What is it?"	"What is it?"	"What is it?"	"What is it?"
		"What does it say?"	"What does it say?"	"What does it say?"	"What does it say?"	"What does it say?"
			"What is an X?"	"What is an X?"	"What is an X?"	"What is an X?"
				"What has it got?"	"What has it got?"	"What has it got?"
					"Where is it?"	"Where is it?"
					"Where do you find it?"	"Where do you find it?"
						"What do you do with it"/"What is it for?"

Yes/No
("Is it X?")

Conditional questions
("Is it X or Y?")

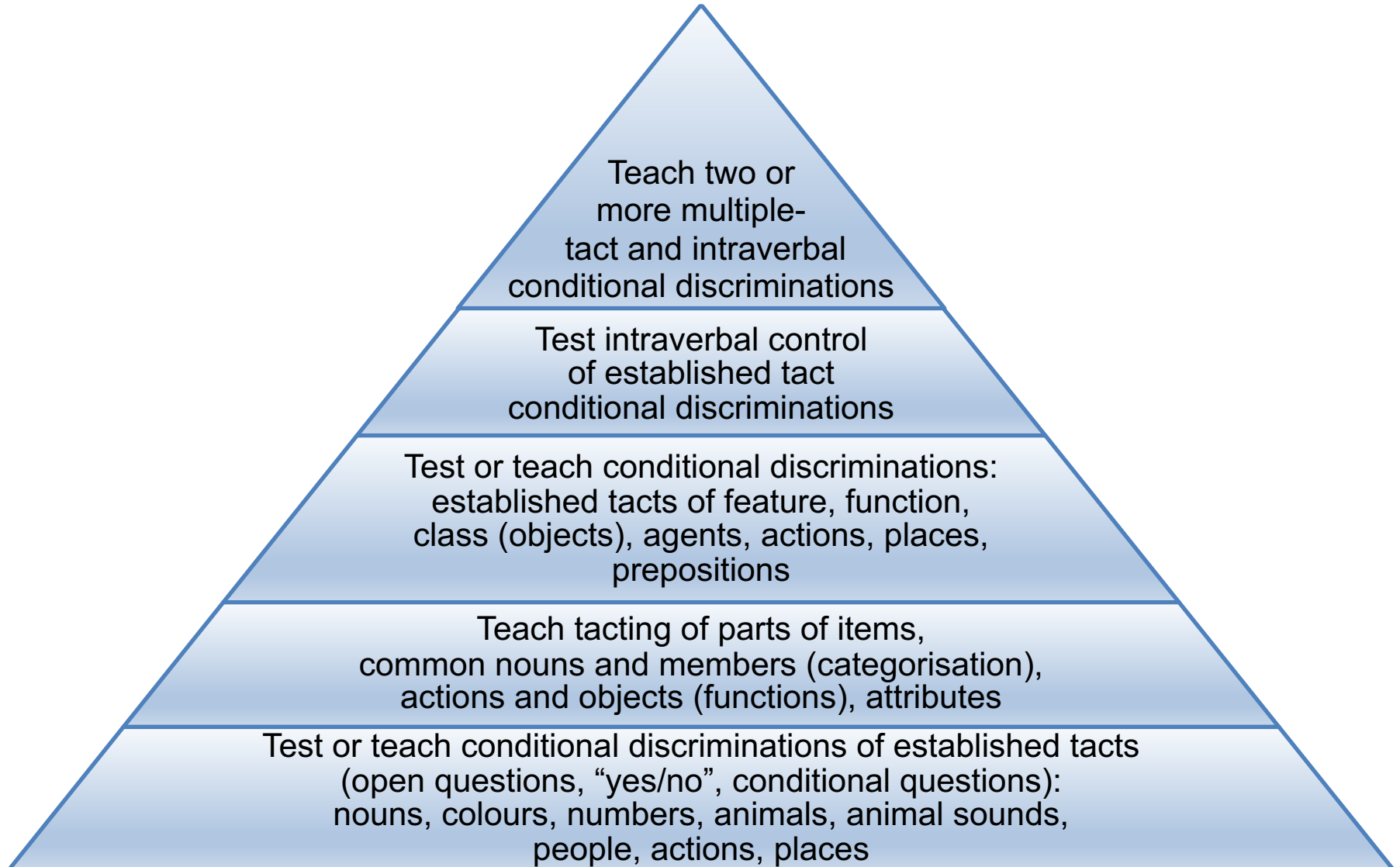# Continuum: tact and intraverbally controlled conditional discrimination - event

People	Actions	Locations	Features	Prepositions	Functions	Past events
"Who is it?"	"Who is it?"	"Who is it?"	"Who is it?"	"Who is it?"	"Who is it?"	"Who was it?"
"What is he doing?"	"What is he doing?"	"What is he doing?"	"What is he doing?"	"What is he doing?"	"What is he doing?"	"What was he doing?"
	"Where is he?"	"Where is he?"	"Where is he?"	"Where is he?"	"Where is he?"	"Where was he?"
			"What colour is his top?"	"What colour is his top?"	"What colour is his top?"	"What colour was his top?"
			"What colour is his hair?"	"What colour is his hair?"	"What colour is his hair?"	"What colour was his hair?"
			"Where is the juice"	"Where is the juice?"	"Where is the juice?"	"Where was the juice?"
				"What is he drinking?"	"Who is drinking?"	"Who was drinking?"
				"What is he drinking with?"	"What is he drinking?"	"What was he drinking?"
					"What is he drinking with?"	"What was he drinking with?"

Yes/No
("Is it X?")

Conditional questions
("Is it X or Y?")

Curricular sequence:
Teach tact, test intraverbal control

Teach two or more multiple-tact and intraverbal conditional discriminations

Test intraverbal control of established tact conditional discriminations

Test or teach conditional discriminations: established tacts of feature, function, class (objects), agents, actions, places, prepositions

Teach tacting of parts of items, common nouns and members (categorisation), actions and objects (functions), attributes

Test or teach conditional discriminations of established tacts (open questions, "yes/no", conditional questions): nouns, colours, numbers, animals, animal sounds, people, actions, places

Differentiating between a tact and an intraverbal response

- Intraverbal control is involved in most verbal interactions: Direct transfer procedures across individual responses between tact to intraverbal may not be required if we teach children to respond under the multiple sources of stimulus control involved in those kinds of verbal interactions

- Differentiating between tact and intraverbal responses may not be so crucial once we consider the role of intraverbal control

A Behavioral Interpretation of "Memory"

- The everyday term "memory" embraces two distinct kinds of behavior:
  - 1) The endurance of stimulus control:
    - A response is reinforced in the presence of a stimulus, and that stimulus is presented again at a later time. The response is said to be "remembered."
    - E.g., "What is the capital of Spain?" "Madrid."
  - 2) Problem solving
    - A response is reinforced in the presence of a stimulus. That response is scheduled for reinforcement at a later time, but the stimulus is not present.
    - E.g., "What did you have for dinner last night?" "Tuna salad with tomotoes."

- "Type 1" is inherent in the principle of reinforcement and requires no further explanation.

- "Type 2" requires a more complex interpretation.

Recall as problem solving

- If a response is under the control of a stimulus, or a constellation of stimuli, and if those stimuli are absent, we must engage in some kind of mediating behavior to reinstate some or all of those stimuli.

Example

- "Where were you on September 1st?"
- "Let's see…today is Wednesday, Oct. 14th. Minus 7 = 7, minus 7 = 0, so two weeks ago would have been Sept. 30. Minus 28 = 2, so Sept. 2nd would've been a Wednesday and the 1st would have been a Tuesday. So not Labor Day. Our anniversary was August 22, so it would have been more than a week later. That was the week I started to get neurotic about school, so I went into the office every day. I was working on study questions for my learning class."

Recall is an acquired skill, typically entailing two kinds of mediating behavior:

- ## Acquisition strategies
  - When we know that something about the current setting will be important later on ("Will this be on the quiz?") we engage in rehearsal, elaboration, imagery, word associations, and other mnemonic strategies to create a web of verbal or visual relationships that provide a "behavioral pathway" to the target response. E.g., when introduced to someone, think of someone familiar with the same name.

- ## Recall strategies
  - At the time of recall, we go through the alphabet, think of related facts, repeat the question in other words, engage in systematic mnemonics, make up a web of verbal or visual relationships that evoke relevant intermediate responses that in turn expand the web.

These strategies need not be explicit

- A salient event is likely to evoke a lot of relevant behavior that may have the same effect as an acquisition strategy:
  - If you see a dead mouse on the floor, you will scold the cat, complain to your spouse, engage in distinctive mouse-disposal behavior, gripe about it to your co-workers, and so on. There are many paths that will lead you back to "seeing a dead mouse on the floor."
  - If the salt-shaker has been moved 6 inches to the left you won't engage in any relevant behavior. You have almost no way of evoking "seeing the salt-shaker in position."

- Likewise, a question signals a negative reinforcement contingency that evokes escape behavior that may have the same effect as an explicit recall strategy. Each response adds to the constellation of variables controlling subsequent behavior.
  - Who did I see in town? I forget! I saw a lot of people in town... I have a lot of friends… maybe somebody from work….

- Typical children acquire these recall techniques without explicit training, and often at an early age.
- Nevertheless, even adults with long experience have difficulty with some recall tasks.
- Skilled mnemonists are able to perform recall tasks that astonish the rest of us.
- So recall behavior lies on a continuum that appears to arise from differences in mnemonic behavior.
- Children with autism or other disabilities are merely near one end of that continuum.
- Our task is to give them a repertoire that will move them up the scale.

The relation between understanding the question and remembering

When we move to past event remembering, question discrimination must be present

The behaviour of remembering

- Does s/he not understand or does s/he not remember?
    - *"Who was in the picture I showed you?"*
    - *"Where was he?"*
    - *"What was he doing?"*
    - *"What was he drinking?"*
    - *"Did he have a straw or a glass?"*
    - *"Was the weather hot?"*
    - *"What was he wearing?"*
    - *"What colour was his top?"*
    - *"What was behind him?"*

- The importance of teaching tacting ongoing events

Applied considerations

- Being verbally present: engaging in matching verbal behaviour to the ongoing event as it happens: the importance of tacting one's environment, public and private

- Understanding the question: no errors in discrimination

  – *"What did you do at school today?" – "Monday 2nd of June"*

- Problem solving, the behaviour of remembering

Skill	Description	Example
Past event recall: static scene	After observing a picture of a scene for 20 to 30 seconds, answers questions regarding the event (yes/no, conditional and some open questions)	"Was the ball stripy?"; "How many ball were there?"; "Where was it?". *The more open the questions the more complex the task is*
Past event recall: video	After watching a brief video, answers questions about concrete information	"Who was in the vide?"; "What was Peppa doing?"; "What colour was her car?"; "What was she holding?"
Past event recall: experience	After a salient event, answers concrete questions related to it (varying latencies - within the day)	"What did you do?"; "What did you use to make cookies?"; "What colour icing did you use?"
Event question discrimination (complex event)	Answers multiple-part questions about an ongoing event. Questions are presented from general to specific (whole scene to details), no pointing involved	"Where is this place?"; "Who is in it?"; "What is the blond boy doing?"; "What is the girl with the red top holding?"; "Where is the girl drawing?"; "Is the person sitting on the brown chair a boy?"
Past verbal event recall: story comprehension	After listening to a story, answers concrete questions related to it.	"Who was in the story?"; "What were their names?"; "Where did they go?"; "What did they do?"; "Where did she hide?". *The longer the story the fewer concrete details (e.g., colours, names of people) can be recalled.*
Past event recall: experience (long latency) and time concepts	Answers questions regarding a past personal event or contacted experience. Questions include temporal concepts such as before and after, times of day (morning, afternoon, evening) and days of the week	"Where did we go?"; "How did we get there?"; "Before we went to the get ice-cream, where did we go?"; "Who did we see at the cinema?"; "What did we see at the cinema?"
Abstract reasoning (tact and past event)	Answers questions regarding private events of others: emotions, inferences, why questions, predictions, generating solutions	"How did she feel when...?"; "Why did she feel that way?"; "Where were they?"; "How do you know?"; "Why did they go there?"; "What should they do?"; "What could they have done?"

Excerpt from "Early Behavioural Intervention Advanced Curriculum Checklist" (degli Espinosa, 2011)

Conclusions

- We must consider the role of conditional discriminations and mediating behaviour, particularly in relation to answering questions about past events

- Ultimately, we want children to be able to answer questions about their personal experiences and what they know about the world, and to engage in meaningful ever-changing verbal interactions