

# Effects of a non-intensive tact training on the emission of spontaneous verbal operants in different non-instructional settings

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## Abstract

*The study evaluates the effects of a tact training on the emission of three verbal operants (i.e., tacts, mands and conversational units) in non-instructional contexts. The participants were a 16-year-old boy with autism and a 14-year-old girl with severe intellectual disability. Both students had achieved the listener repertoire and presented a level of verbal development defined as speaker and emergent speaker, respectively. They were selected on the basis of their difficulties in the production of spontaneous language in different non-instructional settings. A delayed multiple probe design across participants was used for the study. The number of pure mands, pure tacts and conversational units was measured in three non-instructional settings as dependent variables. The tact training consisted of an increase of 100 learn units in the emission of tacts compared to the average daily number of learn units received by each participant. Results show that for both students the procedure was effective in increasing the number of pure tacts and conversational units emitted in non-instructional settings.*

**Keywords:** Tact; Mand; Conversational Unit; Autism; Intellectual Disability.

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## 1. Introduction

Language acquisition occurs spontaneously in the first years of the typical life of developing children. In fact, the quantity of words acquired is not attributable to direct teaching (Greer & Ross, 2008). Children learn easily to communicate by responding to environmental antecedents and by interacting spontaneously in the presence of natural Establishing Operations (EOs; Pistoljevic, Cahill, & Casarini, 2010).

Functional communication is compromised in children with autism (DSM-5; American Psychiatric Association – APA, 2013). It has been estimated that only half of the children with autism and related disabilities use speech as a form of communication (Lord & Paul, 1997). Typically, a child with autism, in the presence of a non-verbal stimulus, does not emit any form of spontaneous interaction. The child remains silent and speaks only if verbally stimulated by another person, for example when a question is asked (Ingenmey & Van Houten, 1991). Communication is also one of the areas commonly compromised in Intellectual Disability (ID) (Kurtz, Boetler, Jarmolowicz, Chin, & Hagopian, 2011; Matson, Horovitz, Kozlowski, Sipes, Worley, & Shoemaker, 2011; Matson, Sipes, Horovitz, Worley, Shoemaker, & Kozlowski, 2011; van der Schuit, Segers, van Balkom, & Verhoeven, 2011). This condition is especially true for people with severe ID because, in most cases, they do not possess any verbal skills (Matson, Terlonge, Gonzalez, & Rivet, 2006). As far as expressive language is concerned, it seems that individuals with ID only use language to communicate simple requests for objects or rejections rather than to request the attention of other people (Casella, 2005).

Overall, it is important to teach children with autism and/or ID to emit tacts (i.e., denominations) for those objects or events that are under the control of a non-verbal antecedent (Matson, Sevin, Box, Francis, & Sevin, 1993; Williams, Carnerero, & Pérez-González, 2006; Greer & Ross, 2008) to promote the emergence of spontaneous language.

Children with communication deficits often benefit from an intensive behavioral intervention that offers many opportunities to compensate their mental delay (Delgado & Oblak, 2007). This procedure involves teaching verbal operants, such as mands and tacts.

Skinner (1957) defines spontaneous verbal interactions as pure mands and pure tacts since they are emitted under the control of a non-verbal antecedent stimulus. In children with developmental disabilities, a possible explanation for a deficit in the emission of pure mands and pure tacts can be

found in their learning history (Nuzzolo-Gomez & Greer, 2004). The learning of tacts may have been introduced under the control of an intraverbal (i.e., an antecedent vocal) stimulus and, consequently, examples of spontaneous speech may have never been taught (Partington, Sundberg, Newhouse, & Spengler, 1994). While the mand repertoire is vitally important for an individual's independence (Michael, 1988), tacts are mostly essential for the expansion of verbal repertoires and for the acquisition of more complex social behaviors (Lamarre & Holland, 1985). Research suggests that tact development represents a crucial stage for the further acquisition of a fluent-speaking repertoire. Tacts are necessary for the acquisition of naming (Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005), conversational units (Donley & Greer, 1993), reading (Greer & Speckman, 2009), and as a support for phonemic control considered as a source of derived relationships between naming, reading and writing (Reilly-Lawson, 2008). Several studies have identified effective procedures for the teaching of functional verbal operants, such as a) the use of echoic prompts to increase the spontaneous emission of tacts and mands (Kodak, Clements, & Ninness, 2009); b) the application of the mand-tact teaching protocol to facilitate the rapid acquisition of tacts (Arntzen & Almås, 2002), as well as c) the administration of an Intensive Tact Training (ITT) to increase the spontaneous emission of tacts, mands and intraverbals (Greer, 2002).

More specifically, the ITT protocol involves the presentation of 100 daily learn units in which the student has the opportunity to be exposed to tact visual stimuli (e.g., cards with two-dimensional pictures), in addition to a general educational instruction (Pistoljevic & Greer, 2006). Learn units outline the student-teacher interactions and define the antecedent of behavior, the desired response, and the consequence of its correct or incorrect emission (Greer & McDonough, 1999). For example, in verbal behavior, a learn unit occurs when the teacher asks the student "Do you want a cookie?" (i.e., antecedent); the student answers with a mand (i.e., desired response) and the teacher reinforces the mand by providing access to the cookie as a consequence. More in detail, Pistoljevic and Greer (2006) measured the effects of an ITT on the number of verbal vocal operants emitted in non-instructional settings by three preschoolers with autism who emitted a very low number of spontaneous tacts and mands. In the described study, students were provided with a picture of a stimulus to emit a tact. A correct response was reinforced with generalized reinforcers, such as verbal approvals. In case of an incorrect response or non-response, the

experimenter provided a correction consisting of having the student echo the correct response, for which no reinforcement was provided. The training consisted of delivering five sets of stimuli, each consisting of four stimulus pictures for five categories (i.e., community helpers, transportation, animals, instruments, and food). Following the mastery of a set, that is the emission of 90 correct tacts out of 100 in two sessions or 100 correct tacts out of 100 in one session, the authors measured the number of mands and tacts emitted in non-instructional settings, such as the playground, the cafeteria, or the hallway. The results showed that intensive daily instruction was effective in increasing the number of spontaneous verbal operants emitted. These results were replicated by Delgado and Oblak (2007).

Greer and Du (2010) examined whether the increase of pure mands and tacts in non-instructional settings was due to the ITT or to the increase in the number of learn units presented. The authors compared the number of pure tacts, mands, and intraverbals emitted during a basic teaching session (e.g., numbers, calendar, letters) to those produced during an ITT session. In both conditions, 100 additional learn units were presented to the participants. The results of the study confirmed the existence of a functional relationship between the intensive tact and the increase in the emission of pure tacts, pure mands, and intraverbals.

Schauffler and Greer (2006) evaluated the effects of the ITT on the acquisition of tacts and conversational units in two middle-school students with emotional and behavioral disorders, applied to a classroom setting. The results showed that the daily presentation of 100 learn units could significantly increase the production of appropriate language.

Lydon and colleagues examined the effects of an ITT on the emission of pure tacts, pure mands and conversational units. The authors showed that, although this training did not affect the number of pure mands and conversational units, it increased the emission of pure tacts (Lydon, Healy, Leader, & Keohane, 2009).

Individuals presenting autism spectrum disorder and/or ID experience marked delays and deficits in the reciprocal and spontaneous use of language and in communication.

Compared to neurotypical age-mates who develop language spontaneously and independently without any direct intervention (i.e., without the presentation of environmental antecedents), individuals with autism spectrum disorder and/or ID typically require an intensive intervention to develop the skills necessary to display spontaneous and generative verbal behavior (Ross, Nuzzolo, Stolfi, & Natarelli, 2006). The

speaker is dependent on the presence of the contrived EOs and the presence of the person (discriminative stimulus) and a majority of teaching trials occur under these particular teaching and reinforcement conditions (Pistoljevic, 2008).

## 2. Aims and hypothesis

The current research partially replicates the study conducted by Lydon and colleagues (2009) although the participants in this study were a 16-year-old boy with autism and a 14-year-old girl with severe ID, diagnosed according to the DSM-5 criteria (APA, 2013) and were thus much older than the two preschool students, as described by the previous authors. Though the ITT has been widely investigated on younger populations, no studies to the best of our knowledge have used this procedure thus far with adolescents characterized by neurodevelopmental disorders. In the current study, tact training was not delivered daily (i.e., intensively), but according to the students' frequency of attendance at the learning center. Therefore, for each participant in this study, only two sets of stimuli (i.e., 200 stimuli divided into 10 categories) were used rather than the five of the intensive tact protocol. Additionally, the stimuli used in this study were from similar but not identical categories to those from Lydon and colleagues (2009).

The purpose of this study was to evaluate the effectiveness of a non-intensive tact training (NITT) on the number of pure tacts, pure mands and conversational units in non-instructional settings emitted by adolescents with autism and ID who have communication deficits.

## 3. Materials and methods

### *3.1. Participants*

Two participants were selected for this study.

Participant A was a 16-year-old male diagnosed with autism and severe ID (DSM-5; APA, 2013). He attended the third year of secondary school in a suburban area of northern Italy, five days a week, for a total of 20 hours per week. He received individualized teaching based on an Applied Behavior Analysis (ABA) for three hours a week in the afternoon. According to the student's level of functioning, a CABAS<sup>®</sup> International Curriculum and Inventory of Repertoires for Children from Pre-School through Kindergarten (C-PIRK<sup>®</sup>) (Greer & McCorkle, 2003) was

administered prior to the onset of the study; assessment results showed that the participant functioned at an emergent speaker level of verbal development (Greer & Ross, 2008). The student was able to communicate his basic needs through the emission of one to two-word requests and could have brief conversational exchanges, but only when engaged by other people and in a structured environment (i.e., emitting yes/no or one to two-word responses to the requests of others).

Participant B was a 14-year-old female diagnosed with severe ID (DSM-5; APA, 2013) who attended the third year of secondary school in a suburban area of northern Italy, six days a week, for a total of 30 hours per week. The student had a teacher or an educator as personal support during her whole school timetable. She received individualized teaching based on an ABA, for four hours a week in the afternoon. The C-PIRK<sup>®</sup> (Greer & McCorkle, 2003) was administered for this student as well, due to her level of functioning; assessment results showed that the participant functioned at an emergent speaker level of verbal development (Greer & Ross, 2008). She was able to repeat single words and presented a very limited number of spontaneous requests.

Participants were selected for this study as they emitted a very low number of spontaneous verbal operants, such as pure mands and tacts and conversational units, in non-instructional settings.

Informed consent was obtained from the parents of the participants for the participation in this study.

### *3.2. Dependent variables*

The dependent variables were the numbers of pure tacts, pure mands and conversational units emitted by each participant during five-minute probe sessions, which were conducted across three non-instructional settings.

A pure tact was defined as a verbal operant under the control of a non-verbal antecedent and reinforced by generalized social reinforcement (Greer, 2002). An example of a tact was when a participant said "That's a cat" upon looking at a picture of a cat and received generalized reinforcement from a listener (i.e., "That's right, it's a cat!").

A pure mand was defined as a verbal operant under the control of a relevant motivating operation (Cooper, Heron, & Heward, 2007) in which the response was reinforced by a characteristic consequence (i.e., the specified item). For example, participants could say "Chocolate" or "Juice"

and the emitted mand was reinforced by the delivery of the item (i.e., the participant receiving chocolate or juice).

A conversational unit was defined as a full exchange in which participants had the opportunity to alternate speaker and listener responses (Donley & Greer, 1993). More in detail, a participant emitted both a speaker response, which was reinforced by another student responding as a listener and, in turn, a listener response to the other person's response (Greer, 2002).

### *3.3. Independent variable*

The independent variable in this study was represented by the NITT, consisting of an increase of 100 tact learn units additionally to other types of learn units delivered daily for each participant. The mastery criterion for the training sessions was defined as 90% correct responses for two consecutive sessions, or 100% for one session. Each time the student mastered the criterion in a category, the stimuli were replaced with a new category to maintain the number of learn units presented at 100. The NITT ended when the participant mastered a total of five categories.

### *3.4. Setting and materials*

The study took place, for both participants, in a learning center in northern Italy. Probe sessions were conducted across three non-instructional settings: activity break, snack time, and free play. The activity break probe was conducted in a room of the center, during the interval of time between the end of one activity and the beginning of another. The snack time probe was recorded in a room where there was a rectangular table with four chairs. Finally, during the free play probe, the students had access to a locker that contained several games (i.e., board games, cards) to play with other students. The materials used for the probes were a clipboard, a data collection sheet, a pencil, and a timer.

The training phase took place in a room of the learning center, where students were engaged in individualized instructional programs and afternoon homework. A rectangular table and two chairs were used. The stimuli (i.e., pictures) were presented through computer slideshows. For each participant, the material used consisted of 200 stimuli divided into 10 categories (see Tab. 1 and Tab. 2). The categories included four target stimuli from one of the following classes: food, animals, transportation, school objects and household objects. Each class, in turn, was repeated twice

so that two categories were created for each class of stimuli (i.e. two categories for Animals, Food etc.). Each of the four target stimuli was repeated within the category, for five different exemplars (see Tab. 1 and Tab. 2).

Table 1 – *Categories and stimuli used during tact training sessions for Participant A*

Categories	Stimuli
1. Animals	Cheetah, Horse, Lizard, Octopus
2. Food	Mortadella, Pear, Peach, Broccoli
3. Household objects	Nightstand, Tub, Broom, Wardrobe
4. School objects	Diary, Eraser, Desk, Map
5. Transportation	Tractor, Jet ski, Tram, Subway
6. Animals	Giraffe, Lion, Penguin, Bull
7. Food	Meat, Fish, Popcorn, Chips
8. Household objects	Knife, Spoon, Mug, Napkin
9. School objects	Glue, Scissors, Smock, Backpack
10. Transportation	Hot air balloon, Roller skates, Ski, Surfboard

Table 2 – *Categories and stimuli used during tact training sessions for Participant B*

Categories	Stimuli
1. Animals	Rabbit, Butterfly, Snake, Mouse
2. Food	Chocolate, Biscuits, Candy, Cake
3. Household objects	Armchair, Toilet, Bed, Sink
4. School objects	Chalk, Markers, Rubber, Correction fluid
5. Transportation	Scooter, Helicopter, Minibus, Raft
6. Animals	Cheetah, Horse, Lizard, Octopus
7. Food	Mortadella, Pear, Peach, Broccoli
8. Household objects	Nightstand, Tub, Broom, Wardrobe
9. School objects	Diary, Eraser, Desk, Map
10. Transportation	Tractor, Jet ski, Tram, Subway



A clipboard, a data collection sheet, and a pencil were used for data collection.

### *3.5. Experimental design*

A delayed multiple probe design across participants (Horner & Baer, 1978) was used to compare the number of verbal operants emitted by each participant in non-instructional settings before and after the acquisition of mastery for each category. Probe sessions were conducted before and after the intervention to measure the effects of the tact training procedure on the emission of pure tacts, pure mands and conversational units for each participant.

### *3.6. Procedure*

The intervention was conducted by psychologists and educationalists with a post-graduate specialization in Applied Behavior Analysis under the supervision of a Board Certified Behavior Analyst<sup>®</sup>. All practitioners had been working for at least nine months as teachers for the organization that owned the learning center, which provided different services for individuals with disabilities or specific educational needs. The teachers served as experimenters and data collectors.

During the implementation of the NITT, the supervisor collected data on treatment integrity through a checklist containing all the steps required in order to provide an accurate instruction.

#### *3.6.1. Pre probes in non-instructional settings*

Prior to the introduction of tact training, 15-minute probe sessions, divided into three five-minute observation intervals, were conducted across three different non-instructional settings: activity break, snack time and free play. The activity break probe consisted of a transition time between the end of an activity (e.g., completing an instructional program) and the beginning of another one.

The experimenter sat at the table with the student and then said "Now let's take a break, what would you like to do?"; the student agreed with the experimenter upon an activity to be done (e.g., watching a video on the computer or listening to a song) and, once it had started, the experimenter proceeded with the observation. During the snack time probe, once the target

student was seated at the table with at least another student, the experimenter told them they could start eating and began the observation procedure. The free play probe was carried out at a specific moment of the daily routine during which all students were engaged in leisure activities. The experimenter invited the target student to decide, together with one or more peers, which game to play among those available. Once the student was engaged in the game activity, the experimenter began the observation procedure. The experimenter used an event recording procedure (Cooper *et al.*, 2007) to register the number of tacts, mands and conversational units emitted by the participants. Tacts were reinforced through verbal approvals and praise. Following the emission of a mand, the requested item was delivered to the participants. Finally, conversational units were reinforced through the alternation between listener and speaker functions.

### *3.6.2. Non-Intensive Tact Training (NITT)*

At the beginning of the training, the experimenter showed to the student the four pictures of the stimuli from one of the categories and provided the participant with an echoic prompt for each stimulus. Independent tact training could begin once the student's response had reached a point-to-point vocal correspondence with the experimenter's model. The experimenter needed to be sure the student paid attention (e.g., by calling him/her by name) before presenting the antecedent, that is, the stimulus picture on the computer. Once the experimenter was sure that the picture to be named was observable, the student was given an opportunity to respond, followed by a consequence (reinforcement or correction). A correct response was defined as the emission of a tact corresponding to the picture shown, within three seconds from the presentation of the stimulus. For example, the experimenter showed the image of a horse to the student and he/she emitted the "horse" tact within three seconds from the picture presentation. Correct responses were reinforced through generalized reinforcers, like praise and attention from the teacher. Other responses, or the emission of a non-response, within three seconds were recorded as incorrect. In this case, the experimenter provided the student with a correction, by repeating the name of the stimulus. The student had to repeat, in turn, the name of the stimulus presented and this repetition was not reinforced; the experimenter then introduced the next learn unit. Twenty learn units were presented daily for five categories for a total of 100 learn units. Mastery criterion was set at 90% correct responses emitted by each participant for two consecutive

sessions (Lydon *et al.*, 2009). After the student had achieved the mastery criterion for a specific category, targets were replaced with another category in order to keep the number of learn units presented to a total of 100. The training ended when the student mastered five categories in total. Instruction was carried out twice a week for Participant A and once a week for Participant B and following the same procedure for both participants.

### 3.7. *Post probes in non-instructional settings*

Post probes were conducted sixty minutes after achieving the criterion for one category by applying the same observation procedure as in the pre probes in non-instructional settings.

## 4. Data collection

During pre-probe sessions, data was collected through five-minute systematic observations in three different non-instructional settings, for a total of 15 minutes. During this time, none of the stimuli targeted during tact training were present in the environment. In the activity break condition, the experimenter activated the timer as soon as the student started the activity he/she had previously chosen (e.g., watching a video or listening to a song), or in the time interval between the end of an activity and the beginning of another one. During the snack time probe, the experimenter turned on the timer as soon as the student sat at the table with at least one other student. During the game probe, the timer was activated as soon as the participant began to play one of the games, chosen among those available, with at least another student. Data was recorded through an event recording procedure (Cooper *et al.*, 2007). Each instance of the emission of vocal behaviors was recorded on a special notation sheet with an X. During probes, the experimenter did not provide any prompts to facilitate the emission of verbal operants by the participants. At the end of the observation sessions, the total number of mands, tacts and conversational units was counted and data was recorded on a graph.

During the tact training phase, responses were recorded on a 20-learn unit (both correct and incorrect) data sheet, marking with a plus (+) if the student correctly named the picture, or with a minus (-) if the student did not respond within three seconds, or responded incorrectly. The collected data was then recorded on a chart.

Post-probe sessions were conducted sixty minutes after the achievement of mastery criterion during the training sessions.

#### 4.1. Treatment Integrity and Inter-Observer Agreement

Treatment integrity data was collected for 45% of tact training sessions, with a mean value of 98%. Inter-Observer Agreement (IOA) was calculated by having a second observer, who independently and simultaneously recorded the frequency of verbal operants emitted during probe sessions in non-instructional settings. Agreements were divided by agreements plus disagreements then multiplied by 100 (Cooper *et al.*, 2007). The IOA was collected for 30% of the treatment sessions and for 50% of the probe sessions with an agreement of 100%.

## 5. Results

Figure 1 shows the number of verbal operants, emitted during the 15-minute probe sessions for each participant, in the three non-instructional settings (refer also to Tab. 3 for a summary of the total number of verbal operants emitted by the two participants).

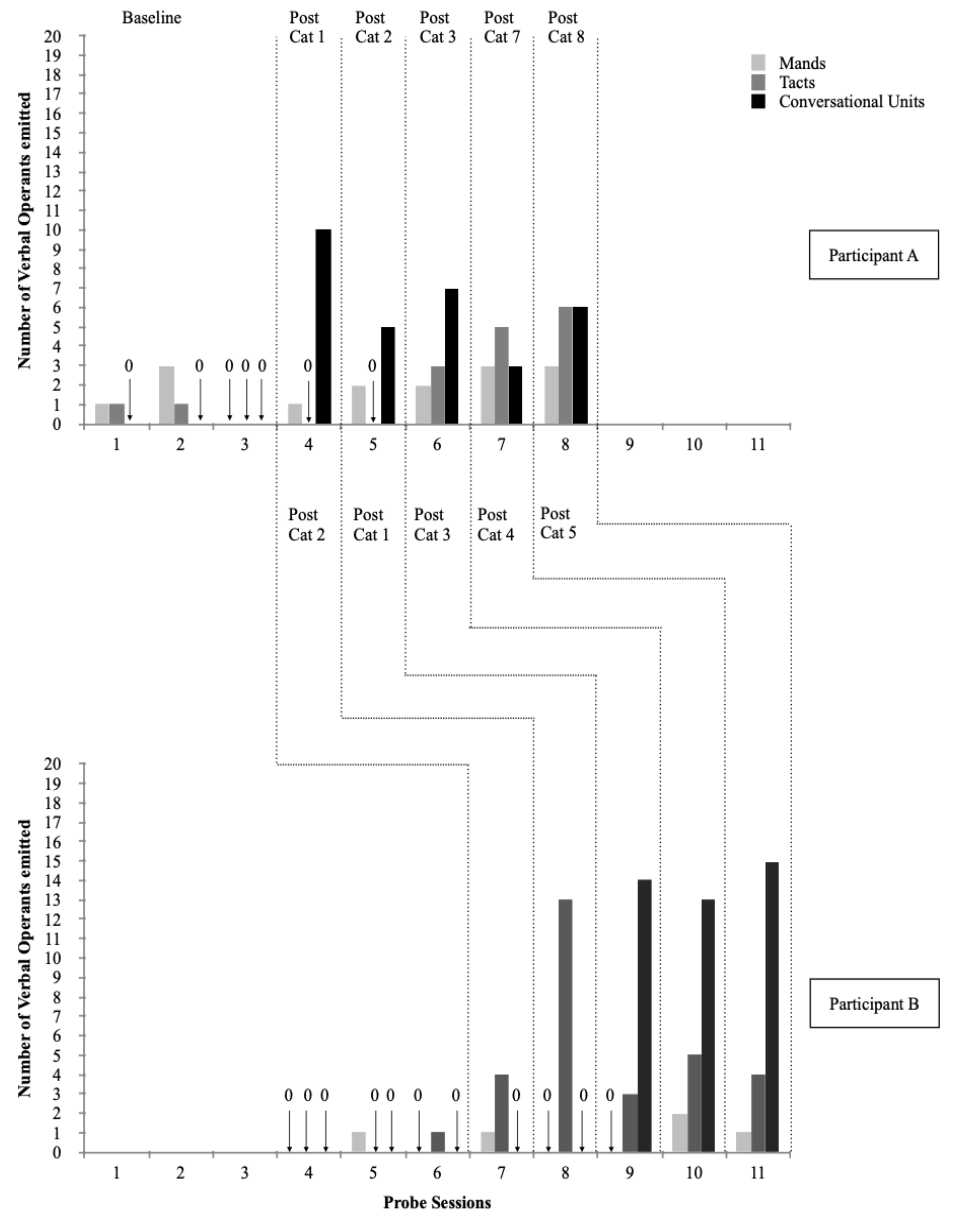
During the three baseline observations, Participant A emitted, respectively, 1, 3, and 0 mands ( $M = 1.3$ ); 1, 1, and 0 tacts ( $M = .6$ ), and 0 conversational units for each session ( $M = 0$ ). After mastering the criterion for Category 1, Participant A emitted a total of 1 mand, 0 tacts, and 10 conversational units. Following the acquisition of Category 2, he emitted 2 mands, 0 tacts, and 5 conversational units. Once the criterion for Category 3 was mastered, the subject emitted 2 mands, 3 tacts, and 7 conversational units. Finally, the individual emitted 3 mands, 5 tacts, and 3 conversational units and 3 mands, 6 tacts, and 6 conversational units, following the acquisition of Category 7 and 8, respectively (see Fig. 1 and Tab. 3).

During the three baseline observations, Participant B emitted, respectively, 0, 1, and 0 mands ( $M = .3$ ); 0, 0, and 1 tact ( $M = .3$ ), and 0 conversational units for each session ( $M = 0$ ). After mastering the criterion for Category 2, Participant B emitted a total of 1 mand, 4 tacts, and 0 conversational units. Once the criterion for Category 1 was reached, she emitted 0 mands, 13 tacts, and 0 conversational units. Following the acquisition of Category 3, the individual emitted 0 mands, 3 tacts, and 14 conversational units. Finally, the subject emitted 2 mands, 5 tacts and 13

conversational units and 1 mand, 4 tacts, and 15 conversational units once the criterion for Category 4 and 5 was met (see Fig. 1 and Tab. 3).

Table 4 summarizes the number of learn units to criterion for each category for each participant.

Figure 1 – Number of verbal operants emitted by Participants A and B during pre- and post-probes in non-instructional settings



This data shows that Participant A's learn units to criterion through the five categories were 40, 40, 40, 140 and 140, respectively. Participant A required 400 learn units ( $M = 80$ ) to master the five categories during tact training. Participant B's learn units to criterion were, instead, 40, 60, 120, 140 and 160, respectively. Participant B required a total of 520 learn units ( $M = 104$ ) to master the five categories.

Table 3 – *Summary of the total number of verbal operants emitted*

<i>Participant</i>	<i>Probe sessions</i>	<i>Total number of verbal operants emitted</i>
Participant A	Baseline	2
	Baseline	4
	Baseline	0
	Post Cat 1	11
	Post Cat 2	7
	Post Cat 3	12
	Post Cat 7	11
	Post Cat 8	15
Participant B	Baseline	0
	Baseline	1
	Baseline	1
	Post Cat 2	5
	Post Cat 1	13
	Post Cat 3	17
	Post Cat 4	20
Post Cat 5	20	

Table 4 – *Learn units to criterion for each stimulus set for Participants A and B*

<i>Participant A</i>	<i>Learn units to criterion</i>	<i>Participant B</i>	<i>Learn units to criterion</i>
Cat 1	40	Cat 2	40
Cat 2	40	Cat 1	60
Cat 3	40	Cat 3	120
Cat 7	140	Cat 4	140
Cat 8	140	Cat 5	160

## 6. Discussion

The present study evaluated the effectiveness of a NITT on the emission of pure mands, pure tacts and conversational units in three different non-instructional settings. The students were selected for this study because they emitted a limited number of spontaneous verbal operants. The intervention represents a partial replication of the experiment conducted by Lydon and colleagues (2009). In fact, the stimuli used in this study were similar but not identical to those originally adopted by the aforementioned authors and, for each participant, only two sets (i.e., ten categories) were used, instead of the five provided in the original procedure. Furthermore, participants in this study were older than the participants from Lydon's group study.

According to previous results (Pistoljevic & Greer, 2006; Schaufler & Greer, 2006; Lydon *et al.*, 2009; Greer & Du, 2010), the study shows a functional relationship between the implementation of NITT and the increase in the emission of spontaneous verbal operants, for both participants. More specifically, both participants showed an increase in the number of tacts following the intervention (see Fig. 1). For participant A, there was an increase in the production of pure tacts in non-instructional settings only after the achievement of criterion for Category 3. Participant B began to produce an increased number of tacts following the acquisition of Category 1. These differences in response across participants might be explained by their different levels of verbal development. It would seem that, following the implementation of NITT, both students had learned to emit tacts as a means of achieving generalized reinforcement in the form of social attention from adults (Pistoljevic & Greer, 2006). In fact, the increase in the number of learn units presented was directly proportional to the

increase of reinforcers. This means that the attention of adults could have been progressively conditioned as a reinforcer for the students. This would have led them to emit more tacts in their natural environment. This result is consistent with previous studies (Pistoljevic & Greer, 2006; Delgado & Oblak, 2007; Lydon *et al.*, 2009). Interestingly, tacts emitted by the participants during post-probe sessions were not the same the students had learned during the intervention; students began to name stimuli that were present in their natural environment, thus emitting an overall higher number of verbal behaviors.

In contrast, a NITT in both participants did not produce significant effects on the emission of pure mands in non-instructional settings. It is likely to be hypothesized that the increase in the emission of tacts, along with the generalized reinforcement obtained through the teachers' social approval for the correct tacts, could have reduced the motivational conditions for the emission of mands during post probes. A further explanation could be that the short duration of post-probe sessions (i.e., 15 minutes) represented a limitation for the participants compared to the number of mands they could have emitted. Therefore, data collected in the present study seems to corroborate the results reported by Lydon and colleagues (2009) and the functional independence of verbal operants (Skinner, 1957).

A significant increase in the production of conversational units was revealed in this study, for both participants, following the introduction of a NITT. A possible explanation could be that the students started to produce conversational units because of the reinforcement obtained both as a speaker and listener (Greer & Ross, 2008). These findings are not in line with the original results of the study by Lydon and colleagues (2009), in which there seemed to be no functional relationship between the ITT and the emission of conversational units in non-instructional settings. In order to produce conversational units, individuals need the relevant EOs for conducting conversations: a) the listener's control, b) the reinforcement for listening behavior, and c) the reinforcement for the behavior of speaking. In the study by Lydon and colleagues (2009) students were younger (i.e. 3 and 4 years old) than those in the present study (i.e. 16 and 14 years old). Therefore, it can be assumed that participants, despite their language delay involving a restricted vocabulary, had verbal skills that allowed them to produce conversational units. In fact, the participants emitted verbal exchanges with others either because they were interested or because their behavior was reinforced by the response of others, thus allowing a hypothesis about their



acquisition of the social control that was determined by the reinforcement of listening behavior (Greer & Ross, 2008).

The study presents some methodological limitations that should be underlined. It would have been advantageous for both participants to implement a tact training with a higher frequency and to present a higher number of stimulus sets. In fact, the data reported in the literature suggests that individuals who received more learn units showed a more significant increase in the production of verbal operants (Pistoljevic & Greer, 2006; Delgado & Oblak, 2007; Lydon *et al.*, 2009). A crucial methodological limitation was the use of different target stimuli for the two participants. This choice was motivated by the differences in the participants' level of verbal development. A further limitation was the choice of carrying out the probes after the participants had mastered the criterion in different categories and not for the same stimuli, as in the original study by Lydon and colleagues (2009). This decision, together with the fact of ending the intervention when the participants had mastered five categories, was determined by the fact that the training was not provided daily but based on the students' frequency of attendance at the learning center. Another limitation was undoubtedly the low number of participants in the study, which did not allow to generalize the results obtained. Using a multiple probe design, three baselines would have been recommended to demonstrate a functional relationship.

The expansion of tact and conversational repertoires in 14- and 16-year-old students in a relatively short time seems to suggest that this procedure could have even more significant effects with younger children. It is possible that the same effects reported in this study could be obtained by simply increasing the number of learning opportunities for students, regardless of whether they are intended for tacts or other teaching objectives. Further research is needed to evaluate the positive effects of a NITT on the emission of other verbal operants and to investigate other student populations.

Despite the limitations mentioned above, the results are promising. The NITT described in this study could represent an effective strategy to increase the emission of verbal operants for students with autism or language delays (Hart & Risley, 1995). The present study, together with previous studies (Pistoljevic & Greer, 2006; Delgado & Oblak, 2007; Lydon *et al.*, 2009), suggests that a NITT could increase the students' capability to gain reinforcement by speaking. When this EO becomes relevant, it can allow students to acquire the naming capability.

Future research should be promoted to investigate the effects of increasing the tact repertoire and the expansion of complex verbal skills, in order to support families and schools in promoting the emergence of spontaneous language in children with autism or language delays. This would offer students a greater number of opportunities to participate in verbal exchanges and to feel more integrated in the social life of the community.

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