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A Comparison of a Matrix Programming and Standard Discrete Trial Training Format to Teach Two-Component Tacts

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A Comparison of a Matrix Programming and Standard Discrete Trial Training Format to Teach Two-Component Tacts

by

Emily Braff

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 University of South Florida

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Dedication

I would like to dedicate this thesis to my parents, for supporting me emotionally and financially throughout this process. This wouldn’t have been possible without them.

I would also like to thank Corey, Joey, and Julie for letting me vent my frustrations and bounce ideas off of them. They talked me down off of many ledges and helped keep me sane!

Finally, I would like to thank everyone who contributed to this project directly and helped shape it. First, Dr. Weil for helping me develop and clarify my ideas and arguing with me until I could defend anything to anyone. Second, Tricia, Jeff, Jessica, and Julianne for running sessions, scoring videos, providing advice, and generally doing anything and everything I couldn’t do on my own. I couldn’t have done it without them!
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Abstract

Teaching using matrix programming has been shown to result in recombinative generalization. However, this procedure has not been compared to more standard discrete trial training formats such as DTT. This study compared acquisition and recombinative generalization of two-component tacts using each procedure. Matrix training was found to be more efficient than the DTT format. Half the amount of teaching was required to teach roughly the same number of targets using matrix training as compared to DTT.
Verbal Behavior

There is a vast number of methods for teaching people how to communicate, and it can be difficult to determine which is most effective. One method with a large body of supporting research is based on Skinner’s *Verbal Behavior* (1957). Skinner divided human communication into individual operants, or units defined primarily by their function. This division made it possible to determine how specific aspects of verbal behavior are typically learned and to reproduce those processes with individuals with disabilities who have communication deficits. The main operants Skinner defined are echoics, tacts, mands, intraverbals, and textual behavior. One of the most important of these is the tact, given its frequent use in everyday life.

**Tact**

Skinner (1957) defined the tact as a verbal response which is evoked by a nonverbal stimulus. In other words, it is labeling a stimulus in the environment. Tacts are reinforced by general conditioned reinforcers, typically praise. It is important for children to learn to tact because it enables them to discuss the stimuli present in their environment (Sundberg & Michael, 2001). Children must engage in this behavior to interact appropriately with their peers since young children often engage in behaviors such as tacting what a toy is doing or pointing out unusual stimuli in the environment. Additionally, tacting is an important academic skill as children are often asked to label colors, shapes, pictures, and various other stimuli.
Discrete Trial Teaching

One of the most common methods for teaching tacts to individuals with disabilities is discrete trial teaching (DTT). DTT consists of five steps: (a) the presentation of a discriminative stimulus ($S^D$), (b) a prompt for the student to respond to the $S^D$, (c) the student’s response, (d) the presentation of either a reinforcer or a correction procedure by the teacher (Lovaas et al., 1981; Smith, 2001; Sundberg & Partington, 1999), and (e) the intertrial interval (Koegel, Russo, & Rincover, 1977; Smith, 2001). Each response is practiced many times during a session, and sessions may last anywhere from a half hour to a full school day with periodic breaks throughout. Typically, sessions take place at a table in an otherwise unoccupied room or set apart from the main area to avoid distractions (McGee, Krantz, & McClannahan, 1985).

DTT has many advantages, including being relatively easy to teach to third party change agents (Sundberg & Partington, 1999), being similar to a school teaching environment and therefore preparing students to succeed in that venue (Sundberg & Partington, 1998), and allowing substantial opportunities for reinforcement for skills which typically take many repeated trials to learn (Steege, Mace, Perry, & Longenecker, 2007). However, each target must be taught individually, making the process of establishing an extensive repertoire time-consuming and prohibitive. It is possible that DTT might be enhanced by utilizing procedures which promote recombinative generalization.
Recombinative Generalization

Recombinative generalization (RG) is defined as “differential responding to novel combinations of stimulus components that have been included previously in other stimulus contexts” (Goldstein, 1983a, p. 281). In other words, individuals may respond accurately to a novel stimulus without being taught as a result of a learning history with its component stimuli. For example, if a red ball and a green car are presented, the learner must attend to the color and the object to correctly label the stimuli. RG would be demonstrated if he or she then accurately labeled a green ball, having never been directly taught to respond to the presentation of the color green and a ball together (Goldstein, 1983a). This phenomenon is important because it may result in individuals correctly responding to more stimuli with less training, which makes teaching more efficient.

RG has particularly important implications for academic skills such as reading. Hubner, Gomes, and McIlvane (2009) taught four preschool children to identify pictures (B) and printed words (C) which corresponded to dictated words (A) in Portuguese. Following training, they tested whether the children matched B to C and vice versa despite never being taught those relations directly. They then tested to see if the children matched pictures to written words when the stimuli were made up of novel combinations of components of trained stimuli. For example, the children were taught the words BOCA, CABO, BOLO, and LOBO as AC relations and the words CACO, BALA, BOLA, and COCA were tested as BC/CB relations. Following training, the children responded with 90-100% accuracy to a set of four stimuli which had not been trained in
any relation, in addition to 12 words which were trained as AC relations. In addition, the children’s naming printed letters, syllables, and words was tested before and after training. Prior to training, none of the children read any of the printed words or syllables and were 50-60% correct on naming letters. After training, children scored between 55 and 100% on reading syllables, 80-100% on words, and 100% on letters despite the fact that these were never trained. These results indicate that using teaching procedures which encourage RG can be used to teach reading skills and that children may generalize these skills to targets which were never taught. Several other studies have shown similar findings with college students (Hanna et al., 2011), typically developing elementary school students (Hanna, de Souza, de Rose, & Fonseca, 2004; Matos, Avanzi, & McIlvane, 2006), typically developing adults (Mahon, Lyddy, & Barnes-Holmes, 2010), and adults with intellectual disability (Saunders, O’Donnell, Vaidya, & Williams, 2003).

A common procedure used to promote RG is matrix training.

**Matrix Training**

Matrix training involves creating a matrix using two or more sets of component stimuli, such as nouns and verbs, adjectives, or pronouns, base words and prefixes or suffixes, or categories. Only some of the targets from this matrix are trained and RG to the untrained targets is assessed. It is important to note that targets are taught using the same procedures as DTT, but it is the format of teaching which makes it unique. From this point on, matrix training will be referred to as matrix programming to clarify that it is the order in which targets are taught which is being investigated and not the training technique. Using a matrix enables the instructor to determine which targets to teach and in what order to optimize learning efficiency. Several studies have been conducted to
determine which targets should be trained to produce the best generalization and under what conditions training is most effective (Bunce, Ruder, & Ruder, 1985; Goldstein, 1983b; Striefel, Wetherby, & Karlan, 1978). Since individual differences between learners can influence which procedures are most effective for a given learner, the following studies illustrate various procedural changes that may be made to optimize learning and efficiency.

In a series of studies, Striefel, Wetherby, and Karlan (1978) used matrix programming to teach instruction-following skills to youth aged 12-17 with severe intellectual disability. A transfer of stimulus control procedure involving a time delay was used in all of the studies. Previous research had shown that training children to follow many specific two-word instructions, called multiple exemplar training, did not result in generalization when the instructions did not have common components (Romski & Ruder, 1984; Striefel, Bryan, & Aikins, 1974; Striefel & Wetherby, 1973). Study 1 was conducted to assess whether training one verb with several nouns and then combining other verbs with the same nouns would result in generalization when new verbs were introduced. Results showed that after one verb was trained with 12 nouns, each subsequent verb needed to be trained with fewer nouns before generalization occurred. Both participants needed only one noun to be trained with a new verb for generalization after 6-7 verbs had been trained. However, no generalization occurred to new verbs without training on at least one noun. The authors reported that it was difficult to establish discrimination when the second verb was introduced, as previously the child had only needed to attend to the noun component of the combination to respond
correctly. Therefore, Study 2 was conducted to determine if training children on the noun and verb components individually would result in generalization to combinations.

In Study 2a, participants were trained to receptively identify nouns and verbs individually before matrix programming. In baseline, participants scored between 83-100% correct on nouns and 0-25% correct on verbs. Following training, all participants scored 100% on nouns and 82-100% on verbs. Three participants responded to 1-3 verb-noun instructions prior to training, and the remaining participants did not exhibit any correct responding. Scores improved following training by 85, 72, 19, 14, 14, and 0% for each participant individually. The participants who emitted some correct responses prior to training improved their performance by 85, 72, and 14%, indicating that some prior ability to follow verb-noun instructions may have been beneficial. Since minimal generalization occurred for four participants, Study 2b was conducted using two of these participants to determine if “step-like” training increased generalization. Step-like training consisted of training the child to respond to the instructions along the diagonal of the matrix in a stair-step pattern, which required the child to discriminate both the noun and the verb in the demand. The first participant was trained on 19 instructions and showed generalized responding to 100 untrained instructions. All but one verb needed to be trained with two nouns before generalization to novel combinations with that verb occurred but after each successive verb was trained she responded to more instructions containing the new verb. The second participant was trained on only 12 instructions before he was removed from the study due to hospitalization but he did not show any generalization to untrained targets.
In Study 3a, a participant from Study 2a who showed generalization from noun and verb training to combinations was taught to respond to combinations of novel verbs and nouns and generalization to nouns and verbs only was assessed. He responded correctly to untrained instructions after the noun and verb in the novel instruction had been trained once in other combinations and generalized to noun and verb only targets after they were trained in one combination. As compared to the results from Study 2b, his ability to generalize following training with one exemplar and in both directions indicates that individual differences in participants’ incoming abilities may have a strong effect on how to most effectively implement training.

Study 3b was conducted using participants from Studies 1 and 2 who showed generalization to untrained combinations. Four new verbs and nouns were used and training was conducted on targets along the diagonal of that matrix. Then the new verbs and nouns were combined with those taught in previous studies and correct responding to these new combinations, in addition to nouns and verbs alone, was assessed. The participants needed training on 6, 11, and 12 instructions before generalization to other targets occurred, which was proportionally more training than was required by the participants in Studies 2b and 3a. This disparity indicates that the training procedures in those studies were more efficient than teaching just the diagonal targets of a new set before incorporating them with previously learned components. Additionally, two participants showed generalized responding to nouns and verbs only and combinations incorporating previously learned targets, while the third did not generalize to verbs and nouns only and required training on these before generalization to combinations using previously trained targets was seen. This difference in generalization provides further
evidence that individual differences may account for the relative effectiveness of training procedures, as all of these participants received similar or identical training in previous studies.

To determine if some individuals may not exhibit generalization due to being unable to discriminate between components when both the verbs and nouns are unknown before training, participants in Study 4 were taught new nouns and generalization was assessed when these were combined with previously learned verbs. One participant responded to combinations using six of the seven new nouns and required training on only one combination before complete generalization was demonstrated. The other participants exhibited incomplete generalization, but this was partially due to the fact that they learned many targets by elimination before any training occurred and these were not included as generalized targets. Therefore, these results indicate that once a target has been trained, it can easily be incorporated with novel stimuli. Study 5 showed similar results when teaching new verbs and combining them with previously learned nouns.

Overall, the results of these studies demonstrate that for RG to occur the individual components of each combination must be trained in at least one other context, or more depending on the individual, until enough combinations have been learned to establish a guideline for incorporating new stimuli. Further support for this theory was provided by Goldstein, Angelo, and Mousetis (1987) who found that training one combination of known words and then just along the diagonal for the rest of the matrix did not produce RG when novel words were used. The pre-training technique which was most effective in promoting RG was teaching the individual components independently and the most efficient matrix programming technique was the step-like training.
The work by Striefel et al. (1978) was extended by Goldstein (1983b) who taught elementary-school children to tact puppets’ actions using nonsense syllables. In Experiment 1, the children were trained on the targets along the diagonal of the matrix which was composed of syllables representing agents and actions. The two older participants (7 and 8 years old) received training on the diagonal targets and the first step-like target when they did not meet mastery criterion following the initial training, after which they generalized to the remaining targets in the matrix. One of the younger participants (4 years old) required training on 12 stimuli before generalizing to the remaining four stimuli. The final participant (4 years old) was trained on 10 targets and then agents and actions separately. He generalized to one target after receiving training on 14. This study suggested that matrix programming can produce RG with expressive language but also showed that this type of training may be more effective with older children. For older children, diagonal training with one overlapping target may be sufficient for generalization to occur while younger children may require step-like training or training on the individual components. Further support for this theory was provided in Experiment 2 in which 4-year-old children were taught action labels independently before being trained on a matrix consisting of the trained actions and novel agents. Four of the participants required training on only four stimuli before generalizing to the remaining 12 targets, while the other participants were trained on 5-7 targets and then generalized to the rest of the matrix.

The previous study indicated that older children may require less training due to prior experience with linguistic structures and vocabulary learning in general. Similarly, Bunce, Ruder, and Ruder (1985) showed that multiple exemplar training may be
sufficient if the individual components are known prior to training. They taught two boys with language delays to label and receptively identify pictures using noun and preposition combinations composed of previously known words. The training targets were the combinations along the top row and first column of the matrix, which resulted in training on 9 out of 25 stimuli. The first participant responded correctly to 40% of the stimuli prior to training and 92% after, and the second scored 28% initially and 100% after. These results suggest that the step-wise teaching method may be unnecessary if the targets are known beforehand. However, step-wise training may still be valuable as it requires training on fewer targets and may therefore be more efficient.

The methodology recommended by Striefel et al. (1978) and Goldstein (1983b) has been tested with many different populations and behaviors and found to be effective. Foss (1968) used matrix programming to teach college students to tact shapes and colors using nonsense syllables. Step-like training was used and 17 out of 20 students were taught 10 targets and generalized to 20-24 out of 24 novel targets. Karlan et al. (1982) used step-wise training to teach three children with moderate language delays to tact actions using verb-noun phrases. Due to time constraints, the participants were not trained on the diagonal for the entire matrix. Despite being exposed to the components of only 66%, for two participants, or 19% of the targets, the students responded correctly to 92%, 78%, and 25%, respectively. Their performance indicates that they generalized to targets composed of stimuli they had never been exposed to in addition to the recombinations of trained stimuli. Similar results were found with teaching expressive and receptive verb-noun responses to children with language delays and/or developmental disabilities (Mineo & Goldstein, 1990) and teaching children with autism
to engage in preliterary academic tasks (Axe & Sainato, 2010), sociodramatic play (Dauphin, Kinney, Stromer, & Koegel, 2004), and spelling (Kinney, Vedora, & Stromer, 2003).

Matrix programming is typically described in terms of syntax. In noun-verb tact training, it is thought that the children discriminate that the first word corresponds to the action and the second word corresponds to the object. If one or more of the components is already known, one exposure may be sufficient to make this discrimination, otherwise step-wise training may be needed. When the verbal stimulus is paired with the corresponding visual stimulus in a sufficient number of exemplars the child can discriminate whether the verbal stimulus refers to the noun or the verb and whether it should be said first or second. For example, if a child is exposed to the verbal stimuli “green ball,” “blue ball,” and “red ball,” and their corresponding visual stimuli, he or she will associate the word ball with the object as that is the only consistent pairing. Once the syntax rule is established, teaching along the diagonal of the matrix ensures that the child is taught to tact each noun and verb within one combination. Step-wise training then provides additional exposure to two of the components by presenting them in a different combination, allowing the child another context in which to discriminate which stimulus corresponds to which word. Once the word order rule is learned, it can then be applied to any combination of stimuli.

Matrix programming has been shown to be effective, but it has yet to be compared directly with any other form of teaching. It is possible that utilizing a matrix programming format might result in quicker acquisition of targets than typical DTT, as the occurrence of RG could enable acquisition of more targets with less teaching. There
are many possible formats for DTT and this study utilized one that may be said to be representative of a typical use of DTT in a clinical setting. To emphasize this distinction, the DTT format will from here on be referred to as individual target training (ITT). This term refers to the idea that each target must be taught individually and is independent of the others, as this is how DTT is characterized in the matrix training literature. Therefore, the purpose of this study was to compare the acquisition of noun-verb tacts using an ITT program and a matrix programming format.
Method

Participants

All participants attended the same verbal behavior clinic and communicated vocally.

Gabe was 5.4 years old at the start of the study. He had a diagnosis of autism. He had been attending the clinic three days a week for 8.25-9 hours per week for one year and eight months. He had over 1,000 tacts in his repertoire at the beginning of the study.

Peter was 4.6 years old at the start of the study. He had a diagnosis of autism. He had been attending the clinic three days a week for 9.5 hours per week for one month. He had over 1,000 tacts in his repertoire at the beginning of the study.

Todd was 5.5 years old at the start of the study. He had a diagnosis of developmental language disorder. He had been attending the clinic two days a week for 4 hours per week for nine months. He had over 200 tacts in his repertoire at the beginning of the study.

Blake was 3.8 years old at the start of the study. He had a diagnosis of pervasive developmental disorder- not otherwise specified and expressive communication delays. He had been attending the clinic three days a week for 6 hours per week for seven months. He had over 1,000 tacts in his repertoire at the beginning of the study.

Setting and Materials

Sessions were conducted at a clinic for verbal behavior or in the participant’s home. Sessions at the clinic were conducted in a room with a table and two chairs. No
other children were present in the room and distractions from other adults were
minimized. Sessions conducted in home took place in a room with no other people
present and minimal distractions. Materials included the stimuli which the children tacted
and tangible reinforcers such as toys, edibles, or movies.

**Experimental Design**

This study utilized a multiple baseline across targets design with a within
participant simultaneous treatment design. The procedures did not influence each other as
the teaching protocols were the same and it was only the order in which the targets were
taught that was different. Given that there were no common components to the tacts
taught using either procedure, the targets learned using one procedure did not affect the
others.

**Response Definitions and Interobserver Agreement**

The dependent variable was a verb-noun tact emitted by the child within 5 s of the
presentation of the $S^D$. Responses were scored as correct or incorrect. A correct response
was saying the appropriate verb followed by the noun within 5 seconds of the verbal
(“Tell me everything you see,”) and visual (the therapist engaging in an action with a
stimulus) $S^D$. An incorrect response was saying either the verb or noun alone, saying the
noun before the verb, emitting an unrelated response (even if this is followed by the
correct response), or no response within 5 s of the $S^D$. Responses were recorded on
separate data sheets for matrix and ITT training blocks (Appendices A and B). Scores
were reported as percent of correct responses per trial block. Scores were calculated by
dividing the number of correct responses by the total number of trials.
IOA data were collected on 30% of sessions. Agreement was calculated by dividing the number of agreements on a trial by trial basis by the number of agreements plus disagreements. The average IOA score was 99%.

Additionally, treatment integrity data were collected on 30% of sessions. An observer scored each step of the trial in a procedure task analysis (Appendix C) as completed or not completed. Data were only collected on the training target trials; interspersed maintenance tasks were not scored. Scores were calculated by dividing the number of steps per trial block performed correctly by the total number of steps. The average treatment integrity score was 97%.

IOA for treatment integrity was calculated by dividing the number of agreements by the total number of steps (up to 110). The average treatment integrity IOA score was 92%.

**Procedure**

**Instructor training.** Instructors were students in an ABA Master’s program and therapists at the clinic with experience implementing DTT. The training procedure used in the study was the same as that used in the clinic so therapy reviews which are conducted monthly in the clinic were used to determine if therapists were qualified to act as instructors. Any therapist who scored above 90% on his or her last two therapy reviews was considered qualified. Procedural integrity data were collected throughout the study and if an instructor had scored below 90% on one trial block, a booster training would have been conducted. No booster trainings were needed.
**Pre-assessment.** To determine known and unknown item tacts, the instructor instructed the child to sit at the table across from him or her, presented an item to the child, and said, “What is it?” The instructor presented 25 items and recorded whether the response was correct or incorrect. If the child responded correctly, praise was provided. No feedback was given for incorrect responses and the instructor moved on to the next trial. If the child did not respond to the first presentation within 5 s, the instructor re-presented the demand only one time. A correct answer resulted in praise and if there was still no response or an incorrect response, the instructor moved on to the next trial. After every two to three incorrect responses the instructor interspersed a known maintenance task and provided praise and/or a tangible reinforcer for correct responses. A trial block consisted of all 25 items and three trial blocks were conducted. The items were: cat, boat, bird, spoon, book, car, fork, blocks, cup, shoe, plate, horse, hat, brush, ball, bowl, shirt, bear, chair, socks, house, fish, frog, pen, and dog. An item was classified as known if the child responded correctly on all three trials. An item was classified as unknown if the child did not respond correctly on any of the trials.

The instructor then conducted an assessment to determine known and unknown actions. He or she engaged in an action with an object not used in the item assessment and asked, “What am I doing?” The same procedure was used as in the item assessment, but a trial block consisted of 20 actions. The actions were: kiss, spin, toss, touch, lift, hold, hug, pet, slide, eat, pinch, drop, sniff, brush, lick, blow, cut, cover, circle, and shake. The criteria for classifying actions as known or unknown were the same as those for objects. For two of the participants flick and flip were added to reach the required number of unknown actions.
The PI used four known items and four unknown actions to create a matrix. Actions were listed along the top of the matrix and items were listed along the side, creating a grid of 16 targets. A set consisting of four different known items and four unknown actions were used for the ITT training. Four actions were listed in the same order for each item. Some known components were used because research has shown that matrix programming is most efficient when at least some the stimuli are taught or known beforehand (Bunce et al., 1985; Striefel et al., 1978). The actions were unknown to enhance experimental control. If one of the components was unknown, the child should not have responded correctly to untrained stimuli until both components were taught in at least one combination.

For Todd and Blake, the verb “sniff” was initially included in their matrix or ITT targets, respectively, and was replaced with another verb which met the requirements for an unknown action. This change was made because both participants persisted in saying “smell” instead of sniff despite multiple training blocks on targets with “sniff” as a component.

**Baseline.** The instructor instructed the child to sit down at the table across from him or her. The instructor then modeled an adjective-noun combination from either the matrix or ITT program and said, “Tell me everything you see.” This instruction was used to differentiate the task from labeling the item or action alone. The child’s response was scored as correct or incorrect. The instructor provided praise for correct answers and no feedback was provided for incorrect answers. Each target in the matrix and ITT program was presented once.
**Probes.** Probes were conducted at the beginning of every session. The procedure was the same as in baseline. All 16 targets for both procedures were presented once during each probe. These were referred to as single probes because each possible target was presented once. Probes were used to assess acquisition of untaught targets. Additionally, individual target probes were conducted before each new target was introduced. These probes consisted of five presentations of each target and the procedure was the same as baseline. These were referred to as five probes.

**Training.** Initial training targets (marked T<sup>1</sup>) during matrix programming were those along the diagonal of the matrix (Figure 1). The child first received training on targets 1 and 2. Training continued until the child scored 100% on a target for two consecutive training blocks or a training block and a five probe. Following mastery of every two to three targets (numbers varied depending on the amount of time required to master the targets), a five probe was conducted. Training was then initiated for target 3, while training continued on the other target which had not yet been mastered. When the mastery criterion was met for either of these targets, probes were conducted and training then began on target 4. A probe was conducted once the mastery criterion was met for all four initial training targets. If the child did not score 100% on the single probe, training on secondary targets (marked T<sup>2</sup>) began. The procedure and mastery criterion for these targets were the same as those for the previous targets, with training being implemented first for target 5, target 6, then 7, then 8. Two single probes and two five probes of any unmastered targets were conducted following completion of target 8. If at any point the child scored 100% on two consecutive single probes then training was concluded.
Table 1: Sample matrix. Initial training targets are marked $T^1$ and secondary training targets are marked $T^2$.

<table>
<thead>
<tr>
<th></th>
<th>Jump</th>
<th>Spin</th>
<th>Throw</th>
<th>Sniff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>1: $T^1$</td>
<td>5: $T^2$</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Teddy bear</td>
<td>8: $T^2$</td>
<td>2: $T^1$</td>
<td>6: $T^2$</td>
<td>11</td>
</tr>
<tr>
<td>Shirt</td>
<td>12</td>
<td>13</td>
<td>3: $T^1$</td>
<td>7: $T^2$</td>
</tr>
<tr>
<td>Chair</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>4: $T^1$</td>
</tr>
</tbody>
</table>

Training was structured in this way because research has shown that individual differences are an important factor which influences how much training is necessary for RG to occur (Bunce et al., 1985; Goldstein, 1983b; Striefel et al., 1978). Diagonal training alone may be sufficient for one child, particularly if one component is known, while another child might require more exemplars before RG occurs. Therefore, diagonal training was conducted first and step-wise training was implemented if RG was not demonstrated. This format ensured that unnecessary training was not conducted, making the training process more efficient.

There is no consensus on the exact format for DTT in the literature but there are certain components which are agreed to be necessary. These are: 1) organized setting with all materials present and distractions minimized, 2) present $S^D$, 3) learner response, 4) consequence delivered by therapist, 5) short intertrial interval, 6) most to least teaching, 7) mass trials, 8) least to most teaching, 9) probes, 10) random rotation, and 11) extended trial. The teaching procedure for both ITT and matrix programming was the same and contained all of these components. The format, or order, in which the targets
were taught in the ITT procedure was the format for DTT targets at the verbal behavior clinic where the study was conducted. This format may be considered representative of a typical DTT procedure in the natural environment. During ITT training, initial training targets were targets 1, 2, 5, and 6 (Figure 2). When the child scored 100% on two consecutive training blocks or a training block and a five probe for one target, the next item for that action was added as a training target. For example, if target 1 was the first target mastered, target 3 would have been added as the next training target. Likewise, if target 5 was mastered first, target 7 would have been the next target added to training. When all of the items for one action were mastered or only one was left in training, target(s) from the next action were trained. There were four targets in training at all times, until fewer than four unmastered targets remained. Following mastery of every two to three targets (numbers varied depending on the amount of time required to master the targets), a five probe was conducted. If at any point the child scored 100% on 2 consecutive single probes, training was concluded.

Table 2: Sample ITT program.

<table>
<thead>
<tr>
<th>Slide</th>
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<tbody>
<tr>
<td>1. Car</td>
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<tr>
<td>2. Teddy bear</td>
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<tr>
<td>3. Socks</td>
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<td>4. Chair</td>
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<tr>
<td>Throw/Toss</td>
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<td>5. Car</td>
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<td>6. Teddy bear</td>
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<td>7. Socks</td>
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<td>8. Chair</td>
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<td>Kiss</td>
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<td>9. Car</td>
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<td>10. Teddy bear</td>
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<td>11. Socks</td>
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<td>12. Chair</td>
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<td>Spin</td>
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<td>13. Car</td>
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<td>14. Teddy bear</td>
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<tr>
<td>15. Socks</td>
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<td>16. Chair</td>
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</tbody>
</table>
The teaching procedure was the same for matrix programming and ITT. First, the instructor told the child to sit at the table across from him or her. The instructor then modeled a training target and said, “Tell me everything you see.” If the child responded correctly, the instructor provided praise and/or a tangible reinforcer. If the child responded incorrectly or did not respond within 5 s, the instructor re-presented the demand and immediately said the correct answer. If the child imitated the response, praise was provided. If the child responded incorrectly or did not respond within 5 s, no feedback was provided. Following either a correct or incorrect response, the instructor presented the demand a third time. If the child responded correctly, praise and/or a tangible reinforcer was provided. If the child responded incorrectly or did not respond within 5 s, no feedback was provided and the next trial was initiated. The intertrial interval was about 3 s. Each training block consisted of five presentations of each training target and two to six training blocks were conducted per session. Blocks consisted of only five trials of each target so as not to take up a prohibitive amount of the child’s regular therapy session.

Some modifications were made to these procedures for a few participants. For Gabe and Todd, the instructor required them to tact the item before presenting the $S^D$, “Tell me everything you see.” This change was made because they were frequently responding with components from the previous trial and then correcting themselves. For example, if the correct answer for the previous trial was “flick chair” and the current trial was supposed to be “spin dog” then they might have said “spin chair” and then correct themselves and give the correct answer.
Additionally, Gabe and Todd both required one training block on an action. They started consistently responding incorrectly to an action (pinch and pet, respectively) to which they had previously been reliably responding correctly. These training blocks consisted of the instructor engaging in the action with an item not being used in any targets and saying, “What am I doing?” The correction procedure was the same as in regular training blocks. Following these additional trainings, both children began responding correctly to those targets again.
Results

Gabe

Gabe’s correct responses to untrained targets can be found in Figures 1 and 2. These were either single probes or the first trial of each target during a five probe. A solid circle indicates a correct response to an untrained target, an open circle indicates a correct response to a trained target, and an asterisk indicates that a target was in training during that session. A line of solid circles indicates that the participant responded correctly to an untrained target consistently over time. The targets are grouped by their action component and shown in the order they were introduced as compared to other targets with the same action component (as opposed to the order in which they were introduced overall).

Gabe responded correctly to 12 untrained targets in matrix training and eight in ITT. Overall, his correct responding to each untrained target maintained throughout the study.

Figure 3 shows the acquisition data for Gabe’s individual ITT targets. Targets 1, 5, and 6 took six to seven trial blocks to reach mastery, while target 2 took 18. Targets 7, 4, and 10 took four to five training blocks to reach mastery and targets 3, 8, 9, 14, 15, and 16 were mastered without any training or all training blocks at 100% (indicating no teaching occurred). After the first set of targets was mastered, acquisition was faster for the remaining targets. It took 65 training blocks across 19 sessions before all 16 targets were acquired and eight targets were directly taught.
Figure 1: Gabe’s performance on untrained responses during ITT probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

Figure 2: Gabe’s performance on untrained responses during matrix probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

Figure 4 shows the acquisition data for the individual matrix programming targets for Gabe. The first five targets took five to seven trial blocks to reach mastery and targets 6, 7, 8, 12, 15 and 16 were mastered in two training blocks at 100% or without any
training. Five targets were not mastered. Similarly to the ITT targets, after the initial 
targets were mastered the remaining targets were acquired more quickly. It took 33 
training blocks across 12 sessions before 11 targets were acquired and only four targets 
were directly trained. 39 fewer training blocks were conducted using matrix 
programming than ITT and three fewer targets were directly trained. Five more targets 
were mastered using ITT than matrix.

In both conditions Gabe’s level of performance on most targets dropped for 
sessions 12 through 17. His sessions were more infrequent during this time due to the 
holidays, and correct responding increased when sessions became more regular.

Table 1 summarizes Gabe’s performance using both procedures. Using matrix 
training, he responded correctly to more untrained targets per probe, on average, and 
mastered more targets per training block. He responded at mastery criterion level without 
training for the same number of targets in both procedures. He mastered all 16 targets 
using ITT and mastered 11 using matrix training.

**Peter**

Figures 5 and 6 indicate which targets Peter responded to correctly without 
training during probes. These were either single probes or the first trial of each target 
during a five probe. He responded correctly to 10 untrained targets in matrix training and 
eight in ITT. His correct responding to some untrained targets was somewhat inconsistent 
over time.

Figure 7 shows the acquisition data for Peter’s individual ITT targets. All targets 
but 3, 7, 9, and 14 took two to four trial blocks to reach mastery and targets 2, 11, and 16 
were mastered with all training blocks at 100% (indicating no teaching occurred). Targets 
3, 7, 9, and 14 took five to eight training blocks to reach mastery. Most of the targets
Figure 3: Acquisition data for individual ITT targets for Gabe. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Figure 4: Acquisition data for individual matrix targets for Gabe. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Table 3: Summary of Gabe’s Performance Across Procedures

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<th>Matrix</th>
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<tr>
<td>Rate of correct responses to untrained targets per probe</td>
<td>6.05 correct untrained responses/probe</td>
<td>2.79 correct untrained responses/probe</td>
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<tr>
<td>Mastered targets per training block</td>
<td>11 targets/33 training blocks</td>
<td>16 targets/65 training blocks</td>
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<tr>
<td>Number targets mastered without training/Total number mastered targets</td>
<td>6/11</td>
<td>6/16</td>
</tr>
</tbody>
</table>

Figure 5: Peter’s performance on untrained responses during ITT probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

were acquired at the same pace throughout the study. It took 61 training blocks across 14 sessions before all 16 targets were acquired and eight targets were directly taught.
Figure 6: Peter’s performance on untrained responses during matrix probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

Figure 8 shows the acquisition data for the individual matrix programming targets for Peter. Target 1 took 14 trial blocks to reach mastery and target 2 took seven. Targets 3-8 took two to four trial blocks to reach mastery, and targets 6, 8, 9, 10, 11, 14, 15, and 16 were mastered in two training blocks at 100% or without any training. Two targets were not mastered. After the initial targets were mastered the remaining targets were acquired more quickly. It took 39 training blocks across 17 sessions before 14 targets were acquired and only six targets were directly trained. 22 fewer training blocks were conducted using matrix programming than ITT and two fewer targets were directly trained. Two more targets were mastered using ITT than matrix.
Figure 7: Acquisition data for individual ITT targets for Peter. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Figure 8: Acquisition data for individual matrix targets for Peter. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Table 4 summarizes Peter’s performance using both procedures. Using matrix training, he responded correctly to more untrained targets per probe, on average, mastered more targets per training block, and responded at mastery criterion level without training for five more targets than in ITT. He mastered all 16 targets using ITT and mastered 14 using matrix training.

Table 4: Summary of Peter’s Performance Across Procedures

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<td>1.13 correct untrained responses/probe</td>
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<tr>
<td>Mastered targets per training block</td>
<td>14 targets/39 training blocks</td>
<td>16 targets/61 training blocks</td>
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<tr>
<td>Number targets mastered without training/Total number mastered targets</td>
<td>8/14</td>
<td>3/16</td>
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</table>

Blake

Figures 9 and 10 indicate which targets Blake responded to correctly without training during probes. These were either single probes or the first trial of each target during a five probe. He responded correctly to 12 untrained targets in matrix training and nine in ITT. His correct responding to some untrained targets was somewhat inconsistent at first and became more consistent over time.

Figure 11 shows the acquisition data for Blake’s individual ITT targets. Targets 1, 2, 5, 6, and 3 took six to eight trial blocks to reach mastery and targets 7, 4, 8, 9, and 14 took three to four. Targets 10, 13, 11, 12, 15, and 16 were mastered with all training blocks at 100% (indicating no teaching occurred) or without any training. After the initial targets were mastered the remaining targets were acquired more quickly. It took 59
Figure 9: Blake’s performance on untrained responses during ITT probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

Figure 10: Blake’s performance on untrained responses during matrix probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.
training blocks across 15 sessions before 15 targets were acquired and seven targets were directly taught.

Figure 12 shows the acquisition data for the individual matrix programming targets for Blake. Targets 1 and 2 took eight trial blocks to reach mastery, target 3 took five, and target 4 took three. Targets 5, 6, 7, 9, 10, 11, 12, 13, 14, and 15 were mastered in two training blocks at 100% or without any training. Two targets were not mastered. After the initial targets were mastered the remaining targets were acquired more quickly. It took 27 training blocks across 15 sessions before 14 targets were acquired and only four targets were directly trained. 37 fewer training blocks were conducted using matrix programming than ITT and three fewer targets were directly trained. One more target was mastered using ITT than matrix.

Table 5 summarizes Blake’s performance using both procedures. Using matrix training, he responded correctly to more untrained targets per probe, on average, mastered more targets per training block, and responded at mastery criterion level without training for four more targets than in ITT. He mastered 15 targets using ITT and mastered 14 using matrix training.

**Todd**

Figures 13 and 14 indicate which targets Todd responded to correctly without training during probes. These were either single probes or the first trial of each target during a five probe. He responded correctly to 13 untrained targets in matrix training and 11 in ITT. His correct responding to some untrained targets was relatively consistent over time.
Figure 11: Acquisition data for individual ITT targets for Blake. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Figure 12: Acquisition data for individual matrix targets for Blake. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Table 5: Summary of Blake’s Performance Across Procedures

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<td>Rate of correct responses to untrained targets per probe</td>
<td>4.29 correct untrained responses/probe</td>
<td>2.79 correct untrained responses/probe</td>
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<tr>
<td>Mastered targets per training block</td>
<td>14 targets/27 training blocks</td>
<td>15 targets/59 training blocks</td>
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<tr>
<td>Number targets mastered without training/Total number mastered targets</td>
<td>10/14</td>
<td>6/15</td>
</tr>
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</table>

Figure 15 shows the acquisition data for Todd’s individual ITT targets. Targets 5, 6, 7, 11, and 10 took nine to 15 trial blocks to reach mastery, targets 1, 3, and 14 took seven, and targets 2 and 8 took three to four. Targets 4, 9, 15, 12, 13, and 16 were mastered with all training blocks at 100% (indicating no teaching occurred) or without any training. The number of training blocks to mastery was variable throughout the study.

Figure 13: Todd’s performance on untrained responses during ITT probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.
Figure 14: Todd’s performance on untrained responses during matrix probes. The solid circles indicate which untrained targets were correct during the probe, the asterisks indicate targets in training which were correct during the probe, and open circles indicate previously trained targets which were correct during the probe.

It took 95 training blocks across 19 sessions before all 16 targets were acquired and five targets were directly taught.

Figure 16 shows the acquisition data for the individual matrix programming targets for Todd. Target 1 took six trial blocks to reach mastery, target 2 took nine, and targets 3, 4, and 5 took three to four. Targets 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16 were mastered in two training blocks at 100% or without any training. After the initial targets were mastered the remaining targets were acquired more quickly. It took 32 training blocks across 18 sessions before all 16 targets were acquired and only three targets were directly trained. 63 fewer training blocks were conducted using matrix programming than ITT and one less target was directly trained. The same number of targets was mastered using ITT and matrix.
Figure 15: Acquisition data for individual ITT targets for Todd. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Figure 16: Acquisition data for individual matrix targets for Todd. Blue diamonds represent the percent of correct trials per trial block during training, green triangles represent five probes, and red asterisks indicate the percentage of correct targets in the single probes.
Table 6 summarizes Todd’s performance using both procedures. Using matrix training, he responded correctly to more untrained targets per probe, on average, mastered more targets per training block, and responded at mastery criterion level without training for five more targets than in ITT. He mastered all 16 targets using both procedures.

Table 6: Summary of Todd’s Performance Across Procedures

<table>
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<tr>
<td>Rate of correct responses to untrained targets per probe</td>
<td>6.28 correct untrained responses/probe</td>
<td>4.68 correct untrained responses/probe</td>
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<tr>
<td>Mastered targets per training block</td>
<td>16 targets/32 training blocks</td>
<td>16 targets/95 training blocks</td>
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<tr>
<td>Number targets mastered without training/Total number mastered targets</td>
<td>11/16</td>
<td>6/16</td>
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Table 4: This table summarizes Todd’s performance across training procedures.

Table 5 summarizes the results for all of the participants. Overall, using matrix training all participants responded correctly to more untrained targets per probe, on average, mastered more targets per training block, and responded at mastery criterion level without training for 3.5 more targets than in ITT. They mastered 15.75 targets on average using ITT and 13.75 using matrix training.

Table 7: Summary of All Participants’ Performance Across Procedures

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<td>Rate of correct responses to untrained targets per probe</td>
<td>4.59 correct untrained responses/probe</td>
<td>2.85 correct untrained responses/probe</td>
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<tr>
<td>Mastered targets per training block</td>
<td>13.75 targets/32.75 training blocks</td>
<td>15.75 targets/70 training blocks</td>
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<tr>
<td>Number targets mastered without training/Total number mastered targets</td>
<td>8.75/13.75</td>
<td>5.25/15.75</td>
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Discussion

The results of this study indicate that matrix training may be more efficient than ITT. On average, participants responded correctly to 1.74 more untrained targets in matrix training than they did in ITT. Additionally, matrix training resulted in 53% fewer training targets needed than in ITT and an average of only two fewer targets were mastered. As a result, less time was required to teach roughly the same amount of material. The format of the ITT procedure was to teach four targets with overlapping components at any given time to promote generalization. The results of this study suggest that matrix training achieves the same goal more efficiently as only two targets are taught at once.

The consistency of the results across participants is somewhat surprising given that the literature on matrix training emphasizes the effects of personal differences on the efficiency of the procedure. Although the number of untrained targets to which each participant responded correctly varied, the proportion of those targets in matrix training to those in ITT was fairly consistent with 1.3 to 2.2 more targets across participants in matrix training. Additionally, there was a difference of 12 training blocks between the participant who required the most training and the participant who required the least amount in matrix training, as compared to ITT with a difference of 36. These data suggest that either individual differences do not influence matrix training as much as previous research suggests or that these participants were not dissimilar enough to show differential results. All of the participants had at least several hundred tacts at the
beginning of the study, but their exposure to instruction in the clinical setting and their ages were considerably different. Given that information, it seems that individual differences did not substantially influence the results.

These results support the use of matrix training and may support the concept of RG. Generalization requires that some formal dimension of the stimulus that the learner is exposed to be shared across multiple stimuli so the learner can respond correctly to a novel stimulus with a similar feature. The formal similarities of the objects and actions used as target components could promote the acquisition of novel noun-verb tacts. Additionally, multiple exemplars may establish RG as an overarching operant class. Thus, RG is one possible explanation for the efficiency of matrix training, but more research would be required to confirm this.

One possible limitation to this study is that some variations to the procedure were made for three participants. Gabe and Todd were required to tact each item before it was presented in a teaching trial because they had repeatedly substituted the item presented previously for the item being used in the current trial. Although tacting the item before each trial was a modification to the procedure, it should not have affected the results in any other way as the items tacted had to be considered “known” during the pre-assessment to be included as target components to begin with.

Additionally, Todd and Blake initially had “sniff” as a target component and it was replaced with a different unknown action as they consistently responded with “smell” instead, despite multiple training blocks where “sniff” was reinforced and “smell” was not. The sometimes competing retrieval (SOCR; Stout & Miller, 2007) theory of learning states that a response may be “blocked” (or be less likely to be emitted)
during training by another response that has been previously paired with the $S^D$ which has a stronger history of reinforcement. Therefore, it would have taken many more training blocks to teach “sniff” targets than any others as the reinforcement history would have to be sufficient to compete with the previous reinforcement of “smell.”

Finally, one training block of a mastered target was conducted for both Gabe and Todd because as a result of their responding incorrectly to an action to which they had been consistently responding correctly. They both replaced the correct response with an action taught after the correct response was mastered and no longer receiving training. Their change in responding may have been due to a relative lack of reinforcement for the previously trained action in comparison to the reinforcement being delivered for the newer action. Following the training block of the mastered target, both children began responding correctly to that action.

Another possible limitation is that for Blake and Todd, there was a gap of 37 days and 28 days, respectively, during training due to the holidays. Gabe had two 2-week gaps in his training during this time. Five probes were conducted for each of these participants when training resumed. Todd’s responses on that probe were not noticeably different from the performance prior to the break and training continued without modification. Blake had mastered only one target in matrix training prior to the gap and got 0% correct on the five probe for that target when he returned. That target was retrained until it met the mastery criterion again. Gabe’s performance dropped during this time (sessions 12-17) but returned to previous levels when training resumed on a more regular schedule.

The delivery of praise for correct responses during probes could be considered a limitation. However, brief praise is routinely delivered during probes in clinical settings.
so as not to place correct responding on extinction. This concern was particularly relevant during five probes, during which the participants would often engage in minor escape-maintained problem behavior (ex: whining, sliding under table, etc.). Five probes tended to be aversive as participants were required to respond to repetitive targets presented in quick succession for long periods of time. Praise delivered for correct responding during these probes was essential to ensure the child received sufficient reinforcement to increase the probability of attending throughout. For instance, Todd would stop responding to all demands if no consequences were provided for his responses so for correct responses the instructor would say, “That’s right,” or “Good job,” and for incorrect responses he or she would say, “Thank you for answering.”

A possible minor limitation is that Todd and Peter each had one session which consisted of at least three times the average number of training blocks per session. However, during these training blocks the pattern of responding was the same as for all other sessions, so this does not appear to have influenced their results.

The DTT and matrix procedures used in this study are each only one of many possible formats. Future studies should investigate other formats in various combinations to more thoroughly compare matrix training and DTT. For example, a DTT format could have only two targets trained at once or matrix training could have four targets trained at once. The number of targets could also be increased to evaluate if differences between procedures would level out over time.

Other skills, such as noun-adjective and verb-preposition-noun combinations, should be taught using both procedures. Comparisons using three-component tacts would help evaluate whether the complexity of the skill influences the efficiency of the training
procedures. Teaching both noun-adjective and noun-verb tacts using each procedure could provide better support for using one procedure over the other if one can be shown to be more efficient across multiple skills.

Given that the matrix training literature has shown that individual learner differences can influence the effectiveness of the procedure, more comparison studies between matrix training and DTT should be conducted with children who are typically developing, have other diagnoses (e.g. ADHD, intellectual disability), and are of different ages. To directly evaluate the extent of the effects of individual differences, each procedure could be used on several groups of learners with certain characteristics.

Comparison studies should also be conducted in schools to compare the feasibility of implementing each of these procedures in that setting. There are many studies on the feasibility of teaching school personnel to implement DTT with integrity and how best to structure DTT instruction in the classroom. Similar assessments should be completed for matrix training to ensure that it has social validity.

Overall, the results of this study suggest that matrix training may be a more efficient way to teach verb-noun tacts than an ITT procedure. This may indicate that matrix training could be a viable alternative to traditional DTT in clinical settings.
References Cited


Appendices
## Appendix A- Sample Matrix Data Sheet

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<tr>
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# Appendix B - Sample ITT Data Sheet

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<th>Child:</th>
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<th>Probe</th>
<th>Training Block #:</th>
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### Appendix C- Treatment Integrity Task Analysis

<table>
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<tr>
<th>Step</th>
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<th>Child:</th>
<th>Training Block #:</th>
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</table>

If the child responds correctly, move to steps 4-5a. If the child responds incorrectly, move to steps 4-

**CORRECT:** 4a. Provide praise and/or edible reinforcer.

5a. No more than 3 seconds before the next trial begins.

**INCORRECT:** 4b. Re-present S².

5b. State correct response immediately after S² is re-presented.

6b. Wait 5 seconds or until child responds.

7b. If the child responds correctly, provide praise. If the child responds incorrectly or does not respond after 5 seconds, do not provide feedback.

8b. Re-present S².

9b. Wait 5 seconds or until child responds.

10b. If the child responds correctly, provide praise. If the child responds incorrectly or does not respond after 5 seconds, do not provide feedback.

11b. No more than 3 seconds before the next trial begins.

<table>
<thead>
<tr>
<th>Step</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>3.</td>
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</table>

If the child responds correctly, move to steps 4-5a. If the child responds incorrectly, move to steps 4-

**CORRECT:** 4a. Provide praise and/or edible reinforcer.

5a. No more than 3 seconds before the next trial begins.

**INCORRECT:** 4b. Re-present S².

5b. State correct response immediately after S² is re-presented.

6b. Wait 5 seconds or until child responds.

7b. If the child responds correctly, provide praise. If the child responds incorrectly or does not respond after 5 seconds, do not provide feedback.

8b. Re-present S².

9b. Wait 5 seconds or until child responds.

10b. If the child responds correctly, provide praise. If the child responds incorrectly or does not respond after 5 seconds, do not provide feedback.

11b. No more than 3 seconds before the next trial begins.
Appendix D- IRB Approval Letter

October 25, 2012

Emily Braff, BS, BCaBA ABA-Applied Behavior Analysis   4202 East Fowler Ave.
Tampa, FL  33620

RE:  Expedited Approval for Initial Review          IRB#: Pro00009716          Title: A
Comparison of a Matrix Programming and Standard Discrete Trial Training
Format to Teach Two-Component Tacts

Dear Ms. Braff:

On 10/25/2012 the Institutional Review Board (IRB) reviewed and APPROVED the
above referenced protocol. Please note that your approval for this study will expire on
10/25/2013.

Approved Items: Protocol Document: A Comparison of a Matrix Programming and
Standard Discrete Trial Training Format to Teach Two-Component Tacts

Consent Document:  Parental Consent.pdf

Please use only the official, IRB- stamped consent document(s) found under the
"Attachment Tab" in the recruitment of participants. Please note that these documents
are only valid during the approval period indicated on the stamped document.

This study involves children; approved under 45CFR46.404: Research not involving
greater than minimal risk. It was the determination of the IRB that your study qualified
for expedited review which includes activities that (1) present no more than minimal risk
to human subjects, and (2) involve only procedures listed in one or more of the categories
outlined below. The IRB may review research through the expedited review procedure
authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is
categorized under the following expedited review categories:

(6) Collection of data from voice, video, digital, or image recordings made for research
purposes.

(7) Research on individual or group characteristics or behavior (including, but not
limited to, research on perception, cognition, motivation, identity, language,
communication, cultural beliefs or practices, and social behavior) or research employing
survey, interview, oral history, focus group, program evaluation, human factors
evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in
accordance with IRB policies and procedures and as approved by the IRB. Any changes
to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Robert Dedrick, Ph.D., Chair Designee USF Institutional Review Board