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The Effects of Manipulating Conditioned Establishing Operations on the Acquisition of Mands in Children with Autism Spectrum Disorders

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The Effects of Manipulating Conditioned Establishing Operations
on the Acquisition of Mands in Children with Autism Spectrum Disorders

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
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Abstract

In *Verbal Behavior*, Skinner (1957) suggested that each verbal operant has independent response functions, in which acquiring one does not automatically result in the other, unless transfer between the verbal operants is directly trained. Although several researchers have shown that mands and tacts are functionally independent, more recent research has demonstrated that mands may emerge following tact training. However, this research has not clarified the influence of establishing operations on the emergence of pure mands following tact training. Therefore, the present study investigated the effects of tact training on the acquisition of impure and pure mands in children with autism spectrum disorders (ASD) when conditioned establishing operations (CEO) were manipulated during mand probes. Three children diagnosed with ASD were taught to tact the utensils needed to consume their preferred edibles and then were assessed on their ability to mand for those utensils during CEO absent versus CEO present pure mand probes using a multiple baseline design across participants. It was hypothesized that children would be able to mand for the missing utensils needed to consume their preferred edibles only when the food items were present (CEO present, pure mand probes), but not when they were absent (CEO absent, pure mand probes). Results showed that responses taught as tacts failed to transfer to mand responses until direct training was implemented for two of the three participants. However, once a mand response was learned, all participants exhibited the mand in the CEO present condition but not in the CEO absent condition.

Chapter One

Introduction

Children diagnosed with autism spectrum disorders (ASD) and other developmental disabilities tend to have language delays that are of significant concern for parents and teachers. One of the most challenging tasks with children who have language delays is teaching them to communicate when they have a limited ability to imitate or do not have spontaneous speech (Drash, High, & Tudor, 1999). In recognition of the importance of teaching communication skills to children with developmental disabilities, understanding how language is acquired has been investigated and continues to be of interest in recent research (Gilliam, Weil, & Miltenberger, 2010; Hernandez, Hanley, Ingvarsson, & Tiger, 2007; Twyman, 1996). Skinner's (1957) theoretical analysis of verbal behavior has been used as the hallmark for teaching individuals with developmental disabilities. In his book, *Verbal Behavior*, Skinner proposed that language is learned behavior that is acquired and maintained by the same types of environmental variables and principles (motivating operations, stimulus control, reinforcement) that control nonverbal behavior (Cooper, Heron, & Heward, 2007). He defined verbal behavior as social interactions between speakers and listeners, in which speakers gain access to reinforcement and control their environment through the behaviors of the listeners (Cooper et al., 2007; Skinner, 1957). In his analysis, Skinner identified six verbal operants: mand, tact, echoic, intraverbal, textual, and transcription. This study focused on two of these verbal operants: the mand and the tact.

Skinner (1957) defined the 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 (also referred to as establishing operations or EOs). For example, a state of deprivation with respect to hunger may evoke the mand “cereal please.” As a result, obtaining a bowl of cereal functions as the reinforcer for the verbal response and strengthens it so it is more likely to occur in the future when the EO is present again. Thus, the reinforced mand, “Give me a bowl of cereal”, would allow the speaker to access the cereal. Contrasted to the other types of verbal operants, the mand response has no specified relation to a prior stimulus and is the only type of verbal behavior that directly benefits the speaker by obtaining a specific reinforcer or item manded. Hence, mands are very important for the early development of language, because children learn that speaking benefits them directly and as a result requesting what they want or do not want is reinforced (Cooper et al., 2007; Drash et al., 1999; Skinner, 1957; Sundberg, 2006). Thus, a focus on mand training for children with ASD is recommended as one of the first skills to be taught in a language program (Cooper et al., 2007; Drash et al., 1999; Sundberg, 2006).

In contrast, a tact, as defined by Skinner (1957), is a type of verbal operant in which a response of a given form is evoked by a particular object or event or property of an object or event. It involves the speaker naming objects or actions that he or she has contact with in the environment through any of the sense modes (Cooper et al., 2007). An example of a tact would be that of a teacher showing a picture of a dog and asking the child, “What is it?” and the child responding “dog”, thus producing generalized reinforcement, typically praise or approval (i.e., “That’s right, it’s a dog!”). In contrary

to the mand that is evoked by establishing operations and maintained by receipt of the specific item manded, the tact is under the functional control of a nonverbal discriminative stimulus and produces generalized conditioned reinforcement.

Despite the fact that the tact and mand differ in terms of their functional properties, their form may, at times, be identical. For instance, a child may say “chips” after the mom points to a picture of a bag of chips, asks “What is it?” and responds “Yes, you are right” when the child says chips. In this scenario, saying “chips” is a tact. Similarly, a hungry child who says “chips” and receives a bag of chips from the mom has emitted “chips” as a mand. However, Skinner (1957) noted that each verbal operant has independent response functions, in which acquiring one does not automatically result in the other, given that each verbal operant depends on its history of reinforcement and prior training. For instance, the ability for a boy to say “cookie” when the teacher points to a cookie and asks, “What is it?” (tact) does not necessarily mean he will say “cookie” as a mand when a relevant EO is present (i.e., hunger).

Several researchers have shown that mands and tacts are functionally independent and that teaching a child to label (tact) an item does not necessarily result in that child being able to request that item (mand) (Hall & Sundberg, 1987; Lamarre & Holland, 1985; Sigafos, Doss, & Reichle, 1989; Twyman, 1996). Lamarre and Holland (1985), for instance, investigated the functional independence of mands and tacts by evaluating whether training one verbal response (tact) would establish another verbal response (mand) with nine preschool children. Some participants were trained to mand for an item and then tested to see if they were able to tact the items, while other participants did the opposite. The response forms evaluated were the prepositional phrases “on the left” and

“on the right.” Results from Lamarre and Holland indicated that establishing one verbal operant did not result in the development of another verbal operant with the same response form. Only the verbal operants that were directly trained maintained, while the untrained verbal operant did not emerge unless direct training was conducted.

In a similar study, Hall and Sundberg (1987) evaluated whether teaching responses as tacts would lead them to occur as mands when completing behavior chains with two adolescents with hearing impairments using sign language. Both participants were initially taught to tact each single item used in the four chains of behaviors (i.e., opening a can of fruits). Mand probes were then conducted, in which all items needed to complete the chain, except a missing item, were presented. The mand probes revealed that the signs taught as tacts failed to emerge as mands when those same items were required to complete the behavioral chain. Mands for the missing items in the chain were eventually established by prompting the correct sign when the missing item was needed to complete the chain. However, these results demonstrated that mands were only established after direct mand training was conducted.

Similarly, Sigafos et al. (1989) taught three adults with severe developmental disabilities to tact food items and then mand for their respective utensils using graphic symbols (i.e., pointing to line drawings depicting the items). Tact probes consisted of holding up a food item, asking “What is this?” and providing social praise for correct responses. Mand probes consisted of the food item placed on the table, but the utensil needed to consume the items withheld in order to see if participants would mand for the missing items. Results indicated that mands for the missing utensils only emerged when

the tacts for those missing items were prompted during the mand probes, thus confirming Skinner's (1957) point that the verbal operants are functionally independent.

Finally, Twyman (1996) investigated the functional independence of impure mands and tacts by teaching four preschool children with existing tact and mand repertoires to tact and mand abstract stimulus properties (i.e., whole crayon, soft play-doh). An impure mand was defined as a mand in which the item needed to engage in an activity (e.g., the crayon for coloring) was present and in view of the participant. Results indicated that students who were taught to tact an abstract stimulus property (i.e., "That is a whole crayon") did not mand the stimulus property (i.e., "I want a whole crayon please"), and vice versa. In other words, the impure mands or tacts did not occur in the untrained operant without direct training. These results extend the literature and provide further support for Skinner's (1957) idea on the functional independence of verbal operants.

Even though several of these research studies have shown that responses taught as tacts often fail to occur as mands unless transfer between these two responses is directly trained, more recent research has demonstrated that mands and tacts are not necessarily independent (Gilliam et al., 2010; Petursdottir, Carr, & Michael, 2005; Sigafos, Reichle, & Doss, 1990; Wallace, Iwata, & Hanley, 2006).

Sigafos et al. (1990) investigated whether transfer of stimulus control from a tact response to a mand response would spontaneously occur in two adults with severe intellectual disabilities that had an established minimal mand repertoire using sign language. Three utensils required to consume an item were identified for each participant. Mand baseline probes for each item were conducted, in which the utensils

were not in sight to control for possible stimulus control of the presence of the item. After mand baseline probes, tact probes were conducted and then another implementation of mand probes to determine if the acquisition of a sign as a tact would lead to its occurrence as a mand. Results indicated that only two of the three mands emerged without direct training, thus demonstrating that the emergence of mands without direct mand training is possible. However, these results could be attributed to the fact that the participants had an existing generalized mand repertoire (pointing to a “want” symbol) that may have facilitated the transfer of stimulus control to the new symbol selections for the mand probes. Despite this, the results of Sigafos et al. suggest that under some circumstances, responses acquired as tacts may emerge as mands without direct training.

Similarly, Petursdottir et al. (2005) systematically replicated the study by Lamarre and Holland (1985) who demonstrated the functional independence of mands and tacts, by investigating the emergence of mands and tacts of novel objects among five preschool children. The children were taught to complete two 4-piece assembly tasks, in which each of the four pieces needed to complete the assembly task was taught as a tact, and consequently were then taught to mand for the missing pieces needed to complete the tasks. Results from Petursdottir et al. demonstrated that mand training led to the emergence of tact responses and tact training also led to some emergent mand responses, although the emergence of untrained tacts following mand training was much greater than untrained mands following tact training. These results differ from Lamarre and Holland’s study in which preschool children failed to exhibit tact responses following mand training, as well as mand responses following tact training. Petursdottir et al. attribute the differences in findings to their use of discrete objects instead of abstract

prepositional phrases as well as their attempt to contrive an establishing operation during mand training by using an interrupted-chain procedure of withholding missing items needed to complete the tasks.

However, in all of the above studies, it is unknown if the mand conditions were designed to manipulate establishing operations. An establishing operation (EO), as defined by Michael (1988), is an environmental event, operation, or stimulus condition which affects an organism by momentarily altering: (a) the reinforcing effectiveness of other events, and (b) the strength of the part of the organism's repertoire that has been reinforced by those other events. Thus, the consumption of salty popcorn, for instance, is likely to (a) momentarily increase the reinforcing effectiveness of water, and (b) momentarily increase the frequency of the different responses that have been reinforced with water in the past (Michael, 1988). In addition, conditioned establishing operations (CEO), as defined by Cooper et al. (2007), are motivating operations with value-altering effects that are learned, or are a result of the organism's history. The stimuli are motivationally neutral prior to either the pairing with another already established motivating operation or a form of reinforcement or punishment. It is through repeated exposure and learning that the stimuli become reinforcing.

As described by Wallace et al. (2006), it is possible that tact training often fails to result in the emergence of mands because the stimuli that individuals are taught to tact do not function as reinforcers. In the Lamarre and Holland (1985) study, it was unclear whether an EO was present for the response form of placing the object on the right or left for the participants. It is also unknown whether obtaining the missing item or completing the behavioral chain functioned as a reinforcer for the participants in both the Hall and

Sundberg (1987) and Sigafoos et al. (1989) studies. Hence, none of these studies demonstrated that an EO was present and that the consequence delivered during the mand conditions served as the reinforcer for the participants.

On the contrary, if the stimuli used during tact training function as reinforcers for the individuals in their natural environment and opportunities to request those items occur at times when the relevant establishing operation conditions are strong, then the emergence of mands could be facilitated following tact training. Wallace et al. (2006) sought to answer this question by teaching three adults with intellectual disabilities to tact preferred and nonpreferred items and consequently testing if those responses acquired as tacts could facilitate the establishment of mands. Participants engaged in limited vocal behavior and verbal behavior (signs or vocalizations) to obtain desired items. Signs were chosen as the response form over words because they could be physically prompted. Correct responses to tact training resulted in a nonrelated reinforcer chosen through a food assessment, while access to the specified reinforcing stimulus during mand training was provided. Preference assessments were conducted to determine high-preferred items and low-preferred items to be used as stimuli during both tact training and mand tests. A multiple baseline design across participants was used, exposing participants to several mand tests in order to establish a baseline level of mands for each participant. Then tact training began, in which participants were taught to tact all the HP and LP leisure items using manual signs. Once a sign was acquired as a tact for both leisure items, mand tests were conducted, in which the HP and LP items were simultaneously placed on a table in front of the participant to determine whether the participants could mand for the leisure items. For only one participant, pure mand tests were conducted, in which the leisure

items were not in view to reduce the probability that responses were under the stimulus control of the presence of the item and thus emitted as tacts rather than mands.

Results of Wallace et al. (2006) showed that all participants were able to tact the HP and LP leisure items within 12 sessions during tact training. However, following tact training, participants only emitted mands for the HP items but rarely for the LP items, thus demonstrating that only the tacts of HP items transferred to mand responses and indicating that conditions can be created to facilitate the transfer from one verbal operant to another. This, in effect, provides further evidence that transfer from tact to mand responses is related to the reinforcing value of the items to be tacted and manded. However, Wallace et al. did not manipulate establishing operations, even though results from the preference assessment conducted show that access to HP items was more reinforcing than access to LP items. Thus, future studies should assess the impact of manipulating establishing operations on the acquisition of mands.

Gilliam et al. (2010) sought to replicate the study conducted by Wallace et al. (2006) and extend their findings that responses from one verbal operant (tact) could transfer to another verbal operant (mand). Gilliam et al. assessed the emergence of untrained verbal operants with three young children diagnosed with ASD using highly preferred (HP) versus low preferred (LP) items. In order to establish possible edible reinforcers and the HP and LP items to use during the tact to mand training, preference assessments were conducted with each participant's parents and trainers. The most preferred food item was used as a reinforcer during the tact training. For the tact training and mand probes, target items were identified based on their HP and LP status for each participant. Due to an existing minimal verbal repertoire by participants, nonsense words

were used for each target item rather than the actual name to control for the children's learning history. A multiple baseline design across three participants was used to demonstrate the effect of tact training on the emergence of untrained mands. Each participant was exposed to a baseline phase, which consisted of tact and mand probes. Then tact training for HP and LP items was introduced and pure mand probes were conducted prior to each session. Pure mand probes consisted of the target items hidden from the participant's view and the verbal response associated with either item resulting in the item being delivered for 30 s. Once mastery for the tact target responses was reached, the participants were exposed to impure mand probes in order to assess if the tacts had transferred to mand responses. Impure mand probes consisted of the target items being present and the verbal response associated with either item resulting in the item being delivered for 30 s. Finally, an impure LP/pure HP mand probe was conducted with two participants that requested the LP item during the impure mand probes. This condition was put in place to determine if the LP item would be requested if it was the only item in view of the participant.

Results from Gilliam et al. (2010) indicated that during baseline, none of the participants emitted the correct tact or mand responses. Once tact training was introduced, all participants learned to tact the HP and LP items, although they never emitted a verbal response during the pure mand probes. However, during the impure mand probes that followed, all participants requested the HP items at a high rate but rarely requested the LP items, thus implying that emergence of untrained verbal operants may be facilitated by preference level of the items.

Therefore, the findings of Gilliam et al. (2010) further support those of Wallace et al. (2006) that responses taught as one verbal operant (tact) could transfer to another untrained verbal operant (mand). They further demonstrated that the transfer occurred almost exclusively for HP items, showing that preference level (reinforcing value) influenced the transfer from tact to mand. However, Wallace et al. and Gilliam et al. showed tact to mand transfer mostly with impure mands, suggesting that the verbal response may have been partly under the control of the nonverbal stimulus (the presence of the object). Furthermore, Wallace et al. and Gilliam et al. did not manipulate motivating operations per se, but rather evaluated the influence of item preference on transfer from tacts to mands. Further studies should focus on transfer from tacts to pure mands and evaluate them after manipulating an EO, so that responses under the control of discriminative stimuli during impure mands are ruled out.

Based on the limitations of the studies described above, further analysis of the conditions in which tact training results in generalization to untrained mands is warranted. Therefore, the present study investigated the effects of tact training on the acquisition of impure and pure mands with children with ASD when CEOs were manipulated during mand probes. Thus, the current study extended previous findings in two ways: (a) by evaluating transfer from tacts to mands in the presence and absence of the nonverbal S^D to assess whether impure mands or pure mands emerged after tact training, and (b) by evaluating CEOs by arranging CEO absent versus CEO present conditions during pure mand probes to determine the influence of motivation on transfer from tacts to pure mands.

Chapter Two

Method

Participants and Setting

Three children were recruited from the local community by means of an e-mail that was sent to the mothers of children with ASD in the desired age range that were enrolled in Applied Behavior Analysis (ABA) therapy at a private clinic and had a minimal tact and mand repertoire. The parents were asked to call or e-mail the researcher if they would like more information about participating in the study. The researcher contacted interested parents, set up a meeting, and conducted a consent meeting for parents, explaining to them the procedures of the study. Three children diagnosed with ASD, ages 3-6 years old, participated in this study. Children were selected based on their limited one-word tact and mand repertoire for preferred items or activities. They expressed themselves through one-word verbal responses for desired items. A fourth child started participating in the study, but due to scheduling and therapist reassignment, was unable to continue participating shortly starting the tact training phase.

Ryan was a 6 years 6 months old Caucasian boy, oldest of 3 children, diagnosed by his neurologist in 2008 with Autism Spectrum Disorder in the mild range and Developmental Verbal Dyspraxia in the severe range. He made his needs known by either pointing to the items or saying one word to label or request the desired items. He had the ability to tact over 30 common objects and mand for over 20 preferred items, activities, and actions. Ryan had poor eye contact and difficulties staying on task, but he

was able to remain seated during task situations and could easily follow 2-step commands. He had an echoic repertoire, but was observed to emit repetitive phrases from preferred movies that were irrelevant to the context. At the time of the study, Ryan was enrolled in a self-contained autism classroom at his elementary school and was receiving 17 hours of ABA therapy a week. Prior to this study, he had received speech therapy for 1 year, occupational therapy for 5 months, and ABA therapy for 4 months.

Danny was a 4 years 9 months old Hispanic boy, second of 3 children, diagnosed by his neurologist in 2008 with Autism Spectrum Disorder. He made his needs known by pointing to the items or saying one word to request his desired items. He demonstrated the ability to tact over 100 common objects and mand for about 30 preferred items and activities. Danny was able to acquire new skills very quickly. He followed some simple commands and remained seated during task situations, but had poor eye contact and difficulty staying on task. At the time of the study, he was enrolled in a self-contained autism classroom at his preschool and was receiving 4 hours of ABA therapy a week. Past services included 1 year of speech therapy.

Jack was a 3 years 7 months old Caucasian boy, only child, diagnosed by his pediatric neurologist in 2010 with Autism Spectrum Disorder and Sensory Integration Disorder. He made his needs known by either taking a person to the items desired or saying and signing one word to request his desired items. He had poor articulation and often spoke in a low voice tone, but he was switched from sign language to vocalizations at the beginning of this study. Jack demonstrated the acquisition of new skills fairly quickly. He had the ability to tact over 40 common objects and mand for about 41 preferred items, activities, and actions of others. He had great eye contact and followed

simple two-step directions, but had difficulties remaining seated during task situations. At the time of the study, he was enrolled in a self-contained autism classroom at his preschool and was receiving 10 hours of ABA therapy a week. In addition, he had been undergoing occupational therapy and speech therapy for 2 years.

Sessions were conducted in a private clinic that provided ABA therapy to children with ASD or at the participant's home. Ryan and Jack were enrolled in the private clinic and Danny was receiving individual ABA therapy sessions at home. The rooms contained a table, chairs, and all relevant materials to be used for individual therapy sessions. A video camera was placed in the room in advance to record the sessions. One session was conducted daily, a minimum of 2 days per week.

Target Behaviors

The target behaviors recorded in this study included tacts, pure mands, and impure mands.

Tact. During tact probes and training, a tact was defined as emitting a one-word vocal response to the verbal discriminative stimulus, "What is it?" when the therapist held up the corresponding utensil. A correct tact response was defined as the child saying the name of the utensil within 5 s of being asked, "What is it?" (i.e., saying "fork" or "spoon" when he was shown the item). A generalized reinforcer, in the form of praise, was provided for emitting a correct tact response. An incorrect tact response was defined as responding with a vocal response that did not match the name of the utensil.

Pure mand. During pure mand probes and training, a pure mand was defined as a one-word verbal request when a food item to be consumed was present but the utensil needed to consume the item was not present. A correct pure mand response was defined

as the child saying the name of the utensil within 10 s of removal of the utensil (i.e., manding for the “spoon” needed to consume the applesauce). The specific utensil requested was provided for approximately 10 s for emitting a correct pure mand response. An incorrect pure mand response was defined as a vocal response that did not match the name of the missing utensil.

Impure mand. A correct impure mand response was defined as the child saying the name of the utensil when the utensil and the food item to be consumed were present. The specific utensil requested was provided for approximately 10 s for emitting a correct impure mand response. An incorrect impure mand response was defined as a vocal response that did not match the name of the utensil.

Data Collection and Interobserver Agreement

The experimenter of this study conducted all sessions. Trial-by-trial data were collected throughout the study on the child’s approach toward an item during the preference assessment or vocal responses during the tact and mand probes. Five pure mand probes, five impure mand probes, and five tact probes were conducted in each baseline session and prior to each tact training session. The number of correct responses over the total number of trials conducted was recorded on a data sheet during the sessions and later reviewed with the videotapes for interobserver agreement purposes (see Appendices B-E).

During pure mand probes, the food item and its respective utensil (e.g., applesauce with its spoon, pancake with its fork) were placed before the child. The child then used the utensil to consume one bite of the food and the utensil was removed out of sight, so that the mands for those utensils (pure mands) were controlled solely by the

CEO (Michael, 1988). The utensil required to consume the displayed items was delivered to the child contingent upon correct pure mand responses for those items (i.e., saying “spoon” when the child had applesauce in front of him). If the child did not mand for the utensil, the pure mand probes were terminated and the impure mand probes were implemented.

For the impure mand probes, the experimenter placed the preferred food item and its respective utensil on the table in front of the child and allowed the child 10 s to consume the items. Then, the utensil needed to consume the item was placed out of reach of the child but in sight. The utensil required to consume the displayed item was delivered to the child contingent upon correct impure mand responses for the utensil (i.e., saying “spoon” when the child saw the spoon and had applesauce in front of him). If the child did not mand for the utensil needed, the impure mand probes were terminated and the tact probes were conducted.

During the tact probes, the experimenter held up a utensil, asked, “What is it?” and waited for the child’s response. No food item was present during tact probes or tact training. Correct responses were followed by praise (e.g., “That’s right, it is a spoon!”). If the child did not respond or made an error, the item was removed and tact training resumed.

Interobserver agreement was assessed by having observers independently record approached responses (preference assessment) and correct or incorrect verbal responses (tact and mand probes) on a trial-by-trial basis from video recordings of at least 76% of all sessions. The researcher trained the observers by reviewing the definitions of pure mands, impure mands, and tact responses, role-playing with sample videos, and

differentiating between an independent (yes) versus a prompted (no) response.

Agreements were defined as both observers scoring the same response during each trial. The percentage of agreement for the occurrence of target behaviors for each session was calculated by dividing the total number of agreements by the total number of agreements plus disagreements (total number of trials), and multiplied by 100. For all responses, one-word responses were considered correct, given that participants did not use mand frames (i.e., “I want the applesauce please”), but rather single word responses to label or request desired items. Agreement for the preference assessment and baseline sessions averaged 100% across all participants. For tact training sessions, agreements averaged 100% for Ryan, 75% for Danny, and 100% for Jack. Agreements for mand training sessions averaged 88% for Ryan and 100% for Danny. During the CEO evaluation, agreements averaged 100% across all participants.

Procedures and Design

The study began with a preference assessment to identify preferred food items to use during tact and mand training. Following the preference assessment, a multiple baseline design across participants was used to evaluate the effects of tact training on the acquisition of tacts and possible transfer to mands. Each participant was exposed to a baseline phase followed by tact training for the utensils needed to consume their preferred food. Impure and pure mand probes were also conducted for the utensils needed during this phase prior to each session in order to assess whether tact training resulted in the emergence of untrained mands. Following the mastery of tact responses and transfer to pure mands, participants were exposed to a CEO absent versus CEO present pure mand condition to evaluate the effects of CEOs on the emission of pure

mands. If transfer to pure mands did not occur following tact training, mand training was conducted before the CEO evaluation. Throughout the study, a potential establishing operation effect (deprivation) was controlled by conducting the sessions at approximately the same time each day.

Preference assessment. Each child's parent and therapist were interviewed to gather information regarding possible edible reinforcers needing one utensil to consume it (i.e., applesauce and a spoon; see Appendix A). Examples of potential edible reinforcers varied per child, as each set included a preferred food or beverage and the utensil needed to consume it; examples included: a juice carton and a straw, a bowl of ice cream and a spoon, and a cup of applesauce and a spoon. These items were presented in a paired stimulus assessment in a randomized order, as described by Fisher et al. (1992). In each trial, two items were placed on a table in front of the child and trial-by-trial data were collected based on the child's approach toward each item in order to calculate the percentage of items approached. Within a pool of 3 items, each item was paired with each other item 5 times. Children's approach to one of the items resulted in access to that item for approximately 10 s and removal of the other item. Children's approach to both items simultaneously was blocked. If a child did not approach either of the items within 5 s, the therapist prompted the child to sample each item for 10 s, and after sampling each, both items were presented again for another 5 s. The child's approach to one item resulted in access to that item for 10 s and removal of the other item. If the child did not approach either item within 5 s, both items were removed and the next trial began. Those items picked in the greatest percentage of trials were chosen for inclusion in the study.

These target items were used in the study because the name of the utensil needed to consume the food item (i.e., fork, spoon) was not in the child's verbal repertoire.

Baseline. Pure mand, impure mand, and tact probes were conducted prior to the tact training phase, in order to determine each participant's baseline level of performance for tacting and manding the utensils needed to consume their preferred foods. Each session lasted approximately 10 min, consisting of five pure mand probes, five impure mand probes, and five tact probes, respectively. During this condition, no breaks between probes and no prompts were provided. Instead, the experimenter provided praise for participation approximately every 30 s.

Tact training. Tact training sessions were approximately 10 min in length, in which the experimenter taught each participant to tact the utensils needed to consume their preferred food items chosen from their preference assessment. In between teaching trials, known motor imitation, receptive, and echoic tasks were presented to the child for behavioral momentum purposes (e.g., touch your head, give me the ball, say apple). Each session consisted of 10 teaching trials of the experimenter holding up a utensil, asking, "What is it?" and immediately prompting the child to say the name of the utensil (i.e., teaching the child to say "spoon" when it was presented and the child was asked, "What is it?"). Correct responses were followed by praise (i.e., "That's right, it is a spoon!"). The trial was then reintroduced by fading the echoic prompt and waiting for the child to respond within 5 s of providing the instruction. If the child did not respond or made an error, the utensil was removed and the trial was reintroduced, with an echoic prompt provided by the experimenter. A tact was only scored as correct when the child emitted the correct vocal response within 5 s of the verbal instruction, "What is it?", and

prior to any prompting. Tact training was complete when the child correctly tacted items in 100% of trials for two consecutive sessions during tact probes.

In each session prior to tact training, five pure and five impure mand probes were conducted as described above to assess whether mand responses for the needed utensils began to occur during tact training. Pure mand probes were conducted first followed by impure mand probes. Following the mand probes, tact probes were conducted. After the tact probes were conducted, tact training was initiated.

Pure mand training. If no transfer from tacts to pure mands took place following tact training, pure mand training was conducted. Pure mand training sessions were approximately 10 min in length, in which the experimenter taught each participant to mand for the utensils needed to consume their preferred food. Each session consisted of 10 teaching trials of the experimenter placing the food item and its respective utensil before the child. The child was allowed to use the utensil to consume one bite of the food and the utensil was removed out of sight. The experimenter immediately prompted the child to say the name of the utensil (i.e., prompting the child to say “fork” and “spoon” when they were needed to consume their preferred food). Correct responses were followed by 10 s to consume the item paired with praise (i.e., “That’s right, you need a spoon!”). The trial was then reintroduced by fading the echoic prompt and waiting for the child to respond within 10 s of removing the utensil. If the child did not respond or made an error, the items were removed and the trial was reintroduced, with an echoic prompt provided by the experimenter. A pure mand was only scored as correct when the child emitted the correct vocal response within 10 s of the removal of the utensil and prior to any subsequent prompting. Pure mand training was completed when the child

correctly manded for the missing utensils in 100% of trials for two consecutive sessions. Five pure mand probes were conducted prior to each pure mand training session to assess the acquisition of pure mands.

Ryan failed to make progress at the beginning of the mand training sessions. The experimenter noticed that Ryan was tacting the items in sight (i.e., saying “ice cream”) instead of manding for the missing spoon to consume the ice cream. Thus, his mand training was modified on the 10th session in the following way. Each session consisted of 10 teaching trials of the experimenter placing the bowl of ice cream and spoon in front of Ryan. Ryan then used the spoon to consume a spoonful of ice cream and the spoon was removed out of sight. The experimenter immediately prompted Ryan to say “spoon”. Correct responses were followed by 10 s to consume the ice cream and praise (i.e., “That’s right, you need a spoon!”). The trial was then reintroduced by fading the echoic prompt and waiting for Ryan to respond within 10 s of removing the spoon. If Ryan said “ice cream” instead of “spoon”, the bowl of ice cream was removed from his sight for 5 s and placed again on the table once he was quiet. He was immediately prompted to say “spoon”. Correct responses were followed by 10 s to consume the ice cream paired with praise. If Ryan continued to say “ice cream” instead of “spoon”, he did not receive a spoonful of ice cream, thus acting as a punishment procedure for tacting the item present versus asking for the utensil needed. A pure mand was only scored as correct when Ryan said spoon within 10 s of the removal of the spoon. Pure mand training was completed when Ryan correctly manded for the spoon in 100% of trials for two consecutive sessions. Five pure mand probes were conducted prior to each pure mand training session to assess the acquisition of pure mands.

Evaluation of CEO absent versus CEO present on pure mand probes. Once pure mands occurred in the mand training phase (Ryan and Danny) or in the tact training phase (Jack), participants were exposed to the CEO absent versus CEO present condition to evaluate the effects of CEOs on the emission of pure mands. Each session consisted of five CEO absent probes conducted first, followed by five CEO present probes.

In the CEO absent condition, the experimenter placed the empty food containers on the table in front of the child with the utensils needed to consume the food out of sight (i.e., providing a bowl without ice cream in it and no spoon). The experimenter waited 10 s to see if the child manded for the utensil. Five trials were implemented in each probe session. This condition was implemented to assess whether children manded for the utensils in the absence of the food.

In the CEO present condition, the experimenter placed the preferred food items on the table in front of the child with the utensils needed to consume the food out of sight. The utensils required to consume the displayed food items were delivered to the child contingent upon correct pure mand responses that occurred within 10 s (i.e., saying “spoon” when the child had a bowl of ice cream in front of him). Five trials were implemented in each probe session. The evaluation of CEO absent versus CEO present was completed once the child correctly manded for the utensils needed on 100% of trials for three consecutive sessions of the CEO present condition.

Chapter Three

Results

Figure 1 illustrates the results of the preference assessments for all 3 participants. Preferred edibles were rank-ordered according to the percentage of trials they were approached. In the top panel, we see that Ryan chose to eat ice cream 90% of the time it was presented to him, juice 40% of the time, and mashed potatoes 20% of the time. Therefore, ice cream was chosen as the preferred edible for Ryan and “spoon” was the response taught to him. In the middle panel, we see that Danny chose pancake 80% of the time it was presented to him, water 40% of the time, 0% for the fruits, and he did not choose anything on 3 occasions. Therefore, pancake was chosen as the preferred edible for Danny and “fork” was the response taught to him. In the last panel, we see that Jack chose applesauce 100% of the time it was presented to him, yogurt 50% of the time, and 0% for fruits. Therefore, applesauce was chosen as the preferred edible for Jack and “spoon” was the response taught to him.

Figure 2 shows the results of tact training, mand training, and the evaluation of CEO absent versus CEO present for all three participants. During baseline, none of the participants emitted the correct tact or mand responses. All participants acquired the tact response for their missing utensil and reached criterion in tact training within 4-8 sessions. However, only one participant, Jack, emitted mands during tact training. Therefore, mand training was only implemented for Ryan and Danny. These participants acquired the mand response within 5-20 sessions. Once the evaluation of CEO absent

versus CEO present was put in place, all participants manded for the missing utensils only in the presence of the food (CEO present).

In the top panel, we see an evaluation of tacting and manding “spoon” for Ryan. Four baseline sessions of tact and mand probes were conducted and results showed that Ryan did not tact the spoon or mand for the spoon. Tact training was thus implemented and Ryan learned to tact the spoon in 8 sessions. Within the tact training phase, Ryan did not mand for the spoon during pure mand and impure mand probes. Therefore, mand training was conducted following tact training. In the first 9 sessions of mand training, Ryan said “spoon” on only 2 occasions. The experimenter noticed that he was saying “ice cream” instead of spoon when the ice cream bowl was placed in front of him, thus tacting the item in front of him instead of manding for the missing utensil (i.e., spoon). Given this, on the 10th mand training session, the experimenter implemented a change in conditions (as described above) in which she removed the ice cream and did not provide Ryan a spoonful of it if he said “ice cream.” This change in protocol was in effect for the last 11 mand training sessions. He got 0% for the pure mand probes on the 18th session due to competing variables during that session, not necessarily because he was not acquiring the verbal response per se. Nevertheless, Ryan learned to mand for the spoon after 10 sessions. When the CEO absent versus CEO present condition was put in place, Ryan only manded for the spoon when the ice cream was present (CEO present), but not when it was absent.

In the middle panel, we see an evaluation of tacting and manding “fork” for Danny. During baseline, tact and mand probes were conducted and results showed that Danny was not tacting or manding for the fork. Tact training was thus implemented and

Danny learned to tact the fork within only 4 sessions. However, in the mand probes conducted during the tact training phase, Danny only manded for the fork once when it was placed on the table (impure mand). Thus, mand training was put in place, and Danny learned to mand for the fork within 5 sessions. We see a drop to 0% on his 3rd mand training session, but like Ryan, it was due to competing variables and not the fact that Danny did not know how to request the fork. When the CEO absent versus CEO present condition was put in place, Danny only manded for the fork when the pancake was present (CEO present), but not when it was absent.

In the bottom panel, we see an evaluation of tacting and manding “spoon” for Jack. During baseline, tact and mand probes were conducted and results showed that Jack was not tacting or manding for the spoon after 12 baseline sessions. Tact training was thus implemented in the 13th session and Jack learned to tact the spoon in just 4 sessions. Within the tact training phase, Jack manded for the spoon within the 6 pure mand probes and 5 impure mand probes conducted. Therefore, mand training was not implemented for Jack, given that the responses taught as tacts during tact training transferred to mand responses without direct training. When the CEO absent versus CEO present condition was put in place, Jack only manded for the spoon when the applesauce was present (CEO present), but not when it was absent.

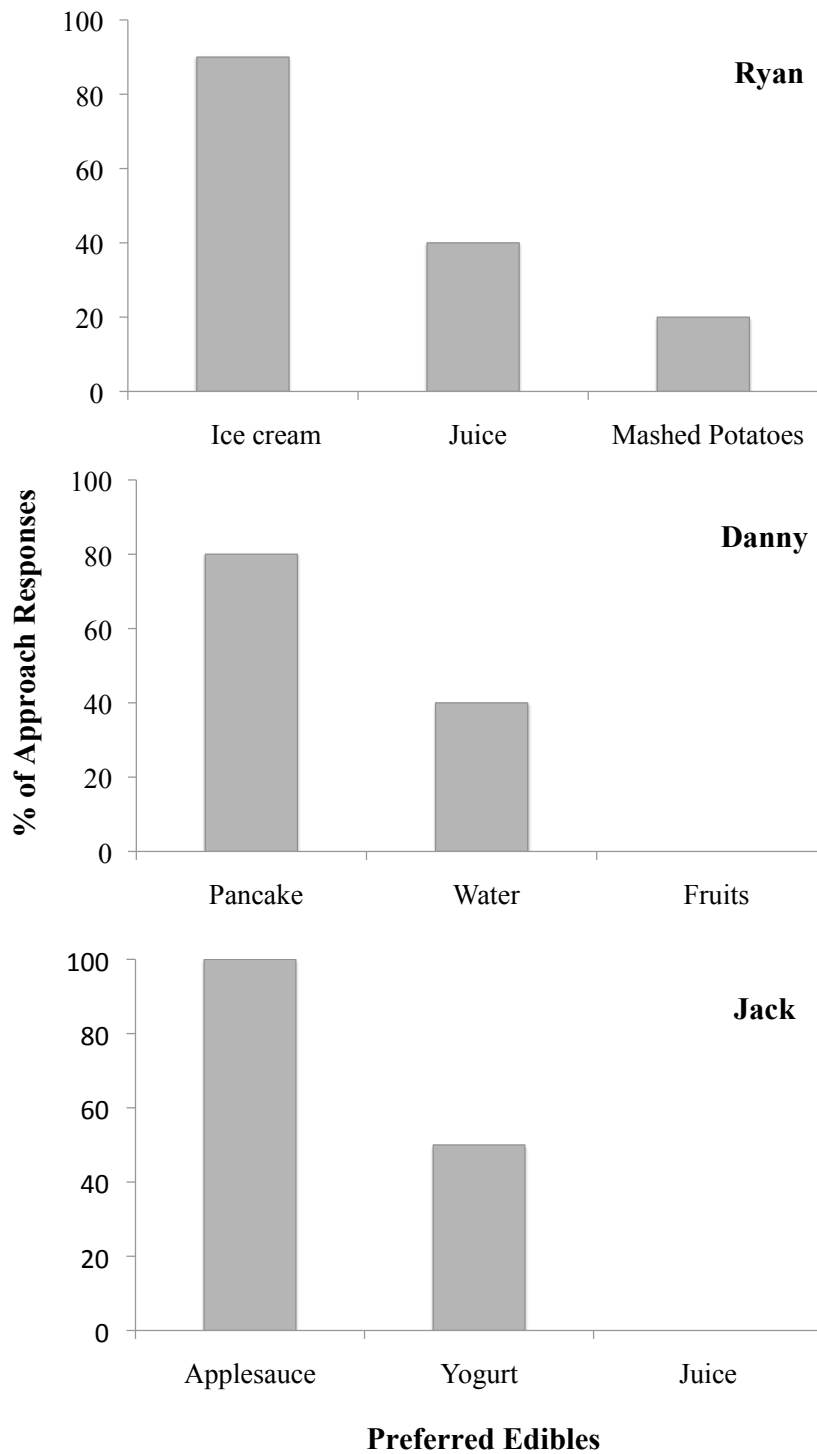


Figure 1. Results of preference assessments. This figure illustrates the percentage of approach responses to each of the 3 stimuli during the preference assessments for all three participants. Preferred edibles were rank-ordered according to the percentage of trials they were approached and the food items chosen for each participant are depicted on the left side of the graph.

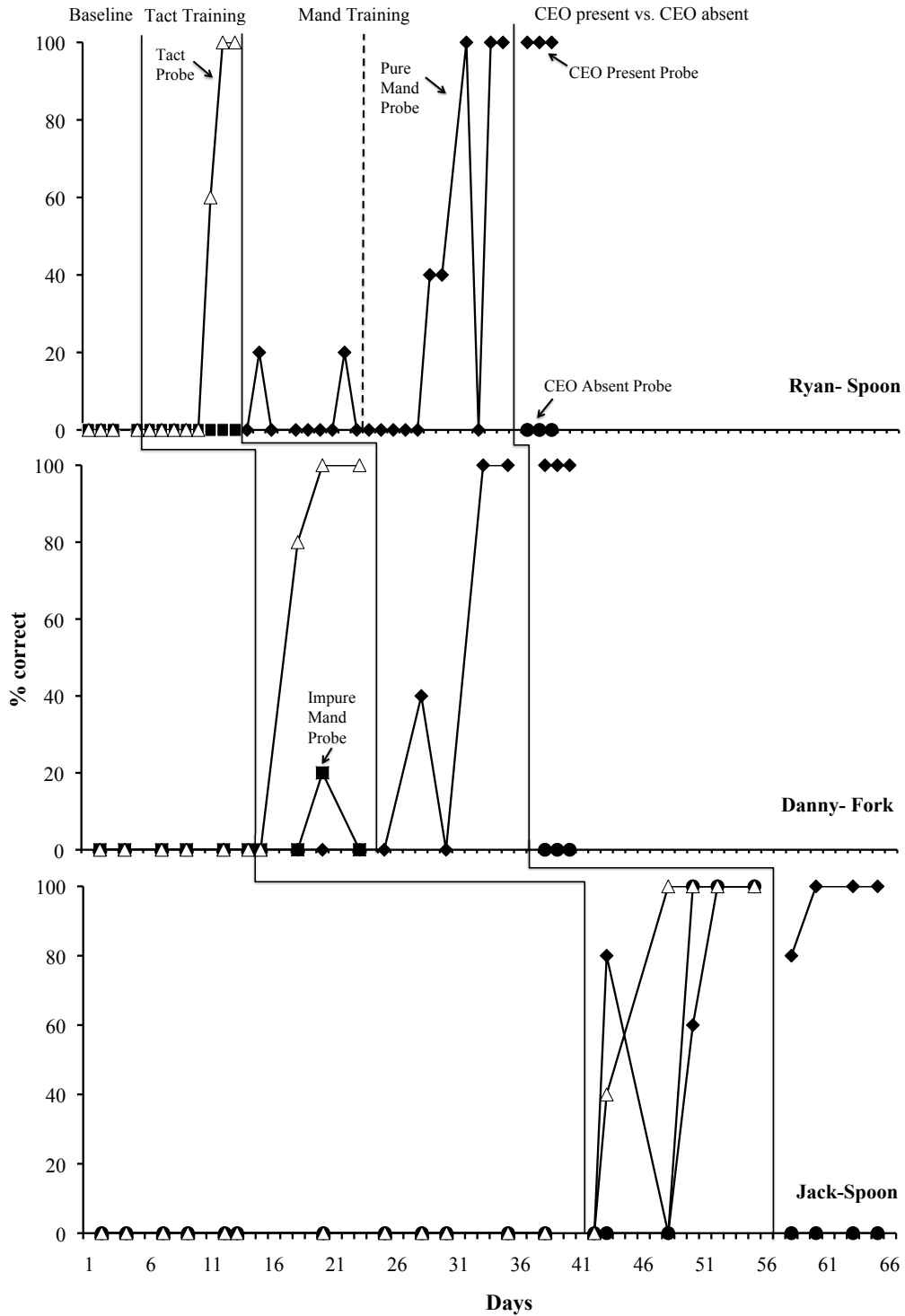


Figure 2. Baseline, tact training, mand training, and the evaluation of CEO absent versus CEO present for all three participants. White triangles represent tact probes. Solid diamonds represent the pure mand probes and the CEO present pure mand probes. Solid squares represent the impure mand probes. Solid circles represent the CEO absent pure mand probes.

Chapter Four

Discussion

The purpose of the present study was to investigate the effects of tact training on the acquisition of mands when CEOs were manipulated during mand probes for children diagnosed with ASD. Results showed that all of the participants acquired vocal responses for the missing utensils as tacts. However, responses taught as tacts during tact training only transferred to mand responses without direct training for one participant (Jack). The other two participants had to be directly trained to mand for the missing utensils. Once the CEO evaluation was put in place, all participants manded for the missing utensil only when the food item was present (CEO present), but not when it was absent.

The results of the present study differ from past research on functional independence in which the tact to mand transfer was observed and extend previous findings in several ways (Gilliam et al., 2010; Petursdottir et al., 2005; Sigafos et al., 1990; Wallace et al., 2006). First, this study differs from Wallace et al. (2006) and Gilliam et al. (2010) in that the responses to be learned were not names of high versus low-preferred items, but rather the names of the utensils needed to consume their preferred food items. Second, previous studies showed tact to mand transfer mostly with impure mands, suggesting that the verbal response may have been partly under the control of the nonverbal stimulus (i.e., the presence of the object). The present study evaluated the transfer from tacts to mands in the presence and absence of the nonverbal

S^D to assess whether impure mands or pure mands emerged after tact training. Even though only one of the participants manded for the missing utensil without direct training (Jack), all participants manded for the missing utensil when it was needed to consume their preferred food item during the CEO evaluation. Thus, the pure mand responses that were acquired for the missing utensils were solely under the control of the CEOs and not emitted after a verbal S^D, “What do you want?”. In addition, mand training was evaluated using pure mand probes only, so that the utensils to be manded were out of sight and the responses for those items were not partly due to the presence of the utensil, as in impure mand probes, but rather occurring only under motivating conditions.

Furthermore, Wallace et al. (2006) and Gilliam et al. (2010) did not manipulate motivating operations per se, but rather evaluated the influence of item preference on transfer from tacts to mands. The present study evaluated CEOs by arranging CEO absent versus CEO present conditions during pure mand probes in order to determine the influence of motivation on the emission of pure mands. Previous studies investigating the functional independence between these two verbal operants failed to provide evidence that the consequences delivered during the mand probes were actually reinforcing stimuli (Hall & Sundberg; 1987; Lamarre & Holland; 1985; Sigafos et al., 1989). For all three participants in the current study, responses learned as mands were emitted only when there was a food item in front of them (CEO present), but not when there was an empty bowl in front of them, given that the momentary effectiveness of the missing utensil as a reinforcer was established when the food item was in sight. These results suggest that the conditions under which a trained verbal operant emerges is in part due to the effects of CEOs, because the presence of the food was required in order for participants to mand for

the missing utensil. Lastly, the participants in this study, unlike those in previous research, were under a constant condition of deprivation for the specific food items chosen (Gilliam et al., 2010; Wallace et al., 2006).

Despite these findings, it is unclear why tacts did not transfer to mands for two of three participants. One possible explanation for this finding could be that for these children, pure mands are not typically addressed in their therapy curriculum until they have at least 100 impure mands in their repertoire. In other words, these children are used to manding for items that are present or in sight, but not for items that are not present. In addition, these children are first taught to mand for items and then once those responses are acquired as mands, they learn to tact those same items. Therefore, these aspects of their training might explain why two of the three participants did not mand for the missing utensil during the pure mand probes conducted in tact training. However, it remains unclear why they did not mand for the utensil during the impure mand probes, given that they were used to manding for items in sight. A reason for this could be that the item to be manded (i.e., utensil) was not an unconditioned reinforcer or established conditioned reinforcer, while most of the mands in their repertoire were for established reinforcers (i.e., fun items and activities). As Wallace et al. (2006) pointed out, it is possible that tact training often fails to result in the emergence of mands because the stimuli that individuals are taught to tact do not function as reinforcers. Thus, it is likely that emitting the name of the utensil did not transfer from a tact to a pure mand because the utensil had no value for them, although it was clear that withholding the utensils required to consume their preferred food items operated to establish those utensils as an effective type of reinforcer. Nonetheless, participants manded for the missing utensil

during mand training and during the CEO manipulation because a relevant CEO was strong.

It is not clear why transfer from tacts to mands occurred for Jack. One possible explanation could be in Jack's learning history related to verbal behavior. The fact that Jack had a history of mands transferring to tacts without direct training may have contributed to the generalization noted in his performance from tacts to mands. He had the ability to quickly grasp responses taught and apply them to other settings and with other individuals. Also, he was the only one of the three participants that had the same number of tacts and mands in his repertoire, given that his therapy curriculum was explicitly followed: once a mand for an item was learned, the tact for that item was subsequently taught to him. This aspect of training, in effect, may have contributed to his fast acquisition of the mand responses during this study.

Some limitations of the current study deserve consideration. First, it is possible that more thorough transfer from tacts to mands would have occurred had we carried out the tact training condition longer. All of the children went through tact training fairly quickly due to our criterion for mastery of two consecutive trials of tacts at 100%. Thus, extending tact training to see if mands would emerge would have been helpful. Perhaps if we had extended the tact training phase, Danny, who manded once for the fork during tact training, would have acquired the mand without direct training. However, extending a training phase once the tact was acquired did not seem warranted. A second potential limitation is that the study was conducted in therapy rooms that contained a number of potentially disruptive stimuli. Other children and therapists intermittently interrupted the sessions, making the noise level vary unsystematically across sessions. This uncontrolled

ambient noise and activity, in effect, could have influenced each child's responding and may be partially responsible for the variability in responding across all participants, especially Ryan, who had difficulties staying on task if his environment was too loud. On the other hand, ambient noise and distractions are a typical part of most school or home environments and results show that the effects of training were robust enough for the acquisition of tacts and mands to occur in the presence of the noise and distractions. A third limitation is the lack of generalization assessment in this study, considering that the study was conducted in a controlled clinical setting for two of the three participants. Perhaps if we had trained in different settings, the responses may or may not have transferred. Nevertheless, some generalization did take place, as two mothers (Danny's and Jack's) reported that their child was manding for the utensils needed to consume other types of untrained food items, such as fruits and chicken, at their home and restaurants (different environments).

Despite these limitations, there are several directions for future research. First, this study should be replicated to confirm that the findings are robust. Replication should occur with other individuals with varying levels of disability across a variety of settings. Second, participants in future studies should be taught more than one tact to see if transfer to mands is facilitated after the second, or third, or fourth tact is acquired. Third, the functional independence of other verbal operants, not just tacts and mands, should be investigated. This study only evaluated the tact and mand relationship, but the findings of this study and those of Wallace et al. (2006) and Gilliam et al. (2010) support the notion that further analysis of the functional independence of other verbal operants is warranted. Future research could perhaps perform the inverse, evaluating the effects of

mand training on the acquisition of tacts when CEOs are manipulated. It could be that transfer from mands to tacts would be facilitated if the stimuli chosen are highly preferred.

In summary, Skinner's (1957) analysis of verbal behavior suggested that tacts and mands are functionally independent verbal operants, in which acquiring one response form does not necessarily transfer to another response form. However, the current research demonstrated that responses learned as tacts transferred to mands without direct training for only one participant, while the other two participants were directly trained to mand for the missing utensils. Once the CEO evaluation was put in place, all participants manded for the missing utensil only when the food item was present (CEO present), but not when it was absent. Therefore, additional research on tact to mand transfer is needed to further our understanding of language development of children with ASD and to help practitioners implement effective language techniques. Knowledge on the functional independence of other verbal operants would be valuable information for practitioners, to help them avoid training time devoted to teaching each verbal operant separately if transfer between the verbal operants could be facilitated.

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Appendices

Appendix A: Preferred Items Interview with Parents

We are asking your child to take part in this research study because he is in the age group in which learning to request items is a prerequisite for further development of language skills. This research will help us learn more about the most efficient way to teach language to children with autism and the influence of motivation on learning language (does needing an object make the child more likely to ask for it after he learns to label it?).

In order to conduct this study, we need to know some relevant information of your child's eating routine and preferred edibles that require a utensil to consume them. This information will be valuable to this research, as we will be teaching your child to label the missing utensil and seeing if he is able to request it to consume the preferred food items.

Please answer the following questions:

- 1. Describe your child's daily eating routine (Does he eat by himself?; Does he require supervision while being fed?; Is he able to hold eating utensils properly?):**

- 2. List what utensils your child usually uses when eating:**

- 3. List any preferred food items (food, drink) that your child enjoys and that require an eating utensil to consume them (i.e., pudding and spoon, juice and straw):**

- 4. Does your child engage in any problem behaviors when preferred food items are taken away? If so, describe what occurs:**

Thank you for taking your time and answering these questions.

Appendix B: Trial-by-Trial Baseline Data Sheet

Participant: _____ Date: _____											
Observer: _____ Time: _____											
Target Item: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						

Appendix C: Trial-by-Trial Tact Training Data Sheet

Participant: _____ Date: _____											
Observer: _____ Time: _____											
Target Item: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Impure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Tact training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Appendix D: Trial-by-Trial Mand Training Data Sheet

Participant: _____ Date: _____											
Observer: _____ Time: _____											
Target Item: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Date: _____											
Trial	1	2	3	4	5	6	7	8	9	10	% Correct
Pure mand probe	Y	Y	Y	Y	Y						
	N	N	N	N	N						
Mand training	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	N	N	N	N	N	N	N	N	N	N	

Appendix E: Trial-by-Trial CEO Manipulation Data Sheet

Participant: _____ Date: _____						
Observer: _____ Time: _____						
Target Item: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	

Date: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	

Date: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	

Date: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	

Date: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	

Date: _____						
Trial	1	2	3	4	5	% Correct
CEO Absent Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	
CEO Present Probe	Y	Y	Y	Y	Y	
	N	N	N	N	N	