The Transitive Conditioned Motivating Operation (CMO-T) and Teaching Complex Language and Social Skills to Children with Autism

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Brief History of Motivation In Behavior Analysis

• Motivation in behavior analysis has frequently been confused with the role of reinforcement as a consequence.

• The clear identification of motivation as an environmental variable as an antecedent event began with the publication of B. F. Skinner’s Behavior of Organisms (1938).

• Skinner included two chapters devoted to motivation

• He argued against the term “drive.” Skinner asserted that, “The ‘drive’ is a hypothetical state interpolated between operation and behavior and is not actually required in a descriptive system.” (p. 368)
• Moreover, he differentiated between motivational control and stimulus control by declaring that a “Drive is Not a Stimulus”.

• He relied on the operations of deprivation/satiation and presentation of aversive stimuli to describe motivation.

• Keller and Schoenfeld’s book *Principles of Psychology* (1950)
  – This book contained a chapter devoted to and titled “Motivation.” It contained several refinements to the topic of motivation (Sundberg, 2005)
    • They further developed the analysis of deprivation/satiation and response strength.
    • They provided detailed analysis of how an aversive stimulus can function as a motivational variable.

• Keller and Schoenfeld gave a name to a newly discovered behavioral variable, “The establishing operation is our independent variable, the behavior our dependent variable; the former is specifiable as to kind and degree, the latter is measured by the extent of change. The concomitant variation of the two gives rise to, and defines, the concept and problem of motivation” (Keller & Schoenfeld, 1950, p. 273).

• In the book *Verbal Behavior* (1957) Skinner provided a comprehensive analysis of how motivational variables contribute to a human’s initial acquisition of language (Sundberg, 2005).

• It is here that he introduced the concept of the mand and argued that it was separate from the other operants because of its control by motivational variables, rather than discriminative stimuli. He also described how motivational variables could be manipulated to evoke verbal behavior.
Refinement of the Concept of the EO

- Through a series of writings, Michael (1982; 1988; 1993; 2000; 2007) refined the concept and principle of the establishing operation (EO) and defined it as an “environmental event, operation, or stimulus condition that affects an organism by momentarily altering a) the reinforcing value of other events and b) and alters the frequency of behavior that has produced what is now valued.

- Michael (1993) described two (2) types of EOs: Unconditioned and Conditioned. Unconditioned EOs (UEOs) are “events or operations or stimulus conditions whose value altering effects are unlearned,” Conditioned EOs (CEOs) “value altering effects have been learned during the individual organism’s learning history.”

- Michael (1993) identified and for the first time clearly described three (3) different types of CEOs or CMOs. He named them the surrogate, the reflexive and the transitive.

- All three (3) have been implicated as behavioral variables within the applied research related to the treatment of persons with autism and developmental disabilities. (For a review of the CMO-R and CMO-T see, Carbone, 2013).

- As a result of Michael’s writings on the topic and terminological revision from “establishing operation” (EO) to “motivating operation” (MO), (Laraway,Syncerski,Michael & Poling, 2003) the concept gained recognition as an important variable in clinical practice.
The CMO-T

• The transitive conditioned motivating operation (CMO-T) appears to be most relevant to the conditioning of stimuli and events as reinforcers (Sundberg, 2004) and may play an important role in teaching language and other skills to children with autism who fail to acquire the repertoires through typical means.

• In technical terms Michael (1993) defined the CMO-T as the correlation of a stimulus with the correlation between another stimulus and a form of reinforcement.

• In practical terms, when an item is highly valuable but some additional action, item or even information is necessary to produce the valued item, the necessary item, event or information will now act as a reinforcer for any behavior that would produce it.

• Michael (1988) originally referred to this conditioning effect as blocked access or interrupted chain effect.
• In this way, CMO-T’s conditionally condition a variety of previously neutral stimuli as reinforcers and evoke responses that have been reinforced with the now conditioned stimulus.

• See the next slide for an example of the effects of a CMO-T.

**CMO-T Example**

- MO for item in locked closet
  - And
  - Key is needed to open closet
    - (Conditioned Transitive Motivating Operation)
  - “Search for key”
  - Finding the key acts as a reinforcer for searching

- Conditions the key as a reinforcer
  - AND
  - Evokes behavior that has led to finding the key, i.e. searching, asking, etc.
**Language Training**

- Skinner (1957) defined the mand as, “a verbal operant in which the response form is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (pp.35-66).

- The mand is unique because it is the only verbal operant for which a response is directly evoked by a motivating operation (Laraway, Synerski, Michael & Poling, 2003; Michael, 1988, 1993, 2007)

- The CMO-T provides an effective mechanism for language trainers in applied settings to condition typically encountered items, activities, and actions as reinforcers through blocked access or interrupted chains and consequently increase the range and sophistication of the mand repertoire of persons with developmental disabilities

<table>
<thead>
<tr>
<th>Hall and Sundberg (1987) demonstrated the benefit of using an interrupted-chain procedure to teach persons with developmental disabilities to mand for missing items needed to complete a chain of responses that ultimately resulted in access to a desirable item.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For example, one participant was taught to mand “hot water” when that item was needed to complete a soup recipe but was not readily available.</td>
</tr>
<tr>
<td>Hall and Sundberg's (1987) findings have since been replicated with diverse participants under varying conditions to teaching both mands for missing items and mands for information. (Albert, Carbone, Murray, Hagerty &amp; Sweeney-Kerwin, 2013 Arntzen &amp; Almas, 2002; Betz, Higbee, &amp; Pollard, 2010; Carroll &amp; Hesse, 1987; Endicott &amp; Higbee, 2007; Hall &amp; Sundberg, 1987; Lechago, Carr, Grow, Love, &amp; Almason, 2010; Rosales &amp; Rehfeldt, 2007; Sigafoos, Doss, &amp; Reichle, 1989; Sundberg, Loeb, Hail, &amp; Eigenheer, 2002; Ziomek &amp; Rehfeldt, 2008)</td>
</tr>
</tbody>
</table>
Clinical Example of the Application of CMO-T (Interrupted-Chain)

MO established for painting picture

BUT

No paintbrush available
(Conditioned Transitive Motivating Operation)

Conditions a paintbrush as a reinforcer

AND

Evolves the mand for the paintbrush

“Please give me a paintbrush”
Delivery of paintbrush acts as a reinforcer for the mand.

• Two recent studies replicated and extended the work of Hall and Sundberg related to teaching mands for missing items to typical children and children with autism studies (Albert, Carbone, Murray, Hagerty & Sweeney-Kerwin, 2013; Sidener, Carr, Karsten, Severston, Cornelius, & Heinicke, 2010).

• In the Albert, et al. (2012) study children with autism were taught to mand for missing items to complete enjoyable activities within the context of an interrupted-chain.

• On the following slides are examples of the interrupted-chains and the vocal mands that were taught.
Increasing the Mand Repertoire of Children With Autism Through the Use of an Interrupted Chain Procedure

Kristin M. Albert, Vincent J. Carbone, Danielle D. Murray, Margaret Hagerty, and Emily J. Sweeney-Kerwin

Carbone Clinic

ABSTRACT

Mand training is an essential component of verbal behavior training for any individual who lacks this skill. The current study replicates and extends, with some procedural differences, the work of Hall and Sundberg (1987) by using an interrupted chain procedure to teach mands for missing items to children with autism. The participants were 3 children with autism, ranging between 5 and 8 years of age, who would regularly mand for a wide variety of reinforcers when they were present but would not mand for items that were not in sight (i.e., missing items). Participants were first taught to complete 3 behavior chains. Subsequently, the chains were interrupted by removing 1 item needed to complete each chain to concentrate motivating operations (MOs) as a means of teaching mands for missing items. Following mand training incorporating vocal prompt and prompt fading procedures, all participants emitted unprompted mands for the missing items within the context of the trained chains and within the context of novel, untrained chains. After teaching mands for missing items, probes were conducted to test for untrained tac acquisition. All participants also demonstrated tac responses relative to the missing items as a result of the mand training.

Keywords: autism, establishing operation, interrupted chain, mand, motivating operation

Table 1. Descriptions of Chains Taught to Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Material</th>
<th>Tact</th>
<th>Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victor</td>
<td>Shapes out from paper, Glue, Glitter</td>
<td>Pick up paper shapes, Put glue on each shape, Arrange shapes into a picture, Put glitter on top of glitter</td>
<td></td>
</tr>
<tr>
<td>Painting a picture</td>
<td>Smocks, Paper, Clip, Paintbrush, Water, Paint, Glue</td>
<td>Put on smocks, Hand clip to instructor (to clip paper onto tooth), Pick up paintbrush, Dip paintbrush in water, Dip paintbrush in paint, Apply paintbrush to paper, Repeat painting steps several times</td>
<td></td>
</tr>
<tr>
<td>Making a sandwich</td>
<td>Bread, Smocks, Plate, Peanut butter, Knife</td>
<td>Open bag of bread, Put bread in toaster, Push down toaster button, Take bread out of toaster (after bread has popped back out), Put bread on plate, Open peanut butter, Put peanut butter on bread, Spread peanut butter on bread, Eat sandwich</td>
<td></td>
</tr>
<tr>
<td>Nathaniel</td>
<td>Porcelain CD player, CD, Headphones</td>
<td>Open CD player, Put CD in CD player, Put headphones on, Press play button, Listen to music</td>
<td></td>
</tr>
<tr>
<td>Science project</td>
<td>Plastic container, Bottle of food coloring, Two bottles of food coloring</td>
<td>Pour water into container, Drop food coloring into container, Pick up spoon, Mix liquid with spoon</td>
<td></td>
</tr>
<tr>
<td>Painting a picture</td>
<td>Smocks, Paper, Paintbrush, Water, Paint, Paint</td>
<td>Put on smocks, Put paper on mand, Pick up paintbrush, Dip paintbrush in water, Dip paintbrush in paint, Apply paintbrush to paper, Repeat painting steps several times</td>
<td></td>
</tr>
<tr>
<td>Carla</td>
<td>Smocks, Paper, Clip, Paintbrush, Water, Paint, Glue</td>
<td>Put on smocks, Hand clip to instructor (to clip paper onto tooth), Pick up paintbrush, Dip paintbrush in water, Dip paintbrush in paint, Apply paintbrush to paper, Repeat painting steps several times</td>
<td></td>
</tr>
<tr>
<td>Making an art project</td>
<td>Paper, Three crayons, Glue stick, Glitter</td>
<td>Color picture, Put glue on paper, Sprinkle glitter on top of glitter</td>
<td></td>
</tr>
<tr>
<td>Making juice</td>
<td>Clip, Powder to make juice, Sponge, Two ice cubes, Measuring cups containing water</td>
<td>Scoop powder into cup, Pour water from measuring cup into cup, Mix solution in cup using spoon, Put ice cubes into cup, Drink juice</td>
<td></td>
</tr>
</tbody>
</table>

Note: Materials removed to teach mands for missing items are shown in boldface.
Figure 1. The occurrence of mands for missing items recorded by controlling variable (MO, prompted, no response) across baseline and treatment conditions.

APPLICATION OF THE CMO-T

EXPOSURE

MO FOR WATER

PREVIOUS EXPOSURE TO THE VALUE OF CUP, OPENING THE BOTTLE AND POURING WHEN CONSUMING WATER

DRINKING WATER

SUBSEQUENTLY, MANDS EVOKED

CMO-T

MO FOR WATER

BLOCKED ACCESS TO CUP, OPEN BOTTLE & POURING

EVOKE MANDS FOR “CUP, OPEN WATER & POUR”

James Video
Skinner (1957) states “A question is a mand which specifies verbal action”.

- In other words, there are stimulus conditions under which a verbal response (information) has been **established** as a reinforcer and therefore **evokes** a question (mand), the answer to which in the past has produced some form of reinforcement (e.g., more effective action by the asker).
• Sundberg, Loeb, Hale, and Eigenheer (2002) demonstrated that mands for information regarding location (where) and specific information about a person (who) could be taught to children with autism by manipulating motivating operations.

• Using the analysis of the CMO-T, where access to a reinforcer is blocked or interrupted, you can contrive conditions under which verbal information is conditionally conditioned as a reinforcer and will evoke behavior that has led to information in the past.

• For example, if a child would like to play with a certain toy and a teacher says "sure, lets play with it" but the location of the toy is unknown to the child then INFORMATION about the location of the toy is now valuable and the teacher can now teach the child to say “where” as a mand for information.

• The CMO-T has also been used to teach mands for information to kids with autism (Betz, Higbee, & Pollard, 2010; Endicott & Higbee, 2007; Lechago, Carr, Grow, Love, & Almason, 2010)).

General Teaching Procedures:

• Contrive motivation for information (e.g., hide an item that the learner needs, interrupt a pre-established routine).

• As soon as the learner declares motivation for “who,” “what,” “which,” “where,” “why,” “how,” or “can/does/do/will” information (e.g., looks for the missing item), prompt the mand by saying, “Ask me, ‘mand for information?’” (e.g., “Ask me, ‘Where is the pencil?’”)

• Immediately following the learner echoing the prompted mand, transfer stimulus control by recontriving motivation and implementing a 3-second time delay to wait for the learner to repeat the mand for information.

• After the learner repeats the mand for information, reinforce the mand by delivering the INFORMATION requested.
Teach the following:

**What:** when the names of people, places, things, and actions would be reinforcing information

**Where:** when location would be reinforcing information

**Who:** when the name of a specific person would be reinforcing

**Whose:** when the name of a person who possesses something would be reinforcing

**When:** when information regarding time would be reinforcing

**Why:** when information for the causes of events would be reinforcing

**How:** when information for instructions and the functions of things would be reinforcing

Adapted from Sundberg (2002)

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Let's now look at a video example of manding for information. Notice how the instructor must prompt some forms of the appropriate mands for information (questions) when the MO is strong but when the learner does not have the form of the response in his repertoire.

Kellen Manding Info

# 4 Diego
TYLER MANDING FOR INFORMATION

- Tyler’s repertoire of manding for information is strong and therefore requires no prompting. The contrived MOs evoke all of the appropriate mands.

- Note how Jimmy contrives the motivation to increase the value of information as a reinforcer for Tyler.

**TYLER VIDEO**

Kellen Manding Info

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**Sample Lesson Plan**

<table>
<thead>
<tr>
<th>Contrived MO (MOTIVATION)</th>
<th>What Now Becomes a Reinforcer?</th>
<th>What should you teach the learner to say?</th>
<th>Teacher’s Response (Reinforcer)</th>
<th>Data Recording of Prompted and Unprompted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guess what?</td>
<td>Info about what they are going to do</td>
<td>What?</td>
<td>I want to play with something...</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>I want to play with something...</td>
<td>Info about what Jimmy wants to play with</td>
<td>What do you want to play with?</td>
<td>I want to play with the trains</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>(Goes to the trains) Not right now though...</td>
<td>Info about when Tyler can play with the trains</td>
<td>When?</td>
<td>After you give me a high five</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>We’ve got to turn it on...</td>
<td>Info about how to turn it on</td>
<td>How do we turn it on?</td>
<td>We have to press that button</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>(Button doesn’t work) I don’t know how to turn it on, but I know someone who does</td>
<td>Info about who knows how to turn on the trains</td>
<td>Who?</td>
<td>Danielle</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>Danielle knows how to turn it on</td>
<td>Info from Danielle about how to turn on the trains</td>
<td>How do we turn it on?</td>
<td>You press the lever</td>
<td>Prompted Spontaneous Novel</td>
</tr>
</tbody>
</table>
# Sample Lesson Plan

## TYLER

### Contrived MO (MOTIVATION)

<table>
<thead>
<tr>
<th>What Now Becomes a Reinforcer?</th>
<th>What should you teach the learner to say?</th>
<th>Teacher's Response (Reinforcer)</th>
<th>Data Recording of Prompted and Unprompted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidentally turn the train off</td>
<td>Why did you do that?</td>
<td>It was an accident, but I want to play another game</td>
<td>Prompted Stonspontaneous Novel</td>
</tr>
<tr>
<td>I want to play another game...</td>
<td>What game?</td>
<td>Perfection</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>Lets go get Perfection</td>
<td>Where’s Perfection?</td>
<td>I don’t know where it is, but I know someone who knows</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>I know someone who knows where Perfection is</td>
<td>Who? (Knows where Perfection is)</td>
<td>Kelly</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>Kelly knows where Perfection is</td>
<td>Where’s Perfection?</td>
<td>In the teacher’s room</td>
<td>Prompted Spontaneous Novel</td>
</tr>
</tbody>
</table>

### Sample Lesson Plan

## TYLER

### Contrived MO (MOTIVATION)

<table>
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<th>What Now Becomes a Reinforcer?</th>
<th>What should you teach the learner to say?</th>
<th>Teacher's Response (Reinforcer)</th>
<th>Data Recording of Prompted and Unprompted</th>
</tr>
</thead>
<tbody>
<tr>
<td>The closet is locked and the key is missing</td>
<td>Where’s the key?</td>
<td>I don’t know where it is, but I know someone who knows</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>I know someone who knows where the key is...</td>
<td>Who?</td>
<td>Danielle</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>Danielle knows where the key is</td>
<td>Where’s the key?</td>
<td>It is on top of the bookshelf</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>You need to open the door with one of the keys</td>
<td>Which key?</td>
<td>This key</td>
<td>Prompted Spontaneous Novel</td>
</tr>
<tr>
<td>Difficulty opening the door with the key</td>
<td>Where are we going to play?</td>
<td>At the table</td>
<td>Prompted Spontaneous Novel</td>
</tr>
</tbody>
</table>
The CMO-T and Social Skills

• Recently researchers and practitioners have acknowledged the value of the MO, and particularly the CMO-T, to teach social skills to children with autism (Carbone, O’Brien, Sweeney-Kerwin, & Albert, 2013; Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004; Holth, 2011; Isaksen & Holth, 2009; Taylor & Hoch, 2008).

• Behavior analytic researchers have suggested that the discrepancy in the acquisition of social skills by children with autism compared to their typical peers may result from the failure of social attention to act as a reinforcer for these children’s behavior, (Carbone et al., 2013; Dube et al., 2004; Holth, 2011; Isaksen & Holth, 2009).

• Therefore, methods that successfully condition social attention as a reinforcer may result in important gains in the area of teaching social skills to children with autism.

• Dube, et al. (2004) implicated the CMO-T as an important variable in conditioning the reactions of adults as reinforcers for bids for joint attention in children with autism.

• More recently, Isaksen and Holth (2009) demonstrated the conditioning of social attention to teach joint attention through manipulation of a relevant CMO-T.

• Carbone et al. (2013), implicated the CMO-T as a variable in conditioning the sight of another’s eye as a reinforcer for eye contact in a child with autism while manding.
Behavioral Analysis of Eye Contact during Language Training

Following frequent exposure to the variables that control the mand response the following behavioral chain occurs:

- **Child Wants Something – Needs Someone Else to Deliver it**
- **Conditioned Transitive Motivating Operation**
- **Conditions the Sight of the Face and Eyes of a Listener as a Reinforcer**
- **Evokes Looking for Face and Eyes of a Listener**
- **Reinforcer for the Looking Response**
- **$S^P$ for the Mand**

Child Mands

- **Delivery of the Item Acts as Reinforcer For Mand**

*Italicized Words = Stimuli*  
**Bold Words = Behavioral Variables**  
**Standard Print Words = Effects of Behavioral Variables**

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**Teaching Eye Contact to Children with Autism: A Conceptual Analysis and Single Case Study**

Vincent J. Carbone  
Leigh O’Brien  
Emily J. Sweeney-Kerwin  
Kristin M. Albert  
*Carbone Clinic*

Abstract

Eye contact occurs very early in development and serves many functions for the young child. It has been implicated in the development of social, cognitive, and language skills. A substantial number of children with autism fail to develop this important skill and therefore experimenters with both developmental and behavior analytic perspectives have researched methods to teach eye contact. However, only a few researchers have recently attempted to condition the response of the communication partner as a reinforcer for social behavior and thereby arrange the conditions under which typical children develop social responses. The purpose of this case study was to extend the analysis of typical development of social skills to the teaching of eye contact as a language pragmatic skill to a child with autism. Data from a single case study of a child with autism are provided.

Keywords: Eye Contact, Social Skills, Mands, Extinction, Autism, Motivating Operations
• Clinically, we have extended this analysis to the teaching of social skills to young children with autism.

• The diagram on the next page provides an analysis of the sources of control for the behavior of inviting others to play as social skill for children with autism.

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**Behavioral Analysis of Early Social Skills Training**

Following frequent exposure to the variables that control the response the following behavioral chain occurs:

- **Sylvia Wants to Bounce.**
  - Meghan Improves Bouncing
  - But
  - Meghan Not on Trampoline
  - Conditioned Transitive Motivating Operation

- Conditions the Sight of Meghan as a Reinforcer
  - Evokes Looking For Meghan

- **Sight of Meghan** is a Reinforcer for the Looking Response
  - + S° for the Mand to Join Her on the Trampoline

- **Mand Response is Evoked**

- **Sylvia Mands**
  - The approach and Jumping on the Trampoline
  - Acts as Reinforcer For Mand

*Italicized Words = Stimuli*  
*Bold Words = Behavioral Variables*  
*Standard Print Words = Effects of Behavioral Variables*
The identification of the CMO-T by Michael, (1993) has provide clinicians with an important tool to teach language and social skills to persons who do not acquire it typically.

Further research on its application to the acquisition of social skills offers substantial promise for the treatment of persons with autism and related disabilities.

THE END

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References


