

Emergence of Untaught Mand or Tacts of Novel Adjective-Object Pairs as a Function of Instructional History

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Skinner (1957) suggested that using a response form such as the vocal form for "milk" as a mand does not result in the use of "milk" as a tact without certain experiences or direct instruction. Findings from several studies have affirmed Skinner's theory in that teaching young or developmentally delayed children to use a topography or form of verbal behavior as one verbal operant (e.g., mand or tact) did not result in the children using that form as the other verbal operant (i.e., mand or tact) without direct instruction (Hall & Sundberg, 1987; Lamarre & Holland, 1985; Ross & Greer, 2003; Tsiouri & Greer, 2003; Williams & Greer, 1993). Similarly, learning to use the adjective "large" as a tact (i.e., that's a large milk) did not result in the use of "large" as a mand (i.e., may I have the "large" milk?) (Twyman, 1996). Thus, much of the current evidence suggests that mands and tacts are independent in the early stages of the development of communicative functions.

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Nevertheless, most individuals do, at some point in the evolution of their repertoires of verbal behavior, demonstrate the emission of untaught functions after learning a form in a single function (Skinner, 1957, p. 191). For example Hall and Sundberg (1987) found that mands and tacts for the same topographies were initially independent, but after 2-4 pairs of tacts and mands for the same objects were established, untaught mands emerged without direct instruction. Sigafos, Doss, Reichle (1989, 1990) also found that untaught verbal operants emerged with adults with diagnoses of severe mental retardation. In both the Hall and Sundberg (1987) and the Sigafos et al. (1989) study, the untaught operants emerged after one or more mands or tacts had been taught. To date, no studies have identified environmental variables that provide an explanation of how individuals come to emit untaught functions for forms taught initially as mands or tacts. Sigafos et al. suggested that perhaps untaught emergences or "transfer between the response classes of tacts and mands might be facilitated by providing one or more exemplars in each respective repertoire" (Sigafos et al., p. 175).

Verbal behavior theory, or indeed any other account that attributes language usage to experience, has been criticized both within the field (Hayes, Barnes-Holmes, & Roche, 2001) and outside (Chomsky, 1959) for not providing an explanation for what has been characterized as "generative" verbal behavior (i.e., the use of "language" in novel or un instructed functions). Barnes-Holmes et al. (2001) in their Relational Frame Theory suggested that until certain functions emerge without direct instruction, behavior is not truly verbal. The relational frame theorists propose that one environmental source for the emission of instances of generative verbal behavior may be multiple exemplar experiences. Indeed, there is a literature on multiple exemplar instruction (MEI) showing its efficacy in producing abstractions from learning a subset of control of stimuli in a specified class of stimuli to novel stimuli belonging to the same class (Becker, 1992). However, MEI has not been studied in the formation of abstract verbal behavior.

The existing evidence suggests that when a language topography or form is learned as a mand, the form is under the control of deprivation of the item and the response specifies its reinforcer (Skinner, 1957). The item mandated

may or may not be present when the item is requested, and in its pure form there is no verbal antecedent controlling the form of the response. For example, Skinner's first example of the mand in his book described an individual asking for bread to be passed, and in this case the item was present. In contrast, when the form functions as a tact, it is under the control of the presence of the stimulus and generalized reinforcement and the item or stimulus is present. Although Skinner (1957) did not specify deprivation conditions associated with the tact, one recent set of experiments found that tact functions were under the control of brief deprivation of a generalized reinforcer (see Tsiouri & Greer, 2003, for research on the isolation of the establishing operation for a tact). That is, first instances of tacts were induced by deprivation of generalized reinforcers, when combined with a rapid imitation procedure in echoic to tact instruction. Thus, even though the form or topography of a response used in a mand or tact is the same, they are different operants because of different establishing operations and consequences that separate the two functions.

When a form learned as one operant, either mand or a tact, is emitted as the other operant without direct instruction, we might characterize the new repertoire as abstraction of forms across mands and tacts. One possible explanation for the emergence of this abstraction is that the conditions preceding the use of the form (in this case establishing operations) occasions the use of forms trained in a single function to evoke the other function, when the relevant establishing operations are present and the individual has had an instructional history that produces the establishing operation control over novel production of forms in a function not directly taught. The identification of variables and instructional tactics for the generative or novel use of untaught verbal operants would prove useful in both the teaching of verbal behavior and the identification of possible sources for generative verbal behavior in the basic sciences.

Multiple exemplar instruction has been successful in teaching other types of abstraction in some of the research literature and in applications to curriculum design. Engelmann and Carnine (1982), drawing on discrimination research, used multiple exemplar instruction, or what they characterized as teaching the general case, to teach concepts that were opera-

tionally task analyzed as abstractions. That is, in their curricular design, a subset of exemplars of a class (e.g., textual responses to vowel and consonant blends) is taught using multiple exemplar instruction such that when students encountered untaught combinations they accurately respond to the new combinations without direct instruction. In another example, concepts or abstraction such as the category of mammals is taught by teaching the essential characteristics of a subset of examples of mammals. The instructional sequence rotates positive exemplars in which the irrelevant characteristics are varied (i.e., large and small mammals, two- and four- legged mammals) with rotated non-exemplars (i.e., not mammals) until students identify exemplars as mammals or not mammals. The goal of the procedure is to provide instructional experiences to students such that when they encounter an unfamiliar animal they can categorize the animal belonging or not belonging to the category of mammal. When the individual has learned the general case or the essential stimulus control untaught responses emerge to novel stimuli.

Researchers have reported functional relations between MEI and classification of novel complex auditory stimuli by secondary students (Greer & Lundquist, 1976), generalized imitation with young children (Stokes & Baer, 1977), and the development of novel categorization repertoires (Fields & Reeve, 2001). In what appears to be one of the earliest applications of MEI to verbal behavior, Greer, Yuan, and Gautreaux (2003), found that spelling in either dictation or intraverbal functions was independent for eight children with autism (See Skinner, 1957, p. 190). However, after they received multiple exemplar instruction to mastery for a subset of words across dictation and intraverbal responding, they emitted untaught responses to words learned as a single response. These findings suggested the possibility that MEI might lead to the production of untaught mands or untaught tacts with individuals for whom the two functions were initially independent.

METHOD

Participants

Four students, Students 1, 2, 3, and 4, participated in the experiment. Student 1 was a 6-year-old boy. He was diagnosed by a medical

doctor using the Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988), on which he achieved an overall score that placed him in the moderate to severe range for an autism spectrum disorder. He had been in his current classroom for 2 years in which he was taught to follow one-step teacher directions, read on a first grade level, and perform single-digit addition. At entry to the classroom, he was not vocal nor did he emit other topographies of verbal behavior (e.g., sign language). He was taught to vocally mand using the autoclitic frame "I want a ___ please" and tact using the autoclitic frame "It's a ___." He had not received instruction on any other autoclitic frames and emitted no mands or tacts that had not been directly trained.

Student 2, a 6-year-old female, also achieved an overall score on the same test that placed her in the moderate to severe range for an autism spectrum disorder. She had been in her current classroom for three years. She could follow one-step teacher directions and could textually respond to approximately 50 simple words. Upon entering the study, she used vocal verbal responses and could mand using the autoclitic frame "I want a ___ please" and could tact using single words without autoclitic frames. She was taught to tact using the frames "It's a ___," and "That's a ___." but had no further autoclitic frames in her repertoire. She did not emit any untaught mands or tacts.

Student 3 was a 6-year-old female with diagnoses of speech impairment and mental retardation. She had a full scale Stanford Binet IQ of 64. She had been in her current classroom for one year and had no prior formal schooling. Student 3 was taught to follow one-step teacher directions and emit match-to-sample responses. She was taught to vocally mand using the autoclitic frame "I want ___" and to tact using single words without autoclitic frames prior to the experiment. No mands or tacts occurred without direct training.

Student 4 was a 9-year-old male with a diagnosis of mental retardation and had a full score Stanford Binet IQ of 68. He had been in his current classroom for two years. During that time he learned to follow one-step directions, textually respond to approximately 100 sight words and perform single digit addition. Upon entering the classroom he could vocally mand and tact in short phrases. He was taught to vocally mand using the autoclitic frame "I want a

___ please” and tact using the frame “It’s a ___.” He had no prior instruction on any further autoclitic frames and did not emit any untaught mands or tacts.

Setting

The experiment took place in a self-contained special education classroom in a public school that offered countywide specialized services. There were eight students and five staff members present in the classroom throughout all sessions of the experiment. The classroom used an applied behavior analysis model that required data collection for all responses to all instruction, and data collection was a daily part of instructional procedures. Data were collected while other students were also receiving individual instructional presentations. The experimenter sat across from the student at a child-sized table during probes and instructional presentations, while the other students in the class received individual instruction or played in the play area in the classroom.

Response Definitions

The dependent variable consisted of correct or incorrect responses to either untaught sets of adjective-object pairs under mand or tact conditions, with respect to different phases of the experimental design. Correct mands were defined as the student’s vocal verbal response “I want the ___.” in which an adjective together with the name for the object was required, for example “I want the large cup”) under conditions of brief deprivation. Incorrect mands were defined as those that did not include an autoclitic frame or did not combine an adjective with the name of the manded object. The experimenter provided no verbal antecedent during the mand condition. Correct tacts were defined as the student’s spoken response “It’s a ___” (i.e., “It’s a large cup”) which was followed by a generalized reinforcer. Incorrect tacts were defined as those that did not include an autoclitic frame or did not combine an adjective with the name of the tacted object. The antecedent for all tact conditions was the experimenter pointing to the item to be tacted; no vocal antecedent was presented. Three sets of three adjective-object pairs were taught. The target adjectives in Set 1 were small, medium, and large; in Set 2 were first, second, and last;

and in Set 3 were left, middle, and right. The three objects paired with those adjectives were cup, bowl, and box. See Tables 1 and 2 for the specific adjective-object pairs used and their assignment to Sets and experimental conditions.

Data Collection

The experimenter recorded student responses using paper and pencil after each probe trial or learn unit (See Greer, & McDonough, 1999, for a review of the research on the learn unit). The dependent variable was untaught verbal operants as measured by responses to probe conditions. Probe trials did not include any consequences from the instructor (i.e., no reinforcement or corrections) and were done to determine responses to untaught relations.

Instruction in the baseline and multiple-exemplar phases consisted of learn unit presentations. All instruction included all of the components of instruction associated with the learn unit (Albers & Greer, 1991; Emurian Hu, Wang, & Durham, 2000; Greer & McDonough, 1999; Ingham & Greer, 1992; Selinske, Greer, & Lodhi, 1991). Learn units consist of presentations of instructional antecedents to which the student attends, followed by an opportunity for the student to respond, followed in turn by an instructional consequence from a teacher or teaching device. Correct responses receive a reinforcement operation using consequences that have functioned as reinforcement according to the student’s instructional history. Incorrect responses by students are followed by the instructor or computer providing the correct response that the student must, in turn, duplicate in while attending to the instructional antecedent. Instructional presentations that lack any of the above components are not learn units.

The learn units received by the students in this study included the reinforcement of correct mands only with the item manded (no verbal praise) and correct tacts with generalized reinforcers such as token chips or stickers. Incorrect responses for both mands and tacts consisted of the instructor providing an echoic prompt for the correct response. The student was then immediately required to repeat the response under the relevant conditions for each verbal function, but not reinforced. While the term “discrete trial” is often used in the litera-

ture to describe an instructional or training presentation, discrete trials may or may not be learn units. For example probe trials without consequences are also discrete trials. Skinner used the term “instructional frame” to characterize components of programmed instruction and did not use the term “discrete trial.” Skinner’s instructional frames are, in fact, learn units (See Emurian et al., 2000, for experiments using computerized presentations of learn units as programmed instruction). Finally, the term “learn unit” constitutes an empirically derived term for operations shown to predict learning, whereas discrete trials that do not contain all of the components of the learn unit do not predict learning.

Correct responses were recorded as pluses (+) and incorrect responses or no responses were recorded as minuses (-). Sessions consisted of fifteen probe trials for the dependent variable (five opportunities for each of the three target adjective-object pairs) or 15 learn units (five opportunities for each of the three target adjective-object pairs) for the baseline instruction and the multiple exemplar instruction that served as the independent variable.

Design. The design was a time lagged multiple probe design across participants with pre-experimental probes for adjective-object pairs under mand and tact conditions prior to baseline training. The dependent variable was untaught verbal operants (e.g., if mands were taught, the probes were for tacts, if tacts were taught, then the probes were for mands) as measured in the probe sessions. The independent variable was multiple exemplar instruction across mand and tact conditions for a subset of adjective-object pairs taught until the students met the criterion for mastery. The sequence was time lagged across participants to control for instructional history, according to multiple baseline logic. Sets of adjective-object pairs and tact and mand conditions were counterbalanced across participants and phases to control for differences in the order that different verbal operants were trained and the particular adjective-object pairs used.

The sequence of the design consisted of 7 steps (see Tables 1 and 2). They were: (a) pre experimental probes, (b) instruction to mastery of a single verbal operant for a set of adjective-object pairs, (c) probes for the untaught verbal operant for the prior set of adjective object pairs, (d) multiple exemplar instruction

across mands and tacts of a second set of adjective-object pairs to mastery (these were not used again), (e) probes of the initial set of adjective-object pairs for the untaught function (repeat of the initial probes), (f) instruction to mastery of a novel and third set of adjective-object pairs for a single verbal operant, and (g) probes for the untaught verbal operant with the last set of adjective-object pairs. These steps are described in detail in the following section.

Pre experimental probe conditions. The experimenter presented each of the three sets of three adjective-object pairs separately under both mand and tact conditions in probe trials prior to the baseline. Each probe session consisted of 15 trials for each of the verbal operants. There were 15 consecutive trials (5 for Sets 1, 2, and 3 adjective-object pairs) for both tacts and mands. Set 1 adjectives, *small, medium and large* modified the object cup, Set 2, *first, second, and last* modified the object box, and Set 3, *right, middle, and left* modified the object bowl. An establishing operation in the form of a preferred edible that was placed in each item was used to create the mand opportunity.

Students were given an opportunity to choose an edible prior to each mand probe trial from their preferred items that were made available only for the experiment on days the experiment was conducted. These preferred items were not available to the students at other times of the day. The experimenter placed an array of preferred edibles (pretzels, crackers, small candy) on the desk and the students were asked which item they would like. If the student did not vocally or gesturally indicate wanting any of the items on the tray of edibles, the session was terminated until later in the day so that a state of deprivation could be established. When the child chose an item, the chosen edible was removed from the tray as the child observed. The item was then placed in a cup, box, or bowl, depending on which set of objects was being taught. This cup, box, or bowl was then placed on the child’s desk along with two other containers of its type. For example, if the edible was put in the small cup, the small cup was then placed next to the medium and large cup in front of the child on the child’s desk. The student was given 5 seconds to mand for the correct object that contained his or her chosen edible reinforcer. If no response was emitted, the reinforcer tray and the instructional mate-

Table 1
*Sequence of Baseline and Multiple Exemplar Instructional Conditions
 and Counterbalance Scheme for Sets of Adjective-Object Pairs*

Students	Training Conditions					
	Baseline Instruction		Multiple Exemplar Instruction (MEI)		Post MEI Instruction	
	Mand	Tact	Mand	Tact	Mand	Tact
1	Set 1 Verbal Response Forms: Small cup Medium cup Large cup		Set 2 Verbal Response Forms: First box Second box Last box	Set 2 Verbal Response Forms: First box Second box Last box		Set 3 Verbal Response Forms: Right bowl Middle bowl Left bowl
2		Set 1 Verbal Response Forms: Small cup Medium cup Large cup	Set 2 Verbal Response Forms: First box Second box Last box	Set 2 Verbal Response Forms: First box Second box Last box	Set 3 Verbal Response Forms: Right bowl Middle bowl Left bowl	
3	Set 2 Verbal Response Forms: First box Second box Last box		Set 1 Verbal Response Forms: Small cup Medium cup Large cup	Set 1 Verbal Response Forms: Small cup Medium cup Large cup		Set 3 Verbal Response Forms: Right bowl Middle bowl Left bowl
4		Set 2 Verbal Response Forms: First box Second box Last box	Set 1 Verbal Response Forms: Small cup Medium cup Large cup	Set 1 Verbal Response Forms: Small cup Medium cup Large cup	Set 3 Verbal Response Forms: Right bowl Middle bowl Left bowl	

rials were removed from the desk for 5-10 seconds and the trial was then repeated. All of the students had previously mastered mands for other preferred items without verbal antecedents.

Tact conditions consisted of the experimenter

placing three items on the desk and pointing to the object to be tacted. No vocal antecedent was given. The students had an instructional history of emitting tact responses to items without verbal antecedents as part of a curriculum designed to teach "spontaneous verbal behav-

ior.” None of the students emitted any correct responses as either mands or tacts to any of the three sets of adjective-object pairs presented during pre-experimental probe trials.

Baseline instruction and probes. Following the pre-experimental probes, students were taught either the mand or tact for the first or second set of adjective-object response forms (see Tables 1 & 2). As in pre-experimental probe conditions, mands were taught using a preferred edible embedded in the item to be manded. Prior to the mand learn unit, the student was presented with a tray of preferred edibles (available at no other time in the day as was the case in the probe trials). If the student gesturally or vocally indicated that an edible was wanted, it was immediately placed in the target item (either cup or box). The student was then given 5 seconds to mand for the item. If a correct mand for the item occurred, using the correct adjective-object, the item was immediately delivered and a plus was recorded on the data sheet. If the mand was incomplete (i.e., not in a sentence using the correct autoclitic frame), the experimenter provided an echoic correction procedure in which the student was required to echo the correct response but was not reinforced. If no response occurred, the items were placed out of sight and re-presented later in the day so that a state of deprivation could be established.

Learn units for tacts consisted of the experimenter placing three objects on the desk and pointing to the object to be tacted. No vocal antecedent was given. If the tact response was correct, in a complete sentence using the correct adjective-object, the student was praised and provided with a generalized reinforcer (token chips or stickers). If the tact response was incomplete or incorrect, the experimenter provided an echoic correction procedure and the student was required to echo the word but was not reinforced.

Student 1 was taught mands for Set 1 adjective-object pairs (probed after instruction for tacts had been completed) and in a counterbalanced fashion, Student 2 was taught tacts for Set 1 adjective-object pairs (probed after the completion of mand instruction). Student 3 was taught mands for Set 2 adjective-object pairs (probed after tact instruction) and Student 4 was taught tacts for Set 2 adjective-object pairs (probed after mand instruction) (see Figure 1). The mastery criterion for each student was

100% correct responding for one 15-learn unit session. Following baseline instruction and probes for the untaught function, multiple exemplar instruction was begun on a new set of adjective-object pairs for each student.

Multiple exemplar instruction. Following the baseline instruction and probes for the untaught verbal operant, students were taught either Set 1 or Set 2 adjective-object pairs (sets the students received only for the MEI) using multiple exemplar instruction (see Tables 1 and 2). Students 1 and 2 were taught both mand and tacts for Set 2 adjective-object pairs and Students 3 and 4 were taught both mands and tacts for Set 1 adjective-object pairs.

Multiple exemplar instruction consisted of learn unit sessions that rotated opportunities for mands and tacts. That is, students received a learn unit under mand conditions for one adjective-object pair in a given set, and next they received a learn unit under tact conditions for the same adjective-object pair. This continued until each of the adjective-object pairs for the set had received five rotated learn units, with the set of 5 receiving five presentations. Data for each verbal operant were recorded in separate columns and blocked by type of verbal operant for the graphs. Criterion was 100% correct responding for each verbal operant for one session (block of 15 verbal operant conditions for each verbal operant for the 5 adjective-object pairs in the set). In cases where criterion was met on one verbal operant prior to the other, the mastered function continued to be rotated with the non-mastered verbal operant as an antecedent condition to the response not yet mastered, until criterion was met for both operants. The student's responses for the mastered operant were no longer recorded. (Had any of the students made an error in the mastered operant after they had met mastery, the responses would have been corrected and repeated again before presenting the next operant for the same adjective-object pair.) For example, if the student met criterion on the mand before he or she met criterion for the tact, mastered mand conditions continued to be presented before tact conditions until the student met the criterion for the tact. This was done in order to maintain the multiple exemplar contrast in order to teach the establishing operation as the abstraction or general case for controlling the emission of functions.

Post multiple exemplar instruction. Follow-

Table 2
Sequence of Probes for Untaught Verbal Operants and Counterbalance Scheme for the Three Sets of Adjective Object Pairs

Students	Pre-Experimental Probes		Baseline Training and Probes		Multiple Exemplar Instruction (MEI) and Probes		Post MEI Instruction and Probes	
	Tact Probes	Mand Probes	Mand Training	Tact Probes	Alternating Mand and Tact Training	Tact Probes	Tact Training	Mand Probes
1	Set 1 Set 2 Set 3	Set 1 Set 2 Set 3	Set 1	Set 1	Set 2	Set 1	Set 3	Set 3
	Tact Probes	Mand Probes	Mand Training	Tact Probes	Alternating Mand and Tact Training	Tact Probes	Tact Training	Mand Probes
2	Set 1 Set 2 Set 3	Set 1 Set 2 Set 3	Set 1	Set 1	Set 2	Set 1	Set 3	Set 3
	Tact Probes	Mand Probes	Tact Training	Mand Probes	Alternating Mand and Tact Training	Mand Probes	Mand Training	Tact Probes
3	Set 1 Set 2 Set 3	Set 1 Set 2 Set 3	Set 2	Set 2	Set 1	Set 2	Set 3	Set 3
	Tact Probes	Mand Probes	Mand Training	Tact Probes	Alternating Mand and Tact Training	Tact Probes	Tact Training	Mand Probes
4	Set 1 Set 2 Set 3	Set 1 Set 2 Set 3	Set 2	Set 2	Set 1	Set 2	Set 3	Set 3
	Tact Probes	Mand Probes	Tact Training	Mand Probes	Alternating Mand and Tact Training	Mand Probes	Mand Training	Tact Probes

ing achievement of criteria for both the mand and tact verbal operants, using multiple exemplar instruction for the second set of adjective-object pairs assigned to each student, the experimenter again conducted probe trials for the untaught verbal operants that had not emerged in the probes following the baseline instruc-

tion. Following these probes, a third set of three adjective-object pairs was taught under either mand or tact conditions. Students 1 and 3 were taught the tact and probed for the untaught mand, and Students 2 and 4 were taught the mand and probed for the untaught tact.

Interobserver agreement. The percentage of

Figure 1

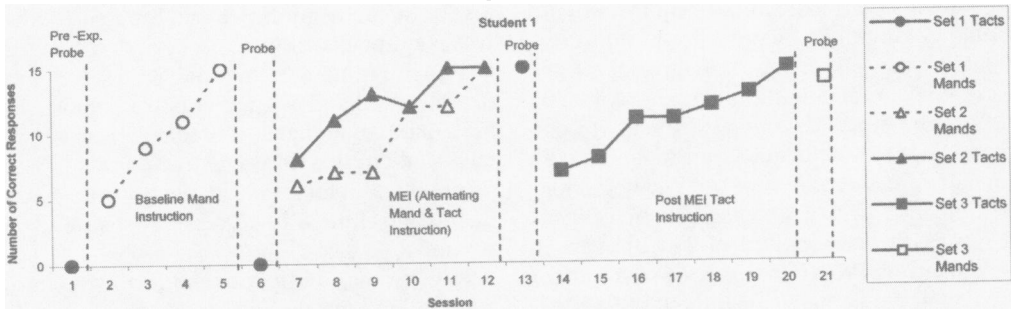


Figure 2

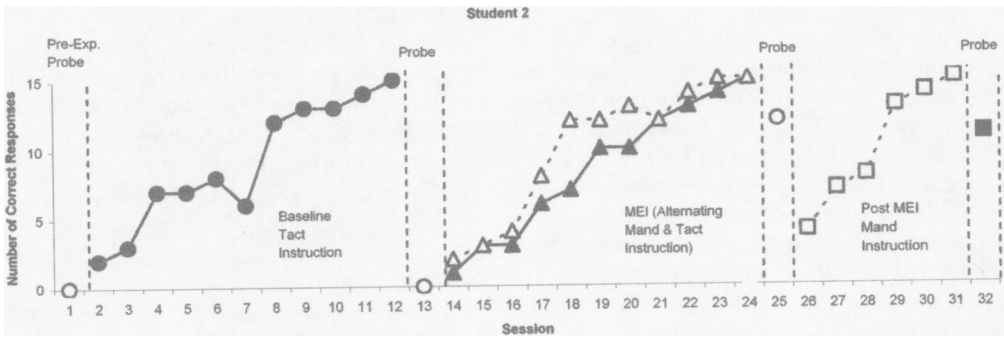


Figure 3

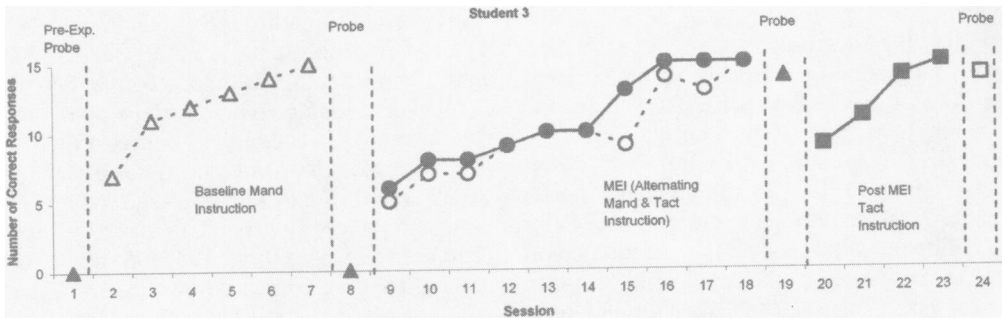
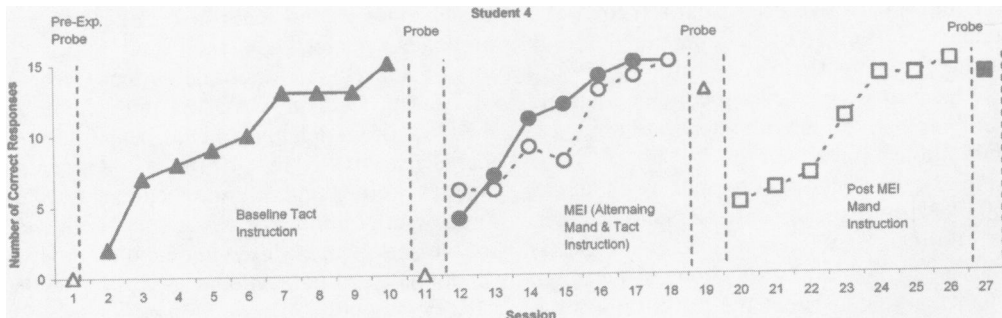


Figure 4



interobserver agreement was calculated for both the instructional and probe phases by dividing the number of point-by-point agreements by the total number of agreements and disagreements and multiplying this number by 100%. The percentage of agreement was calculated in 55% of sessions for Student 1, with a mean agreement of 100%; 65% of sessions for Student 2, with a mean agreement of 99%; 65% of sessions for Student 3, with a mean agreement of 100%; and 61% of sessions for Student 4, with a mean agreement of 98%.

RESULTS

Figure 1 shows the students' responses to untaught verbal operants (phases, 1, 3, and 5), responses to learn unit instruction in single operants (phases 2 and 6), and responses to MEI (phase 4). The students' responses to pre-experimental probes showed that none of the four participants emitted any correct responses to the 3 sets of adjective-object pairs as either of the mands or tacts. Following baseline training sessions for the mand for the first set of adjective-object pairs; neither Student 1 or 3 emitted any correct responses for the untaught tacts, while neither Student 2 or 4 emitted any correct untaught mands following mastery of the tact.

Following the multiple exemplar instruction on a new set of adjective object pairs, Student 1 emitted 15 correct responses (100%) of the untaught tacts for his first set of adjective-object pairs (set 1), and Student 2 emitted 12 correct responses (80%) of the untaught mands for her first set of adjective-object pairs (set 1). Following multiple-exemplar instruction on set 1 adjective-object pairs, Student 3 emitted 14 correct responses (93%) for the untaught tacts of her first set of adjective-object pairs (set 2), and Student 4 emitted 13 correct responses (87%) for the untaught mands of his first set of adjective-object pairs (set 2). All students emitted the verbal operants that they did not have in their repertoire following baseline instruction after receiving multiple exemplar instruction with a separate set of adjective-object pairs.

Finally, all students were once again taught a single verbal operant, either a mand or a tact, for a third set of adjective-object pairs (Set 3) in a similar fashion as was done in baseline. When the students met the criterion for the

single verbal operant, we conducted probe trials for the untaught functions. Student 1, who was taught tacts, emitted 14 correct responses (93%) for untaught mands. Student 2 was taught mands and emitted 11 correct responses (73%) for untaught tacts. Student 3 was taught tacts and emitted 14 correct responses (93%) for untaught mands and Student 4 was taught mands and emitted 14 correct responses (93%) for untaught tacts.

Prior to the multiple exemplar instruction, none of the students could emit untaught mands following tact instruction or tacts following mand instruction. After the multiple exemplar instruction for another set of adjective-object pairs across different verbal operants, the students emitted the untaught verbal operant to the initial adjective-object pairs that had been taught as a single verbal operant and emitted the untaught verbal operant for a novel adjective-object pair taught as a single operant.

DISCUSSION

The untaught mand or tact verbal operants for adjective-object pairs emerged as a function of multiple exemplar instructional experiences. The MEI operations were used to teach the two verbal operants across establishing and reinforcement conditions for each function for a subset of forms. Lamarre and Holland (1985) first demonstrated that mands and tacts were independent for nine typically developing preschool students. The independence of the two functions was also found in studies by Hall & Sundberg (1987), Ross & Greer (2003), Williams and Greer (1993) and Tsiouri and Greer (2003). In addition, Twyman (1996) found that untaught verbal operants for adjective-object pairs, taught under either mand or tact conditions, did not emerge without specific instruction, extending the findings on the independence of the verbal operants. Data have been collected for several years on the independence of mands and tacts using the Preschool Inventory of Repertoires for Kindergarten (Greer & McCorkle, 1995) in CABAS[®] pre-schools in the USA, England, and Ireland. These assessments also showed that the mand and tact repertoires were frequently independent for students with communicative delays. Moreover, for the particular children in our study the two functions were independent also prior to the MEI treatment.

However, typically and non-typically developing children and adults do come to use adjective-object pairs as untaught verbal operants after learning only one function. For example, Hall and Sundberg (1987) and Sigafos et al. (1989, 1990) found that mands and tacts were initially independent, but after they had taught one or more mands and tacts as both operants, the untaught operants emerged. Perhaps their findings were related to ours, in that they may have provided a kind of multiple-exemplar instruction that led to the emission of the untaught verbal operants.

The production of untaught verbal operants for verbal operants is a type of verbal behavior that has been characterized as “generative” in the sense that the student is said to “generate” the untaught response as a result of hypothetical psychological constructs. Theories, like those of Chomsky (1959), have attributed such generative behavior to a capacity that is not tied to environmental experiences, although inherent genetically evolved capacities may still be present even if environmental sources are located. From a behavior analytic perspective, the emergence of the novel usage has remained unexplained in terms of environmental experiences. The data in the present experiment showed that, at least for these students, such generative verbal functions could be taught by multiple exemplar instruction. This in turn suggests that multiple exemplar experiences can serve as a source of this particular generative function. While this does not mean that such generative behavior is attributable to multiple exemplar experiences in all or many cases, it does show that such generative behavior can emerge as a function of these experiences or instructional histories. Our findings replicated and extended those of Greer, Yuan and Gautreaux (2002), who found that untaught spelling responses (either written or spoken) taught as a single response for novel words resulted from multiple exemplar instruction on a sample of set of words in which the words were rotated across different responses.

The research on stimulus equivalence also is concerned with the emergence of untaught relations. Much of the interest in stimulus equivalence stems from the demonstration of the emergence of untaught relations that have not been tied to existing behavioral principles. The emergence of other untaught relations such as the contextual control for stimulus equiva-

lence is not a form of stimulus generalization as explained by Dougher, Perkins, Greenway, Koons, and Chiasson (2002). Emergences like those associated with stimulus equivalence, have been characterized in Relational Frame Theory as derived relations that stem from certain multiple exemplar experiences that result in an “overarching operant.”

In the research we report herein, the emergence of untaught functions for mands or tacts is not an instance of stimulus generalization. Rather, we argue that what was learned was the contextual control or abstraction of the establishing operations associated with each of the two verbal operant functions. The learning of a novel adjective-object pair as a single verbal operant resulted in the emergence of the other verbal operant without direct instruction with children who could not do so prior to the MEI. At present, we think that the rotation across the different establishing operations led to the contextual control of different functions, such that once the student had experienced the conditions that rotated the contextual control of establishing operations, the student could use novel adjective-object pairs as an untaught verbal operant provided that the relevant establishing operations were present. The establishing operations evoked the emergence of the untaught verbal operant. In short, the establishing operations came to control untaught operants for adjective-object pairs that had been taught as another verbal operant. This latter interpretation is based on the theory that deprivation of generalized reinforcement creates motivation for tacts while deprivation of a specific item acts as an establishing operation for the mand. We base the latter on the work of Tsiouri and Greer (2003) that showed that generalized reinforcer deprivation could occasion tacts.

Skinner (1957, p. 90) suggested that learning to write words in dictation and spell words vocally as an intraverbal function were independent repertoires but that literate individuals learn to respond in “different media” as a result of transcription experiences. Greer et al. (2003) found this was likely to be the case with young children who were just developing spelling responses. That is, learning to spell a word vocally after being given the word by a teacher (i.e., “spell cat”) did not result in the child spelling the word as a dictation response or spelling the word in a dictation response did not

result in spelling the word in a vocal response. As Skinner pointed out, writing is a different behavior from speaking. In the Greer et al. experiments (2003), multiple exemplar experiences across spelling intraverbally with vocal responses, and by dictation for a subset of words, led to the emergence of the untaught response to novel words. However, in the latter study, it is likely that the control for the emergence of the untaught functions was made possible because the stimulus control of the letters. That is, as the students wrote the letters they also said the letters such that the MEI experiences taught the students the relationship between intraverbal and dictation responding consistent with Skinner's transcriptions explanation. The contextual controlling relations were due to the letter stimuli, whereas in the present study, the contextual controlling relations were establishing operations. This suggests that a history of experiences with establishing operations may explain certain generative verbal functions, while in other cases the control may lie in histories of instruction associated with discriminative stimuli. Thus, the source for the untaught usage is located in pre- and postcedent events surrounding the operant, sometimes historically removed. In the case of the conversion of mand/tact from independent to related responding, the control is exerted by abstraction of the establishing operation function. Given a particular establishing operation, novel responses learned in as one verbal operant can be evoked in another function by specific establishing operations after relevant multiple exemplar experiences. Of course, other interpretations are possible, but this explanation does appear parsimonious at present.

We have replicated the findings of this study with other pre-school children with language delays in unpublished experiments in which the particular tactics for creating establishing operations were slightly different than those we used herein (Greer, Park, & Speckman, 2003; Greer & Nirgudkar, 2003). However, other researchers need to test our findings. In the replication studies we used the same design that we used in the current study, and the children all had communicative delays, ranging from mild to severe delays.

The procedures also remain to be tested with typically developing students like those used in the Lamarre and Holland study. Also, our

responses were pure tacts and mands unlike the impure mands and tacts studied by Lamarre and Holland. Impure mands and tacts may be controlled by verbal stimuli in addition to or instead of establishing operations.

Of course, the notion of an establishing operation for the tact is a new notion. While Skinner did not use the establishing operation in his description of the controlling relations for the tact, we argue that there are establishing operations for generalized reinforcers as there are for specific reinforcers in the mand. We speculate that the incidences of the tact are much more common for typically developing children than the mand and that this is a function of establishing operations for generalized reinforcers (e.g., adult attention). Tsiouri and Greer (2003) used deprivation of generalized reinforcers to induce first incidences of vocal tacts, building on the procedures for inducing vocal mands developed by Ross and Greer (2003). However, the notion of establishing operations associated with the tact calls for additional research.

While our findings need to be subjected to further research, the current data suggest that heretofore-unexplained emergence of novel verbal functions associated with mands and tacts can be attributed to multiple exemplar experiences at least for the children we studied. While MEI may not be necessary for such emergences, it was sufficient in cases of the children we studied. Whether or not the transformation of function for forms taught either as mands or tacts is necessarily tied to Relational Frame Theory calls for additional research. However, at present, it does seem consistent with the theory. It is important to note that in our case the transformation was a function of the controlling establishing operations rather than derived relations for stimuli.

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