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Effects of Multiple Exemplar Instruction on the Emergence of Derived Relations in Children with Developmental Disabilities

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Abstract

Multiple Exemplar Instruction (MEI) was evaluated, as an instructional protocol, on its effectiveness of establishing derived tact relations (B-A) in three children with developmental disabilities. Educationally relevant stimuli in the form of constellations were used as stimuli in this study. Following assessment of current listener (A-B) and tact relations amongst participants, listener training was implemented in which participants were asked to "Point to" a dictated constellation out of four choices. Participants needed to respond with 88% accuracy in order to be tested on tact relations. In the event that participants failed tact test probes, Multiple Exemplar Instruction was introduced. Results were inconclusive on the effectiveness of MEI in the emergence of derived tact relations, as time restrictions hindered the ability to begin Multiple Exemplar Instruction.

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Introduction

Understanding the true depths of language ability and the boundaries of verbal behavior is an area that has shown progressive success within the field of Behavior Analysis. While influential theories have been established and growth in research has occurred, there are still notable gaps in which applied work needs to be done in order to test and ultimately understand implications of such proposed theories (Berens & Hayes, 2007). Derived stimulus relations are an example of a prominent subject matter in which few applied studies have been published. In an Analysis of Articles published in the Journal of Applied Behavior Analysis (JABA), Dr. Ruth Anne Rehfeldt noted only 27 applied studies on derived stimulus relations that had been published in JABA (Rehfeldt, 2011). In support of this, Berens and Hayes called for a need of "more direct experimental evidence on the operant nature of relating… before relational will be fully admitted into the conceptual armamentarium of behavior analysis." (2007). They also noted that a significant amount of applied work is still in need of completion to further test the implications that result from RFT (Berens & Hayes, 2007).

As derived relations have risen as a research area with the ability to yield influential work, a proliferation of researchers appear to be examining more complex and abstract theories of verbal behavior. In the analysis of human language and cognition, arbitrarily applicable relational responding has surfaced as a core matter amongst several theories (Luciano, Gomez-Becerra, & Rodrigues-Valverde, 2007). Since Sidman's early pioneering work on stimulus equivalence, the most fundamental and commonly studied form of derived relations (Luciano et al., 2007), this field has seen the emergence of three theoretical approaches in which we have been able to better understand complex human

behavior (Rehfeldt, 2011). These theories have offered varying proposed explanations on

the emergence of equivalence. They seek to expose the historical conditions that elicit

novel emergent relations in which most verbally able humans learn, thus expanding upon

their verbal repertoires (Luciano et al., 2007). One such theory that has offered its own

interpretation on the ever-challenging area of human language and stimulus equivalence is

the Relational Frame Theory (RFT). (Davlin, Rehfeldt, & Lovett, 2010). This contemporary

account has continually sought to exhibit derived relational responding through a history

of training and reinforcement across multiple exemplars (Davlin et al., 2010). Relational

Frame Theory has placed an emphasis on Multiple Exemplar Instruction (MEI) as an

intervention to establish arbitrarily applicable relational responding. This is implemented

through directly teaching and reinforcing relational responding to specified stimuli in

order to produce responding to novel stimuli without direct reinforcement. In other

words, a learner is taught through the establishment of a history of reinforcement across a

variety of response topographies, or variations of stimuli, in order to yield a response in the

form of untrained topographies (Rosales, Rehfeldt, & Lovett, 2011).

Current literature has suggested that, without the emergence of novel functions,

behavior is not truly verbal (Hayes, Barnes-Holmes, & Roche, 2001). This highlights the

importance of an instructional protocol, such as Multiple Exemplar Instruction, for the

continued empirical expansion of Relational Frame Theory. Current findings have offered

support towards the effectiveness of MEI as a facilitator in the establishment of derived

relational responding. One such example examined the effectiveness of Multiple Exemplar

Instruction on the acquisition of joint spelling responses in Kindergarteners (Greer, Yaun, &

Gautreaux, 2005). Students were not able to spell any of the identified words during

baseline. After MEI was implemented, all students were able to emit novel spelling

responses for two stimulus sets with 80-100% accuracy (Greer et al., 2005).

　　　While previous studies have supported the effectiveness of MEI, researchers have

also called attention to the necessity of further research amongst varying populations. For

example, Berens and Hayes conducted a study in 2007 that demonstrated the facilitation of

developing arbitrary comparative relations as a result of Multiple Exemplar Instruction

(2007). Within their study they offered a review of the theoretical and applied implications

of Multiple Exemplar Instruction. They deemed the experimental manipulation of a history

of reinforcement as the appropriate test for derived relations (Berens & Hayes, 2007).

However, researchers have noted that, despite the current success of MEI, further research

is needed amongst populations with less developed naming and categorization repertoires

(Luciano, 2007). Additionally, Berens and Hayes identified a trend amongst current

research in which the majority of applications have emerged in clinical settings and

programs. They suggested that it is, perhaps, in the fields' best interest to test the

boundaries of the rudimentary account of RFT (Berens & Hayes, 2007). Despite this

pattern, it was suggested that a change in published literature has begun to appear through

the application of a Relational Frame Theory concept, such as MEI, in educational settings

(Berens & Hayes, 2007). The contrived nature of current literature on Multiple Exemplar

Instruction was also discussed in a study that involved the evaluation of MEI's effectiveness

as an instructional protocol on the establishment of derived tact relations in children

whose first language was Spanish (Rosales et al., 2011). Researchers reviewed that

empirical work, thus far, has continually utilized abstract shapes or other visual images as

its stimuli (Rosales et al., 2011). In other words, there is little mention of studies that

incorporate educational stimuli, as to increase relevance for participants (Rosales et al., 2011). Applied research is, after all, the domain in which we are most likely to see predictability and influence of verbal and cognitive theories (Berens & Hayes, 2007).

Within complex verbal behavior comes the ability to name and label objects. Barnes-Holmes and Barnes-Holmes have acknowledged that learning to name objects is one of the earliest, most fundamental, and most crucial forms of relational responding (2000). They continue to explain that, during the early stages of language training, explicit reinforcement, however, after numerous A-B and B-A exemplars have been trained, derived naming becomes an established part of ones behavioral repertoire (Barnes-Holmes & Barnes-Holmes, 2000).

As tacting is a fundamental operant in one's verbal repertoire, an investigation of tacting with educationally relevant stimuli in individuals with a delayed verbal repertoire might prove beneficial to current literature on Multiple Exemplar Instruction. This purpose of this present investigation was to examine the effects of Multiple Exemplar Instruction on the establishment of derived tact relations in children with Developmental Disabilities. This study was an expansion on previously conducted experiment (Rosales et al., 2011).

Methods

Participants, Setting, and Stimulus Materials

Three children all at the age of 7 were recruited as participants from a second grade special education classroom at a local Elementary School. All three participants have been identified as having a Developmental Disability. The participants used in this study were selected by their teachers as plausible students before consent forms were distributed to
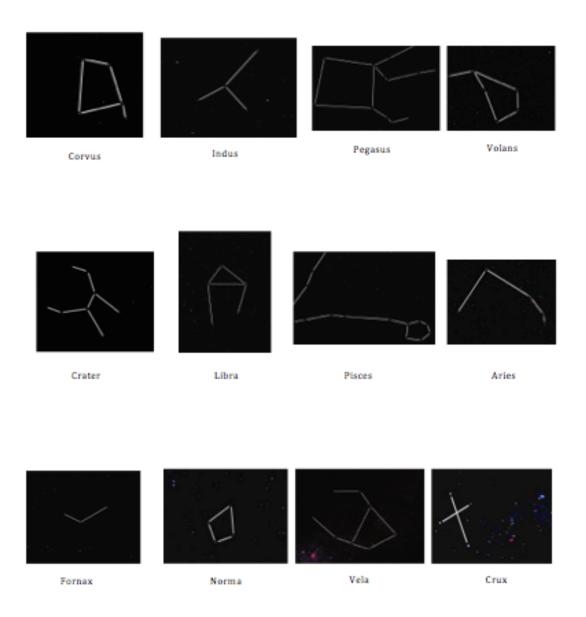
their parents. Sessions were conducted three times a week per week in the copy room of the school's office. Each participant worked individually with the researcher for 20 minutes per day. During sessions, the participant was seated at a table across from the researcher. 3-4 minute breaks were given in between trial blocks in which participants chose between six preferred items (i.e. short games, toys, etc.). These items were determined after a paired-choice preference assessment was conducted with each participant.

In the assessment of the emergence of derived tact relations (B-A), three 4-item stimulus sets were used throughout the phases of the study (See Table 1). An additional nine, 4-item stimulus sets were identified for use during Multiple Exemplar Instruction. All 48 stimuli were randomly assigned into the 12 total stimulus sets. Stimuli sets 1-3 were the only sets that were used to test for a functional relationship between training and post-training probe performance. Stimuli consisted of pictures of various constellations printed and attached to a 3 x 5 in. index card (see Figure 1). All pictures used in non-generalization trials were obtained from one astrological website, in which all constellations appeared similar in the way that they were displayed as to ensure consistency between presented. Different images of the constellations were displayed in the same manner for generalization probes. During listener training, stimuli were presented in four sections of a stimulus placement board created for use during this study. The rectangular placement board was made out of a white foam board and placed directly in front of participants during listener trials. The use of this board helped ensure the equidistant presentation of stimuli in order to avoid inadvertent positional prompting (Rosales et al., 2011). The board was removed during breaks and tact trials.

Table 1

Names of Stimuli used During Listener Training and Testing

Set 1	Corvus
	Indus
	Pegasus
	Volans
Set 2	Crater
	Libra
	Pisces
	Aries
Set 3	Fornax
	Norma
	Vela
	Crux

Figure 1. This figure displays the images that were used for stimuli during listener and tact trials. These particular stimuli are from the first three sets used during listener training and testing.

Experimental Design, Dependent Measure, and Interobserver Agreement

      This investigation utilized a multiple-probe design across stimulus sets (Horner &

Baer, 1978). Initially, pre-training probes were conducted for stimulus sets 1-3 (training

sets) in which pre-existing tact and listener relations were assessed. Following data

collection on pre-training probes, listener training occurred in stimulus set 1 across all

three participants. If an emergence of derived tact relations were observed following

training in stimulus set 1, pre-training probes were to be repeated for next stimulus set.

The remaining nine stimulus sets were designated for use only if Multiple Exemplar

Instruction was needed and, therefore, pre-training probes were not conducted for the

remaining sets.

The dependent variable in this study was the percentage of correct responses that

demonstrated derived intraverbal tact relations (B-A) during pre- and post-training probes

(Rosales et al., 2011). As noted in the Rehfedlt, Rosales study that this study's methodology

was based off of, a "derived relation was defined as the participant saying the name of an

item correctly within 5-10 s of presentation of the item with the instruction 'What is this?'

by the experimenter, and in the absence of reinforcement," (2011). Trial blocks consisted of

eight trials in which each stimulus was randomly presented twice per block. Criterion was

set at 7/8 trials correct (88%) in one trial block in order to conclude the emergence of

derived relations in a stimulus set.

A trained independent observer was present for 50% of sessions for all participants

throughout the duration of this study to score interobserver agreement (IOA) and

procedural integrity. An agreement was scored if both observers recorded a correct

response, while incorrect responses were denoted by a disagreement between observers.

IOA was then calculated by dividing the number of agreements by the number of

agreements added to the number of disagreements, then multiplied by 100 for the total

percentage. Procedural reliability was recorded on a checklist and was scored by either a

"+", "-", or "NA". This total percentage was calculated by dividing the number of correct

marks (+) by the total possible number, and then multiplied by 100. The total agreement

was 100% across all trials and sessions for all three participants for both IOA and

procedural reliability.

Procedure

Pre- and post-training probes

Before pre-training probes were conducted, participants were assessed on their

pronunciation of all 48 constellations through an echoic pre-test. No stimuli were in sight

for this assessment. Participants were instructed to repeat the experimenter after each

word. Correct and incorrect responses were recorded. In the next session, participants

were assessed on stimulus sets 1-3 for listener (A-B) and tact (B-A) relations in one eight-

trial block probe per training set (Rosales et al., 2011). Tact probes were always presented

first, followed by the random alternation between tact and listener probes.

Tact trials began with the experimenter holding one stimulus in front of the participant,

instructing, "What is it?" The order of stimuli presented was randomly selected for each

trial block. Tact probes assessed the oral naming of each presented stimulus. Correct

responses were defined as the participant accurately labeling the stimulus within 5-10

seconds after presentation and instruction. Incorrect responses were defined as the

participating naming something other than the presented stimulus, responding with "I

don't know," or no response within 5-10 seconds of the onset of the trial. Correct responses

were not reinforced during pre- and post-training probes, however, cooperative behaviors

were reinforced during trials in order to maintain a high schedule of reinforcement

(Rosales et al., 2011).

Listener trials began with the experimenter randomly placing the 4-stimuli on the stimulus placement board in a table top, simultaneous, match-to-sample format (Rosales et al., 2011), then delivering the instruction "Point to _____" to the participant. Correct responses were defined as the participant pointing to the dictated stimulus amongst the comparison stimuli within 5-10 seconds of the instruction. Incorrect responses were defined as the participant pointing to one of the comparison stimuli, and not the dictated one, or not responding within 5-10 seconds of the instruction. Only the first emitted response was recorded for all trials (Rosales et al., 2011).

Pre- and post-generalization probes.

Generalization probes were conducted following the same procedure as pre- and post-training probes, except with different images of the same stimuli. The images used for generalization were selected from a different website than the stimuli used during training and testing (Credner, n.d.).

Listener Training

The presentation of trials and definitions of responses were the same as described above for pre- and post-training trials. The procedure for listener training differed in that consequences were delivered for correct and incorrect responses. Differential reinforcement followed correct responses in the form of descriptive praise (i.e., "Nice Job! That is _____") and the delivery of a token. The tokens used in this study were decorated sticks. Participants were able to place the tokens they received into a small glass container in which they were given the opportunity to decorate or write their name on with a dry-erase marker. The number of tokens they received corresponded with a reinforcer. Items were given for use during breaks in between trials. Incorrect responses were followed by

corrective feedback (i.e., "Try again") and then re-presentation of the trial with a model

point prompt (Rosales et al., 2011). Listener training was conducted until participants met

the mastery criterion of 7/8 (88%) correct responses over two consecutive trial blocks

(Rosales et al., 2011). Upon mastery, the participant was presented with a tact-test (B-A)

probe for that stimulus set. After this probe, listener training began with the subsequent

stimulus set.

Multiple Exemplar Instruction

MEI was conducted only if a participant did not successfully satisfy mastery

criterion for all derived relations in a training set for the first post-training probe, after all

three stimulus sets were trained. Each stimulus set was allocated three MEI sets (see Table

2). All Multiple Exemplar Instruction sets were set to be conducted as listener relations,

through listener training, in the same procedure as previously described. Following this,

tact training would occur in which verbal prompts were immediately delivered, for the first

three trials, and then subsequently faded (Rosales et al., 2011). Correct and incorrect

responses were to be defined the same as the correct and incorrect definitions noted

during pre- and post-training probes. Correct responses were followed by differentially

consequated praise, as described above, and incorrect responses were followed by

corrective feedback and a model point prompt, also as described above. For MEI trials,

mastery criterion was designated at three consecutive correct unprompted responses for

each stimulus in one set (Rosales et al., 2011). Subsequently, one trial-block was conducted

under extinction so that participants were exposed to the contingencies under effect for the

remaining post-training probes (Rosales et al., 2011).

Maintenance Probes

Follow-up probes were set to be conducted one month after the termination of all training for each stimulus set. Probes followed the same procedure as described above for pre- and post-training probes. The same criterion was also used to infer maintenance of any derived relations (Rosales et al., 2011).

Results and Discussion

Only one participant successfully demonstrated the emergence of tact relations (B-A) at the end of listener training. The other two Participants were not able to meet mastery criterion during listener training in the first stimulus set and, therefore, did not display derived tact relations. Time constraints due to numerous school cancellations ultimately hindered the ability to implement Multiple Exemplar Instruction. Furthermore, as a result of these delays in data collection, Participants 1 and 2 were not tested for tact relations since they did not meet criterion in time. Additionally, Participant 3 was not given a second generalization probe across stimulus sets. Results for all three participants are displayed in Figures 1-3.

Participant 1

During pre-training probes, Participant 1 responded with a range of 0-25% accuracy on listener relations (A-B). She scored 0% on all initial tact probes (B-A), signifying that no tacts were within her current verbal repertoire. During generalization probes, Participant 1 responded with 25% accuracy during the listener probe, and 0% accuracy for the tact probe. At the start of listener training, Participant 1 demonstrated an initial increase from 13% to 38% across the first three trial blocks. The remainder of her scores for listener relations (A-B) ranged from 0-63% over the final 14 trial blocks. Pre-training probes for
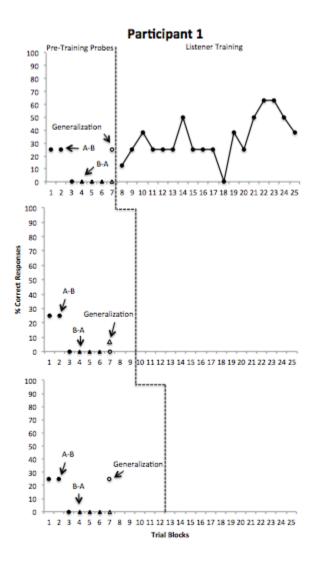
stimulus sets 2 and 3 were also similar. Pre-training scores ranged from 0-25% for listener

relations for both sets. Additionally, tact relations exhibited 0% correct responding in the

remaining two stimulus sets, further demonstrating the absence of tacts in her repertoire.

Participant 1 scored 7% on the generalization test probe for listener relations in the second

stimulus set, and 25% in the third. She scored 0% for the generalization test probe for tact

relations in both sets. See figure 2.
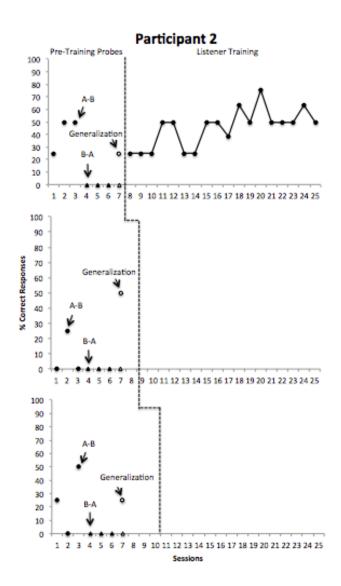
Participant 2

        During pre-training probes, Participant 2 responded with a range of 25-50%

accuracy on listener relations (A-B) in the first stimulus set. He scored between 0-25% in

the second set, and 0-50% in the third set. Participant 2 scored 0% on all tact relations

across all stimulus sets, demonstrating no prior tact relations in his verbal repertoire.

During generalization probes, Participant 2 scored between 25-50% on listener relations,

and 0% for all tact relations. During listener training, this participant displayed a 50%

increase from his lowest (A-B) pre-training probe 12 trial blocks in to training. Towards

the end of training, Participant 2 was responding at around 50% accuracy. See figure 3.

Participant 3

        In initial pre-training probes, Participant 3 scored between 0-25% in the first two

stimulus sets. In the third stimulus set, he was responding between 25%-100% accuracy

for listener relations. For tact relations, Participant 3 responded with 0% accuracy across

all three-stimulus sets. In the first set, this participant responded with 25% accuracy

during the generalization probe for listener relations. In the second set, he was able to

score 75% correct, and 50% correct in the third set. He scored 0% for tact relations during

all generalization probes. During listener training in the first set, Participant 3 met showed

a rapid initial increase before meeting mastery criterion after 4 trial blocks of training. He

responded with 88% accuracy (7/8) for two consecutive blocks. Following the completion

of instruction for this set, Participant 3 was given a tact test probe (B-A) in which he scored

50% on. In the second stimulus set, this participant was able to reach criterion after only

three trial blocks. He was given another tact test probe in which he responded with 0%

accuracy. In the third stimulus set he, again, met criterion after three trial blocks. He scored

0% correct responses on his tact test probe. See figure 4.

Figure 2. Percentage of correct responses for listener relations are denoted as A-B on all graphs, and tact relations are denoted as B-A. Stimulus sets are displayed in order.

Figure 3. Correct responses are displayed for Participant 2. Stimulus sets are arranged in order.
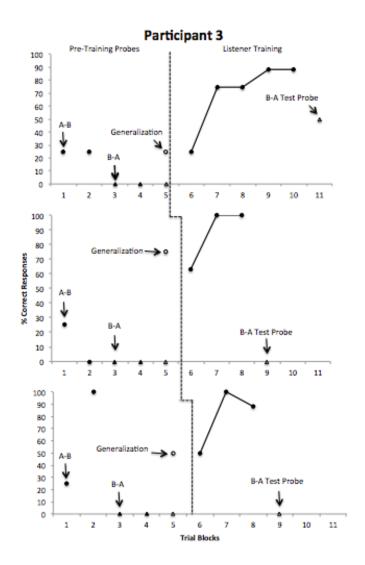
Figure 4. Correct responses are displayed for Participant 3. Stimulus sets are arranged in order.

Discussion

This study sought to examine the influence of Multiple Exemplar Instruction in a

population that is in need of further research in order to understand the full implications of

this protocol. Specifically, the purpose was to evaluate the emergence of novel tact

relations following Multiple Exemplar Instruction. Current research has noted the

inconclusiveness of MEI's role in speaker-listener repertoires and relations in arbitrarily

applicable responding amongst those with a limited verbal repertoire (Luciano et al., 2007). Therefore, this present investigation sought to examine the influence of MEI amongst three children with documented Developmental Disabilities. While their verbal repertoire was more advanced than anticipated, their teacher identified them as students who struggled with multiple facets of learning. Although their current verbal repertoire appeared to be standard, they may demonstrate delays in their repertoire compared to that of their typically developing peers.

The procedures of this study were terminated early due to time constraints with data collection. As a result, the instructional protocol was never implemented. This served as a significant limitation to this investigation, and needs to be considered in the examination of the results. Participant 3 was the only participant to meet mastery criterion during listener training. He scored 50% on his test tact probe following the completion of instruction. Therefore, we can conclude that a tact relation was established within his repertoire; however, we were not able to test for generalized response classes. Participant 2 was beginning to display more consistent levels of responding during listener training, while Participant 1 was demonstrating a decrease in correct responses. In this current investigation, it was decided that remedial listener training would not be implemented, as it was in the 2011 investigation that this study was based off of. The use of remedial listener training may have facilitated higher levels of responding during tact probes with Participant 3. Although this may have helped, remedial listener training was noted as a limitation in their study, as MEI was always accompanied by it (Rosales et al., 2011).

While this particular investigation was not able to successfully conclude the establishment of derived tact relations, there are other studies that have demonstrated this occurrence. One particular investigation examined the effects of Multiple Exemplar Instruction on the emergence of untaught mands or tacts in participants with autism/developmental disabilities (Nuzzolo-Gomez & Greer, 2004). During their implementation of MEI, mand and tact conditions were altered and a second set of adjective-object pairs were trained (Nuzzolo-Gomez & Greer, 2004). At the end of the study they found that all students were able to emit novel mands and tacts in the first stimulus set, and responded highly in the remaining two stimulus sets. Their results indicated that Multiple Exemplar Instruction was effective in establishing untaught verbal operants

The study in which this present investigation was based off of is also an example of a similar application in which Multiple Exemplar Instruction proved to be effective in the establishment of arbitrarily applicable relational responding. This specific example had typically developing children whose first language was Spanish as participants. Results indicated that the emergence of generalized response classes for the speaker component of verbal behavior was observed as a result of MEI (Rosales et al., 2011).

While Skinner's account on verbal behavior did not incorporate the phenomenon of stimulus equivalence, Hayes and colleagues have noted the importance of stimulus equivalence in transforming non-linguistic conditional discriminations into linguistic behavior (Horne & Lowe, 1996). Horne and Lowe also shed light on speaker-listener relations and its role in emergent behavior, including stimulus equivalence. Speaker-listener relations were not demonstrated beyond listener training in this current investigation. Therefore, future studies need to further examine these relations, as well as

the effectiveness of Multiple Exemplar Instruction in applied settings and various

populations. In his analysis of Multiple Exemplar Instruction, Greer claimed that, if Multiple

Exemplar Instruction can further demonstrate effectiveness in expanding upon the

formation of other generative verbal behavior, then implications and contributions in

support of Skinner's verbal behavior would be vast (Greer et al., 2005).

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