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# Studying the effects of motivation on the emergence of untrained verbal operants

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Studying the Effects of Motivation on the Emergence of Untrained Verbal Operants

by

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A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Arts  
Department of Child and Family Studies  
College of Behavioral and Community Sciences  
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## Studying the Effects of Motivation on the Emergence of Untrained Verbal Operants

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### ABSTRACT

In Skinner's (1957) analysis of verbal behavior, the tact and mand are suggested to be functionally independent verbal operants. Many studies evaluating the verbal operants have provided results consistent with Skinner's notion of functional independence. For example, previous studies have yielded results showing that responses taught as tacts failed to emerge as mands unless they were directly trained as such. However, in many of the studies evaluating the functional independence of the verbal operants it is unclear whether the mand conditions were designed to actually evaluate that response function. The current study replicated and extended the findings of Wallace, Iwata, and Hanley (2006), who empirically demonstrated conditions that facilitated the transfer from tact to mand relations. Students in the current study were taught to tact both high preference and low preference items and were subsequently assessed on their ability to mand for those items. Responses taught as tacts transferred to mand responses without direct training for the high preference items only. These results suggest that the conditions under which training of one operant facilitates the emergence of an untrained verbal operant may be related to motivating operations.

## Chapter One

### Introduction

Individuals diagnosed with autism and other developmental disabilities tend to have language delays requiring programming to establish spontaneous and functional language. Consequently, understanding the conditions under which various aspects of language are acquired has been an ongoing focus of language researchers for many decades. In formulating a behavioral account of language, Skinner (1957) developed a theoretical analysis of verbal behavior, in which he concluded that language was a learned behavioral repertoire and, as with any behavior in a behavioral account, was controlled by variables in the environment. Unlike traditional linguists who interpret language according to word meaning and syntactical structure, Skinner's analysis of verbal behavior identifies the functional, and, to a lesser extent, structural elements of an individual's verbal repertoire (Skinner). As a result, this analysis has been used as the framework for a variety of language assessment and remedial language acquisition programs for individuals with language deficits, including children with autism (Sundberg & Partington, 1998).

Skinner (1957) suggested that an individual's verbal repertoire is composed of various types of speaker and listener behaviors and classified language according to the functional variables (i.e., motivational variables, discriminative stimuli, and consequences) controlling these behaviors (Sundberg, 2007). These functionally

independent classes of behavior or verbal operants are identified as the: mand, tact, intraverbal, textual, echoic, transcription, and copying-a-text.

According to Skinner (1957), the mand is “a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the control of relevant conditions of deprivation or aversive stimulation” (p. 35-36). In other words, the mand response is evoked by an establishing operation (EO) (Michael, 1988; Michael, 1993) and is maintained by a specific reinforcer relevant to the EO. Thus, the mand is a verbal operant in which a speaker requests or asks for what he wants or needs (what is currently reinforcing) at a particular moment in time. In contrast, the tact is defined as a “verbal operant in which a response form is evoked by a particular object or event or property of an object or event” (Skinner, 1957, p.82). That is, the tact is a type of verbal behavior in which a speaker names or labels aspects of his environment. Unlike the mand, which is evoked by establishing operations and maintained by specific reinforcement, the tact is under the functional control of discriminative stimuli and is strengthened by generalized reinforcers provided by the speaker’s verbal community.

Although the mand and tact may differ in terms of the functional properties (i.e., the controlling antecedent and consequent variables) that define them, they often have identical responses topographies. For example, a child may say “bubbles” after being deprived of bubbles for days and as a result a teacher gives the child bubbles. In this scenario, “bubbles” is a mand response. On the other hand, a tact is emitted if the child said “bubbles” after a teacher held up a bottle of bubbles, asked “What is this?”, and subsequently provided praise for the correct answer. Although identical response forms may function as both mands and tacts, Skinner indicates that each verbal operant is

functionally independent as defined by the distinct properties of the environmental variables that control it (Skinner, 1957, pp. 187-190). By this, Skinner is referring to the notion that each operant is acquired through a unique history of reinforcement, and that training in one operant does not automatically transfer to the other verbal operants. Thus, ability to label “juice” when a child sees juice (tact) does not automatically lead to the ability to request “juice” when the child is thirsty (mand).

The notion of functional independence has been well documented in the literature and has been the focus of many empirical studies investigating Skinner’s analysis of verbal behavior (Sautter & LeBlanc, 2006). Previous research has illustrated the functional independence of mands and tacts in various populations, including the vocal repertoires of typically developing preschool children (Lamarre & Holland, 1985), the signing repertoires of hearing impaired and developmentally delayed teenagers (Hall & Sundberg, 1987), in the verbal behavior of adults with severe mental retardation using graphic symbols (Sigafoos, Doss, & Reichle, 1989) and in the acquisition of impure mands and impure tacts of young children with language delays (Twyman, 1995).

For example, Lamarre and Holland (1985) were the first to empirically investigate the functional independence of mands and tacts with human participants (preschool children). Previous studies in this regard had been limited to chimpanzee-language research (Savage-Rumbaugh, Rumbaugh, Smith, & Lawson, 1980). In the investigation by Lamarre and Holland, some participants were taught to mand for the experimenter to place items “on the left” and “on the right”. Subsequently, the experimenters assessed whether the participants could use the same topographical responses (“on the left” or “on the right”) as tacts as a result of mand training. The other participants learned to tact the

prepositional locations of items (i.e., “on the left” and “on the right”) and were then assessed for the ability to mand using these prepositional phrases. In short, the authors sought to determine if training one verbal response to function as a mand would generalize to a tact function and vice versa. Results indicated generalization across operants did not occur and that the participants only acquired the verbal operant that was directly trained.

Similarly, Hall and Sundberg (1987) taught deaf adolescents with multiple disabilities to complete a series of behaviors in a behavior chain (i.e., making instant soup). The participants were then taught to tact every item used in the chain. After tact training, mand responses were probed by withholding an item necessary to complete the chain, thus increasing the reinforcing value of that item. The results indicated that mands were rarely emitted following tact training, meaning that teaching tacts and contriving situations in which items trained as tacts functioned as reinforcers was insufficient in producing mand responses for the same items. However, one untrained mand response did occur with one participant after two other mand responses were taught, which may suggest that an existing mand repertoire is needed in order for transfer to occur.

In a similar study involving daily living skills, Sigafoos et al. (1989) taught adults with mental retardation to use graphic symbols to tact food and beverage items and the utensils necessary to consume those items. The participants’ ability to mand for those items was then tested. In order to determine whether mand responses would emerge following tact training, mand probes were conducted in which the food items were placed on the table but the utensil necessary to consume the item was withheld. None of the participants requested the missing items until they were directly trained to do so using

tact to mand transfer of stimulus control procedures, in which an experimenter held up an item asking “What is this” and delivered the item contingent upon the correct response.

Twyman (1995) investigated the functional independence of impure tacts and impure mands involving abstract properties. In this investigation, the experimenters sought to determine if training impure mands or tacts of abstract properties (i.e., the whole crayon) would lead to the emergence of the other operant without direct training. The term “impure” was used to define these verbal operants because multiple controlling variables were present during both the mand and tact conditions, thus making the responses part tact and part mand. For example, in the mand condition, the desired item was present and, as a result, the mand response could have been partly controlled by the discriminative stimulus. Similarly, in the tact conditions, the participants were not allowed to engage in a preferred activity until they emitted the correct tact response. Thus, the tact response could have functioned as part mand. Preschoolers identified as having language delays and existing mand and tact repertoires participated in the study. The results indicated that the participants only emitted responses that were directly trained. In other words, participants who were taught to mand the abstract stimulus property (“I want the whole crayon”) did not tact the stimulus property (“That is the whole crayon”) until after they were trained to do so and vice versa.

Although research supports the notion that verbal operants are functionally independent, research in which established verbal repertoires can be used to develop other functional repertoires using transfer of stimulus control procedures suggests that the verbal operants may be inter-related or functionally interdependent (Sautter & LeBlanc, 2006). Recently, researchers have investigated the practical implications of the

functional inter-dependence of the verbal operants to determine whether training procedures designed to establish one verbal operant (i.e., the tact) can facilitate the emergence of another operant (i.e., the mand) (Wallace, Iwata, & Hanley, 2006).

For example, in a systematic replication of Sigafos et al. (1989), Sigafos, Reichle, Doss, Hall, and Pettitt (1990) demonstrated that participants with an existing minimal mand repertoire were able to mand for utensils required to consume an item after being taught to tact the utensils. In other words, the authors investigated whether a response trained as a tact could spontaneously transfer to a mand response among participants who had an established minimal mand repertoire consisting of a single generalized topography (i.e., pointing to a “want” symbol). The authors set up contingencies in which the participants had to mand for the utensils (i.e., spoon, opener, and cup/straw) needed to access the requested food or beverage items. However, all participants already had the ability to use a symbol that served as a generalized mand for “want”. Prior to and following tact training, the researchers assessed whether the children manded for the utensils. The results indicated that after tact training two of the three mands appeared without any direct training. These results differed from the results of Sigafos et al. (1989) and the authors suggested that including participants with an existing generalized mand repertoire may accounted for the emergence of mands following tact training. However, these results are both similar to and different from Hall and Sundberg (1987), in that the results also suggest that an existing minimal repertoire may be necessary for generalization to occur. With Hall and Sundberg (1987) the relevant factor affecting transfer of function was the number of mands existing in the

subjects' repertoire prior to the study, whereas with Sigafoos et al. (1989) a previously acquired mand frame may have contributed to transfer observed.

Petursdottir, Carr, and Michael (2005) replicated the study by Lamarre and Holland (1985), who, as discussed earlier, demonstrated the functional independence of mands and tacts with typically developing preschool aged children. Petursdottir et al. (2005) investigated the relations of the mand and tact by teaching students to complete two 4-piece assembly tasks. They taught children to tact the four pieces that comprised one of the assembly tasks and to mand for the pieces that comprised the other task and then assessed generalization across the operants.

Results of Petursdottir et al. (2005) differed from those of Lamarre and Holland (1985). In fact, results indicated that all of the participants were able to tact items following mand training. However, tact training proved to have inconsistent effects on the acquisition of mands. Only after subsequent mand training did all of the participants correctly mand for the items. Petursdottir et al. suggest that the use of discrete objects versus the use of abstract stimulus properties ("on the left" or "on the right") as in Lamarre and Holland may have contributed to the different outcomes. Additionally, the authors suggest that the use of the interrupted-chain procedure (withholding pieces necessary to complete a task) may have contrived an EO during mand training and testing which led to the transfer of control from the EO to the  $S^D$  and vice versa. By contrast, EOs were not under the control of the researchers in the Lamarre and Holland study and may not have been present during mand training and testing.

In a similar vein, Wallace et al. (2006) suggested that the conditions under which the training of one operant can facilitate the emergence of an untrained verbal operant

may be related to motivating operations. The authors argued that in many of the studies evaluating the functional independence of the verbal operants it is unclear whether motivating operations were present in the mand conditions. For example, in the Lamarre and Holland (1985) study, the experimenters never examined whether placing an item to the left or right actually had any reinforcing value for the participants. Some studies have claimed to contrive conditioned motivating operations (CMO) by requiring participants to complete response chains or to request missing items (i.e., utensils) needed to consume a food or beverage item (Hall & Sundberg, 1987; Petursdottir et al., 1989; Sigafoos et al., 1989). Many of these studies argue that contriving a CMO ensures that a motivating operation is in effect at the time of training. However, in all the above mentioned studies it was unknown whether completing the chain or receiving a utensil functioned as a reinforcer. In addition, in the Twyman (1995) study there was no indication that the abstract property (“whole crayon”) of an object served as a reinforcer.

Consequently, several of the above mentioned studies failed to provide evidence that the item delivered in the mand test conditions actually served as a specific reinforcer for the target response. Therefore, without the presence of the relevant EO and specific reinforcers during mand tests, it is possible that any potential effect of tact training on the emergence of mands was not observed (Wallace et al., 2006). In short, it is sensible to conclude that in these studies, finding the functional independence of verbal operants might have been an artifact of the procedures used rather than the nature of the verbal operants themselves.

Therefore, Wallace et al. (2006) sought to investigate the function of reinforcer strength on the emergence of mands after tact training in adults with mental retardation.

The participants had limited vocal behavior and did not readily use verbal behavior (i.e., vocalizations or signs) to obtain desired items. In addition, none of the participants used formal signs to communicate.

Preference assessments were used to determine which leisure items were highly preferred and which items held little value. The participants were taught to tact all the leisure items (both high preference and low preference items) using manual signs. Following tact training, mand tests were initiated and the results showed that only the tacts of the highly preferred items transferred to mand responses. Providing further evidence that in order for mand responses to emerge, these responses must be evoked under the control of relevant establishing operations. Thus, the authors demonstrated that the transfer from tact to mand relations was related to the value of the items to be manded.

Strategies that promote the transfer from one verbal operant to another have practical implications for teaching verbal behavior to children with language delays and would be a valuable instructional tool. Therefore, the current study systematically replicated Wallace et al (2006) with young children with autism. Additionally, this study attempted to extend the Wallace et al. study in five respects: First, the response modality selected for this study was vocal behavior rather than sign. Second, the participants selected for the study had an existing minimal vocal verbal repertoire. Third, the participants in the present study were children diagnosed with autism instead of adults with mental retardation. Fourth, a single *pure* mand probe was conducted in the beginning of every session during both the tact and mand probe conditions rather than as a separate condition following the tact acquisition phase. Fifth, the response form

associated with each target item consisted of nonsense words to control for prior learning history and exposure to the labels outside of session.

## Chapter Two

### Method

#### *Participants and Setting*

Three children diagnosed with autism spectrum disorder, between the ages of 3-5, were selected for this study. Selected participants had an existing minimal tact and mand repertoire. These participants also had an existing echoic repertoire. However, participants did not exhibit untrained verbal responses that served the tact or mand function. In other words, the participants did not emit tacts or mands that had not been directly trained. Matthew was 4 years 6 months and had been diagnosed with autism in the mild to moderate range. Matthew could follow 3-step directions and could remain seated during task situations for long durations. He exhibited the ability to mand for both reinforcing activities and items and would occasionally mand for information. He also demonstrated the ability to tact the actions of others and over 100 common objects, including reinforcers. At the time of the study he was enrolled in a self-contained autism pre-school classroom at his elementary school and was receiving 5 hours a week of applied behavior analysis (ABA) services, which consisted mainly of language training. Jason was 4 years 5 months and had been diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). He was able to follow simple directions and was relatively compliant during instructional situations. He had poor articulation and would often speak in a low voice tone which served as a barrier to effective

communication. Jason demonstrated the ability to mand for preferred items and activities and the actions of others. He could also tact over 60 common objects. Jason was receiving ABA and speech therapy services and was currently enrolled in a pre-school classroom at the time of the study. Christian was 3 years 3 months and been recently diagnosed with autism in the mild to moderate range. He could follow some simple directions but had a short attention span and difficulty remaining seated during task situations. He was observed to emit many vocalizations throughout the day and would frequently repeat the vocalizations of others. However, many of these vocalizations were echolalic utterances and would not always occur under appropriate stimulus conditions. Christian's mand and tact repertoires were weak but developing. He demonstrated the ability to mand for some of his reinforcers and he could tact a limited amount of common objects, many of which were preferred items. He attended pre-school part-time and received 8-hours of ABA services a week when the study was conducted.

Sessions were conducted in a center that served children with autism or in the participants' homes. At the center, sessions took place in a room containing a table, two chairs, and the materials necessary to conduct the sessions. The sessions that took place at the participants' homes were conducted in the participants' bedrooms. One to two sessions were conducted daily, a minimum of 2 days per week.

### *Materials*

Materials for this study included a video camera with a tripod to record the sessions as well as other materials necessary to conduct sessions (a timer, targets items, reinforcers, data sheets, etc.). The stimuli in this study included both 1) preferred edible food items used as reinforcers during tact training and 2) low preference and high

preference leisure items that were used as target items during tact training and mand probes. See Appendix A and B for data sheets to be used during tact training and mand probes.

### *Response Definitions*

A tact was defined as emitting a correct vocal verbal response when presented with the vocal verbal discriminative stimulus “What is it?” while the experimenter held up an item. A generalized reinforcer was obtained for emitting the correct tact response. A mand was defined as the participants’ vocal verbal request for either of the two items available during the mand probe sessions. To control for prior learning history as well as to prevent the participants from acquiring the target responses outside of the experimental conditions, nonsense words were assigned to each target item and thus the response forms consisted of nonsense words (i.e., *doso*) rather than the traditional names of the target items (i.e., Play Pod).

### *Data Collection and Interobserver Agreement*

The experimenter scored the occurrence of tacts and mands on data sheets during sessions. In addition, all sessions were videotaped. Therefore, interobserver agreement (IOA) was assessed by having an independent observer score the occurrence of tacts and mands via video recorded sessions during at least 75% of tact sessions and at least 50% of mand sessions. For tact sessions, an independent observer scored the occurrence of tact responses and interobserver agreement was calculated by dividing the number of agreements by the total number of agreements and disagreements and dividing this number by 100%. Agreement for tact sessions averaged 99.8% across all participants (range, 99.5% to 100%). For mand sessions, a second observer simultaneously but

independently scored the occurrence of mands during 10-s intervals. Scored-interval IOA was utilized to calculate exact agreement for mand sessions, thus IOA was only based on intervals in which the behaviors were recorded to occur by either of the observers. Agreement was calculated by dividing the number of intervals in which both of the observers agreed on the occurrence of the behavior by the total number of scored intervals (in which either or both observers recorded the occurrence of the behavior). Agreement for mand sessions averaged 96% across all participants (range, 90% to 100%).

#### *Preference Assessments*

*Food assessments.* Each participant's parents and/or trainers were interviewed in order to gather information regarding possible reinforcers. Items suggested to be reinforcers for each participant by their parents or trainers were presented in a multiple-stimulus without replacement (DeLeon & Iwata, 1996) assessment. The most preferred (top-ranked) food item was used as a reinforcer during tact training. Food assessments were conducted periodically throughout the study to ensure that the most preferred edible items were utilized during tact training. Correct responding to either HP or LP items produced the same reinforcer.

*Leisure assessments.* Items not currently in the participant's mand repertoire and suggested to be reinforcers during parent and/or trainer interviews were presented in a multiple-stimulus without replacement (DeLeon & Iwata, 1996) assessment to determine relative preference for each leisure item. A high-preference (HP) item (top-ranked item) and a low-preference (LP) item (lowest ranked item) were identified as target items to be

used during both tact training and mand probes. For each participant, nonsense words were assigned to each HP and LP target items.

### *Experimental Procedure and Design*

The effect of tact training on the emergence of untrained mands was evaluated in a multiple baseline design across participants. Each participant was exposed to a baseline phase followed by tact training for the HP and LP items. Manding was also evaluated during this phase in a pure mand probe conducted prior to each session. Following mastery of the tact responses, the students were exposed to a post-tact training impure mand condition to evaluate transfer from tact to mand. For Jason and Christian, an additional phase was added to evaluate potential effects of response restriction on the EO for the LP item.

*Pre instructional tact probe.* A series of tact probes was conducted prior to tact training to determine a baseline level of tact performance. Sessions were 10 minutes in length. Each session consisted of 20 trials in which two items were presented one at a time in a semi random order until both items were presented 10 times, with new trials being initiated every 30 s. During each trial, the experimenter held up either an HP or LP item and asked the participant “What is it?” Percent correct tacting was recorded. There were no programmed consequences or prompts delivered for any tact responses emitted during this probe condition. Pre instructional tact probe conditions alternated with mand probe sessions. At least 2 pre instructional tact probe sessions were conducted.

*Pre instructional mand probe.* To determine a baseline level of manding, mand probes were conducted prior to tact training. Sessions were 10 minutes in length. During each session, the experimenter simultaneously placed the HP and LP leisure items on the

table in front of the participant. However, no other prompts or instructions were delivered. If the participant correctly emitted the vocal response for either item, the experimenter would have delivered the specified item. Had the participant manded for the item, he would have been given access to the item for 30 s, after which the item would have been placed back on the table next to the other item.

*Tact training.* Tact training sessions were 10 minutes in length, during which the experimenter taught the participants to tact both the HP and LP leisure items from their preference assessments. In addition, to determine if mand responses were beginning to occur during tact training, a single 30 s *pure* mand probe was conducted at the beginning of each tact training session. During the pure mand probes, the target items were hidden from the participants' view and the experimenter recorded the occurrence or nonoccurrence of a pure mand response. There were no instructions, programmed consequences, or prompts delivered for any mand responses emitted during this pure mand probe; the experimenter simply recorded the occurrence (or nonoccurrence) of mand responses. After the pure mand probe, tact training was initiated. Tact training consisted of 20 trials in which two items were presented one at a time in a semi random order until both items were presented 10 times, with new trials being initiated every 30 s in the early stages of training and 20 s as prompting on trials was faded.

During each trial, the experimenter held up either an HP or LP item and asked the participant "What is it?" Correct vocal responses resulted in the delivery of a piece of the participant's preferred food item. Incorrect responses were followed by an echoic correction procedure (re-presentation of the item and S<sup>D</sup>, "What is it?", and an experimenter vocal model) and the student was required to echo the response. In order to

immediately fade the echoic prompts, following the correction procedure (for Matthew and Jason) the antecedent was re-presented as a transfer trial. The experimenter then waited for the next scheduled trial. If the participant did not respond within 5 s of the delivery of the S<sup>D</sup> (“What is it?”), experimenter then conducted the echoic correction procedure described above. A tact was scored as correct only if the participant emitted the correct vocal response within 5 s of the verbal S<sup>D</sup> (“What is it?”) and prior to any subsequent prompting. The responses were reinforced differentially, in which a prompted response resulted in a smaller amount of the edible reinforcer than did a correct independent response. Tact training was complete when the participant correctly tacted both the HP and LP item on 90% of the trials (with the first trial being correct for both items) over two consecutive sessions.

*Post instructional impure mand probe.* Given that no pure mands occurred during pre-session mand probes during the tact training condition, a post instructional *impure* mand probe (in the presence of the target items) was conducted to determine whether participants exhibited target responses as impure mands. During these 10 min impure mand probe sessions, the target items were present. However, a *pure* mand test was also embedded within the *impure* mand probe to give the participants the opportunity to mand for the target items (HP and LP) without them being displayed during the first 30 s of the session. This pre-session pure mand opportunity was conducted in the same fashion as discussed previously. To ensure that the target items were not in the participants’ view, the experimenter placed both items in a box under the table prior to each session.

At the start of each session, the experimenter sat at the table with the participant but did not deliver any prompts or instructions. If the participant correctly emitted the

vocal response for either item, the experimenter delivered the specified item. The participant had access to the item for 30 s, after which the item was placed on the table next to the other item. However, if the participant did not emit a mand for either item within 30 sec of the start of the session, then the experimenter simultaneously placed the HP and LP leisure items on the table in front of the participant. No other prompts or instructions were delivered during the session. If the participant correctly emitted the vocal response for either item, the experimenter delivered the specified item. The participant had access to the item for 30 s, after which the item was placed back on the table next to the other item.

*Post instructional impure LP/ pure HP mand probe.* Given that some participants (Jason and Christian) requested the LP item during the post instructional impure mand probe, an LP alone probe was implemented to determine if the LP responses would be maintained if the LP item was the only item available. During these 10 min probe sessions, the LP item was present on the table while the HP item was hidden in a box under the table. Just as with the tact training and impure mand phases, a *pure* mand test was also embedded within this phase to give the participants the opportunity to mand for the target items (HP and LP) without them being displayed for the first 30 s of the session. To ensure that the target items were not in the participants' view, the experimenter placed both items in a box under the table prior to each session. Following this, at the start of each session, the experimenter sat at the table with the participant but did not deliver any prompts or instructions. The LP item was placed on the table while the HP item remained in the box. If the participant correctly emitted the vocal response for either item, the experimenter delivered the specified item. The participant had access

to the item for 30 s, after which the item was either placed on the table (for the LP item) or back in the box (for the HP item). During this phase, no other prompts or instructions were delivered. Mands for the HP item were considered *pure* mands because these vocal responses did not occur in the presence of the HP item. Mand responses for the LP item were considered *impure* mands because these vocal responses occurred in the presence of the LP item.

## Chapter Three

### Results

Figure 1 shows the results of leisure preference assessments for all 3 participants. Matthew's HP and LP leisure items were the Pin print and Pokémon toys (selected on 100% and 14% of trials respectively), Jason's were also the Pin print and Pokémon toys (selected on 83% and 5% of trials respectively), and Christian's were a Play Pod and MP3 player (selected on 73% and 20% of trials respectively). Nonsense words were assigned to each target item and thus the response forms for Matthew's HP and LP items were "doso" and "boosha" respectively. The response forms for Jason's HP and LP items were "doso" and "beebe" respectively. The nonsense words "doso" and "boosha" were also assigned to Christian's HP and LP leisure items.

Figure 2 shows the results of the mand probes and tact training for all participants. During baseline, none of the participants emitted the correct mand or tact responses. All participants acquired the tact responses for the HP and LP items during tact training within 12 or fewer sessions. During subsequent mand probes, all participants requested the HP item at high rates (an average rate of 1.6 mands per minute [MPM] for Matthew, 1.0 MPM for Jason, and 1.1 MPM for Christian) and requested the LP item at low rates (an average of 0.01, 0.04, and 0.03 MPM respectively for all three participants). For Jason, manding for the LP item initially increased to 0.8 responses per minute when it was the only item present during the post instructional impure LP/ pure HP mand probe

condition. However, LP responses decreased to 0.4 MPM over subsequent sessions. A pure mand for the HP item occurred during the first session of this condition but did not occur during any subsequent sessions. For Christian, during the post instructional impure LP/ pure HP mand probe sessions, manding for the LP item did not increase even though it was the only item present on the table. Christian only requested for the LP item during the first session of this condition at a rate of 0.1 responses per minute. During subsequent sessions, Christian resumed manding for the HP item at an average of 0.7 *pure* MPM. During the third session of this condition, Christian also emitted a pure mand response during the pure mand test at the start of the session. Matthew did not emit any pure mands during the pure mand probes. However, he did engage in impure mand responses for the HP item during tact training. In other words, he only requested for the HP item in the presence of the stimulus.

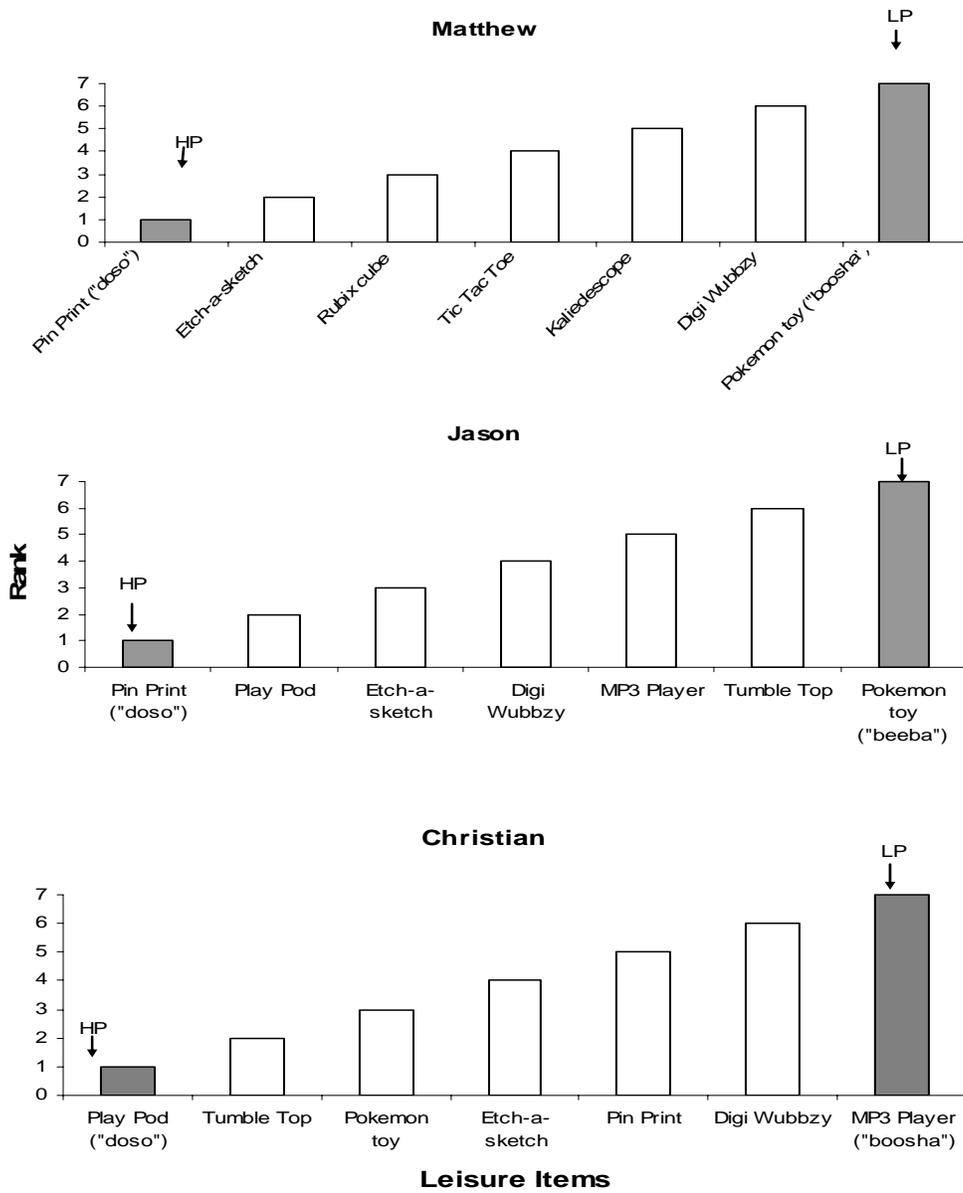


Figure 1. Represents the results of leisure assessments for all three participants (shaded bars represent items taught as facts). Items are rank ordered.

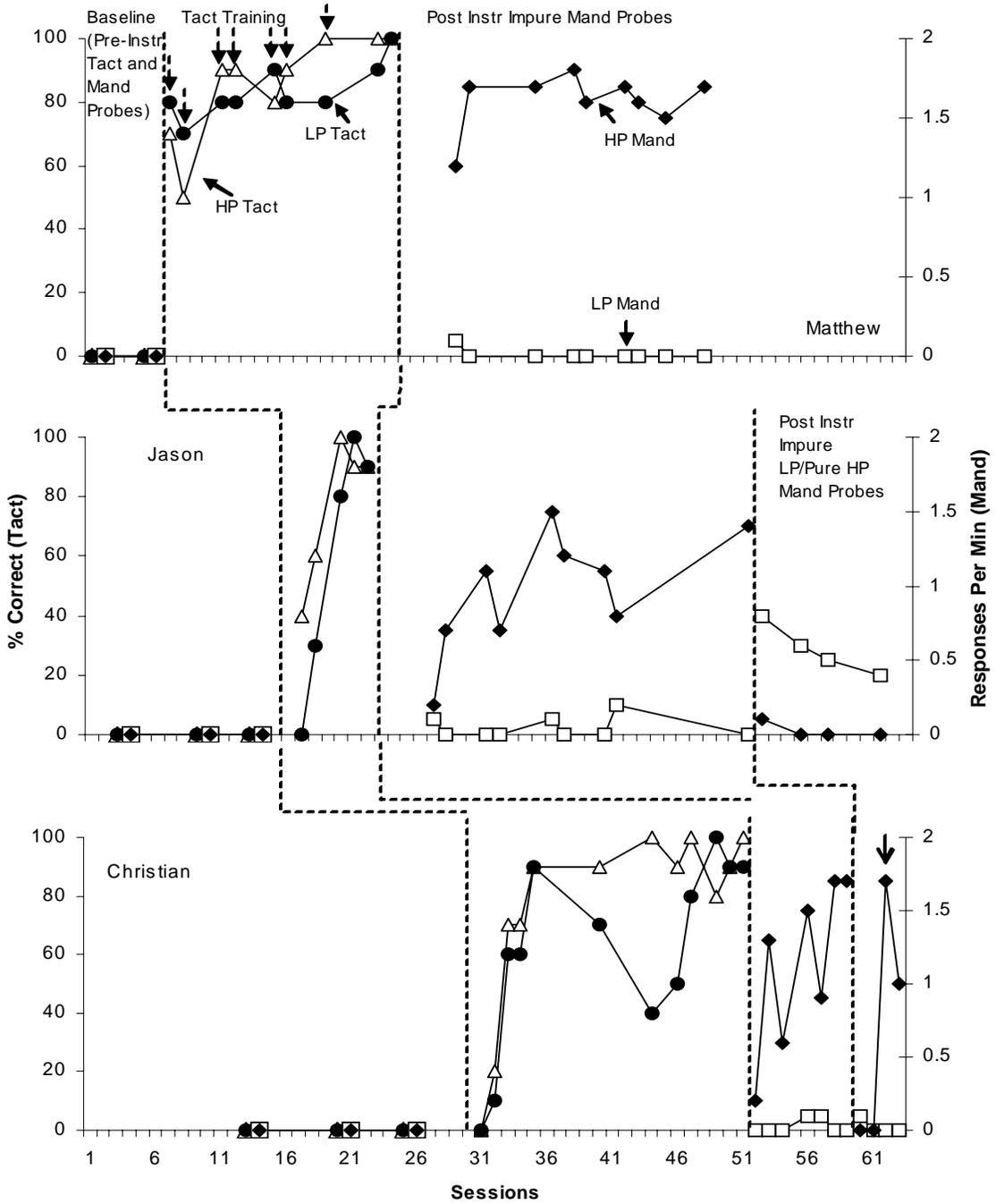


Figure 2. Mands for HP and LP items during mand probes (right scale) and tacts for HP and LP items during tact training (left scale). Dashed down arrows represent sessions in which impure HP mands were emitted during tact training. Solid down arrows represent sessions in which a pure HP mand was emitted during the pure mand tests.

## Chapter Four

### Discussion

The purpose of the present study was to test conditions that resulted in the emergence of untrained mand responses following the acquisition of tact responses for children diagnosed with autism or related disorders. All of the participants acquired vocal responses for both HP and LP items as tacts. The responses taught as tacts transferred to impure mand responses without direct training for the HP items for all participants and occurred at high rates during the initial post instructional impure mand probe conditions. By contrast, impure mand responses for the LP item occurred at low rates for all the participants. These results suggest that the conditions under which training of one operant facilitates the emergence of an untrained verbal operant may be related to motivating operations. The findings of this current investigation provide further support for the results of Wallace et al. (2006) and provide evidence that the results can be extended to other populations and response topographies.

However, the results of the present study differ from previous research on functional independence in which the tact to mand transfer was not observed (Hall & Sundberg, 1987; Lamarre & Holland, 1985; Sigafoos et al., 1989; Twyman, 1995). A possible explanation for the discrepancy in results is that previous studies did not manipulate EOs or evaluate motivation while investigating the transfer of responses across verbal operants. For example, previous studies investigating functional

independence failed to provide evidence that the consequences delivered in the mand test conditions actually served as a specific reinforcers for the target response. The presence of a relevant EO is required in order for mand responses to occur. Thus, it is possible that the tact-to-mand transfer failed to occur in previous investigations due to the absence of a relevant establishing operation and specific reinforcers.

The results of the preference assessments conducted in the current study suggested that HP items would function as reinforcers relative to LP items. The data collected throughout this study were consistent with these results suggesting that the transfer between tact and mand relations may be a function of reinforcer strength. In other words, the transfer from tact to mand responses was more likely to occur for items that had reinforcing value to the participants (HP items) than for items that were less preferred (LP items). Nonetheless, the study also identified conditions in which LP mand responses were evoked. For example, when the LP item was the only item present during the post instructional impure LP/pure HP mand probe, Jason's requesting for the LP item increased, however, as expected, manding subsequently decreased overtime.

The current study has practical implications for teaching verbal behavior to children with autism or related disorders. Strategies that promote the transfer from one verbal operant to another would be a valuable tool for practitioners developing skill acquisition programs for children diagnosed with language delays. Based on the results of this study, practitioners could develop verbal behavior teaching procedures that require less training time or trials than traditional approaches to language training. For example, if individuals were taught to tact highly reinforcing stimuli, mands may be more likely to

emerge without direct training if those stimuli were available outside of tact training conditions.

A potential limitation to the current study is the limited number of pure mands that were emitted by the participants throughout the study. All three participants failed to emit a pure mand during the 30 s pure mand probes embedded within each post instructional impure mand probe. In other words, the participants only requested for the HP item when the item was present. Only during the second phase of the study, in which the LP item was present and the HP item was hidden, did Jason and Christian began to engage in pure mand responses for the HP item. Thus, it could be argued that the mand responses were partly under the control of the discriminative stimuli instead of solely under the control of the establishing operation. However, differential responding (high rates of manding for the HP item and low rates of manding for the LP item) during the post-instructional mand probes indicates that responses that occurred during this condition were under motivational rather, than discriminative control. Additionally, the utilization of a mand frame while requesting for the HP item by some of the participants indicate that the responses functioned as mands rather than as tacts. For example, throughout the study Matthew would request the HP items using the mand frame “I want \_\_\_” or “I need.” In fact, he began requesting the HP item during tact training using these mand frames as early as the first tact training session. Thus, despite the fact the Matthew never emitted a pure mand response, it is reasonable to suggest that his mand responses were under the control of the relevant establishing operations rather than the discriminative stimulus. Additionally, it is possible that 30 s may have not been an adequate amount of time to evoke a pure mand response during the pure mand probes

occurring prior to the mand and tact sessions. The participants may have emitted pure mands had the pure mand probe been extended.

A second potential limitation is the variability in the mand responses during the post-instructional impure mand probes for all the participants, especially Jason and Christian. However, given the nature of the establishing operation some variability is expected. In addition, variability may be accounted for by the fact that two impure mand probe sessions often occurred on the same day. As a result, manding for the HP items often decreased during the second session indicating that satiation may have been occurring. For example, during sessions 2 and 3 of the post-instructional impure mand probe condition, Christian emitted 1.3 and 0.6 MPM respectively. Both sessions occurred on the same day. The authors attempted to ameliorate the effects of satiation by reducing the number of sessions that occurred per day.

During this study, differential consequences were delivered during mand probe conditions. It could be suggested that the delivery of the programmed consequences (access to the HP items) during mand probes could have possibly served as mand training, which is a potential limitation to the current investigation. Given this limitation future researchers should investigate the transfer from tacts to mands under mand probe conditions in which no programmed consequences are delivered following mand responses. Future researchers should also further investigate the role motivation plays in the establishment of untrained verbal operants. For example, future research could evaluate the tact-to-mand transfer when participants are under conditions of deprivation or satiation (Wallace et al., 2006).

During the last phase of the current study, LP responses were maintained for Jason but not for Christian. The discrepancy in results is unclear but may be related to relative reinforcer strength. In other words, the LP item selected for Jason may have not functioned as a reinforcer relative to the HP item under conditions in which both the HP and LP items were both present. However, under conditions in which the LP item was the only item available (the last phase of the study) its reinforcing value may have increased and as a result mands for the LP item increased as well. Conversely, for Christian it appears that the presence of the LP item alone was not enough to maintain mand responses and instead seemed to function as an establishing operation that evoked pure mands for the HP item. However, it is quite possible that Christian's manding for the LP item may have increased if items less preferred than the LP item were also available. Given the discrepant results, future research is warranted to further investigate conditions under which LP responses could be maintained.

Future research should also investigate the role pre-existing mand and tact repertoires may play in the transfer from tact to mand relations. Both Hall and Sundberg (1987) and Sigafos et al. (1989) suggest that a pre-existing minimal mand repertoire may be necessary for the tact-to-mand transfer to occur. Given that all of the participants in the current study had a pre-existing minimal tact and mand repertoire, it may be necessary to determine how a pre-existing mand frame or how the number of mands acquired prior to tact training will effect emergence of untrained mand responses. In addition, with the findings of this study and that of Wallace et al. (2006), further investigation into the functional independence of the other verbal operants (echoics, intraverbals, etc.) is warranted. This current study only evaluated the mand and tact

relations. However, it is likely that transfer could occur among the other verbal operants as well. For example, it is possible that there exist conditions (that are yet to be identified) under which the establishment of intraverbals could lead to the emergence of other untrained operants.

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## Appendices

Appendix A: Tact Training Data Sheet

Participant: _____		Date: _____ Time: _____		Session: _____		Pure Mand: Y or N				
Observer _____		Primary: <input type="checkbox"/>		Reli: <input type="checkbox"/>		Percent correct: % HP: _____ % LP: _____				
Trial	1	2	3	4	5	6	7	8	9	10
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										
Trial	11	12	13	14	15	16	17	18	19	20
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										
Participant: _____		Date: _____ Time: _____		Session: _____		Pure Mand: Y or N				
Observer _____		Primary: <input type="checkbox"/>		Reli: <input type="checkbox"/>		Percent correct: % HP: _____ % LP: _____				
Trial	1	2	3	4	5	6	7	8	9	10
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										
Trial	11	12	13	14	15	16	17	18	19	20
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										
Participant: _____		Date: _____ Time: _____		Session: _____		Pure Mand: Y or N				
Observer _____		Primary: <input type="checkbox"/>		Reli: <input type="checkbox"/>		Percent correct: % HP: _____ % LP: _____				
Trial	1	2	3	4	5	6	7	8	9	10
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										
Trial	11	12	13	14	15	16	17	18	19	20
Target	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
Item	LP	LP	LP	LP	LP	LP	LP	LP	LP	LP
Yes/No										

### Appendix B: Mand Test Data Sheet

Pure Mand Emitted During Pure Mand Probe: Yes or No						
Interval #						
Min 1	1	2	3	4	5	6
	:00-:10	:10-:20	:20-:30	:30-:40	:40-:50	:50-1:00
HP						
LP						
Interval #						
Min 2	7	8	9	10	11	12
	1:00-1:10	1:10-1:20	1:20-1:30	1:30-1:40	1:40-1:50	1:50-2:00
HP						
LP						
Interval #						
Min 3	13	14	15	16	17	18
	2:00-2:10	2:10-2:20	2:20-2:30	2:30-2:40	2:40-2:50	2:50-3:00
HP						
LP						
Interval #						
Min 4	19	20	21	22	23	24
	3:00-3:10	3:10-3:20	3:20-3:30	3:30-3:40	3:40-3:50	3:50-4:00
HP						
LP						
Interval #						
Min 5	25	26	27	28	29	30
	4:00-4:10	4:10-4:20	4:20-4:30	4:30-4:40	4:40-4:50	4:50-5:00
HP						
LP						
Interval #						
Min 6	31	32	33	34	35	36
	5:00-5:10	5:10-5:20	5:20-5:30	5:30-5:40	5:40-5:50	5:50-6:00
HP						
LP						
Interval #						
Min 7	37	38	39	40	41	42
	6:00-6:10	6:10-6:20	6:20-6:30	6:30-6:40	6:40-6:50	6:50-7:00
HP						
LP						
Interval #						
Min 8	43	44	45	46	47	48
	7:00-7:10	7:10-7:20	7:20-7:30	7:30-7:40	7:40-7:50	7:50-8:00
HP						
LP						
Interval #						
Min 9	49	50	51	52	53	54
	8:00-8:10	8:10-8:20	8:20-8:30	8:30-8:40	8:40-8:50	8:50-9:00
HP						
LP						
Interval #						
Min 10	55	56	57	58	59	60
	9:00-9:10	9:10-9:20	9:20-9:30	9:30-9:40	9:40-9:50	9:50-10:00
HP						
LP						