TRANSFER OF MAND-TO-TACT AND TACT-TO-MAND TOPOGRAPHIES
IN TWO VOCAL-VERBAL CHILDREN WITH AUTISM:
A REPLICATION AND EXTENSION STUDY
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Skinner (1957) suggested that different verbal operants are acquired independently of each other and establishing a verbal operant as a mand will not necessarily result in the appearance of a tact having the same response form and vice versa. Recent empirical research has found that newly acquired mands and tacts can be transferred to different relations without direct training. The present study investigated 1) how verbal responses taught as pure mands affect untrained tact relations; 2) how verbal responses taught as pure tacts affect untrained mand relations; 3) how the size of mand and tact repertoires relate to speed of acquisition of new mands and tacts; and 4) how size of entering repertoires affect the transfer of mand topographies to tacts and vice versa. 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 a higher entering repertoire.
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INTRODUCTION

Skinner’s (1957) functional analysis of verbal behavior identified seven types of primary verbal relations. He used the term verbal behavior to “emphasize the individual speaker” and “specify behavior shaped and maintained by mediated consequences” (Skinner, 1957, p. 2). It is important to note that the consequences that shape and maintain verbal behavior depend on the behavior of a “listener.” The listener mediates the reinforcement for the behavior of the speaker, because the listener has been specifically trained by a verbal community to do so (Skinner, 1957, p. 226). Each of the seven types of verbal operants is defined by the type of antecedent that evokes the response and the type of consequences that select and maintain that antecedent/response relation. For the purposes of this study, mands and tacts are the verbal operants that will be discussed in greater detail.

Mands and tacts have been given the most experimental attention to date. Skinner (1957) suggested that mands and tacts could be functionally independent verbal relations even when they shared the same response topographies. The designation of operants as mands or tacts depends on the functional relation between the response forms and their controlling variables. To further understand the functional properties of mands and tacts it is important to consider the definition of each.

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) endorsed the term establishing operation for those controlling variables and clarified Skinner’s definition by pointing out that a mand is “a type of verbal operant where the
response is determined by a prior EO, as contrasted with the other verbal operants where it is determined by a prior \( S^D \)" (p. 6). Michael (1988) emphasized that Skinner’s “deprivation and aversive stimulation” may not be broad enough to cover all the motivative variables (i.e., establishing operations) involved in mands, and he emphasized that motivative variables in mands may be either learned or unlearned.

Lamarre and Holland (1985) emphasized the point that mands are reinforced by consequences specific to the form of the response rather than by generalized reinforcers. In other words, the specific consequence that reinforces a mand is determined by the topography of the response. In keeping with Skinner’s analysis, the refinements cited, and for the purpose of this study, mands are defined as verbal operants in which relations between motivative conditions and specific response topographies are reinforced by consequences specific to that response topography.

Skinner (1957) stated that a tact is, “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). Paraphrasing Skinner, Carroll and Hesse (1987) for purposes of their research defined a tact as, “a verbal response whose form is controlled by a nonverbal discriminative stimulus” (p. 55). Carroll and Hesse (1987) emphasized that the antecedent in a tact relation is a nonverbal discriminative stimulus. An object or event is able to acquire unique discriminative control due to the fact that reinforcement for emission of a particular response form occurs if and only if that object or event is present. Also the form of the reinforcer is not related to the form of the response (as is the case with the mand). Rather, tact relations are selected by generalized conditioned reinforcers (Skinner, p. 84).
Combining the discussions of Skinner (1957) and Carroll and Hesse (1987) for purposes of this study, tacts are herein defined as verbal operants whose response form is controlled by a nonverbal discriminative stimulus, which can be a particular object, event, or property of an object or event. Unlike in the case of mands, the form of the reinforcer that establishes and maintains tact relations is non-specific and is usually some form of generalized conditioned reinforcement such as money, points, or approval (e.g., “Right” or “Good”).

The distinction between the different controlling relations in tacts and mands and simple differences in topography of responses may be clarified by an example. When a child says the word “chip” it can mean different things. If the child is not in the presence of a potato chip and a chip is desired, the verbal response “chip” is likely a mand. If the same child sees a potato chip and says “chip,” although a chip is not desired, then the response the child is emitting is likely a tact. When comparing mands and tacts as established by a verbal community of speakers and listeners, manding benefits the speaker, while tacting benefits the listener. More specifically, manding allows the listener to learn more about the speaker’s condition regardless of any environmental variables, while tacting allows the listener to learn more about the environment regardless of the variables associated with the speaker.

According to Skinner’s analysis (1957), different verbal operants are acquired independently of each other and establishing a verbal operant as a mand will not necessarily result in the appearance of a tact having the same response form and vice versa. However, Skinner gave an example which implied that the ability to transfer from one verbal operant to another may be a skill that can develop over time with experience.
in the verbal community. The example (Skinner, 1957, p.188) is that of a child in a toy store who could not identify a particular toy upon visual inspection. When the child asked what it was the adult responded by calling it “a doodler.” The child immediately manded, “Buy me a doodler!” The explanation that Skinner (1957) gave is that, asking for the word needed to ask for the toy is a mand reinforced by the listener’s saying the word which, when echoed, characteristically produces the toy. Once this occurs, the response exists as an independent mand because it has been reinforced as such” (pp. 188-189). The example is important because one would expect that as this skill develops it would take *less* time with a new response form for it to transfer from one verbal operant to another. However, in the example above, level of mand and tact repertoires the child had are unknown. In any case, transfer was shown although Skinner did not describe it as such.

Skinner’s analysis was based on a naturalistic observation and was “an exercise in interpretation” (1957, p. 11) rather than one geared to experimental results. More recently, several experimental analyses have been undertaken with varying outcomes. Hall and Sundberg (1987) and Lamarre and Holland (1985) provided experimental evidence that mands and tacts acquired *independently* did not automatically transfer to the other type of relation. Other researchers have examined the conditions under which response forms learned in one verbal relation did appear in untrained relations. Sigafoos, Reichle, Doss, Hall and Pettitt (1990) sought to research spontaneous transfer of stimulus control from tact to mand contingencies. Those authors noted that in previous studies (e.g., Hall & Sundberg, 1987; Sigafoos, Doss, & Reichle, 1989)… “the spontaneous emergence of mands appeared to depend upon acquisition of at least one other
topography as a mand” (p. 167). However, the studies by Hall and Sundberg (1987) and Sigafoos, Doss, and Reichle (1989) developed experimental designs that did not permit analysis of the variables responsible for the generalized effects observed in the two studies (Sigafoos, Reichle, Doss, Hall & Pettitt, 1990).

In their efforts to research spontaneous transfer of stimulus control from tact to mand contingencies, Sigafoos, Reichle, Doss, Hall, and Pettit (1990) targeted the effects of a tact intervention on the acquisition of mands when tact intervention was superimposed on an existing mand repertoire (e.g., pointing to a “want” symbol). Two adults with diagnoses of Down’s syndrome and severe mental retardation participated in the study. Materials for the study consisted of three object/ utensil sets that were identified for each participant. The sets used contained a preferred food or beverage and the utensil required to access either the food or beverage. Prior to the start of the study the participants were taught to select the appropriate utensil from a field containing all three utensils, and once the utensil was selected they had to functionally use the utensil required for that particular food or beverage. After the training sets were identified the participants were presented with wallets containing small index cards with the word “want” in uppercase letters. On successive pages black and white line drawings of the aforementioned utensils were targeted for the study. Prior to this study, both participants had been taught a generalized request (“want”) using a picture exchange communication system. Using an A-B-A design, each set started with a mand baseline probe, followed by a tact probe, and ended with a mand probe. The mand probes were immediately applied again to determine if tact topography transfer would occur in the mand relations.
Mand baseline probes consisted of placing a single food or beverage on a table delivered contingent on a response of pointing to the “want” symbol displayed in front of the participant. The utensils required to consume the food or beverage were delivered if the same pointing response was made to a line drawing that corresponded to the appropriate utensil. If the participant was unable to mand both items within 10s the items were removed. The utensils were not visible so their absence could function as a conditioned establishing operation. Tact probes consisted of the experimenter holding one of the utensils and providing a vocal instruction, “What is this?” The correct response was a point to the corresponding line drawing. During baseline no corrections were delivered during a session for responding to any of the three line drawings. Once intervention began with all three items gestural and/or physical prompts were delivered toward the corresponding line drawing, and prompts were faded at the onset of the next trial.

Results indicated that for both participants two of the three mands emerged without direct training, demonstrating that the intervention used to teach tacts with the same topographies was ideal for creating a corresponding mand repertoire. Development of a generalized mand (i.e., want) may have helped the transfer of symbol selections to the mand baseline probes as well. The facilitative effects of teaching a generalized mand were not isolated. Another factor that may have been responsible for the results was the close temporal proximity of the mand and tact probes. In addition, the interventions were implemented using the same experimenter, setting, and objects. Sigafoos, Reichle, Doss, Hall, and Pettitt suggested that because of the rapid acquisition by individuals described as “severely retarded,” a prior favorable history in relation to these particular tasks could
have been a variable. Withholding utensils was an effective establishing operation as it established the utensils as reinforcers. The availability of a minimal mand repertoire in the assistance of spontaneous transfer was not clear from this study and, in addition, did not support nor oppose prior research indicating that tact intervention in and of itself is sufficient to induce a corresponding mand repertoire and vice versa.

Carroll and Hesse (1987) compared speed of tact acquisition when tact training trials were alternated with mand training trials having the same response topography vs. tact training alone. Their study was systematically replicated by Arntzen and Almas (2002); while Carroll and Hesse (1987) included typically developing pre-school children in their study, Arntzen and Almas (2002) included participants with and without disabilities. Both studies randomly divided participants into two groups; both groups received a tact-only training procedure and a mand-tact training procedure. One group received the tact-only procedure first using three objects, followed by the mand-tact procedure using three additional objects (A-B design). The other group received the mand-tact procedure first followed by the tact-only procedure (B-A design).

In the tact-only training phase the experimenter placed an object in front of the participant with a vocal prompt, “This is a _______. What is this?” Correct responses were praised (e.g., “Yes, that’s correct. Good girl!”). If the participant failed to respond to the question, the experimenter read the label and asked, “What is this?” If the participant answered with the wrong label, an echoic prompt was delivered, and the original question was represented. The mand-tact training consisted of an alternation between mand and tact trials. In a mand training trial, five of six objects needed to assemble a puzzle were placed in front of the participant and the experimenter instructed
the participant to “Finish the puzzle.” The participant was to mand for the missing piece.
One student did a different task, and was instructed to “Find the object” in a photo album consisting of five photos. The correct response was supposed to be a mand for the item missing in the photo album. Once the participant noticed there was a piece missing to complete the task, the experimenter vocally modeled the name of the missing piece.
After the participant repeated the name, the participant received the piece and was able to complete the task and play with the object that had been assembled. Tact training followed immediately, using the same procedures as in the tact-only training.

An important element, a tact-retention test, was administered after the participant had named all parts for each condition. Parts were presented in random order and the experimenter asked, “What is this?” Both Carroll and Hesse (1987) and Arntzen and Almas (2002) found that training mands and tacts concurrently resulted in faster acquisition of tacts than did teaching tacts alone. These two studies differed in the retention test. While Carroll and Hesse found that the mand-tact training was more effective in retention of the tact labels, the Arntzen and Almas study did not produce the same results. There was no difference in retention outcomes between the two procedures. The differing outcomes could have been a function of the timing of the follow-up test. Carroll and Hesse performed a follow-up test immediately after completing training; whereas, Arntzen and Almas administered a follow-up test several days after the completion of training. The number of objects selected for the follow-up test also could have made a difference. Carroll and Hesse used half of the objects in a follow-up test; whereas, Arntzen and Almas used all the objects trained.
Petursdottir, Carr, and Michael’s (2005) replication of Lamarre and Holland (1985) indicated that mands and tacts are not necessarily independent of each other. Using 5 typically developing children between the ages of 2 years 6 months and 3 years 8 months. Petursdottir et al. used a multiple-probe design to assess the effect of training mands on the emergence of untrained tacts as well as the effect of training tacts on the emergence of untrained mands. The participants were presented with one of two objects, a cube or a puzzle, each having four pieces. The participants were trained either to name the pieces (tact) or request absent pieces when they were required to complete a task (mand). Vocal prompts were used in training and testing for both mand and tact conditions. On tact trials the experimenter held up one piece and asked, “What is this?” If the participant emitted the target response, the experimenter delivered praise (e.g., “Very good!”) and a sticker. If the participant made an incorrect response or no response at all, the experimenter vocally prompted a correct response and then repeated the trial. For mand trials participants were presented with an assembly task in which one out of the four objects needed was missing. Once the participant attempted to finish the task, the participant was asked, “What do you need?” If the participant emitted the target response the experimenter immediately delivered that piece but provided no other consequences (e.g. praise or smiles). Once the participant completed the puzzle with the piece provided, the experimenter praised task completion (e.g., “Good job putting them together!”) and the participant received a sticker.

This study resulted in reliable tacting following mand training, and some manding following tact training in typically developing children approximately 2 - ½ to 3 - ½ years old. Of some interest here is the fact that the two youngest children in Pettursdottir,
et al. failed to demonstrate tact-to-mand transfer. However, the older children did demonstrate tact-to-mand transfer, signifying a possible link between a higher repertoire of verbal skills and more effective tact-to-mand transfer.

Castellani (2004) investigated the functional independence of mands and tacts using two vocal-verbal children with autism. She attempted to train “pure” mands and tacts pointing out that those operants are defined by both their antecedents and their reinforcers. For a mand to be “pure” a verbal response would have to be under the sole control of an establishing operation (occasioned by the absence of a needed object). That relation must be established by delivering the needed object (and nothing else) contingent on emission of the response. In other words, an item such as a potato chip could not be present, nor a question such as, “What would you like?” asked if the pure mand was the “chip.” Only a condition that established the value of the item would be in effect. For a tact to be considered “pure” the verbal response must be emitted under the sole control of a nonverbal discriminative stimulus and in the absence of a verbal stimulus such as, “What is it?” Further, that relation must be established via generalized conditioned reinforcement.

Castellani (2004) sought to investigate whether novel responses taught in mand relations would be emitted as tacts when the opportunity to do so was presented, and vice versa. Castellani also examined whether the size of pre-experimental mand and tact repertoires affected the rate of acquisition and/or transfer. Two vocal-verbal children with autism, ages 9 and 13, participated in her study. Unlike previous studies, the approximate number of mands and tacts in each individual’s repertoire was identified. The 9-year-old participant had a repertoire of approximately 100 mands and 100 tacts,
while the 13-year-old participant had a repertoire of approximately 175 mands and 175 tacts.

Each of the participants was taught three novel responses as mands and three novel responses as tacts. The objects serving as discriminative stimuli in tact training were puzzle pieces depicting three different types of truck. The objects serving as reinforcing consequences in mand training were puzzle pieces depicting three different tools. Two Easy-Grip© wooden peg puzzles, one containing different tools and the other containing different trucks, were used. The puzzle pieces not used as manipulanda were glued into the frame and painted over. The bottoms of the apertures where manipulanda were inserted were also painted over. After establishing a history of reinforcement for completing the puzzles, a missing puzzle piece was used in mand trials as an establishing operation for manding the missing piece. Delivery of the piece was the sole consequence for manding. Tact trials involved presenting a puzzle piece without instruction and providing social reinforcement for emitting the correct name. After baseline both mand training with tool pieces and tact training with truck pieces were conducted in daily sessions. At a different time of the day tests were conducted for transfer from manding to tacting for tool pieces and for transfer of tacting to manding for truck pieces. Mand topographies transferred to tact relations, and tact topographies transferred to mand relations for both participants. In addition, both acquisition and transfer occurred in fewer sessions for the participant with the greater repertoire of mands and tacts.

The purpose of the present study was to extend the generality of the Castellani (2004) study by including two participants with autism with even greater differences in the size of their mand and tact repertoires.
The current study asked the following experimental questions: 1) How will verbal responses taught as pure mands affect untrained tact relations? 2) How will verbal responses taught as pure tacts affect untrained mand relations? 3) How will the size of mand and tact repertoires relate to speed of acquisition of new mands and tacts? 4) How will size of the entering repertoires affect the transfer of mand topographies to tacts and vice versa?
METHOD

Participants

Two English speaking students with autism at a private school for children with autism participated in the study. Both participants could respond echoically. Participant 1 was a 16-year-old male with a repertoire of approximately 300 tacts. Many of the response topographies he emitted as tacts were also emitted as mands. Participant 2 was a 9-year-old female with a repertoire of approximately 20 tacts. During the time of the study she was on medication including, Haldol®, Cogentin®, Tenex®, and Trileptol®. Unlike Participant 1, Participant 2 did not emit tact response topographies as mands. Participant 1’s programming did not include data collection on spontaneous language. Over a 2-week assessment, or 10 school days, the average number of mands prior to the study was 85/day. Data from school records indicated Participant 2 was averaging 20 mands/day before the study began. While both participants had the ability to mand using gestures, the mand average reported here for both participants was based solely on vocal manding.

Setting and Materials

All sessions occurred at the school. Baseline and all probe sessions for Participant 1 took place in a 10 ft x 10 ft room containing a video camera and tripod, and one 2 ft x 2 - ½ ft desk and 1 chair. Baseline and all training and probe sessions for Participant 2 occurred in a 7 - ½ ft x 8 - ¾ ft room that also served as her regular workspace. In addition, to her personal belongings (backpack and reinforcers from home) that she placed to the side of the room, there was a 2 ft x 2 - ½ ft desk and two chairs, along with a video camera and tripod.
Two Fresh Start© chunky wooden puzzles were used, one containing seven different tool puzzle pieces and one containing six different truck puzzle pieces. Three unfamiliar pieces from each puzzle were used to train both participants. The puzzle pieces not used for the study were painted white to conceal the pictured objects and were glued into their respective puzzle boards. For the puzzle pieces used in the study, pictures of the pieces could be seen in the apertures where puzzle pieces were to be fitted into the puzzle boards. Both participants were taught the same mands and tacts in the study. The tool puzzle was used to teach mands wrench, pliers, and tape measure. The truck puzzle was used to teach tacts dump truck, back hoe, and pick-up.

In the mand sessions edibles were used for both participants with Participant 1 earning Tostitos© corn chips and Participant 2 earning pieces of Peppermint Patties©. These items had been demonstrated to function as reinforcers for learning targets at school. While these edibles were highly preferred they were not the most preferred, as the most preferred were reserved as reinforcers for regular daily programming in school. In addition to the edibles, both participants had access to water during all the sessions.

**Procedures**

*Pre-training Sessions*

To ensure missing puzzle pieces constituted an establishing operation for requesting them, daily pre-training sessions occurred for 5 consecutive days before baseline began. A history of completing a puzzle and then receiving the edible item was the target of this pre-training phase. While in their respective rooms, each participant was presented with one puzzle and the corresponding pieces placed on the desk in front
of them. Each puzzle was presented a total of three times/session and presentation order of the two puzzles was alternated.

Participant 1. The experimenter instructed, “Puzzle, then Tostitos.” When the participant completed the puzzle, he received three corn chips. Also water was available to him. After he finished his food and drink, the experimenter removed that puzzle and presented the next puzzle. The session continued until each puzzle had been presented three times.

Participant 2. The experimenter instructed, “Puzzle, then peppermint patty.” When the participant completed the puzzle, she received three small pieces of a peppermint patty. Also water was available to her at all times. After she finished her food and drink, the experimenter removed the puzzle and presented the next puzzle. Each puzzle was presented three times.

From the start of the pre-training phase until completion of the study, access to the edibles used as reinforcers was limited to the experimental sessions. Furthermore, edible reinforcers were available only upon completion of a puzzle and at no other time during the school day.

Baseline Phase

Baseline sessions began the day after conclusion of pre-training sessions. Baseline sessions were conducted to assess each participant’s initial ability to tact the pictured tools and trucks and to mand for those puzzle pieces orally. Baseline sessions were conducted twice daily over 3 days for each participant; one session occurred in the morning and the other, in the afternoon. Both puzzles were assessed under tact and mand conditions. Order of conditions was alternated each day (e.g., if the mand baseline
occurred on the morning of day 1, then the tact baseline was conducted on the morning of
day 2 for that participant). Order of puzzle pieces presented alternated from session to
session.

Mand baseline. While the participant sat at a desk in the designated work space
the experimenter stood behind and slightly to the side of the participant. One of the
puzzle frames was placed in front of the participant along with two puzzle pieces with
one piece missing. The experimenter instructed, “Do your puzzle.” The order of pieces
designated to be missing across the three trials differed across the 3-day baseline. For
example, if on the first day of the baseline with the tool puzzle, the order for the
designated missing pieces on the three trials was wrench, then pliers, and then the tape
measure, presentation order the next day might be pliers, tape measure, and then wrench.
The same type of presentation order was followed for the truck puzzle as well. Each
puzzle was presented three times for a total of six puzzle presentations with one piece
missing/ session.

The experimenter recorded any vocal responses made by the participant within
the next 5s. Whether the participant emitted the target vocal response, any other vocal
response, or no vocal response within 5s, no consequence was delivered. Then the
experimenter removed the puzzle and the puzzle pieces from the table and prepared the
next trial out of the participant’s view. Before a new trial began the experimenter waited
briefly for appropriate attending behavior and if necessary vocally or non-vocally
prompted attending behavior (e.g., hands on lap or hands on desk). After all six trials
were completed the participant took a break before returning to the daily schedules and/
or routines. These breaks were supervised by their regular instructors for the amount of
time normally allotted. Figure 1 illustrates the data sheet used during mand baseline sessions.

**Tact baseline.** The tact baseline was similar to the mand baseline in that the sessions were conducted at the desk in the designated area, and the experimenter stood behind and slightly to the side of the participant. Each puzzle piece was presented one time for a total of six presentations/session. The experimenter did not deliver any instruction and placed the puzzle piece in front of the participant, waited for no more than 5s, and recorded any of the participant’s vocal responses. Whether the participant emitted the target vocal response, and/or any other response, or 5s elapsed with no responding, no consequence was delivered. The experimenter then removed that puzzle piece and began a new trial with a different puzzle piece. After all six trials were conducted the participant was allowed to take a break before returning to the daily schedules and/or routines. Breaks were supervised by the classroom instructors for the normally allotted amount of time. Figure 2 illustrates the data sheet used in tact baseline sessions.

**Probes and Training**

The probe and training phase of the study began the day after baseline sessions ended for both mand and tact conditions. Training occurred in the participant’s designated work space, and, as in baseline sessions, data collection occurred twice a day, morning and afternoon, with one time designated for mand training and the other, for tact training. Training time was alternated so that training did not occur at the same time as on the previous day. Within this phase of the study training was conducted on any day
that the participant did not pass a probe test conducted at the beginning of the training session. Training was discontinued when the participant met mastery criterion of 100% accuracy over 3 consecutive days for both the mand and tact probes. That is, if one relation met criterion first, training was continued on that relation until criterion was reached on the other. Training was discontinued for both at that time.

*Mand probes and training sessions.* The tool puzzle was used to train mands for both participants. Mand probes, conducted at the beginning of each mand training session, were identical to baseline trials, except edibles and vocal praise were delivered after each correct independent response. Three probe trials, one with each puzzle piece, were conducted. If there was at least one incorrect response during the mand probe training was conducted immediately.

Probes began with the experimenter standing behind and slightly to the side of the participant while placing the tool puzzle and two puzzle pieces on the desk. The third piece that was needed to finish the puzzle was in the experimenter’s pocket. The experimenter instructed, “Puzzle, then (edible)” and the participant was required to place the pieces on the desk into the puzzle. This was followed by a verbal request for the missing piece. If the participant emitted the correct response independently and within the 5s allotted for each trial, the participant received the puzzle piece and, upon completing the puzzle, received three pieces of his or her preferred edible. In a departure from the protocol as designed, praise often accompanied receipt of the puzzle piece and/or delivery of the edible.

Mand training trials began immediately following mand probe trials. The mand training consisted of 15 trials, 5 trials for each target puzzle piece. Mand training started
each time with three consecutive trials for one puzzle piece, followed by three
consecutive trials of another, etc. (e.g., wrench, wrench, wrench, pliers, pliers, pliers,
tape measure, tape measure, tape measure). Once the consecutive presentations
concluded, six quasi-random presentations followed (e.g., wrench, tape measure, pliers,
tape measure, pliers, wrench). Presentation order was changed for each training session.

The training procedure was conducted as follows. After 1-2s elapsed following
the participant placing both puzzle pieces into the puzzle, the experimenter provided the
name of the missing puzzle piece. When the participant correctly echoed the name of
that tool the experimenter handed the missing piece to the participant. If the participant
was unresponsive the experimenter repeated the tool name. Once the participant emitted
the tool name, received the tool piece, and correctly placed the missing piece into the
puzzle, the participant received a piece of the preferred edible. If the participant required
a full or partial vocal prompt for the required response, the participant received a single
piece of the reinforcer and a low level of vocal praise. The participant received three
pieces of the reinforcer and more extensive vocal praise for independent, unprompted
responses. Figure 3 illustrates the data sheet used in mand training.

Tact probes and training. The truck puzzle pieces were taught to both
participants as tacts. Three probe trials, one for each truck puzzle piece, were conducted
at the beginning of each tact training session. Tact probes were identical to baseline trials
except social reinforcement was delivered after each correct independent response. If
there was at least one incorrect response during the tact probe trials, tact training was
conducted.
The probes began with the experimenter standing behind and slightly to the side of the participant while placing a truck puzzle piece on the desk. The experimenter did not give an instruction and waited no more than 5s for a response. If the participant emitted the correct verbal response independently, animated vocal praise was delivered as a consequence. There were three tact probes (one trial for each piece) at the beginning of each session. If there was at least one incorrect response, tact training trials followed. Tact training consisted of 15 trials, 5 trials for each target puzzle piece. Tact training began with three consecutive trials for one puzzle piece, followed by three consecutive trials of another, etc. (e.g., *pick-up, pick-up, pick-up, back hoe, back hoe, back hoe, dump truck, dump truck, dump truck*). Once the consecutive presentations concluded, six quasi-random trials followed (e.g., *pick-up, dump truck, back hoe, dump truck, back hoe, pick-up*). The presentation order was changed for each training session.

Tact training trials were similar to probe trials, except that after a 1-2s time delay, a gestural prompt (i.e., the experimenter pointed to the puzzle piece) was followed by an echoic prompt. If the participant required a prompt to emit the target response, brief vocal praise was delivered (e.g., “Good work”). If the participant independently labeled the puzzle piece, more extended and animated praise was delivered (e.g., “Awesome work buddy!”). Figure 4 illustrates the data sheet used in tact training.

**Transfer Tests**

Testing for transfer was conducted to determine if the response topographies taught under mand conditions occurred under tact conditions and vice versa. Transfer test sessions occurred in the work space designated for the study. This testing occurred at different times of the day than did the training sessions. Testing for transfer began the
day after the first probe/training sessions for both conditions. If the first day of mand training occurred in the morning, testing for transfer of those responses under tact conditions occurred in the late afternoon of the next day. Transfer test trials were identical to probe trials that occurred before each training session, except the truck puzzle was tested under mand conditions and the tool puzzle was tested under tact conditions. Mastery of transfer had the same mastery criterion as mand and tact training. When the vocal responses were emitted in both untrained conditions over 3 consecutive days at 100% accuracy, the experiment was terminated. Figure 5 illustrates the data sheet used in transfer tests.

Reliability

Inter-observer agreement (IOA) data were collected by an independent observer on 25% of the trials during all conditions of the study for both participants. Using the formula Agreement/Agreement + Disagreement x 100, percentage agreement was at 100% for both participants.

Treatment integrity data could not be adequately collected due to the data collector’s difficulty seeing on the tapes what piece was missing in the puzzles. However, in accordance with standard training procedures in the school setting, social reinforcement was delivered with puzzle pieces, as reported above, although that had not been planned.
RESULTS

Comparison of Participant 1 and Participant 2 Mand and Tact Acquisition

The course of Participant 1’s mand and tact acquisition is shown in Figure 6. Participant 1 did not emit correct mand or tact responses during baseline. Correct responding during training began in the 3rd mand probe and also in the 3rd tact probe sessions. Participant 1 manded correctly on 2 trials and tacted on 1 trial in their respective sessions. During the 4th probe session, Participant 1 responded correctly on all 3 probe trials for both mands and tacts. Subsequent sessions for mand and tact probes were at 100% accuracy during the remainder of the study for Participant 1. Acquisition criteria were met in the 6th mand probe and in the 6th tact probe sessions.

The course of Participant 2’s mand and tact acquisition is shown in Figure 7. Participant 2 did not emit correct mand or tact responses during baseline. Correct responding during mand probe trials began during the 5th probe session, and Participant 2 manded correctly on all 3 trials. During the following session Participant 2 manded correctly on only 2 trials. Beginning with the 7th session and for the remainder of the study, mand probes were at 100% accuracy for Participant 2. Mand acquisition criterion was met in the 9th probe session. Correct responding during tact probe trials began at the 16th probe session. Subsequent sessions (with the exception of four sessions) produced at least 1 correct response. During the 29th probe session, Participant 2 responded correctly on all 3 tact probe trials. In 4 of the 7 sessions that followed, correct responding occurred on all trials, and the last three sessions were at 100% accuracy, thus meeting mastery criteria. Tact acquisition criterion was met in the 36th probe session.
In summary, despite Participant 2’s limited verbal repertoire, she needed only three sessions more than Participant 1 to meet the mand training mastery criterion. Although the difference in the number of training sessions required is relatively small, Participant 2 required 50% more mand training sessions than Participant 1. The two participants’ acquisition differed greatly in tact acquisition. Participant 2 met criterion in the 6th tact probe session; whereas, Participant 1 met tact training criterion in the 36th tact probe session.

**Comparison of Participant 1 and Participant 2 Mand-to-Tact and Tact-to-Mand Transfer**

The course of Participant 1’s mand-to-tact and tact-to-mand transfers is shown in Figure 8. In the first transfer test session, tact-to-mand transfer occurred on two of the three trials for Participant 1. The next two sessions produced the same result, 2 correct responses. At the 4th tact-to-mand transfer test, Participant 1 responded correctly on all three trials. The subsequent sessions were at 100% accuracy, and a mastery criterion for tact-to-mand transfer was met in the 6th transfer test session. For mand-to-tact transfers correct responses emerged during the 3rd transfer test, and 100% accuracy was maintained for the duration of the study. Mand-to-tact criterion was met in the 5th transfer test.

The course of Participant 2’s mand-to-tact and tact-to-mand transfers is shown in Figure 9. Neither of the topographies transferred for Participant 2 until after several test sessions. Transfer occurred in 1 trial during the 5th mand transfer test and in 1 trial during the 5th tact transfer test. Participant 2 began to show reliable tact-to-mand transfer in the 11th transfer test. Thereafter until the end of the study, Participant 2 responded correctly at least once during all transfer tests for the tact-to-mand condition. From the
17th to the 23rd tact-to-mand transfer tests, Participant 2 emitted 2 correct responses. From the 23rd transfer test until the end of the study, Participant 2 was 100% accurate on tact-to-mand transfers with the exception of session 24 wherein 2 of 3 responses were correct. Tact-to-mand mastery criterion was met on the 27th transfer test. Participant 2 did not begin to show reliable mand-to-tact transfer until the 20th transfer test. While the previous 19 mand-to-tact transfer tests displayed variability, from the 20th transfer test until the end of the study Participant 2 was 100% accurate on mand-to-tact transfers with the exception of session 26 in which 2 of 3 responses were correct. Mand-to-tact mastery criterion was met on the 22nd transfer test.

Overall, Participant 2 required four times as many transfer test sessions than did Participant 1 to achieve mand-to-tact transfer and also to achieve tact-to-mand transfer.

In summary, transfer of topographies from mand-to-tact relations, and vice versa, was accomplished by both participants. Participant 1 achieved mastery before Participant 2. However, both participants displayed more variable performance in the mand-to-tact condition before abruptly responding with 100% accuracy, which they maintained for the duration of the study. Similarly, both participants showed steady progress in the tact to mand transfer.

Effect of Pure Mand and Pure Tact Training on Transfer

Because tacts were taught as pure tacts and mands were taught as impure mands, it is not possible to answer the first two questions the study was designed to answer: 1) How will verbal responses taught as pure mands affect untrained tact relations? 2) How will verbal responses taught as pure tacts affect untrained mand relations? Even so,
differences in the way that Participant 1 and Participant 2 responded to pure tact training and impure mand training is interesting and will be discussed in the section below.
DISCUSSION

Results of the present study support the findings of Castellani (2004) that a larger repertoire of mands and tacts allows for faster acquisition of mand and tacts as well as faster transfer of mand and tact relations.

Although this study was planned to compare rate of acquisition of pure mands and pure tacts, the procedures that were implemented did not allow for this comparison. Specifically, in mand training and probe conditions as well as in tact to mand transfer tests, both an EO and specific nonverbal stimuli in the form of pictures of the puzzle pieces in the apertures were present during those conditions. While pictures of the puzzle pieces in the apertures in Castellani (2004) were painted over with only an outline of the puzzle piece visible, pictures in the apertures in the present study were not painted over, thus allowing for the possibility of stimulus control by those pictures during the mand conditions. Another departure from Castellani (2004) was the addition of social reinforcement during the mand conditions when a correct response was made. Thus, pure tacts were trained and transferred; whereas, mand training and transfer tests always allowed for the possibility of multiple control by EO$s and SD$s.

Even so, it is possible to state that for Participant 1 the additional sources of control during mand training did not appear to make a difference. As can be seen in Fig. 10, Participant 1 mastered acquisition of (pure) tacts and (impure) mands at approximately the same time and very quickly; and he also showed transfer in both cases by the time he demonstrated acquisition.

The lag in Participant 2’s acquisition of tacts vs. mands seen in Figure 11 cannot be attributed to the fact that impure mands were trained and pure tacts were trained;
however, that is a possibility. Figure 11 also shows that topographies trained as tacts transferred to the mand condition 8 sessions earlier than tact training had been completed, suggesting that reinforcers in the mand conditions were more effective than reinforcers in the tact condition. This could be the case, because there were both social and nonsocial reinforcers in the mand training and testing conditions; whereas, only social reinforcers were delivered in the tact training and testing. This interpretation is supported by the fact that the rapidly acquired mand topographies (which were trained as impure mands) took 22 sessions to transfer to tact conditions; whereas, the tact topographies (trained as pure tacts) transferred to mand conditions well before they achieved training criterion.

In summary, the results of the present study support Castellani’s findings that size of tacting and manding repertoires contributes to speed of tact and mand acquisition and speed of transfer of topographies from one verbal relation to the other. Comparison of pure mand and pure tact acquisition was not possible because pure mand conditions were not implemented. However, this difference in procedure had no effect on acquisition or transfer across topographies for Participant 1 because all criteria were met at approximately the same time.
<table>
<thead>
<tr>
<th>Participant</th>
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</thead>
<tbody>
<tr>
<td>Experimenter</td>
<td>Julio Ruiz</td>
</tr>
<tr>
<td>Materials</td>
<td>Tool puzzle, truck puzzle, data sheet, pen/ pencil</td>
</tr>
<tr>
<td>Experimenter Instructions</td>
<td>Stand behind and/ or slightly to the side of the participant. Place the puzzle and 2 puzzle pieces in front of the participant (the 3rd piece should be hidden). Each puzzle will be presented 3 times with a different tool or truck missing. Instruct the participant, “Do your puzzle.” Wait for 5 seconds and write down everything the participant says. If the participant emits the correct label, incorrect label or has 5 seconds of no responding no consequence is delivered and the puzzle pieces are removed and a new trial is presented.</td>
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<tbody>
<tr>
<td>Wrench ____</td>
<td>Back hoe_____</td>
<td>Pliers_____</td>
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<tr>
<td>Pliers ____</td>
<td>Dump truck_____</td>
<td>Tape measure____</td>
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<tr>
<td>Tape Measure ____</td>
<td>Pick-up ______</td>
<td>Wrench____</td>
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<tr>
<td>Pick-up ____</td>
<td>Tape measure____</td>
<td>Dump truck____</td>
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<tr>
<td>Back hoe ____</td>
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</tr>
<tr>
<td>Dump truck ____</td>
<td>Pliers ______</td>
<td>Back hoe____</td>
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*Figure 1.* Mand baseline data sheet.
Participant

Experimenter  Julio Ruiz

Materials  Tool puzzle, truck puzzle, data sheet, pen/ pencil

Experimenter Instructions  Stand behind and/ or slightly to the side of the participant. Place 1 puzzle piece in front of the participant. There will be a total of 6 presentations of a puzzle piece with 3 from the truck puzzle and 3 from the tool puzzle. Wait for 5 seconds and write down everything the participant says. If the participant emits the correct label, incorrect label, or has 5 seconds of no responding no consequence is delivered and new trial is presented.

DATE_________  DATE___________  DATE _________

Back hoe ____  Pliers ____  Pick-up ____
Pick-up ____  Wrench ____  Dump truck ____
Dump truck ____  Tape measure ____  Back hoe ____
Tape measure ____  Dump truck ____  Wrench ____
Pliers ____  Back hoe ____  Tape measure ____
Wrench ____  Pick-up ____  Pliers ____

Figure 2. Tact baseline data sheet.
Participant

Experimenter  Julio Ruiz

Materials  3 pieces from the Tool puzzle, data sheet, pen/pencil, SR+

Experimenter Instructions

PROBE
Present the puzzle 3 different times with a different piece missing each time. Instruct, “Puzzle, then SR+.” Wait 5 seconds and score (+) for correct response and (-) for incorrect response. For correct responses, participant can receive SR+.

TRAINING
Stand behind and/or slightly to the side of the participant. Place the puzzle and 2 puzzle pieces in front of the participant (the 3rd piece should be hidden). Instruct the participant, “Puzzle, then SR+.” 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 SR+. PROMPTED responses = small amount of SR+. UNPROMPTED responses = larger amount of SR+. When training is complete, there is a 3 min break given before getting back to daily schedule.

DATE_____

PROBE
Wrench ____  Pliers ____  Tape measure ____

<table>
<thead>
<tr>
<th>Wrench</th>
<th>Wrench</th>
<th>Wrench</th>
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</tbody>
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Figure 3. Mand training data sheet.
Participant | Julio Ruiz  
---|---
Materials | 3 pieces from the Truck puzzle, data sheet, pen/ pencil  
Experimenter Instructions | **PROBE**  
Present a puzzle piece 1 at a time in front of the participant. Wait 5 seconds and score (+) for correct response and (-) for incorrect response. There is a 1 min break before training begins. For correct responses, participant can receive large amount of praise and eye contact.  
**TRAINING**  
Stand behind and/or slightly to the side of the participant. Place 1 puzzle piece in front of the participant. Physically or gesturally prompt the participant to point to the puzzle piece and the experimenter vocally prompts, with or without time-delay, the whole or part of the piece name. When the participant vocalizes the piece name praise and eye contact to the participant is delivered. PROMPTED RESPONSES = small amount of praise. UNPROMPTED RESPONSES = larger amount of praise. When training is complete, there is a 3 min break given before getting back to daily schedule.

**DATE____**

**PROBE**  
Pick-up _____  
Back hoe _____  
Dump truck _____

| Pick-up |  
|---|---|---|---|
| Pick-up |  
| Pick-up |  
| Back hoe |  
| Back hoe |  
| Back hoe |  
| Dump truck |  
| Dump truck |  
| Dump truck |  
| Back hoe |  
| Dump truck |  
| Pick-up |  
| Dump truck |  
| Pick-up |  
| Back hoe |  

*Figure 4. Tact training data sheet.*
### Participant | Julio Ruiz
---|---
### Experimenter | Julio Ruiz
### Materials | 3 pieces from the Tool puzzle, data sheet, pen/ pencil
### Experimenter Instructions | **PROBE**
Present a puzzle piece 1 at a time in front of the participant. Wait 5 seconds and score (+) for correct response and (-) for incorrect response. There is a 1 min break before training begins. For correct responses, participant can receive large amount of praise and eye contact.

---

**DATE_____**

**Mand to Tact PROBE**

- Wrench ____
- Pliers ____
- Tape measure ____

---

### Participant | Julio Ruiz
---|---
### Experimenter | Julio Ruiz
### Materials | 3 pieces from the Truck puzzle, data sheet, pen/ pencil, SR+
### Experimenter Instructions | **PROBE**
Present the puzzle 3 different times with a different piece missing each time. Instruct, “Puzzle, then SR+.” Wait 5 seconds and score (+) for correct response and (-) for incorrect response. For correct responses, participant can receive SR+.

---

**DATE_____**

**Tact to Mand PROBE**

- Back hoe ____
- Dump truck ____
- Pick-up ____

*Figure 5. Mand to tact & tact to mand data sheets.*
Figure 6. Participant 1: Mand & tact acquisition.

Figure 7. Participant 2: Mand & tact acquisition.
**Figure 8.** Participant 1: Mand to tact & tact to mand transfer.

**Figure 9.** Participant 2: Mand to tact & tact to mand transfer.
Figure 10. Participant 1: Mand & tact acquisition vs. mand & tact transfer.

Figure 11. Participant 2: Mand & tact acquisition vs. mand & tact transfer.
REFERENCES


