

# Teaching Generalised Multiply Controlled Verbal Behaviour to Children with Autism

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## A massive “Thank you” ....

- To Dave Palmer, for the analysis, the mentoring, and his friendship
- To Vince Carbone, for shaping my initial verbal behaviour about verbal behaviour
- To my students, past and present, for their questions, their enthusiasm, and their trust

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### Early Intensive Behavioral Intervention: Outcomes for Children With Autism and Their Parents After Two Years

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#### Abstract

An intervention group ( $n = 23$ ) of preschool children with autism was identified on the basis of parent preference for early intensive behavioral intervention and a comparison group ( $n = 21$ ) identified as receiving treatment as usual. Prospective assessment was undertaken before treatment, after 1 year of treatment, and again after 2 years. Groups did not differ on assessments at baseline but after 2 years, robust differences favoring intensive behavioral intervention were observed on measures of intelligence, language, daily living skills, positive social behavior, and a statistical measure of best outcome for individual children. Measures of parental well-being, obtained at the same three time points, produced no evidence that behavioral intervention created increased problems for either mothers or fathers of children receiving it.

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### The whole is greater than the sum of its parts

- “Readers sometimes fail to recognize that pure forms of the respective verbal operants are rare outside the laboratory or instructional contexts, and a common preoccupation of students is to try to classify utterances as one or another verbal operant on the assumption that the example must be exclusively one type”

*Michael, Palmer, and Sundberg (2011, p. 4)*

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### A shift in stimulus control for curriculum design

- As soon as a basic verbal behaviour repertoire has been established, further explanations (and procedures) become necessary to account for (and to teach) the interactions of its parts
- “Little or no previous research has attempted to establish relational instructional control in individuals with developmental disabilities who do not already possess it”

*Tarbox, Zuckerman, Bishop, Olive, and O’Hora (2009, p. 123)*

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### 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 (i.e., that establish finite classes of behaviour) 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

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## Beyond specific curriculum content

- As soon as research into the emergence of generalised behaviour classes is accepted as relevant to EIBI, curriculum design can no longer remain solely concerned with the nature and structure of curriculum content
- Instead, the focus necessarily changes to consideration of the design and arrangement of teaching procedures that will ensure that the greatest gains in novel, untaught, skills that can be obtained from the minimum amount of direct teaching
- In other words, the focus of curriculum design shifts from programmes that establish finite numbers of directly taught individual behaviours to teaching procedures that are designed to establish generalised classes of behaviour on the basis of finite subsets of specifically taught behaviours

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## Curriculum structure, content, and overall objectives

	Beginner	Intermediate	Advanced
<b>Social</b>	People need to become SR for delivery of SR. Eg: conduct as CMO-T and joint attention	Attention and shared activities as the SR: reciprocal commenting and comment extensions	Verbal interaction as the SR: conversation
<b>Verbal: Function and structure</b>	<p>Conditional discriminations: visual and unmediated selection (receptive)</p> <p>Communication: Mands</p> <p>Establishing basic noun and action vocabulary: tacts and receptive</p> <p>Generalised imitation</p> <p>Naming</p> <p>Structure: single words</p>	<p>Tact and intraverbal conditional discriminations: objects and ongoing events</p> <p>Listener (mediated selection, jointly controlled responding)</p> <p>Relations between nouns and classes (categories), nouns and actions (functions)</p> <p>Descriptions (tacts of compound stimuli): events and objects</p> <p>Structure: basic utterance (SVO + articles and agreements)</p>	<p>Tact and intraverbal conditional discriminations: general topics and past events</p> <p>Descriptions of past events (remembering)</p> <p>Abstract reasoning: predictions, inferences, temporal relations/sequences</p> <p>Problem solving and tacting private events of others (Theory of Mind)</p> <p>Structure: Multi-clause, connected sentences (discourse)</p>
<b>Academic</b>	Drawing imitation and coloring	Textual (dictating) & tating: dictation; number/quantity relations	Story comprehension and story writing; math word problems; sums

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## Intermediate curricular objectives

- Listener responding to novel combinations of learned vocabulary (i.e., joint control)
- Tact conditional discrimination: answering different questions about a single non-verbal/visual stimulus
- Intraverbal conditional discrimination: answering different questions about a verbal stimulus (i.e., a special case of intraverbal control)
- Tact divergent control and autoclitic frames, descriptions of present objects and events: generating novel combinations of vocabulary in grammatically correct sentences

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## Listener responding to novel combinations of learned vocabulary

*Teaching to respond under joint stimulus control*

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### Analysis of the listener

“Separate variables combine to extend their functional control, and new forms of behavior emerge from the recombination of old fragments. All of this has appropriate effects upon the listener, whose behavior then calls for analysis. Still another set of problems arises from the fact, often pointed out, that a speaker is normally also a listener. He reacts to his own behavior in several important ways. Part of what he says is under the control of other parts of his verbal behavior. We refer to this interaction when we say that the speaker qualifies, orders, or elaborates his behavior at the moment it is produced”

*Skinner (1957, p. 10)*

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### Responding to multiple-component verbal stimuli

- How does a child learn to respond to “Go and get your shoes and bag and then come to the kitchen”?
- How is a child able to progress from responding to single-component instructions to responding to instructions composed of multiple components in combinations that have not been previously explicitly taught and reinforced?

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The speaker controls the listener

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030731	939317
931793	939173
939137	937193

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Teaching jointly controlled responding

- Tu (2006)
- Causin, Albert, Carbone, and Sweeney-Kerwin (2013)
- degli Espinosa, Randell, and Remington (2014)

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Method

- Participants: three children with autism aged between 6 and 8 years
- Procedure (five phases):
  1. Pre-experimental vocabulary test
  2. Baseline assessments
  3. Teaching joint control
  4. Generalisation
  5. Maintenance

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### Phase 1. Pre-experimental vocabulary test

- Children were asked to tact, select and to echo the names of the pictorial stimuli when these were presented individually.
  - Six pictures of objects
  - Six colour swatches
  - Four photographs of puppets
  - Four pictures of actions



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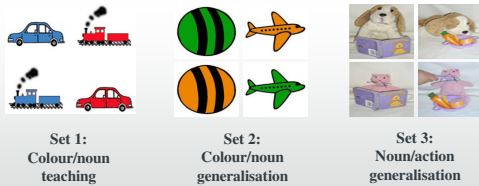
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### Phase 2: Baseline assessments

- Children were randomly assigned to two-, three-, or four-sessions baseline
- Children's selection responses upon a spoken instruction were tested on three stimulus sets



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### Phase 3: Teaching Joint Control

- Set 1 stimuli only
- Two stages:
  - i. Training colour/noun tacts
  - ii. Training selection following a self-echoic with a time delay

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### Phases 4 & 5: Generalisation and Maintenance

- Children were retested on stimulus Sets 2 and 3 after achieving errorless performance on Set 1
- Children were retested after 1 month on all three sets

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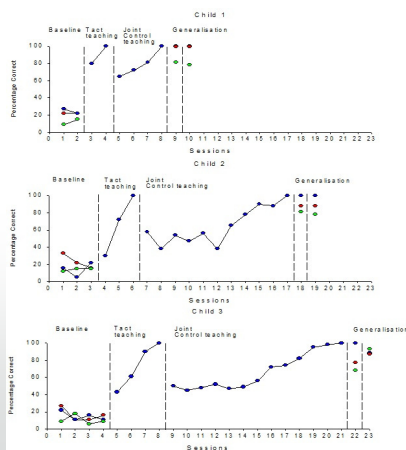
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Percentage of correct selection responses pre- and post-joint control training (Phases 2 to 5)




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### Child 3: Mismatch between echoic and signed responses

- Child 3 had only recently developed generalised echoics and had previously used sign language
- Error analyses: did not select correctly when words “purple”, “eating”, and “drinking” were part of the instruction
  - “Purple”: echoed full instruction but only signed object word
  - “Drinking”: sign appeared similar to drinking
- Additional teaching procedure
  - Simultaneous (intraverbal) sign and echoic responding to words “purple”, “eating”, and “drinking”
  - Tact pictorial stimuli of colour “purple” and actions “eating” and “drinking” using vocal and sign

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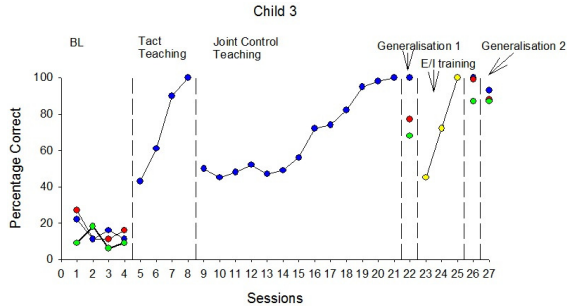
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### Child 3: Complete results

Percentage of correct selection responses pre- and post-joint control teaching and echoic/sign teaching




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### The omnipresence of joint control

• “As for joint control, I regard multiple control as ubiquitous, so the question is how joint control can be an important variable. Lowenkron has made a good start, but I think his account is incomplete. I believe the answer is that the value of joint control is context specific. We learn, when faced with matching tasks, and perhaps other things, to use the saltation of response strength as an important variable. At all other times, such saltations are happening more or less constantly but don't signal anything important. That is, when you are scanning for that long number in the array, joint control matters. When Tom says "cat" when you have a cat in your lap, joint control is irrelevant. Delayed matching is a case where it matters. I think this was one of your points, following Michael, 1996. I think we also exploit it in recall tasks, problem solving tasks and complex matching tasks (is this painting a forgery?)”

*D. C. Palmer (personal communication, July 5, 2012)*

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### Listener applications of joint control

- Multiple-component instructions
  - Compound stimuli (blue train)
  - Selection of multiple stimuli (train, car, and dog)
  - Multiple instructions (clap hands and wave)
- Complexity of instructions proportionally increases with the acquisition of new tact relations and echoic ability

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	Object	Action	Adjective	Places/locations	Preposition
<b>Object</b>	Spoon and bottle	Open/shake the bottle vs open/shake the box	Blue car vs blue train vs red car vs red train	Got to the bathroom and get a pillow	Put the block on top
<b>Action</b>	Point to car vs touch vs give	Clap and wave	Clap fast, clap slowly	Go to the kitchen and jump	Run under the table, jump on the sofa
<b>Adjective</b>	Big car little car, big train little train	Run fast, run slowly			Put the big car on top
<b>Places and locations</b>		Run to the kitchen, clap in the bathroom		Go to the bathroom and then the kitchen	Put this on top of the table in the kitchen
<b>Preposition</b>					Put this on top then under

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### Jointly controlled tact and intraverbal responding: a case of “Yes” and “No”



- Yes and No: autoclitic for the presence or absence of joint control between the verbal and non-verbal antecedent: right/wrong relations
- In the presence of non-verbal stimulus CAT (see above)
  - Hears “Is it a cat?” and sees/tacts CAT
  - Match between hear/say achieves joint control: says “Yes”
  - Hears “Is it a dog?” and sees/tacts CAT, no match between hear/say: says “No”
  - Nouns, colour, action, category, function, part, etc.
- Conditional question: “Is it a cat or a dog?”
  - Nouns, colour, action, category, function, part, etc.
  - When child first responds to the direct question (e.g., “what is it?": “A cat”. “What is a cat?": “An animal”) it increases the probability that subsequent responses to conditional questions will be under joint stimulus control (e.g., “What is a cat?": “An animal”. “Is this an animal or transport?": “Is it transport?”)

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### Speaker applications

	Tact (yes/no)	Intraverbal (yes/no)	Tact (conditional questions)	Intraverbal (conditional questions)
<b>Nouns</b>	Is this an elephant?		Is it an elephant or a cat?	
<b>Colours and adjectives</b>	Is the elephant white? (white elephant and grey dog)	Is an elephant grey?	Is it grey or red? Is it big or small?	Is an elephant grey or red? Which is grey, a lion or an elephant?
<b>Categories</b>	Is it an animal? Is it transport?	Is an elephant transport? Is an elephant an animal?	Is it an animal or transport?	Is an elephant an animal or transport?
<b>Functions</b>	Does it miao? Does it bark? Does it live in the savannah? Does it drink milk?	Does the elephant fly?	Does it fly or walk?	Which on walks, snake or an elephant? Does an elephant walk or flies?
<b>Parts</b>	Does it have a tail? Does it have wings?	Does an elephant have wings? Does an elephant have a trunk?	Does it have wings or legs?	Does an elephant have legs or wings?

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### A discriminable jump in response strength

- “The particular stimuli that jointly control a response are specific to the example at hand [but] the saltation in response strength is general from one example to the next” (Palmer, 2006, p. 210)
- The sudden increase in response strength is proposed to provide a discriminable stimulus property that can, itself, serve as a controlling variable for specific topographies of responding within complex environments (e.g., selection in visual search tasks involving multi-element conditional discriminations). This discriminable jump in response strength occurs when two concurrent SDs control a response of a common topography
- Given a typical history, such an event becomes an SD for a matching or selection response, and, on this basis, jointly controlled responding can also occur in relation to abstract non-verbal stimulus dimensions such as colour, size, shape, or even the structural components of verbal stimuli such as nouns, verbs, and prepositions (Lowenkron, 1998, 2006). The necessary prerequisites, however, remain the same: The listener must simultaneously tact the relevant features of stimuli involved while emitting the appropriate echoic (and, when occasioned by the context, self-echoic) behaviour

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### Tact conditional discrimination and intraverbal control

*Answering different questions about a individual non-verbal (tact) and verbal (intraverbal) stimuli*

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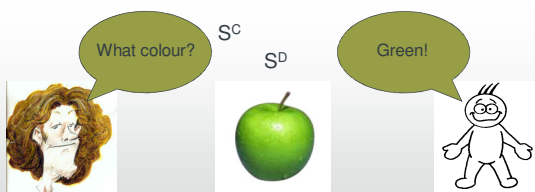
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### Conditional Discrimination in Verbal Behaviour

- Inherent in all verbal operants as probabilities of verbal responses vary with the presence of conditional and discriminative stimuli (Catania, 1998)



Adapted from Axe (2008)

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### Conditional Discriminations

- “The nature or extent of operant control by a stimulus condition depends on some other stimulus condition”

*Michael (2004, p. 64)*

- “That is, one discriminative stimulus (SD) alters the evocative effect of a second stimulus in the same antecedent event (or vice versa), and they collectively evoke a response”

*Sundberg and Sundberg (2011, p. 25)*

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### Verbal conditional discriminations

- An adult shows a green apple to a child and asks “ what colour is it?”
- The auditory verbal stimulus colour strengthens a variety of intraverbal responses related to colours (blue, yellow, red, and green) and the non-verbal stimulus strengthens related tacts (round, small, you eat it, sweet, and **green**). The response green is under the control of both antecedent variables

*Michael, Palmer, and Sundberg (2011)*

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### Teaching problems

- *Colour/noun* - “What colour?”/“What is it?”
- *Agent/action* - “Who is it?”/“What is s/he doing?”
- *Animal/sound* - “What is it?”/“What does it say?”
- *Person/action* - “Who is reading?”/“What is he reading?”
- *Agent/object/function* - “Who is eating?”/“What is s/he eating?”/“What is s/he eating with?”

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### 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 the response under multiple echoic, intraverbal and tact control in a tact conditional discrimination without specifically teaching it.

*degli Espinosa and Brocchin (in preparation)*

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### 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 tacts (or intraverbals if you prefer...) of numbers with the autoclitic frame “Number [X]”**
  - Stimuli are black numbers on white paper. Ask “What number?” in each presentation. The response is partly an echoic, partly intraverbally controlled, and partly a tact (specific sample), thus establishing multiply controlled responding
- 3. Establish tact 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

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### Procedure: Testing

4. When these groups of tacts are established in this way, begin testing for tact conditional discrimination 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 on a single stimulus (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 (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, then randomise colour and number questions

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### Additional pairs

- What is it? **It's a** object name
- What colour? **Colour** green
- 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

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### The problem with directly training intraverbal responses

- “[...] researchers are able to establish small and somewhat restricted categorization repertoires by directly training the responses using stimulus control transfer procedures. However, some have suggested that the resulting responses may differ from how most verbally competent individuals answer categorization questions”

*D. C. Palmer, personal communication, September 12, 2006, as cited in Sautter, Leblanc, Jay, Goldsmith, & Carr (2011, p. 228)*

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### Considerations

- The trap of teaching intraverbal responses through an echoic/tact to intraverbal transfer before tact conditional discriminations are acquired
  - “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 only (i.e., a pure intraverbal). Because it has temporal contiguity, by definition, a pure intraverbal cannot be a variable response

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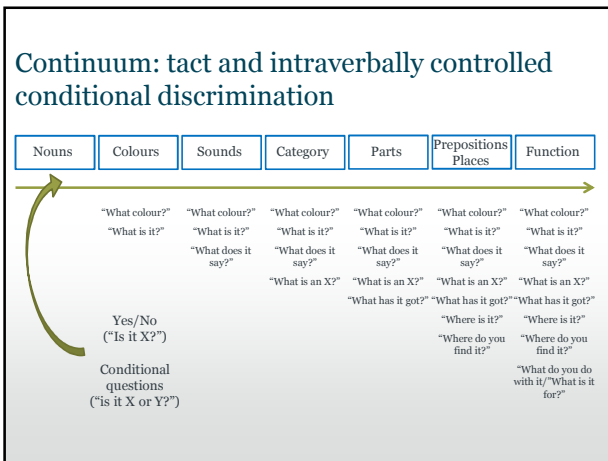
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### Teaching intraverbal responses (contiguity)

- Completion of fixed strings (e.g., songs, word games)
- Animal sounds: says sound when hears animal name, says animal name when hears sound
- Object sounds
- Sentence completion in context (part tact)

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### Teaching intraverbal control

<p><b>Conditional discriminations</b></p> <ul style="list-style-type: none"> <li>• Answers multiple questions about objects</li> <li>• Answers multiple questions about topics</li> <li>• Answers questions about past events (but also remembering)</li> </ul>	<p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Describes objects not present</li> <li>• Sequences routine events</li> <li>• Reciprocates a story</li> <li>• Completes a story</li> <li>• Tells a story</li> <li>• Retells a conversation</li> <li>• Recounts a past event</li> </ul>
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### The behaviour of remembering

- Does s/he not understand or does he not remember?
  - “What did you do at school today?": “Nothing”
  - “What did you do at school today?": “Friday 18<sup>th</sup> November”
- “On Tuesday, where did you have breakfast?": “I was still in Italy. Monday I was in Bologna, then I left for Florence - in Florence, in the café opposite the Duomo!”
- The importance of teaching tacting ongoing events

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### Tact divergent control and autoclitic frames, descriptions of present objects and events

*Generating novel combinations of tacts in grammatically correct sentences*

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### Autoclitic frames and descriptions

- The function of tacting: enables listener to come into contact with the environment of the speaker
- Structure and content: Which of these two is an example of a description?
  - Boy *There are two boys*
  - Car *They are in a car*
  - Giraffe *One boy is feeding a giraffe a peanut*
  - Peanut *The giraffe has its tongue out*
  - Tongue out *The other boy is smiling*
  - Smiling

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### Autoclitic frames

- Intraverbal frames, grammatical frames, sentence 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 (Palmer, 2007)
- Note that autoclitic frames are intraverbals and that intraverbals have a formal structure, unlike other verbal operants: You can't substitute other forms. The functional feature is the structure. This fact perhaps accounts for the prevalence of structuralist approaches to verbal behaviour
- Verbs as dominant form and nouns as variable elements

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### Autoclitic acquisition

- Three important variables
  1. Intraverbal control of the autoclitic frame
  2. Discriminative control of the auditory properties of the verbal behaviour of the speakers as s/he hears him/herself speak (the speaker as his/her own listener)
  3. Automatic shaping of verbal responses to achieve parity with the verbal practices of the verbal community

*Palmer (1998)*

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### Parity, joint control, and automatic reinforcement

- Parity as the achievement of joint control between what is said and what is heard at that moment and what was previously heard and said by the verbal community
- The achievement of parity is automatically reinforced, deviations are automatically punished
- What is the best way to learn a foreign language?

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### Autoclitic frames teaching

- Echoic teaching of specific frames (e.g., "I am", "you are", "s/he is", "it's a", "they are")
- Teach to respond to questions with a full sentence (echoic and intraverbal control) that matches the structure. In most foreign language training, teachers explicitly reinforce a full sentence extension even though this is not normally expected in day to day verbal discourse, think of when you first learned Spanish:
  - Teacher: "¿Como te llamas?"
  - Student: "Yo me llamo Francesca"
  - Teacher: "¿Dónde vives?"
  - Student: "Yo vivo en Inglaterra"

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### Autoclitic frames teaching

- Echoic teaching of specific frames
- Explicitly train the fixed elements of a sentence with variable tacts: Example, four pictorial stimuli on the table:
  - Teacher: "tell me the colour"
  - Student: "the dog is black, the table is brown, the shirt is white, the car is blue"
  - Teacher: "Tell me the category"
  - Student: "A dog is an animal, a table is furniture, a shirt is clothes, a car is a vehicle"
  - Teacher: "Tell me what they have"
  - Student: "The dog has a blue collar, the table has four legs, the t-shirt has buttons, the car has four wheels"
- Description: "The dog is black, the dog is an animal, the dog has a blue collar"

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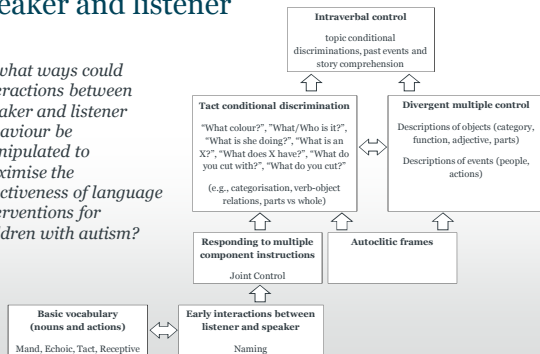
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## Manipulating interactions between speaker and listener

*In what ways could interactions between speaker and listener behaviour be manipulated to maximise the effectiveness of language interventions for children with autism?*




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## To conclude

- Skinner's (1957) account of verbal behaviour provides a parsimonious and practically applicable account of language
- More recent analyses of multiple control provide clinicians with a conceptually systematic framework for teaching complex and generalised verbal behaviour to children with autism and other disabilities
- "There is nothing so practical as good theory"

*Lewin (1951, p. 169)*

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## Further challenges

- EIBI curricula, whether organised around behavioural or structural models, face the same fundamental difficulty: How can behaviour be established for which typically reinforcing stimuli do not function as reinforcers?
- In other words, how can social behaviour be established through interaction with other people, when such interactions are not naturally reinforcing?
- Only when key aspects of human interpersonal interactions have obtained reinforcing properties can the full effectiveness of operant techniques be brought to bear on establishing generalised verbal and non-verbal behaviour among children with autism

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