The Effects of Daily Intensive Tact Instruction on the Emission of Pure Mands and Tacts in Non-Instructional Settings by Three Preschool Children with Developmental Delays

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Abstract

We tested the effects of an intensive tact instruction procedure on the emission of verbal operants in non-instructional settings by three preschool students with developmental delays. The participants were selected because they emitted low numbers pure verbal operants in non-instructional settings throughout the school day. Specifically, we measured the number of pure mands and tacts emitted during probes in the non-instructional settings. During the intensive tact procedure, the participants received an additional 100 tacts above their average number of daily learn units. In a delayed multiple probe design, we found that the intensive tact instruction was effective in increasing the number of pure mands and tacts emitted in the non-instructional settings by all three of the participants in the study.

Keywords: Tacts, Mands, Learn units.

The development of a fluent speaker repertoire is critical for young children with language delays. Students with a fluent speaker repertoire use an extensive vocabulary across settings and overtime, extrapolate new vocabulary based on existing vocabulary and are reinforced naturally by communicative behavior (Hart & Risley, 1996). Furthermore, students who function as "speakers" can govern consequences in the presence of "listeners" in their environment by using another individual to mediate the contingencies (Greer, 2002). Deficits in the development of a speaker repertoire may be attributed to native or environmental factors. The latter was demonstrated by Hart & Risley (1995) who found a correlation between SES and vocabulary growth, where 3 year-old children from families categorized as low SES had acquired approximately half the vocabulary compared with children from higher SES or professional families. These findings were attributed to overall language interactions between parents and their children, in which parents of high SES used a vocabulary of over 2000 different words versus 1000 words used by parents of low SES. Additionally, the low SES children experienced infrequent opportunities for interactions, which placed these children at risk for failure in future language-learning opportunities.

Students that present with deficits in their speaker repertoire often receive intense behavioral interventions that provide opportunities for compensation. This instruction involves teaching the vocal operants-- mands and tacts. According to Skinner's analysis of verbal behavior (1957), mands and tacts are two of the functional relations in terms of their controlling antecedent and consequent events. Children typically learn tacts through direct instruction, naming or via observation if the student has an observational learning repertoire. The term "tact," is derived from "contact" with one's own environment, and can represent aspects of an individuals' environment across all five senses: taste, smell, sound, touch and sight (Greer & Ross, 2006). More specifically, a tact is a vocal verbal operant that is under non-verbal control and is reinforced by a generalized reinforcer (Skinner, 1957; Becker, 1989). In this case a generalized reinforcer would be the attention of another person. For example, a child may emit the tact car with a vocal response "car" in the presence of an actual car and the child's mother may respond "that is a red car." In this case the mother's response functioned to reinforce the child's initial tact. This then increases the likelihood that the child would emit further tacts in the future.

Skinner (1957) differentiated between two different types of tacts; pure and intraverbal tacts, where an intraverbal or impure tact occurs under multiple controlling antecedents, which are both verbal and physical. At times during direct instruction students are required to emit impure tacts where the teacher points to a stimulus and as part of the antecedent and may ask "What is it?" Typically, children are learning the form and the correspondence between the stimulus and the word during instruction under the antecedent control of both a verbal stimulus and a nonverbal stimulus. A pure tact, however, is a tact that occurs under the control of a physical stimulus, but not under verbal stimulus control and occurs under natural motivational conditions. Greer & Ross (2007) state, "It is reinforced by attention or other forms of generalized reinforcement, such as the opportunity to mand." (475). A child may emit the pure tact "apple", if they are walking in a grocery store and see a stimulus whose properties are round and red. In this case example, the child here has learned the form under relevant conditions and does not rely solely on the vocal antecedent of a teacher to evoke a functional response. Furthermore, the consequence for emitting the tact may be adult attention that may consist of a conversational response (i.e. "I love apples, don't you?") or the delivery of the specified item, which would constitute an impure mand.

The tact repertoire is critical for the advancement of a fluent speaker repertoire in children with developmental delays. More recent research on developmental capabilities identifies the presence of the tact repertoire as key component to developing other speaker and listener capabilities, and eventually joining those capabilities together (Greer & Ross, 2007). Those higher order capabilities are naming, observational learning of tacts, textual responding, and recruitment of tacts using "Wh" (Greer & Ross, 2006; Lowe, Horne, Harris & Handle, 2002; Greer, Stolfi, Chavez-Brown & Rivera-Valdes, 2005).

Skinner (1957) defined a mand as a verbal operant in which the response is controlled by a condition of deprivation or aversive stimulation as a result of a history of reinforcement with a consequence specific to that condition. Unlike a tact response, which is controlled by a discriminative stimulus, a mand is controlled by an establishing or motivating operation (Laraway et al., 2003). Michael (1998) defined establishing operations (EOs) as events that momentarily alter the reinforcing effects of a stimulus. The form may be the same for a tact and mand, however the functional properties differ. The consequence for a mand results in delivery of the item itself whereas the consequence of a tact results in generalized reinforcement.

Skinner noted that mands and tacts develop independently from one another (Skinner, 1957). That is, if one learns to directly tact "Juice" in the presence of the discriminative stimulus (picture of juice), they may not emit the mand or "Juice" given relevant EO (cup of juice). Several applied studies have investigated the functional independence of mands and tacts in children with developmental disabilities (Nuzzolo & Greer, 2004; Twyman, 1996) and young children without developmental disabilities (Lamarre & Holland, 1985; Petursdottir, Carr & Michael, 2005). Research has shown that multiple exemplar experiences, in which mand a tact responses were rotated across the separate establishing operations for the mand and tact resulted in the acquisition of untaught verbal functions (Greer, Nirgudkar, & Park, 2003; Nuzzolo & Greer, 2004; Petursdottir, Carr, & Michael, 2005).

There has been a plethora of research on successful procedures and tactics that increase early speaker behavior. Procedures such as stimulus-stimulus pairing (Sundberg, Michael, Partington, & Sundberg, 1996; Yoon & Bennett, 2000) and presenting a series of rapid motor imitations (Ross & Greer, 2003; Tsiouri & Greer, 2003) have functioned to advance students from a pre-speaker to an emergent speaker level of verbal behavior. Some research on first instances of speech has emphasized teaching students form or production of words by teaching students to match different sounds (i.e. "c-a-t") (Chavez-Brown, 2005). However, there have been few findings on procedures that increase the function or the emission of learned vocabulary in the environment.

In some cases, even when students received intense behavioral intervention such as the echoic to tact or mand teaching procedures (Partington & Sundberg, 1998; Williams & Greer, 1993) in effort to

compensate from limited language interactions, children may emit few verbal operants in their environment. One explanation among behavior analysts is that these students are indeed under control of vocal verbal antecedents, perhaps due to their instructional history versus generalized reinforcement such as adult attention or praise (Partington, Sundberg, Newhouse, & Spengler, 1994; Greer & Ross, 2006).

Some research has focused on setting up the appropriate establishing operations (Eos) to evoke independent language (Michael, 1988). Schwartz (1994) compared 3 types of EOs (incidental, brief deprivation and interrupted chains) for teaching mands and found that each EO was successful in acquisition, generalization and maintenance of pure mands. Ross, Nuzzolo, Stolfi & Natarelli (1995) tested the effects of a speaker emersion procedure on independent tacts and mands for students who had limited mand and tact repertoires. The speaker emersion procedure used an intense number of EOs where students were required to mand for specific items and activities throughout the school day. The authors found an increase in independent (pure) mands and tacts by the participants in non-instructional settings following the speaker immersion procedure.

Recently, Schauffler and Greer (2006) tested the effects of intensive tact instruction on the acquisition of audience-accurate tacts and conversational units with middle school aged students diagnosed with emotional and behavioral disorders. The participants emitted a low number of audience appropriate tacts and conversational units. In this study, an audience accurate tact included the emission of a tact operant that corresponded with a stimulus within the environment that was appropriate for a school audience. A conversational unit is a verbal exchange where each individual functions as both a speaker and a listener (Skinner, 1957; Chu, 1998). The independent measure was the intensive tact instruction where students where taught an additional 100 tacts daily. These tacts included the use of autoclitics (i.e. “It’s a huge pine tree”). Specifically, an autoclitic is verbal behavior that functions to qualify, affirm, negate, specify, or in some way modify the effect of the speaker’s behavior on the listener or audience (Skinner, 1957). The results of the study found that after the daily intensive tact procedure, both participants emitted a higher numbers of accurate tacts and conversational units.

Pistoljevic and Greer (2006) found similar results in the emission of pure tacts and mands in non-instructional settings (lunch, recess, and play area) by preschool students with developmental delays. The daily intensive tact protocol required the students to learn an additional 100 tacts daily using learn units. A learn unit is a 3 term contingency for the student and 2 or more three term contingencies for the teacher (Greer, 2002; Albers & Greer, 1991). Responses to the learn unit presentation from a teacher results in a response from the student. The student’s response then occasions reinforcement or a correction operation by the teacher. In a multiple probe design, the results demonstrated an overall increase in the number of pure mands and tacts emitted during non-instructional time (hallway, lunch and toy area) following mastery of each set of tacts.

The purpose of the present study was to test the effects of the intensive tact protocol across three participants with developmental delays who emitted low levels of vocal verbal behavior throughout the school day. More specifically, will our findings replicate those found by Pistoljevic & Greer (2006) where there were increases in pure mands and tacts emitted by students with developmental delays?

Method

Participants

The participants in this study were 3 preschool students diagnosed with developmental delays. The participants all had acquired several tacts with autoclitics through instruction using learn units but still emitted few pure tacts throughout the school day. In addition, the participants had several generalized mands in their repertoire. More specifically, the participants were selected because they emitted low numbers verbal operants in non-instructional settings, such as the play area, hallway, and lunchtime.

Participant A attended a classroom with a 10:3:1 student: teaching assistant: teacher ratio and was educated in a class for students with and without disabilities. Participant B and C attended a classroom with a 6:2:1 student: teaching assistant: teacher ratio. See Table 1 for a complete description of the participants including a list of present verbal capabilities.

Table 1. Participant A, B, and C's Gender, Level of Verbal Behavior, Present Capabilities, Current Objectives and Standardized Test Scores

Participant & Gender	Level of Verbal Behavior	Present Capabilities	Some Current Programs	Preschool Language Scale- 4 Test Scores
A Male	Listener Speaker Early Reader Beginner Writer	Conditioned reinforcement for listening to voices, Sensory matching, capacity for sameness across senses, listener literacy, parroting, echoic to mand and tact, independent mands and tacts with autoclitics, generalized matching	Print transcription, conditioned reinforcement of book for the observing response, textually responding to numbers	*Auditory Comprehension:* Standard Score (SS) = 59 Age equivalent (AE) = 2.4; *Expressive Communication:* SS= 62 AE = 2.7 *Total Age Equivalent*= 2.5; P*ercentile rank* = 1%
B Female	Listener Beginner Speaker Beginning Reader Early Writer	Conditioned reinforcement for listening to voices, auditory matching, listener literacy, parroting, echoic to mand, echoic to tact, independent mands and tacts with autoclitics, generalized matching	Conditioned reinforcement for the observing of books, print transcription, textual responding to numbers, and Multiple Exemplar Instruction (MEI) with lowercase letters	*Auditory Comprehension:* SS = 63 AE = 2.7 *Expressive Communication:* SS = 57 AE = 2.4; *Total Age Equivalent* = 2.5; *Percentile Rank* = 1%
C Male	Listener Beginner Speaker, Pre-Reader Pre-Writer	Conditioned reinforcement for listening to voices, auditory matching, listener literacy, parroting, echoic to mand, echoic to tact, independent mands and tacts with autoclitics, generalized matching	Conditioned reinforcement for books through observation, print transcription, and conditioning blocks	*Auditory Comprehension:* SS= 52 AE = 2.2 *Expressive Communication:* SS = 59 AE = 2.8 *Total Age Equivalent* = 2.3 *Percentile Rank* = 1%

Setting

The participants attended a private, publicly funded pre-school that serviced children with and without developmental delays. The school was located outside of a large metropolitan area and employs the Comprehensive Application of Behavior Analysis to Schooling (CABAS®). There were four classrooms in the school that vary in terms of the students levels of verbal behavior (pre-listeners/speakers through speakers and emerging self-editors) and ratio of students to teachers (10:1:3; 7:1:7; 6:1:3 & 7:1:4). The students were assessed according to the Pre-School Inventories of Repertoires as well as the Verbal Capabilities (Greer & McCorkle, 2003; Greer & Ross, 2007). Programs and Protocols were selected from these assessments in order to move students to higher developmental levels.

This study took place in various locations at the school. The probe sessions were conducted upon arrival and departure to and from school, during lunchtime, and in the free-play area. Tact instruction took place in the hallway, the free-play area, and in various other places in classroom (i.e. small table near the play area, computer area, by teacher's desk and at the lunch table). Instruction on tacts did not take place in the typical setting where instruction would normally take place (at the students' assigned table).

Dependent Variable

The target behaviors in this study were pure tacts and pure mands emitted during non-instructional time. Pure tacts were defined as vocal verbal operants that were under the control of non-verbal antecedents and reinforced by generalized reinforcement. An example of a pure tact included the student was walking out of the school toward the bus and emitted the tact "the bus". Some pure tacts emitted in this study included, "it's a cow", "it's stuck" (referring to zipper on a backpack), "He's crying". Pure mands were defined as verbal operants that were under the control of non-verbal antecedents and in which the response is reinforced by a characteristic consequence (the specified item). In this case, a pure mand would constitute a child emitting the mand "open the door" in the presence of a closed door. Some pure mands emitted in this study included, "I want the play area", "help", & "what about me?" The consequence for the mand was the teacher delivering the item or activity. The delivery of the item (in the case of the mand) or teacher attention (in the case of the tact) functioned as reinforcement for the student, which would increase the likelihood that the student would emit pure mands and tacts in the future.

Intensive Tact Instruction

The independent variable in this study was the daily intensive tact instruction protocol. This procedure required each participant to receive the same number of learn units as in baseline for all other academic programs. Participants received 100 additional learn units daily of tacts while the amount of other instruction remained constant. This was calculated by determining an average number of learn units presented to the participant prior to the start of intensive tact instruction.

Learn unit instruction for all sets of stimuli were conducted in non-instructional settings. Five sets of two-dimensional stimuli printed on 3 by 5 index cards were used. Each set consisted of 5 categories with multiple exemplars of 4 novel stimuli. Table 2, 3 and 4 shows the sets of stimuli for each participant that were selected from the Preschool Inventory of Repertoires for Kindergarten (PIRK®), (Greer & McCorkle, 2003); 1) Community Helpers, 2) Transportation, 3) Fruits, 4) Animals & 5) Instruments. The multiple exemplars of each stimulus varied across irrelevant dimensions such as color or size. The categories were consistent throughout all participants, however, the stimuli within each set varied to based on the participants prior instructional history. Each category was presented in isolation with 20-learn unit opportunities.

Table 2.
Set Stimuli Used for Participant A

	Set 1	Set 2	Set 3
Community Helpers	Ballerina	Stewardess	Football Player
	Photographer	Computer Tech	Electrician
	Fisherman	Cab Driver	Scientist
	Barber	Hockey Player	Painter
Transportation	Ambulance	Scooter	Buggy
	Motorboat	Wheelchair	Sled
	Ferry	Crane	Rocket
	Canoe	Snowmobile	Forklift
Animals	Platypus	Squid	Coyote
	Ostrich	Guinea pig	Leopard
	Seahorse	Anteater	Mere cat
	Buffalo	Iguana	Slug
Instruments	Harp	Bongo	Fiddle
	Choir	Recorder	Tuba
	Drums	Saxophone	Harmonica
	Cello	Tambourine	Banjo
Food	Sour Sap	Taco	Sushi
	Toddy Palm	Fortune Cookie	Burrito
	Mangosteen	Avacado	Pomegranate
	Dragon Fruit	Pear	Cauliflower

Table 5 depicts a learn unit presentation in this study. All antecedents were non-vocal presentations by the teacher. That is, the teacher provided opportunities for the students to emit pure tacts by holding up pictures of the stimuli, as part of the learn unit in the non-instructional settings. Thus, the teacher would bring the student to non-instructional areas, obtain the student's attention and present the stimulus. A correct response was recorded if the student emitted the target word that had point-to-point correspondence with the stimuli presented. Additionally, autoclitics were required as part of the response, since the participants readily emitted autoclitics as part of their prior mand and tact instruction. For example, upon presentation of the stimulus "policeman" a response with autoclitics would be "It's a policeman". For all of the participants for a response to be recorded as correct, the participant was required to say, "It's a _____". Omission of the autoclitic was recorded as an incorrect response. The consequence for a correct response included the instructor delivering vocal praise, and/or tokens, which could be exchanged for back-up reinforcers. An incorrect response included the student emitting an incompatible or unclear response, as well as omitting the autoclitics. The consequence for an incorrect response resulted in the teacher representing the antecedent (holding up the stimulus) and requiring the student to repeat the correct answer. Mastery on a set of stimuli constituted the student responding at 90% accuracy for 2 consecutive sessions or 100% accuracy for 1 session.

Table 3. Set Stimuli Used for Participant B

	Set 1	Set 2	Set 3	Set 4	Set 5
Community Helpers	Stewardess	Painter	Lifeguard	Delivery Man	Veterinarian
	Basketball player	Ballerina	Scientist	Captain	Musician
	Rower	Garbage Man	Fisherman	Construction	Judge
	Referee	Florist	Baseball player	Worker	Astronaut
				Policeman	
Transportation	Tricycle	Tractor	Bicycle	Elevator	Snowboard
	Crane	Jet Ski	Speedboat	Roller Skates	Ambulance
	Ferry	Escalator	Dump Truck	Skis	Submarine
	Sled	Airplane	Helicopter	Stroller	Fire Truck
Animals	Dragonfly	Penguin	Octopus	Dolphin	Mongoose
	Shark	Ants	Goal	Ostrich	Sea Horse
	Alligator	Lizard	Guinea pig	Platypus	Cheetah
	Squirrel	Fox	Dingo	Mountain Lion	Whale
Instruments	Tuba	Violin	Trombone	Cymbal	Timpani
	Harmonica	Drums	Accordion	Gong	Bongos
	Flute	Saxophone	Banjo	Ganza	Tambourine
	Cello	Piano	Clarinet	Bagpipes	Cow bell
Food	Salad	Pasta	Grapefruit	Lemon	Flan
	Coffee	Beans	Pie	Onion	Sundae
	Sushi	Bacon	Potatoes	Tomato	Lasagna
	Donut	Waffle	Bagel	Wheat	Radish

Table 4.
Set Stimuli Used for Participant C

	Set 1	Set 2
Community Helpers	Taxi Driver	Flight Attendant
	Crossing Guard	Basketball Player
	Surgeon	Rower
	Photographer	Referee
Transportation	Forklift	Tricycle
	Bulldozer	Ferry
	Sailboat	Sled
	Motorcycle	Crane
Animals	Gerbil	Dragonfly
	Starfish	Zebra
	Bumble Bee	Alligator
	Raccoon	Squirrel
Instruments	Harp	Flute

	Organ	Cello
	Guitar	Tuba
	Xylophone	Harmonica
Food	Cotton Candy	Salad
	Watermelon	Sushi
	Cashews	Cucumber
	Asparagus	Pineapple

Table 5. Example of a Tact Learn Unit for Correct and Incorrect Student Responses Event Operant

Correct Learn Unit	
1) Attending Student	Teacher Discriminative Stimulus (Sd)
2) Teacher holds up picture of a cat	Teacher Behavior Student Sd
3) Student responds "It's a cat"	Student Behavior Teacher Consequence Teacher Sd
4) Teacher provides consequence in the form of generalized reinforcement by saying "good"	Teacher Behavior Student Consequence
5) Completion of the learn unit	Teacher consequence
Incorrect Learn Unit	
1) Attending Student	Teacher Sd
2) Teacher holds up picture of a cat	Teacher Behavior Student Sd
3) Student responds "It's a dog"	Student Behavior Teacher Consequence Teacher Sd
4) Teacher provides consequence in the form of a correction procedure, by representing the stimulus and having the student echo the correct response "It's a cat".	Teacher Behavior Student consequence Teacher Sd
5) Completion of the learn unit	Teacher consequence

Data Collection

Pure Mand and Tact Probe Sessions: During probe sessions, data were collected on the frequency of pure tacts and mands using a pen, data collection sheet and clipboard by one or two observers. A timer was also used to ensure that each probe was exactly 5 min in length for each non-instructional setting; hallway, lunch, and free play area. The data were then added across settings and graphed as the total number of pure mands and tacts emitted across the cumulative 15 min period.

Intensive Tact Instruction: Data were collected during instructional sessions using a data collection sheet and pen. The learn unit was used, where the instructor recorded the number of correct and incorrect responses to 5 different categories of stimuli (Table 2, 3 and 4). Each category consisted of 4 stimuli and the student received 20 learn unit presentations per category. Data were recorded and graphed as the numbers of learn units correct and displayed on a 20 learn unit graph.

Procedure

During baseline and following mastery of each set of stimuli (post experimental probes), data were collected using an event recording on the frequency of pure tacts and mands emitted by each participant in each of the three non-instructional settings during 5 min observational sessions. Data were blocked daily into 15 min probe sessions (5 min for each setting). During the transition setting, a timer was set during arrival from when the student stepped off the bus through when the student entered the classroom. The timer was then restarted during the next transitional time to ensure that a full 5 min probe session was conducted during transitions. The timer was started and stopped after a full 5 consecutive min across both lunchtime and free play area. Data were collected at the lunch table when the student finished their lunch and began their snack and in the toy area when at least 1 other student was present.

During the intensive tact instruction, when the participant achieved mastery on one category of stimuli in a set, another category was presented twice throughout the day to insure the student received 100 tact learn units within a day. Thus, the instructor did not introduce another set of stimuli until the student acquired mastery on each category within a set. After mastery was met on all five categories, one day of post probes were conducted, and then instruction began on a new set of stimuli.

Interobserver Agreement

During the intensive tact instruction, interobserver agreement was conducted using the Teacher Performance Rate Accuracy (TPRA) observations (Ingham & Greer, 1992). All teachers that instructed the students during tact instruction had errorless TPRAs with 100% accuracy. During probe sessions, a second observer, who independently and simultaneously recorded the frequency of pure tacts and mands emitted during non-instructional time, conducted interobserver agreement. Interobserver agreement was calculated by dividing the total number of agreements by the total number of agreements and disagreements and multiplying that number by 100. Interobserver agreement was conducted for 35% of all sessions for Participant A with mean agreement of 100%. Interobserver agreement was conducted for 19% of the total sessions for Participant B and with a mean agreement of 98% and a range of 95-100%. Interobserver agreement was conducted for 30% of all sessions for Participant C with a mean agreement of 99% and a range of 95% to 100%. Procedural integrity was also measured by the TPRA observations and was 100% throughout.

Design

A delayed multiple probe design across participants was used for this study (Horner & Baer, 1978). Baseline probe sessions were conducted for each participant for three consecutive days prior to the start of the intensive tact instruction. Following mastery on a given set of stimuli during the intensive tact instruction, one post-probe session was conducted to measure the number of pure mands and tacts across non-instructional settings (15 min). The sequence of the study was as follows 1) Baseline Probe Sessions, 2) Instruction on Set 1, 3) Post probe sessions, 4) Instruction on Set 2 stimuli, 5) Post Probe

sessions, 6) Instruction on Set 3, 7) Post probe sessions, 8) Instruction on Set 4, 9) Post probe sessions. Participant A completed 3 sets of tact instruction, Participant B completed 5 sets of tact instruction and Participant C completed 2 sets of tact instruction.

Results

A functional relationship was demonstrated in that the daily intensive tact training increased the number of verbal operants emitted in non-instructional settings across all three of the participants. Figure 1 shows the number of verbal operants emitted in the non-instructional setting. Figures 2, 3 and 4 show mastery on each set of stimuli during the intensive tact instruction for Participants A, B, and C respectively.

FIGURE 1, NEXT PAGE!

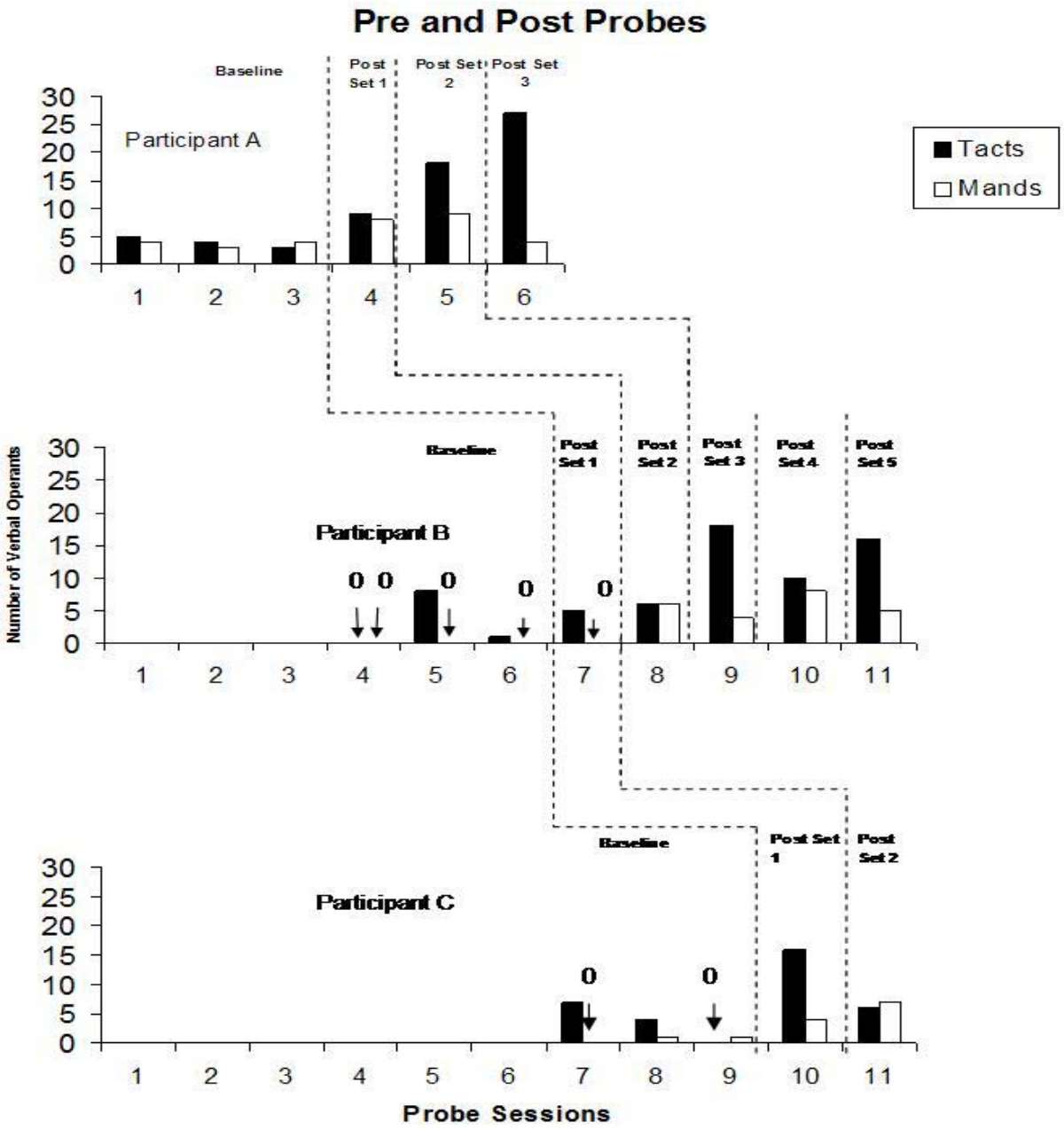

Figure 1. **The Number of Verbal Operants Emitted during Pre and Post Probes in Non-Instructional Settings for Participants A, B B, and C.**

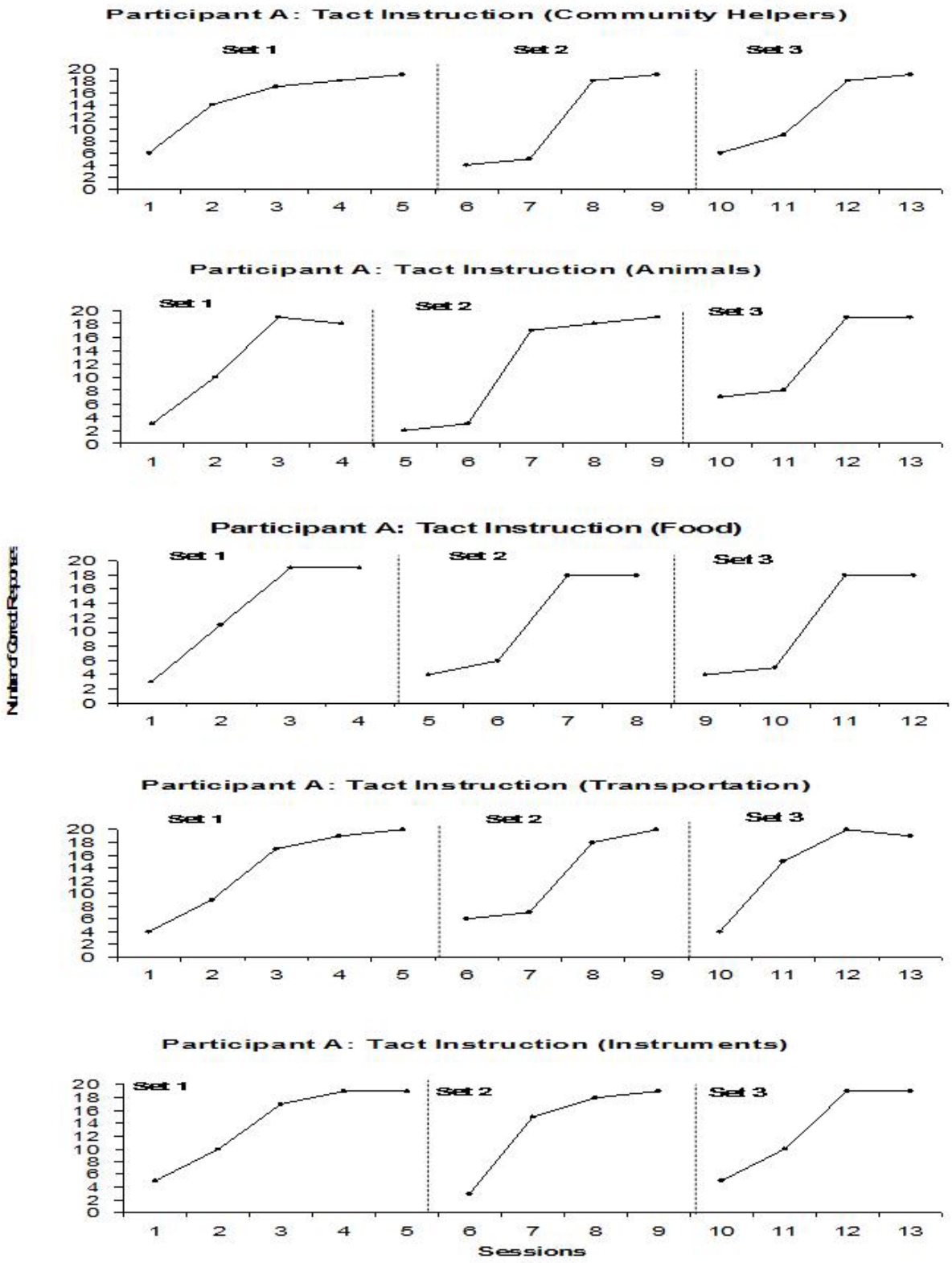

Figure 2. **Intensive Tact Training Graphs for Sets 1, 2, and 3 for Participant A.**

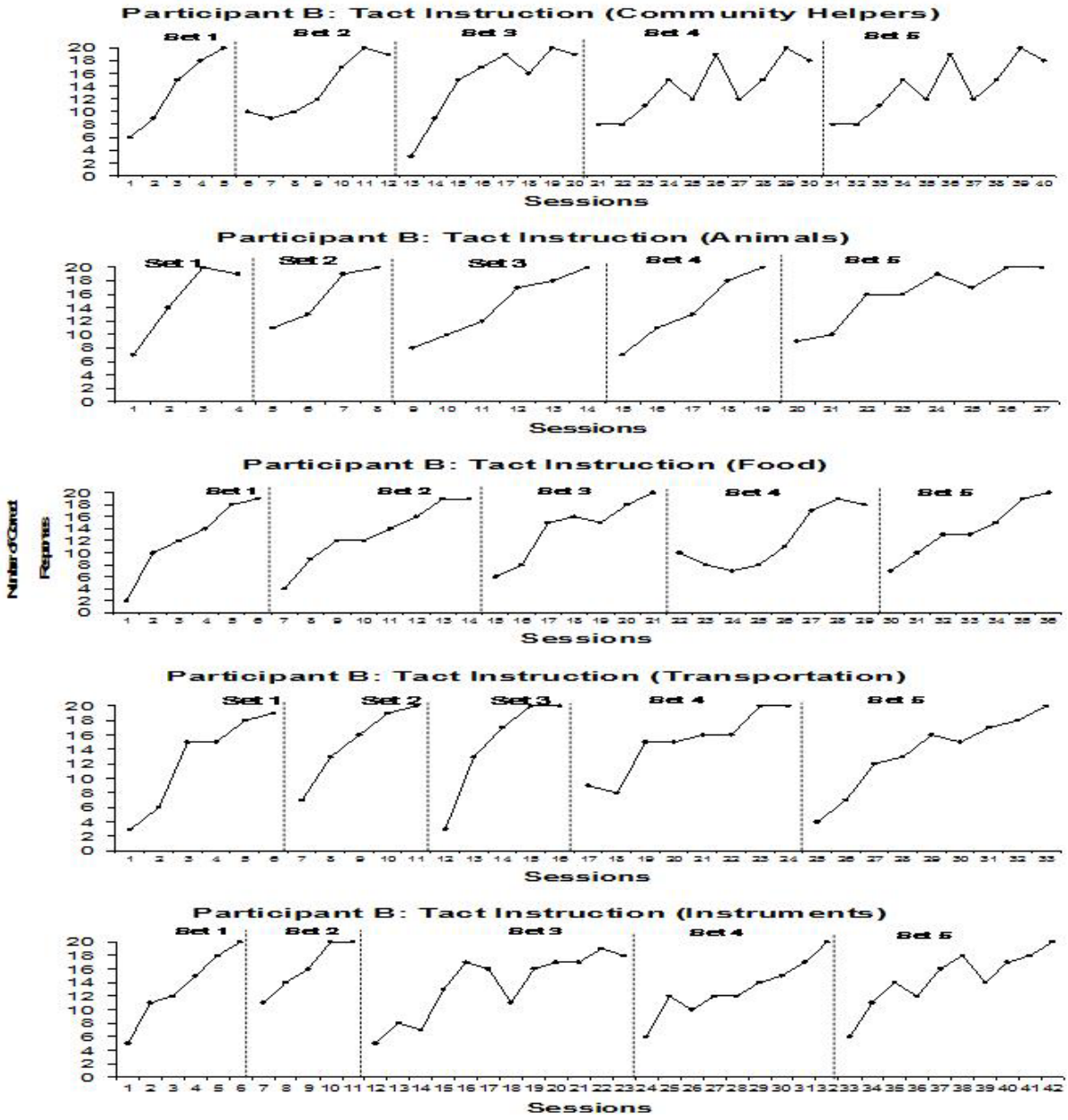

Figure 3. **Intensive Tact Training Graphs for Sets 1, 2, 3, 4, and 5 for Participant B.**

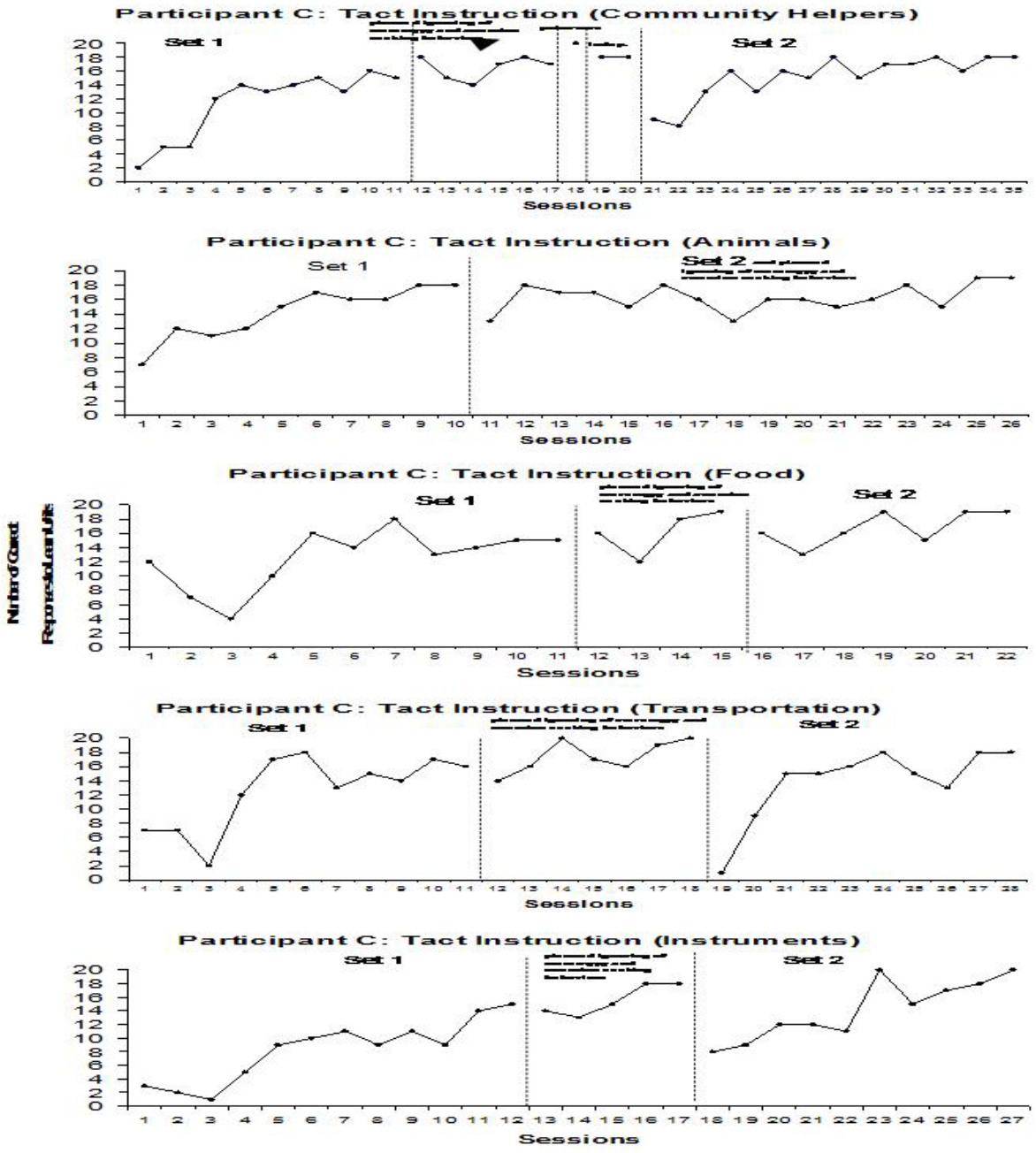

Figure 4. **Intensive Tact Training Graphs for Sets 1 and 2 for Participant C**

As shown in Figure 1, during the three days of baseline probes in the non-instructional settings, Participant A emitted 5, 4, and 3 pure tacts (mean=4), and 4, 3, and 4 (mean=3.7) pure mands respectively. After mastery of Set 1 (Figure 2), Participant A emitted 9 pure tacts and 8 pure mands during post probes in non-instructional settings. Following mastery of set 2, Participant A emitted 18 pure tacts and 8 mands during the post probes in non-instructional settings. After mastery of Set 3,

Participant A emitted 27 pure tacts and 3 mands during post-probes in non-instructional settings. The learn units to criterion for mastery of sets of stimuli decreased with each set (Table 6). Additionally, Participant A's rate of tacts emitted during the post probes in non-instructional settings increased as the study progressed (Table 7).

Table 6. Learn Units to Criterion for Each Set of Stimuli for Participants A, B, and C

	Set 1	Set 2	Set 3	Set 4	Set 5
Participant A	92	84	80	n/a	n/a
Participant B	116	108	168	160	136
Participant C	320	232	n/a	n/a	n/a

Table 7. The Number of Tacts Emitted Per Minute During Pre and Post Probe Sessions in Non-Instructional Settings

	Participant A	Participant B	Participant C
Baseline Probe 1	.33	None	.47
Baseline Probe 2	.26	.533	.27
Baseline Probe 3	.20	.06	None
Post Set 1 Probe	.6	.33	1.07
Post Set 2 Probe	1.2	.4	.4
Post Set 3 Probe	1.8	1.2	n/a
Post Set 4 Probe	n/a	.67	n/a
Post Set 5 Probe	n/a	1.07	n/a

During the three days of baseline probes in non-instructional settings, Participant B emitted 0, 8, and 1 tacts (mean=3) and 0, 0, and 0 mands (mean = 0) in non-instructional settings, respectively (Figure 1). After mastery of Set 1 stimuli (Figure 3), Participant B emitted 5 tacts and 0 mands during the post probes in non-instructional settings. After mastery of Set 2 stimuli, Participant B emitted 6 tacts and 6 mands during the post probes in non-instructional settings. After mastery of Set 3 stimuli, Participant B emitted 18 tacts and 4 mands on post probes in non-instructional settings. After mastery of Set 4 stimuli, Participant B emitted 10 tacts and 8 mands on post probes in non-instructional settings. After mastery of Set 5 stimuli, Participant B emitted 16 tacts and 5 mands on post probes in non-instructional settings. The learn units to criterion for mastery of sets of stimuli decreased from Set 1 (116) to Set 2 (108), but there was an increase in the number of learn units required to master Sets 3, 4 and 5 (168, 160 and 136) (Table 6). Additionally, Participant B's rate of tacts emitted during the post probes in non-instructional settings increased as the study progressed (Table 7).

During the three days of baseline probes in non-instructional settings, Participant C emitted 7, 4, and 0 tacts (mean=3.7) and 0, 1, and 1 mands (mean=.67) in non-instructional settings, respectively (Figure 1). After mastery of Set 1 stimuli (Figure 4), Participant C emitted 16 tacts and 4 mands on post probes in non-instructional settings. After mastery of set 2 stimuli, Participant C emitted 6 tacts and 7 mands on post probes in non-instructional settings. The learn units to criterion for mastery of sets of stimuli decreased with each set (Table 6). Additionally, Participant C's rate of tacts emitted during the post probes in non-instructional settings increased as the study progressed (Table 7).

Discussion

This study was conducted to test the effects of the intensive tact procedure on the number of pure mands and tacts emitted during non-instructional time by students who emitted a low level of independent

mands and tacts. These results paralleled the results found by Pistoljevic & Greer (2006), where a functional relationship was demonstrated between the intensive tact protocol and increases in independent verbal operants. All of the participants in the study emitted an overall increase in both the number and rate of pure mands and tacts in the non-instructional setting.

Limitations

One limitation in this study was methodological in that it was difficult to control for the number of learn units presented throughout the day. Some days, the sessions were slightly under the number of learn units required due to setting events (i.e. student picked up early from school). Also, as the study progressed, the students' rate increased across instruction. Therefore, the students were meeting their required learn unit goal at a faster rate. Because of ethical issues, at times the instructors would deliver slightly over the required number of learn units. Overall, the mean numbers of learn units presented daily closely matched the baseline measure. A second limitation of this study was that Participant A received after school instruction that could not be controlled for. This of course increased the number of "daily" learn units that he was required to receive. However, tact instruction was not part of his after school program.

Another limitation of the study is that Participants A and C did not receive all of the sets of stimuli. This of course could account for the levels of tacts and mands emitted in the non-instructional setting following the intensive tact treatment. In addition, Participant C had high rates of stereotypy that could also have accounted for his lower levels of responding. During the study a planned ignoring procedure was put in place as a tactic decrease his stereotypy and increase correct responses to tacts (Figure 4), which was interfering with his acquisition on sets of tacts. This tactic was successful in increasing mastery on sets of tacts. Rates of stereotypy decreased throughout the course of the study, which may possibly be attributed to the intensive tact procedure although that cannot be confirmed. Also Participant B required a slightly higher number of learn units to master the tacts during the intensive tact procedure (Table 6). This may be because of the difficulty associated with the stimuli in Sets 3 and 4 (Table 3).

Potential Explanations

The increase in the number of independent tacts emitted in the non-instructional setting are explained in terms of the findings on tacts and its link to the recruitment of generalized reinforcement. Furthermore, the rate of tacts emitted per minute also increased for all participants (Table 7). It is critical to note that the tacts emitted by the students during non-instructional time were not the tacts that were taught specifically during the tact instruction. Instead, the students' tacts were stimuli in the students' natural environment (i.e. pictures in a book, stimuli on the walls). Because the students were required to tact an additional 100 items per day during instruction, the numbers of reinforcements from adults increased through learn unit presentations. Thus, the students became progressively more under the control of adult attention and perhaps this resulted in the likelihood that the students would emit tacts in their natural environment.

There was a marginal increase in the number of mands emitted across all participants. The mand operant is a critical component in verbal behavior and in many instances is the first operant learned (Sundberg et al, 1996; Greer, 2002). However, once children surpass the pre-speaker level of verbal behavior, it is imperative that students learn tacts to exponentially increase their vocabulary. Without tacts, a student is limited and cannot advance to a fluent speaker level of verbal behavior (Greer & Keohane, 2005). Since the students (in particular Participant A) in the study were classified as possessing speaker or emergent speaker levels of verbal behavior, prior to the onset of the study they had several generalized mands in their repertoire. Furthermore, we collected data during the probe sessions for a short period of time across instructional settings (cumulative 15 min), which limited the student on the number of mands they may emit. For example, Participant A emitted a mean of 3.7 mands during baseline

levels. Although, there was an increase following post set 1 and 2, the data for the mands decreased to baseline levels, following set 3. These results are consistent with the limitation of the mand operant alone; in that one is restricted in the number of items they can mand in a given time, even if they have a fluent mand repertoire. This may also explain the slight increase from baseline levels for Participants B and C in comparison to tacts. Furthermore, the participants in the study acquired more independence in terms of self-help skills. In particular, this was noted across all of the participants during the non-instructional times, such as transitioning from the bus where the student did not need to emit a mand for help associated with putting or gathering their belongs (i.e. zipping up coat, getting back-pack).

The collateral effects in this study were apparent in that all of the participants completed the tact instruction at progressively faster rates (Table 7). In particular, Participant B actively sought out stimuli to tact on her own outside of instruction and often delivered learn units to herself. A change was also observed in the learn units to criterion for the mastery of each set of stimuli for Participants A and C (Table 6). As the research progressed, the numbers of learn units to criterion for mastery of each set of stimuli decreased for these participants. These findings contribute to the research on inducing verbal capabilities, which provides teachers with "tools" to advance students at an accelerated rate more advanced verbal developmental cusps.

Future Implications

The results of these findings are promising. The intensive tact procedure may provide as one means of increasing verbal operants for both students with native disabilities as well as those who do not have rich language interactions in early years as prescribed by Hart and Risley's (1995) research. These children require approximately double the amount of language instruction to catch up to their peers. This research not only serves to bridge the gap in vocabulary growth but more importantly examines the production of pure mands and tacts, which are critical to the advancement through developmental milestones (Greer & Ross, 2006). This includes increasing verbal exchanges (joining the listener and speaker) and eventually the opportunity to access more advanced verbal capabilities. These capabilities include naming, which is the ability to acquire novel vocabulary without direct instruction (Horne & Lowe, 1996). The acquisition of naming is equated with an increase in vocabulary and with independent learning, which is the goal for all children.

Furthermore, it is important to note the functional independence of mands and tacts as describe by Skinner (1957). He noted that establishment or acquisition of one verbal operant (e.g. mand or tact) does not always result in the appearance of the other without direct instruction. This has been identified as a verbal capability, the transformation of establishing operation between mands and tacts (Greer & Ross, 2007). Several experiments showed that young and/or developmentally delayed students do not demonstrate this capability (Hall & Sundberg, 1987; Lamarre & Holland, 1985; Ross & Greer, 2003; Tsiouri & Greer; 2003). We did not specifically test for this capability but it would be interesting to examine this relationship in terms of the effects of the intensive tact protocol. The participants did overall demonstrate an increase in the number of mands emitted, which suggests that the treatment of tacts may have had an effect on the number of mands emitted in the non-instructional setting. Future research would further investigate the relationship between tacts and mands and more specifically the effects of the intensive tact procedure on the emission of mands.

The researchers will continue to teach additional sets of stimuli for Participants A and C. In addition instruction will continue for each participant until the naming capability, observational learning of tacts capabilities are present, the participant has fluent and independent textual responding as well as the capability to recruit new tacts using "Wh" questions (Greer & Ross, 2007). Future research and replications using the intensive tact instruction should examine the effects on conversational units and the acquisition of the above mention capabilities. This may include increasing the time of the probe sessions to look at these measures and perhaps conduct probes across other settings to evaluate its effect. This is

imperative toward the progression of more advanced developmental milestones that translates into more educational outcomes for students.

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