TRANSFER OF MAND TOPOGRAPHIES TO TACT RELATIONS AND VICE VERA IN
TWO VOCAL-VERBAL CHILDREN WITH AUTISM

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Thesis Prepared for the Degree of
MASTERT OF SCIENCE

UNIVERSITY OF NORTH TEXAS
May 2004

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Castellani, Jill E., *Transfer of Mand Topographies to Tact Relations and Vice Versa in Two Vocal-Verbal Children with Autism*. Master of Science (Behavior Analysis), May 2004, 38 pp., 12 figures, references, 8 titles.

Skinner (1957) suggested that verbal responses learned as mands are not necessarily emitted in tact relations and vice versa. Previous empirical research has found that newly acquired mands and tacts can be functionally independent. The present study investigated 1) whether novel responses taught in mand relations would be emitted as tacts when opportunity for tacting was presented; 2) whether novel responses taught in tact relations would be emitted as mands when opportunity for manding was presented; and 3) whether the size of pre-experimental mand and tact repertoires affected the rate of acquisition and/or transfer. Two vocal-verbal children with autism were taught three novel responses as mands and three other responses as tacts. Mand topographies transferred to tact relations and tact topographies transferred to mand relations for both participants. Overall acquisition as well as transfer of mands and tacts was faster for the participant with an entering repertoire of approximately 175 mands and 175 tacts than for the participant with a repertoire of approximately 100 mands and 100 tacts.
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Jill E. Castellani
I would like to acknowledge the University of North Texas and their Department of Behavior Analysis for allowing me this opportunity to receive my Masters in Behavior Analysis through their distance learning program.

I would also like to acknowledge Suzanne Letso, Executive Director of the Connecticut Center for Child Development, for her willingness to provide her employees with the opportunity to advance themselves and to advance the field of Behavior Analysis through the distance learning program.

I would like to especially acknowledge Dr. Sigrid Glenn and Dr. Janet Ellis for their constant support and feedback as I have gone through this process. Their guidance and encouragement have provided me with knowledge and confidence in my current research and in my abilities to become a Behavior Analyst.
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INTRODUCTION

B.F. Skinner (1957) introduced a functional analysis of verbal events to the science of behavior analysis. Skinner (1957, p. 2) defined verbal behavior as “behavior shaped and maintained by mediated consequences,” adding that the mediating behavior of the listener must “have been conditioned precisely in order to reinforce the behavior of the speaker” (p. 224). In other words, verbal behavior is unique because the reinforcement for such behavior is mediated by listeners specifically trained to provide such reinforcement. He identified several types of functional relations between verbal response forms and their controlling variables. Of the seven types of primary verbal operants Skinner identified, the two that have been given most experimental attention are mands and tacts.

Skinner (1957) defined a mand as, “a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (pp. 35-36). Michael (1988) stated that when the response form is controlled by a current unlearned or learned motivational variable (an unconditioned or conditioned establishing operation), such as deprivation or the warning stimulus in an avoidance situation, the relation is called a mand. In everyday language, what is said (manded) is what a speaker wants. A mand is said to specify its reinforcement because the consequence that reinforces a mand is contingent on emission of that specific response form. Further, that response is emitted only when that particular consequence is wanted. For example, the response form ‘cookie’ is a mand if the speaker “wants a cookie” and in the past saying “cookie” has resulted in a cookie.
"Pure" mands were identified by Skinner (1957) as verbal responses exclusively controlled by an unconditioned or conditioned establishing operation. That is, control over the specific response is not shared by a prior nonverbal or verbal discriminative stimulus. For example, a child’s emission of the verbal response, “Cookie,” would not be a pure mand if an actual cookie or the verbal stimulus “What do you want?” was present and affected the speaker’s saying “Cookie”.

Skinner (1957) defined a tact as, “a verbal operant in which a response of a given form is evoked (or at least strengthened) by a particular object or event or property of an object or event” (pp. 81-82). A tact is acquired when a particular response form is consistently reinforced in the presence of one stimulus with many different reinforcers or with a generalized reinforcer. The object or event acquires unique discriminative control over a particular response form for two reasons. First, emission of the response form is reinforced if and only if the appropriate object or event is present. Second, the form of the reinforcer is not distinctly related to the form of the response (as is the case with the mand).

Skinner (1957) identified “pure” tacts as verbal responses controlled exclusively by a specified discriminative stimulus. No verbal stimulus, such as “What is it?” is present, nor is the response controlled by a current establishing operation. Historically, the controlling relation between the object or event present and the verbal response form is reinforced exclusively in the form of a generalized reinforcer, such as the verbal statement, “Right.”

Because mands and tacts are functional units, they cannot be identified by their response forms alone. Although mand response forms and tact response forms may
appear to be quite similar, as when a child simply states, “cookie,” their functional properties are very different. If the response “cookie” is controlled by wanting a cookie, and no cookie is present, then the response is a mand. But if the response “cookie” is controlled solely by the presence of a cookie, and a cookie is not wanted, then the response is a tact.

In terms of speaker/listener relations, a mand has ultimate value to the speaker while a tact has ultimate value to the listener. “A mand allows the listener to infer something about the speaker’s condition, regardless of external circumstances, whereas, a tact allows the listener to infer something about the external circumstances, regardless of the speaker’s condition” (Skinner, 1957, p. 83).

Skinner suggested that speaker/listener repertoires, as well as the response forms shared by many operants, could be functionally independent. For example, he suggested it would be a mistake to assume that learners would automatically be able to point to a cookie when they were told to do so just because they were able to say “cookie” when they wanted one. Similarly, just because a learner asked for a cookie when he/she wanted one did not necessarily mean he/she could label the cookie as a “cookie” when he/she saw it but didn’t want it. Thus, establishing one type of verbal operant will not necessarily result in the automatic appearance of another type of verbal operant having the same response form.

Lee (1981) was the first to experimentally analyze the functional independence of speaker and listener repertoires. Two vocal children, ages 9 and 10, and described as having moderate mental retardation, participated in this study. The children were asked to respond nonverbally (that is, as a listener) to a speaker’s instructions, such as “Put the
cup/book on the left/right of the book/cup,” and they were asked to respond verbally (that is, as a speaker) regarding the same environmental events. For example, they were asked, “Where is the cup/book?” Lee reinforced either the correct listener responses or the correct speaker responses and tested to see if the children acquired the untrained repertoire. Results indicated that when a child’s nonverbal (listener) responses were reinforced, only the nonverbal repertoire was strengthened. When the child’s verbal (speaker) responses were reinforced, the child’s verbal and nonverbal repertoires were strengthened. Specifically, reinforced emission of prepositions under appropriate environmental conditions resulted in the child being able to describe spatial relations with prepositions and to point to relations among objects that were described with prepositions by an instructor. While this study provided evidence that speaker repertoires may transfer to listener repertoires without formal training of the listener’s repertoire, it also found that listener repertoires did not transfer to speaker repertoires without formal training. Lee (1981) was one of the first to provide evidence for Skinner’s claim that listener/speaker repertoires can be acquired independently of each other.

Lamarre and Holland (1985) were the first to investigate the functional independence of mands and tacts, specifically. Nine typical children, ranging in age from 3 to 5 years old, participated in the study. Screening tests had determined that the children did not consistently demonstrate the response forms to be trained. These response forms were prepositional phrases “on the left” and “on the right.” Both mands and tacts were taught as responses to questions. Tact training consisted of the experimenter’s question, “Where is the (object)?” prompting the participants to answer, “On the left” or “On the right.” The children were given a marble and praise after correct
responses. Mand training consisted of the experimenter’s question, “Where do you want me to put the (object)?” prompting the participants to answer “On the left” or “On the right.” If the experimenter put the correct object in the correct position, the child was to give the experimenter a marble; the child was to say “No” when the experimenter made an incorrect response. The child’s mand was counted as “correct” if he/she delivered the consequence appropriate to the experimenter’s response to the instruction (that is, if he/she got what he/she asked for).

Participants 1 through 4 received mand training, during which test questions assessed emergence of tacts with the same response form. Participants 5 through 9 received tact training, during which test questions assessed the emergence of mands with the same response form. After completion of mand training and tact training, the respective participants received training on the other type of verbal operant (i.e., participants who received mand training then received tact training and vice versa). After all participants were manding and tacting to criterion, (i.e., completion of correct mand and tact responses to all mand and tact-evaluating questions with five consecutive pairs of novel objects), reversal training began. Participants who had initially received mand training were given reversed-mand training (i.e., participants were reinforced for giving the experimenter a marble when the experimenter placed the object on the opposite side of that manded by the participant, on the right when participants manded “on the left”). Reversed-tact training was then assessed. Participants who had initially received tact training were given reversed-tact training (i.e., participants were reinforced for answering “on the left” when the object was actually on the right). Reversed-mand training was then assessed.
Results indicated that reversed-tact responses did not automatically emerge in the 4 children who were taught reversed-mand responses, and reversed-mand responses did not automatically emerge in the 4 children who were taught reversed-tact responses. Lamarre and Holland’s findings supported Skinner’s hypothesis and provided experimental evidence that mands and tacts can be acquired independently of each other.

Although research by Savage-Rumbaugh (1984) was not guided by a behavioral interpretation, her work with chimpanzees demonstrates more evidence of the functional independence of mands and tacts. Two chimpanzees were taught to mand food items by choosing a symbol from an array of symbols and handing it to the experimenter when the experimenter held a preferred food in front of the chimpanzees. Once the chimpanzees learned to mand an unspecified number of food items, the chimpanzees were taught to tact the foods by choosing the correct symbol in the presence of the item itself. These conditions looked identical to the mand condition; however, the chimpanzees were rewarded with a food other than the one present when they chose the symbol. The chimpanzees initially chose the correct symbol during the tact condition; however, after approximately five tact trials, correct symbol identification deteriorated rapidly as the chimpanzees selected random symbols, whimpered, gestured toward the food they had “labeled,” and pushed away the food that was given as the reinforcer. This experiment indicated that chimpanzees were able to learn mands but were unable to emit those response forms as tacts for preferred food items.

As a result of evidence that mands and tacts may be functionally independent at the time of acquisition, a few studies have investigated whether teaching one operant helps to establish more quickly the other operant in a person’s verbal repertoire. Carroll
and Hesse (1987) investigated the effects of alternating mand and tact training on the acquisition of tacts. Six typically developing 3- to 4-year-old children participated in the study. Pre-training consisted of teaching each participant to assemble four different toys, using toys having at least four parts. Each toy was given a name (e.g., “crane”), but no names for the parts were used. Three parts from each toy were then trained in a tact-only training condition or a mand-tact training condition. Each condition consisted of two phases: phase 1 part-names were fairly easy to master, while phase 2 part-names were more difficult. Participants 1-3 were given tact-only training and Participants 4-6 were given mand-tact training as their first condition. Tact-only training consisted of the experimenter placing a part in front of the participant and saying “This is a____. What is this?” Correct responses were praised (e.g., “Good job”). When the participant had correctly tacted a part in six of six trials for two consecutive sessions, the next part was trained, until all three parts were mastered. Mand-tact training consisted of alternating mand and tact trials. The first trial for each part was a mand training trial; the unassembled parts of the toy were placed in front of the participant, with the target part missing. The experimenter told the participant to make the (toy name); when the participant needed the missing part to finish the task, the experimenter said the name of the part and when the participant repeated the name, the experimenter gave it to him/her. The participant then completed the task and played with the toy. A tact training trial immediately followed.

When all parts for each condition were mastered, each participant was given a tact-retention test. Each trained part was placed in front of each participant in random order, and the experimenter asked, “What is this?” Correct responses were followed by
praise. Results show that it took participants fewer trials to acquire tacts for parts trained under the mand-tact training phase than in the tact-only training phase. Because responses in the mand-tact training phases were trained under both mand and tact conditions, two repertoires developed versus one repertoire in the tact-only condition. Apparently, less training was required for both the mand and tact repertoires when training for both repertoires was combined. These results offer support for faster acquisition of tacts by training mands not initially and independently of tacts, but in combination with tact training.

Different outcomes have been reported by Sundberg (1990) in his research with individuals with traumatic brain injury. Two males who had sustained traumatic brain injuries participated in the study. Nine familiar objects were chosen for each participant after each object was demonstrated to be unknown under tact, mand, and intraverbal conditions. Skinner (1957) defined an intraverbal as verbal responses under control of verbal stimuli (e.g. saying “four” when asked “What is two plus two?”). The nine items were divided into three sets - three items to be taught as mands, three to be taught as tacts, and three to be taught as intraverbals. Each training session began with a probe for each word. Tact training consisted of the experimenter holding up an object and asking, “What is this?” Correct responses were followed by social praise and incorrect responses were followed by a quietly spoken, “No.” Echoic prompts were used to evoke correct responses. Tact training sessions ended when the participant correctly tacted all three objects consecutively. Mand training consisted of teaching each participant a chain of responses using the target object and then withholding the target item. Correct responses were followed by presentation of the target item and praise, while incorrect responses
were followed by a quietly stated, “No.” Echoic prompts were used to evoke correct responses. Mand training ended when the participant correctly manded all three objects in succession. Intraverbal training consisted of presenting the participant with a verbal stimulus – e.g., “What do you use to fix a hole in the radiator hose?” Correct responses were followed by verbal praise and incorrect responses were followed by a softly stated, “No.” Echoic prompts were used and intraverbal training ended when the participant correctly responded to all three questions in succession. Each item was then tested under the other conditions; one item tested under tact conditions was then tested under mand conditions and then intraverbal conditions, respectively, and another item was tested under intraverbal conditions and then mand conditions, respectively, etc.

Results indicate that all objects transferred to the other conditions without specific training of those items under those conditions. However, direct mand training proved to be the least efficient method to evoke manding. Direct tact training and intraverbal training were most efficient in generating manding. It is possible that the conditioned establishing operations manipulated during mand training were not strong enough to evoke mands. This study also provided evidence that for some individuals, collateral transfer of verbal operants may occur without direct training.

Hall and Sundberg (1987) manipulated establishing operations in order to test the functional independence of mands and tacts as well as two different prompting procedures. Two participants, ages 16 and 17, diagnosed as profoundly deaf with severe mental retardation, participated in the study. They emitted extremely low rates of manding and never manded in the absence of a verbal discriminative stimulus. Prior to baseline conditions, both participants were taught to complete four chains of behavior
leading to a reinforcer (e.g., making soup, opening a can of fruit, wiping up water spilled on the table, etc). For each chain of behavior to be considered mastered, each participant had to initiate at least the first action for each object at 100% accuracy across 2 consecutive days. After mastering each behavior chain, both participants were tested and then taught correct tacts for each item in the chain. The experimenter held up each item and signed “What’s that?” Correct responses were reinforced with tokens. If a tact was incorrect, the experimenter modeled the correct response and re-presented the discriminative stimulus. Tacts were tested or trained until 100% accuracy was achieved for 2 consecutive days.

During baseline conditions the experimenter signed the beginning of each chain, while withholding one object necessary to complete the chain; thus, a total of four objects (one from each chain) were to be tested and trained for each participant. If the missing item was manded, the experimenter presented the item and the participant finished the chain of behavior. If the missing item was not manded, the entire task was removed and the next chain was presented. Only four instances of correct manding occurred in baseline conditions, - two for each participant.

Then training was implemented using either a tact prompt or imitative prompt to teach the mand response. The tact prompt was identical to tact training. During each chain of responses if the missing item was not manded within 10 s, the experimenter held up the missing item and signed, “What’s that?” If the correct tact did not occur the experimenter modeled the topography and re-presented the question. When the correct tact occurred, the experimenter put the item in front of the participant and asked, “What do you want?” After a correct response to “What do you want?” occurred, all items
except for the previously missing item were removed for 5 s and then re-presented. The imitative prompt procedure was identical to the tact prompt procedure except the experimenter signed, “Do this,” and then modeled the correct mand response instead of holding up the item and asking, “What’s that?”

While prompting effectiveness yielded similar results, neither prompting strategy produced faster acquisition of the mand responses. However, results indicated that only after specific mand training did mand responses occur; tact training alone was not sufficient in producing responses in the mand condition. Hall and Sundberg demonstrated that mands and tacts may be functionally independent at the point of acquisition.

The current study asked the following experimental questions: 1) Will verbal responses taught as pure mands appear in tact relations without training? 2) Will verbal responses taught as pure tacts appear in mand relations without training? 3) Will the sizes of mand and tact repertoires affect how quickly new mands and tacts are acquired or appear in untrained relations?
METHOD

Participants

Two male students with autism at a private school for children with autism participated in the study. A 9-year-old participant had a repertoire of approximately 100 different mands and 100 different tacts. The 13-year-old participant had a repertoire of approximately 175 different mands and 175 different tacts. Both participants spoke English.

Setting and Materials

All sessions occurred at the school. Baseline and probe sessions occurred in a 14-ft by 12 ft study room containing a video camera and stand, an 8- ft table, 10-15 chairs, and one 2- ft by 2-½- ft desk. Tests of mand and tact transfer occurred in the participants’ regular classrooms at their desks.

Two Easy-Grip® wooden peg puzzles, one containing nine different tool puzzle pieces and one containing nine different truck puzzle pieces, were used. Three unfamiliar pieces from each puzzle were used for training. The puzzle apertures and the six remaining puzzle pieces for each puzzle were painted a single color to conceal them, and the six pieces were glued into their corresponding apertures in their respective puzzle boards. The three remaining tool puzzle pieces were used in mand training, and the three remaining truck puzzle pieces were used in tact training for both participants. For Participant 1, screwdriver, pliers, and wrench were taught as mands and forklift, bulldozer, and dumptruck were taught as tacts. For Participant 2, tape measure, pliers, and wrench were taught as mands and forklift, cement mixer, and green digger were taught as tacts.
In the mand sessions, cheese popcorn and Welch® grape juice were used as back-up reinforcers for Participant 1, and sour tarts® and water were used as back-up reinforcers for Participant 2. Plastic cups held the edibles and drinks.

Procedures

Pre-Training Phase

Pre-training sessions were conducted over 5 consecutive days to establish a contingency between completing a puzzle and receiving cheese popcorn, thus creating a conditioned establishing operation for requesting missing pieces. Each participant sat at the desk in the study room. One puzzle and its corresponding pieces were placed on the desk in front of the participant. Each puzzle was presented three times in a session and presentations alternated between tool puzzle and truck puzzle.

Participant 1. The experimenter instructed, “Puzzle, then cheese popcorn.” When the participant completed the puzzle, he received a plastic cup containing three pieces of cheese popcorn and ½ cup of an 8-oz plastic cup of grape juice. After he consumed the food and drink, the experimenter removed the puzzle and presented the next piece, until the puzzle had been presented three times.

Participant 2. The experimenter instructed, “Puzzle, then sour tarts.” A plastic cup of water was on the participant’s desk throughout the sessions. When he completed the puzzle, he received 3 sour tart pieces and an opportunity to drink some water. After he consumed the food and drink, the experimenter removed the puzzle and presented the next puzzle until each puzzle had been presented three times.

Once these pre-training sessions began, and for the duration of the study, access to the items used as reinforcers in the experiment was limited to the experimental
sessions. During the sessions consumables were only available contingent on completion of a puzzle.

**Baseline Phase**

Baseline sessions began the day after pre-training sessions were completed. Baseline sessions were conducted to assess participants’ prior knowledge of the puzzle piece labels under both mand and tact conditions and to establish a pre-intervention performance baseline. Baseline sessions occurred in the study room and lasted 3 days for Participant 1 and 2 days for Participant 2. Two sessions of baseline data were collected each day - one in the morning and one in the afternoon. In one session, the mand condition was run with both truck and tool puzzle, and in the other, the tact condition was run with both puzzles. The order of conditions was alternated each day (e.g., if mand assessments were presented in the morning on day 1, then tact assessments were conducted in the morning on day 2). The order in which puzzle pieces were presented also varied across sessions.

**Mand baseline.** Each participant was seated at the desk in the study room. The experimenter stood behind the participant and placed the designated puzzle in front of him (either tool or truck puzzle) with the designated piece missing. For example, on day 1, piece A, then piece B, then piece C was missing in presentations of the tool puzzle and also in presentations of the truck puzzle. On day 2, piece B, then piece C, then piece A was missing in presentations of the truck puzzle and also in presentations of the tool puzzle, etc. All trials were conducted at the desk. Each trial began with the experimenter’s instruction “Puzzle, then (edible).” Experimenter waited 5 s and recorded any responses occurring during that time. No consequence was delivered. The
experimenter removed puzzle and pieces from the participant’s desk, gathered the next trial’s materials, waited for and/or non-vocally prompted attending behavior, and then began the next trial. After six trials were completed (three with each puzzle), the experimenter told Participant 1, “Go take a break” and Participant 2, “We’re all done.” Then each participant was given access to preferred items for 2-3 min before returning to their daily schedules. Figure 1 illustrates the data sheet used during mand baseline sessions.

*Tact baseline.* Each child sat at the desk in the study room. The experimenter stood behind the participant and placed one puzzle piece on the desk in front of him. Presentation order of puzzle pieces varied across sessions, (e.g., on day 1 piece A, then piece B, then piece C from the tool puzzle and from the truck puzzle were presented. On day 2 piece B, then piece C, then piece A from the truck puzzle and from the tool puzzle were presented). After a 5-s interval, the experimenter recorded any responses occurring during that interval. No consequence was delivered. The experimenter removed puzzle and pieces from the participant’s desk, obtained the next trial’s materials, waited for and/or non-vocally prompted attending behavior, and then began the next trial. After completing six trials (three on each puzzle), the experimenter told Participant 1, “Go take a break,” and told Participant 2, “We’re all done.” Then each participant was given access to preferred items for 2-3 min before returning to their daily schedules. Figure 2 depicts the data sheet used in tact baseline sessions.

*Training*

Mand and tact training, conducted in the study room, began the day after baseline sessions ended. Training of mands alternated between mornings and afternoons, with
tacts trained in the other session. One probe trial for each puzzle piece was conducted before each training session. Probe trials were identical to baseline trials, except the reinforcer (a cup of three edibles) was delivered to the participant for correct responses. Each training session consisted of a total of 15 trials (fives trials each for the three puzzle pieces in the condition being trained).

*Mand training.* The tool puzzle pieces were taught as mands. The experimenter stood behind the participant and presented the puzzle and two of the three puzzle pieces, holding the designated missing piece either behind her back or in her pocket. She instructed, “Puzzle, then (edible).” After the participant fitted the 2 available pieces into the puzzle frame, the experimenter vocally modeled the missing piece name, (e.g., “screwdriver”). When the participant correctly echoed the name of the tool, the experimenter gave the participant the puzzle piece. When the participant correctly placed the piece in the puzzle aperture, the experimenter gave the participant a plastic cup with one piece of cheese popcorn or a sour tart, respectively. The experimenter then removed the same piece, instructing, “Puzzle, then (edible),” and introduced a 1- to 2- s time delay before providing the echoic prompt. If the participant required a full or partial vocal echoic prompt for the piece name, the participant received one piece of edible; if the participant independently manded the missing piece; he received three pieces of edible. No eye contact, praise, or affection followed correct responses during mand training. Both correct and incorrect responses were followed by silence from the experimenter until a new trial began.

All mand training sessions began with three consecutive trials of each puzzle piece, (e.g., screwdriver, screwdriver, screwdriver, pliers, pliers, pliers, wrench, wrench,
wrench) and ended in 6 quasi-random presentations of the puzzle pieces (e.g., wrench, screwdriver, pliers, screwdriver, wrench, pliers). The order of missing puzzle pieces was changed for each training session. Figure 3 shows the data sheet used in mand training.

**Tact training.** The truck puzzle pieces were taught as tacts. The experimenter stood behind and slightly to the side of the participant, placing the designated puzzle piece in front of him. The experimenter physically prompted the participant to point to the piece and provided a vocal model of the piece name. When the participant correctly echoed the piece name, the experimenter provided a brief praise statement. The experimenter then removed the same piece and re-presented it in front of the participant. The experimenter used most-to-least physical prompts for pointing to the puzzle piece and introduced a 1- to 2- s time delay before providing the echoic prompt. If the participant required prompting to point or label the puzzle piece, he received a brief statement of praise (e.g., “Good”) and eye contact; whereas, if the participant independently pointed and labeled the puzzle piece he received a longer, more enthusiastic statement of praise and affection, (e.g., “You’re so smart!” with a tickle on the head) and eye contact. Incorrect puzzle piece echoes were followed by 5 s of silence from the experimenter until a new trial began. All tact training sessions began with three consecutive trials of each puzzle piece (e.g., forklift, forklift, forklift, bulldozer, bulldozer, bulldozer, dumptruck, dumptruck, dumptruck) and ended with quasi-random presentations of each puzzle piece (e.g., dumptruck, bulldozer, forklift, forklift, dumptruck, bulldozer). The order of puzzle piece presentations changed for each training session. Figure 4 illustrates the data sheet used in tact training.
Mand training sessions continued until the participated maintained 100% correct mands over 3 consecutive days. Tact training sessions continued until the participant maintained 100% correct tacts over 3 consecutive days.

*Testing of Untrained Relations*

Collateral testing of transfer was conducted to determine whether topographies taught under mand conditions occurred under tact conditions, and vice versa. These sessions occurred in the participants’ regular classrooms at their desks. This testing occurred at different times of the day than did the training sessions. That is, if the tool puzzle was trained under mand conditions in the morning on day 3, collateral testing of those responses under tact conditions would be tested in the late afternoon on day 4. Collateral testing procedures were identical to probe trial procedures that occurred before each training session; however, the tool puzzle pieces (used in mand training) were presented under the tact condition and the truck puzzle pieces (used in tact training) were presented under the mand condition.

While there was no purposeful delay in collateral testing conditions, this testing began after four tact and mand training sessions for Participant 2.
RESULTS

Table 1 summarizes and compares the criterion performances of the participants. Similarities in results for the two participants are as follows: 1) responses trained as mands (column a) were learned faster than responses trained as tacts (column b); 2) topographies trained under mand conditions (column a) transferred to tact conditions (column d); 3) topographies trained under tact conditions (column b) transferred to mand conditions (column d); and 4) responses trained as tacts (column b) transferred to mand conditions (column c) one session before mands being trained were learned (column a).

Table 1: Number of Probe Sessions to Reach Criterion

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<th>(a) Mand Acquisition</th>
<th>(b) Tact Acquisition</th>
<th>(c) Tact &gt; Mand Trnsfr</th>
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<td>Cement mixer, Green digger, Forklift</td>
<td>Cement mixer, Green digger, Forklift</td>
<td>Tape measure, Pliers, Wrench</td>
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<td>8</td>
<td>11</td>
<td>7</td>
<td>4</td>
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</table>

* criterion not met

Participant 2, who had a larger vocal/verbal repertoire of mands and tacts than Participant 1, acquired both mands and tacts faster than Participant 1. Transfer from mand responses to tact conditions and tact responses to mand conditions also occurred in fewer sessions for Participant 2 than for Participant 1. In addition, Participant 2 met criterion for emitting responses in both untrained (transfer) conditions before meeting criterion for acquisition of those same responses under the trained conditions. Figures 5-14 illustrate session by session performances of the two participants.

Acquisition of mands and tacts.
The course of Participant 1’s acquisition of mands and tacts is shown in Figure 5. The target mand responses for Participant 1 were screwdriver, pliers, and wrench and the target tact responses were forklift, bulldozer, and dumptruck. Participant 1 did not emit correct mand or tact responses under baseline conditions. Criterion for mand acquisition was met in the 13th probe session, but the criterion for tact acquisition was not met after 17 training sessions, at which time training was discontinued. Participant 1 first responded correctly on all three probe trials for both tacts and mands in the 9th probe session. In the next eight probe sessions, correct mands were emitted on all but 2 of 24 probe trials (one incorrect in the 10th probe session and one in the 16th probe session.) Probes of tacts undergoing training showed much less consistency, alternating between two and three correct over the eight probe sessions following the first session in which all three tacts were correct.

Acquisition of mands and tacts for Participant 2 is shown in Figure 6. The target mand responses were tape measure, pliers and wrench and the target tact responses were forklift, cement mixer, and green digger. Participant 2 did not emit correct mand or tact responses under baseline conditions. By the 4th probe session, Participant 2 emitted all three mand responses, but in the next session manded correctly only twice. Three sessions later (8th probe session) he met the training criterion of three consecutive sessions of emitted mands. In the 6th probe session Participant 2 first emitted all 3 tacts correctly, but performance was variable for the next several sessions. He met criterion for tact acquisition after 11 training sessions.

Acquisition of mands and transfer to tacts.
Figure 7 tracks the acquisition of mands and the concomitant transfer of those novel responses to tact conditions for Participant 1. By the 9th probe session, the participant emitted all three mand responses, but in the following session, he emitted only two mand responses. In the following three sessions (11-13), he manded all puzzle pieces, thereby meeting the transfer criterion. Responses trained as mands transferred to tact conditions after 19 sessions of mand training.

The acquisition of mands and the concomitant transfer of those responses to tact conditions for Participant 2 are shown in Figure 8. By the 4th probe session, Participant 2 emitted all three mand responses, but emitted only two mand responses in the 5th session. In the remaining four sessions he emitted all three mand responses and met training criterion in the 8th probe session. Probes for the transfer from responses trained as mands to tact conditions began after four sessions of mand training. In the first probe session for transfer to tact conditions, Participant 2 emitted two mands. In the three subsequent sessions, responses trained as mands transferred to tact conditions on all trials, resulting in Participant 2’s meeting criterion for transfer one session before meeting the criterion for mand acquisition.

Acquisition of tacts and transfer to mands.

Figure 9 tracks the acquisition of tacts and the concomitant transfer of those responses to mand conditions for Participant 1. By the 8th probe session, Participant 1 emitted all 3 tact responses; however, this participant failed to meet the criterion for tact acquisition after 17 training sessions. By the 10th transfer probe session, Participant 1 emitted as mands all 3 responses that were being trained as tacts. Transfer criterion was met in the 13th probe session.
Participant 2’s acquisition of tacts and concomitant transfer of those responses to mand conditions is shown in Figure 10. In the 6th session, Participant 2 emitted all tact responses and met tact training criterion after 11 training sessions. After seven transfer probe sessions, Participant 2 met criterion on the transfer from tact responses to mand conditions. This was one session before he met criterion for acquisition of those responses being trained as tacts.

Comparison of transferred response forms.

Figure 11 compares the tact trained responses emitted under mand conditions to mand trained responses emitted under tact conditions for Participant 1. Responses trained as tacts met the criterion for transfer to mand conditions after 12 sessions of tact training; whereas, responses trained as mands required 19 sessions to meet criterion for transfer to tact conditions. Finer grained examination of the data supports the greater ease of transfer from tact to mand than from mand to tact for Participant 1. For example, untrained mands (tact responses transferred to mand conditions) began to be emitted sooner (session 6) than did untrained tacts (mand responses transferred to tact conditions), the first occurrence of which was in session 9. In addition, although the first session in which all untrained tacts occurred (session 14) was only one later than the session in which all untrained mands occurred (session 13), mand responses were more consistent thereafter than tacts. Overall, 65% (33 of 51 trials) of the mand probes resulted in transferred tact to mand responses once the first transferred response occurred. By contrast, only 46% (26 of 57) trials of the tact probes showed transferred mand to tact responses.
Figure 12 compares the tact trained responses emitted under mand conditions to mand trained responses emitted under tact conditions for Participant 2. Responses trained as mands first occurred as tacts on all three probe trials after four sessions of tact training, and these transferred response forms continued in tact probes across the next two sessions. Thus, Participant 2 met the criterion for transfer to tact conditions after eight sessions of mand training. Although the first session in which responses trained as tacts were emitted as mands was only one session later than the reverse transfer, four further probe sessions were required for Participant 2 to meet criterion for transfer of tact-trained responses to mand conditions.
DISCUSSION

Evidence from the present study indicates that a repertoire of approximately 100 different mands and 100 different tacts may be sufficient to engender transfer soon after, or soon before, acquisition of response forms in mand relations or in tact relations. A repertoire of an approximately 75 additional mands and 75 additional tacts may be sufficient to allow both faster acquisition and faster transfer of mand and tact relations.

Previous research (Hall & Sundberg, 1987; Lamarre & Holland, 1985) indicates that transfer of response topographies trained under mand and tact conditions have not transferred without specific training of response forms under a particular condition. The quantity of the participant’s mand and tact repertoires were not specified in either study. Thus, further research is needed, for both typically-developing children and children with learning disabilities, to determine the minimum repertoire needed for the functional independence of mand-trained topographies and tact-trained topographies to give way to automatic transfer.

The present study also indicates that, similar to results reported by Carroll and Hesse (1987), acquisition of both relations may be faster if mands and tacts having the same topography are taught concurrently. Both participants met criterion on the transfer of tacts to mand conditions one session before acquisition of tacts themselves and met criterion on the transfer of mands to tact conditions one session before acquisition of mands themselves. Training responses under mand conditions while testing the responses under tact conditions, and vice versa, led to acquisition of the responses under the untrained condition occurring faster (by one session) than acquisition of the responses under the trained condition. For Participant 2, however, testing of the untrained response
began after 4 sessions of the trained response. It is unknown whether the delay in testing the untrained response affected the speed of acquisition for either response form.

Also indicated in the present study is that, for both participants, speed of acquisition of mands was significantly faster than speed of acquisition of tacts. The reinforcement for mand responses is the actual item manded and is of utmost value to the speaker (Skinner, 1957). This specific reinforcement produced by the mand may be more potent than the generalized conditioned reinforcement of tacts. Data from Participant 1 especially illustrates the differing potency of the reinforcement of mand and tact responses; Participant 1 failed to acquire tact responses after 17 training sessions but acquired mand responses after only 13 training sessions.

The present study was the first to investigate the functional independence of mands and tacts in two crucial ways. First, the participants were 2 vocal-verbal children with autism. Typical vocal-verbal children participated in Lamarre and Holland’s study (1985), while 2 profoundly deaf young adults with mental retardation, who used sign language to communicate, participated in Hall and Sundberg’s study (1987). The diagnosis of autism and the use of vocal-verbal language are two variables that warrant further experimental attention.

Secondly, the investigation of the functional independence of mands and tacts was based on the teaching of “pure” mands and tacts. “Pure” mands and tacts are defined by both their controlling variables and their reinforcement. Pure mands are under sole control of an establishing operation; a verbal discriminative stimulus such as “What do you want?” or a nonverbal stimulus such as an actual cookie are not present for the pure mand of “Cookie,” to be emitted. Reinforcement for a pure mand is the same topography
of the emitted mand response. “Pure” tacts are under sole control of a nonverbal
discriminative stimulus; a verbal discriminative stimulus such as, “What is it?” is not
present for a pure tact to be emitted. Pure tacts are reinforced by a generalized
conditioned reinforcer, such as the vocal-verbal statement “Good.” Mands in the present
study were trained after the conditioned establishing operation of “puzzle, then
(reinforcer)” was created, and the mand responses occurred without a verbal
discriminative stimulus and without the presence of the item to be manded (the
experimenter silently presented the puzzle and held the missing piece behind her back).
The reinforcer was the puzzle piece emitted in the response form. Tacts in the present
study were trained without a verbal discriminative stimulus present; the experimenter
physically prompted the participant to point, and orient to the nonverbal stimulus, in
order to emit a tact response. The reinforcer was a praise statement and affection. The
variable of teaching “pure” mand and tact response forms should be given experimental
attention, to help determine the external validity of the present study.
Figure 1: Mand Baseline Data Sheet

DATE__________
PARTICIPANT #__________
EXPERIMENTER__________

Mand Baseline

Materials: 3 cups with 3 small pieces of sour tarts/cheese popcorn in each
Tool puzzle
Data Sheet
Pencil/Pen

Instructions: Stand behind and/or slightly to side of participant. Place puzzle and 2
puzzle pieces in front of participant (other piece should be hidden). Instruct, “Puzzle,
then sour tarts/cheese popcorn.” Wait 5 seconds and write down everything participant
says. If participant emits the correct label, hand him on of the cups (make no eye contact
and deliver no vocal responses). If participant requests for the puzzle piece, but without
correct label, it is okay to respond, “I don’t know where it is.” After 5 seconds of no
responding by participant, remove puzzle pieces and present new trial.

Do 1 trial of each puzzle piece missing:

1. Pliers
2. Wrench
3. Tape Measure
Figure 2: Tact Baseline Data Sheet

DATE__________
PARTICIPANT #__________
EXPERIMENTER__________

Tact Baseline

Materials:  3 puzzle pieces from Truck puzzle
            Data Sheet
            Pencil/Pen

Instructions: Stand behind and/or slightly to side of participant. Place 1 puzzle piece in front of participant. Wait 5 second and write down everything participant says. If participant emits the correct label, deliver lots of praise and affection. If participant emits other labels, do not respond. After 5 seconds of no responding by participant, silently remove puzzle piece and present next trial.

Do 1 trial of each puzzle piece
  1. Forklift
  2. Green digger
  3. Cement Mixer
Figure 3: Mand Training Data Sheet

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<tr>
<th>DATE__________</th>
<th>PARTICIPANT #__________</th>
<th>EXPERIMENTER__________</th>
</tr>
</thead>
</table>

**Mand Training**

**PROBE:** Experimenter presents puzzle 3 different Times with each of the following missing. “Puzzle, Then sour tarts/cheese popcorn.” Experimenter waits 5 secs. (+) = correct (-) = incorrect. 1 min break before training begins.

**Training:** Experimenter sits next to participant. Presents puzzle with two pieces out of puzzle and the designated piece in experimenter’s hand, out of participant’s view. Instruction, “Puzzle, the sour tarts/cheese popcorn.” After participant puts two available pieces in, experimenter vocally prompts, with or without time-delay, the whole or part of the piece name. When participant vocalizes the piece name, experimenter gives piece to participant. After participant puts the designated piece in the puzzle and the puzzle is complete, participant receives popcorn/sour tarts and grape juice/water. PROMPTED responses = 1 piece of sour tart/popcorn, ¼ cup juice/water. UNPROMPTED responses = 3 pieces of sour tarts/popcorn, ½ cup juice/water.

<table>
<thead>
<tr>
<th>Wrench</th>
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<th>Pliers</th>
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<td>Pliers</td>
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Then, 3- min break before back to daily schedule.
Figure 4: Tact Training Data Sheet

DATE__________
PARTICIPANT #__________
EXPERIMENTER__________

**Tact Training**

**PROBE:** Experimenter presents the following Puzzle pieces 1 at a time in front of participant. Experimenter waits 5 secs. (+) = correct (-) = incorrect. 1 min. break before training begins.

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<thead>
<tr>
<th>Forklift</th>
<th>Bulldozer</th>
<th>Dumptruck</th>
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<td>Dumptruck</td>
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**Training:** Experimenter sits next to participant. Presents 1 piece at a time in front of participant. Experimenter physically prompts participant to point to puzzle piece and vocally prompts, with or without time-delay, the whole or part of the piece name. When participant vocalizes the piece name, experimenter delivers affection, praise, and eye contact to the participant. PROMPTED responses = small amount of praise. UNPROMPTED responses = lots of praise and affection

Then, 3 -min break before back to daily schedule.
Figure 7  Participant 1 - Acquisition of Mands and Transfer to Tacts

![Graph showing acquisition of Mands and transfer to Tacts for Participant 1. The graph plots number of Mand and Tact Topographies against Sessions. The x-axis represents sessions from 1 to 22, and the y-axis represents the number of mand and tact topographies from 0 to 3.5. The graph includes data points for both Mands Trained and Mand Responses Transferred to Tacts. Criteria for A and B as shown in the legend.](image)

Figure 8  Participant 2 - Acquisition of Mands and Transfer to Tacts

![Graph showing acquisition of Mands and transfer to Tacts for Participant 2. The graph plots number of Mand and Tact Topographies against Sessions. The x-axis represents sessions from 1 to 12, and the y-axis represents the number of mand and tact topographies from 0 to 3.5. The graph includes data points for both Mands Trained and Mand Responses Transferred to Tacts. Criteria for A and B as shown in the legend.](image)
Figure 9

Participant 1 - Acquisition of Tacts and Transfer to Mands

- Tacts Trained
- Tact Responses Transferred to Mands

A = Criterion met on transfer from tact responses to mands

Figure 10

Participant 2 - Acquisition of Tacts and Transfer to Mands

- Tacts Trained
- Tact Responses Transferred to Mands

A = Criterion met on transfer from tact responses to mands
B = Criterion met on tacts
Figure 11  
Participant 1 - Comparison of Transferred Response Forms

![Graph showing the comparison of transferred response forms for Participant 1. The graph displays the number of mand and tact topographies in the baseline and probe phases. The red line represents tact responses transferred to mands, and the green line represents mand responses transferred to tacts. Points A and B indicate where the criterion met on transfer from tact responses to mands and from mand responses to tacts, respectively.]

Figure 12  
Participant 2 - Comparison of Transferred Response Forms

![Graph showing the comparison of transferred response forms for Participant 2. The graph displays the number of mand and tact topographies in the baseline and probe phases. The red line represents tact responses transferred to mands, and the green line represents mand responses transferred to tacts. Points A and B indicate where the criterion met on transfer from mand responses to tacts and from tact responses to mands, respectively.]

Legend:
- Red Line: Tact Responses Transferred to Mands
- Green Line: Mand Responses Transferred to Tacts
- A: Criterion met on transfer from tact responses to mands
- B: Criterion met on transfer from mand responses to tacts
REFERENCE LIST


