Comparison of Acquisition Rates and Child Preference for Varying Amounts of Teacher Directedness when Teaching Intraverbals

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Comparison of Acquisition Rates and Child Preference for Varying Amounts of Teacher Directedness when Teaching Intraverbals

by

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

The intraverbal is argued to be the most socially significant verbal operant and yet it is the least studied. Heal and Hanley (2011) suggest that different teaching strategies will lead to different rates of acquisition and child-preference with the tacting operant. This study continued this research into the realm of intraverbals, with focus on whether the embedded teaching strategy could be punishing on play or engaging in learning opportunities. The teaching strategies of discovery teaching, embedded prompting, and direct teaching were compared to see which strategy correlated with higher rates of acquisition and higher child preference. The study utilized a multi-element design by rapidly alternating teaching strategies while evaluating rate of acquisition and number of learning opportunities within the teaching strategies. Child preference was also demonstrated through card selection of associated teaching strategies in a concurrent chains agreement design. The teaching strategies differed in the amount of teacher directedness and taught intraverbal “Wh” questions. It was found through this study that embedded prompting did not punish play or the engagement in learning opportunities. The three participants preferred the three strategies differently and all participants were responding correctly the highest percentage of the time during the direct teaching contingencies by the end of the teaching sessions.
Introduction

In Skinner’s 1957 analysis of verbal behavior focus is on environmental antecedent variables that occur prior to the verbal responses of the speaker, in addition to consequence events facilitated by the listener to explain verbal behavior in terms of operant behavior. Thus, verbal behavior may serve various functions (i.e. varying discriminative stimuli, and motivating operations can evoke verbal behavior for different functions). The varying contingencies establish functional relationships between speaker and listener verbal behavior and the maintaining environmental variables. These functional relationships are categorized as verbal operants. The intraverbal is a verbal operant that is usually acquired last in development. The intraverbal operant comes under the control of a verbal discriminative stimulus with which it has no formal similarity or point-to-point correspondence as does to a tact or echoic response. Rather, intraverbal responses are reinforced by generalized conditioned reinforcers such as socially mediated verbal reinforcement. An example of an intraverbal response to the question “What do you do when you’re sad?” would be, “frown”.

Sautter and LeBlanc (2006) conducted a review of the peer reviewed research in the area of verbal behavior and noted a striking lack of research conducted on the intraverbal. At the time of publication, only 16 studies had been completed researching the intraverbal, nine of which were produced between 1989 and 2004. Sautter and LeBlanc cite the focus of recent research on those with limited verbal capacities as the primary reason for limited publications on the intraverbal. The intaverbal operant is
usually harder for populations with limited verbal capacities to acquire because of the large variety of verbal discriminative stimuli (e.g. “Hi”, “Hey”, “Hello”, “What’s up” and “Good Morning” should all evoke the response “Hi”). This hardship has resulted in a forgoing of studies focusing on complex operants in favor of researching earlier developing operants such as the mand and tact. Sautter and LeBlanc suggest that future studies with typically developing populations seek to further research the application of Skinner’s framework with complex operants such as the intraverbal. Due to the lack of research on the intraverbal, especially with typically developing populations, this study sought to extend knowledge on the best methods for acquisition of this operant.

The intraverbal is a socially important and valuable verbal operant as it serves the function of evoking the majority of reciprocal conversation. Varying categories of discriminative stimuli can evoke intraverbal behavior, such as: story-telling, problem solving, filling in the blanks, and answering questions. Given the large number of discriminative stimuli, intraverbals constitute a large degree of daily verbal behavior. Therefore, deficits in this repertoire are likely to result in significant limitations to daily functional living. These hindrances highlight the importance of capturing the best strategy for teaching the intraverbal.

A primary method of teaching intraverbal skills is based on Skinner’s determination of functional independence between verbal operants. Functional independence has obtained support in a growing number of studies (e.g., Braam & Poling, 1983; Luciano, 1986; Miguel, Petursdottir, & Carr, 2005; Partington & Bailey, 1993). An example of functional independence would be illustrated in the following: if a child manded for a car, he still may not tact a car, or verbally respond “car” when asked
“what is this/that?” Therefore, functional independence dictates that the intraverbal skill has to be targeted directly, with previous mastered operants potentially serving as a prompt (such as an echoic or tact response).

Transfer of stimulus control has served as the basis for intraverbal. The transfer of stimulus control procedures involve transferring the stimulus control from a prompt, whether textual, echoic, or tact, to the discriminative stimulus of the intraverbal through a process of prompt fading. Transfer of stimulus control has been replicated with multiple populations including children diagnosed with Autism (Finkel & Williams, 2001), typically developing children (Miguel et al., 2005; Partington & Bailey, 1993), adults diagnosed with mental retardation, and adults with traumatic brain injuries (Braam & Poling, 1983; Luciano, 1986; Watkins, Pack-Texteria, & Howard, 1989). Although the majority of the research has been conducted on those with limited verbal repertoires, one could say that typical populations also develop intraverbal repertoires from transfer of stimulus control from echoic prompts (a mom telling her child the correct answer).

Sautter, LeBlanc, Jay, Goldsmith and Carr (2011) added an additional element to the transfer of stimulus control procedure, utilizing self-prompting problem solving following transfer of stimulus control procedures to train intraverbal chains and then to move between chains in order to provide multiple responses to categorization questions. Although the self-prompting problem solving strategy was only effective when the strategy was modeled to the children; modeling the problem solving strategy could lead to an increased intraverbal repertoire with varying responses. A repertoire of varying responses could help to eliminate a common limitation of direct intraverbal training, which is rote responding. This study however, still utilized a transfer of stimulus control
procedure, thus future focus needs to be on what variables may make the transfer easier and more likely to happen.

Finkel and Williams (2001) studied whether echoic or textual prompts faded over the course of transfer of stimulus control procedure were more effective in producing accurate intraverbal responding. This study was conducted with one participant diagnosed with autism using a multiple baseline design over different behaviors (sets of questions). The results demonstrated that although both prompting strategies resulted in intraverbal acquisition, the textual prompt was deemed more efficient and effective at transferring to an independent intraverbal and maintaining the responses. However, by only utilizing one participant diagnosed with autism, the results may not be readily generalized to other children or populations. Furthermore, a textual prompt cannot be used with populations that do not utilize a textual repertoire (e.g., preschoolers) and could be stigmatizing for those who have the repertoire (e.g., reading a script). The research should also be extended to distinguish which type of teaching strategy is most efficient for the prompting of intraverbals. There are a variety of different teaching strategies that vary the amount of teacher-directness and also the utilization of a correction procedure.

Early learning psychologist Piaget, asserted that child-led learning was most profitable (Klahr & Nigam, 2004). This assumption was based on the philosophy if a child constructs his/her own knowledge the child’s abilities are more valuable than a child that has his/her knowledge modeled for them (Klahr & Nigam, 2004). The belief extends to the thought that knowledge created by the child is more easily applied and manipulated in the natural environment. Also, if a child creates something, he/she understands it completely. Discovery teaching is based on these core concepts.
Although there is no definition of discovery teaching, it usually describes a strategy that allows the child to find the targeted information with no or very minimal support (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). The amount of assistance usually differs on how hard the task is to discover (Alfieri et al., 2011).

Although discovery teaching has a theoretical background that requires minimal resources, there are many limitations within the strategy. Mayer (2004) found that unassisted teaching techniques did not help children in problem-solving. Also, cognitive researchers believe that discovery teaching would have less impact on young learners than older learners because young children have a very small amount of organized knowledge, therefore it would be difficult to integrate new knowledge effectively without assistance. Alfieri et al. (2011) completed a meta-analysis of studies comparing an explicit or direct teaching strategy to an unassisted or discovery teaching strategy. They found a significant favor of explicit teaching strategies for acquisition over unassisted discovery teaching. However, they also found that assisted discovery teaching was favorable over other teaching strategies, suggesting that the amount of teacher directness may hold a key factor in the amount of acquisition from learners.

Embedded teaching strategies are the next level of increased teacher directedness (Heal & Hanley 2011). Embedded teaching is child initiated but teacher mediated. This strategy targets learning opportunities that occur in naturally occurring routines, such as play. The naturalistic setting helps promote generalization into everyday routines while the prompting and error correction procedures help facilitate acquisition.

Rakap and Parlak- Rakap (2011) completed a literature review of studies utilizing embedded teaching strategies used in special education. In the 17 studies that they
reviewed, 60 children were targeted. Of those 60 children, 55 profited from embedded teaching in rates of acquisition. These studies did not necessarily compare other teaching strategies to embedded teaching but collectively they did demonstrate a profitable nature to embedded prompting with children in special education classrooms.

Although in those diagnosed with developmental delays embedded teaching is most often used to increase language, it has also been used with typically developing children (Hart & Risley, 1968; Hart & Risley, 1974; Hart & Risley, 1975). Embedded prompting has also been used with a variety of tasks. For example, Venn et al. (1993) taught imitation of peers to children with developmental disabilities by embedding teacher prompts within an ongoing art activity. Although embedded teaching shows many beneficial results, there are no direct comparisons with other teaching strategies on the tasks for which embedded teaching is supposed to be an adequate teaching method.

Direct teaching has been compared with other teaching strategies and although it has limitations, it has been used to teach children with developmental disabilities for decades. Lovaas (1977) was the first to write on the power direct teaching had on teaching children diagnosed with autism and from him a method of discrete trial training arose. Direct teaching is characterized by the teacher initiating the interactions. The environment is highly structured with very little to no distractors available (usually occurs while a teacher and child sit at a table next to one another). The antecedents to learning behavior are usually discriminative stimuli (SD) delivered by the teacher. Following a correct response the child will receive reinforcement. Following an incorrect answer the teacher will conduct an error correction procedure in which the SD is represented and the correct response is modeled. Differential reinforcement is given for
correct answers during error correction procedures (Lovaas, 2003). Due to the structured environment and fast paced presentation, more learning opportunities are available. The children have fewer chances to engage in inappropriate behavior.

Direct, or explicit teaching, has been compared to both embedded teaching and discovery teaching. As mentioned earlier, direct teaching was found to be a more efficient teaching strategy than discovery teaching in a review done by Alfieri et al. (2011). However, Alfieri et al. showed that assisted discovery teaching could result in levels of acquisition comparable to explicit instruction. Embedded teaching is close to assisted discovery in that teachers provide help in the learning objectives in a non-contrived environment. When direct teaching has been compared to embedded teaching strategies, the embedded teaching strategies seem to lead to better acquisition and maintenance of skills over time (Delprato, 2001; Sigafoos et al., 2006). However, these studies did not focus on a certain task or verbal operant. Also, they did not assess child preference or score the number of learning opportunities for the different teaching strategies.

Studies have sought to find if a certain teaching strategy leads to higher child preference and if certain strategies could actually punish engaging in learning opportunities. Heal, Hanley, and Layer (2009) designed a study to identify whether the amount of teacher directedness had an effect on the rate of acquisition for tacting relationships. They also assessed child preference for certain teaching strategies. They conducted three different teaching strategies, discovery teaching, embedded teaching which involved embedded prompting in a play situation, and direct teaching they used direct teaching for approximately 1 min and the embedded prompting strategy for the
remainder of the 5 min session. There was a progression of increased teacher
directedness through discovery teaching and direct instruction. The results indicated that
the direct teaching strategy demonstrated the highest acquisition and highest preference
from the students. The embedded prompting strategy led to higher efficacy and results
than the discovery teaching strategy but less than the direct instruction strategy. Another
notable result from the study was the number of learning opportunities was much higher
in direct instruction than in both the discovery teaching strategy and embedded
prompting.

Heal and Hanley (2011) extended the 2009 study with one change. In the direct
instruction strategy, direct teaching was again given for 1 min, but unlike the 2009 study,
the rest of the session was conducted under the procedures for the discovery teaching
strategy for 4 min. This procedure was conducted to isolate embedded teaching (the
teaching strategy was not confounded by being in more than one strategy). The results
indicated that the highest rate of correct responding correlated with direct teaching, also
children ranked this strategy highest in preference, which was consistent with the 2009
study. However, in the embedded prompting strategy there was a downward trend in
number of learning opportunities across the session, and the number of learning
opportunities overall was lowest for embedded prompting (remember learning
opportunities were child initiated). Also, children clearly chose embedded prompting as
the least preferred choice. Heal and Hanley inferred from these results that embedded
prompts served as a punisher for the children engaging in learning opportunities.
However Heal and Hanley’s results have only been reported with one verbal operant (the
tact) and with one participant. Research needs to be conducted to see if the efficacy of
different teaching strategies found in Heal and Hanley (2009, 2011) can be generalized to other operants and if the punishing effect of embedded prompting on engaging in learning opportunities is seen with other verbal operants and other participants.

The intraverbal is one of the most commonly used verbal operants due to its role in conversation and question answering. The current primary procedure for teaching intraverbals is transfer of stimulus control, however there is no research on what teaching strategy is most efficient using this procedure (e.g. is transfer of stimulus control more effective in embedded teaching or direct teaching). Thus the purpose of this study was to identify which teaching strategy (discovery teaching, embedded prompting, or direct teaching) would produce higher rates of acquisition for intraverbals. In addition, secondary measures of child preference, number of learning opportunities, and percentage of intervals containing play sought to extend Heal and Hanley’s (2011) research to determine if embedded prompting is punishing to the acquisition of intraverbals as it was to the tact.
Method

Participants and Setting

Study participants included three English speaking typically developing preschool girls. Participant R was 34 months, participant L was 27 months and participant E was 25 months at the beginning of the study. The primary reason for targeting children within this age range is due to their underdeveloped intraverbal skills. Sunberg (2010) noted that children in this age range typically have difficulty answering “Wh” questions, which was the targets of this investigation, due to problems with verbal conditional discriminations. Children were selected based on parent willingness to participate following the informed consent process and consistent classroom attendance. Participants were recruited from a local preschool in the greater Tampa Bay area. Sessions were conducted on the preschool campus, in an unoccupied office area.

Session Materials

The room was cleared of as many potential distracters as possible and held study materials, a video camera and an Ipad for a timer. The children were taught 12 intraverbal relations regarding animals by three different types of teaching strategies. Each teaching strategy was conducted with a set of four intraverbals. Stimuli (animal toy) was associated as a target for each intraverbal. For example, the child touched or the main investigator held up a frog before asking “what do frogs do?” with the correct answer being leap. For each strategy, there were three sets of toys. The sets of toys were rotated so that the participants were not choosing a strategy in efforts to access a specific
set of toys. Each set of toys contained two different distractor toys that were not targets. Also, colored cards were needed to assess preference of teaching strategies.

**Data Collection/Dependent Variables**

Data was collected in 15 s intervals from the video recording of the session. Learning opportunities were scored as a frequency count within each interval. A learning opportunity within the embedded prompting strategy and the dependent variable play was scored when a child touched a target toy for at least 2 s. If the child remained playing with a toy for successive 15- s intervals the learning opportunity was only scored in the first interval, however, if the child remained playing with the same target toy for 30 s or more a second learning opportunity was scored. Play was scored in the same manner in all three strategies. The main investigator presented an SD or question during the discovery teaching and direct instruction strategies (main investigator initiated). Thus, learning opportunities stayed consistent within these two strategies. The number of learning opportunities during the embedded prompting strategy was examined to see if there was variance from the other two strategies, where learning opportunities were held constant. Correct responding was defined as independently and correctly saying the target phrase within 5 s of a learning opportunity. Correct responding was scored as percent correct over a session (number of correct responses/ number of learning opportunities). Selection of cards associated with a given teaching strategy during the free choice conditions served as a preference measure and was presented as a rank for each session block. The main investigator conducted all sessions and collected all data.
Inter-observer Agreement (IOA)

IOA was scored by a research assistant independently from the main investigator using the same video tape for 89% of the sessions. IOA was scored across intervals. An agreement per interval was defined as the same number of learning opportunities, and correct responses in addition to whether play was seen within an interval. Overall agreement was calculated by dividing the total number of agreements by the number of agreements plus disagreements. IOA was also calculated in the same manner for the preference of sessions. An agreement was scored when the primary investigator and second observer both scored the same card selection. IOA was scored at 96.7% overall agreement with a range of 85% to 100% agreement for the training phase. The data for Participant R had 97.7% agreement between observers, while the data for participant L had 97.4% agreement, and the data for participant E had 94.9% agreement. Overall 100% agreement was scored for the preference assessment with no disagreements. Most disagreements within the training phase occurred while scoring play, or the child touching a toy for more than 2s, as the children and toys were sometimes hard to see in the videos.

Procedural Fidelity

Procedural fidelity data were taken by the research assistants on the deliverance of a vocal SD and the consequences following a learning opportunity in the varying teaching strategies that the main investigator was leading. Fidelity was scored independently by two different observers from a video recording of the session. The observers were trained to collect procedural fidelity by the main investigator and had to correctly score two practice videos prior to scoring recorded sessions.
The three different teaching strategies required different antecedent and consequence manipulations. However, procedural fidelity always was scored as a percentage of steps completed correctly from the total number of steps in a session block (Appendix C). Procedural fidelity never fell below 90% for the duration of the study.

In evaluating fidelity of the card selection procedure that was conducted to test child preference, a correct score was given if the main investigator provided the correct prompt for card selection based on whether the session was a free choice or forced choice condition. Also, it was scored correct if the main investigator appropriately moved into the associated teaching strategy and did not replace the card.

For the discovery teaching strategy a correct teaching was scored if no vocal SD was given following a child-initiated learning opportunity and no consequence was given other than praise after a correct response. Although, at the beginning of the session the main investigator modeled the targeted responses and then gave the direction “tell me what the animals do.” The SD, “tell me what the animals do” was repeated on a VI schedule of 30 s.

For the embedded teaching strategy, a vocal SD was given following a child initiated learning opportunity and corrective feedback was given for incorrect responses, with praise being given for correct responding. The corrective feedback was a teach transfer procedure where the vocal SD was represented and immediately following the SD the correct answer was recited by the main investigator. The vocal SD was then represented to give the learner an opportunity to independently answer. If the learner did not answer correctly the teach transfer procedure was started over.
There were two phases for the direct instruction strategy sessions. The two phases differed in the delivery of the SD and consequences following a learning opportunity. In phase 1 verbal SDs were presented with main investigator initiated learning opportunities. The same correction procedure was utilized as in the embedded teaching strategy for incorrect responding and praise was given for correct responding. Phase two of the direct instruction strategy was identical to the discovery teaching strategy.

Procedural fidelity was taken on 100% of sessions and was found to be 96% procedurally sound with the only mistake being on the error correction procedure in sessions.

**Experimental Design**

The experimental design for this study was a multi-element design within a multiple baseline across participants. This design compared the efficacy of three different teaching strategies in acquisition levels of intraverbals for three subjects. The three different teaching strategies were rapidly and frequently alternated to control for extraneous environmental variables such as time of day and amount of sleep. A concurrent-chains arrangement (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997) was used to determine children’s preferences for the teaching strategies.

**Procedure**

**Preassessments.** Three preassessments were conducted prior to the training phase and preference assessments for three different teaching strategies. Prior to the preassessments, the main investigator built rapport with the child by spending time playing with the child and establishing herself as a potential reinforcer for the child.
**Color preference assessment.** To determine what color was to be associated with each teaching strategy, a color preference assessment was conducted. The preference assessment was a paired-stimulus assessment where each of the ten colored cards was paired with every other colored card at least once. One pair of cards was presented to the child at a time and the child was asked to pick which color she liked most. Praise such as “thanks” was given by the main investigator after each selection so that no color choice was reinforced more than another. Preference was scored as the number of times the color was selected divided by the number of times the card was presented and was represented as a percentage. For each participant, a hierarchy of preference for colors was made by placing the preference percentages from least to most. The median colors in the hierarchy were chosen to be associated with the teaching strategies so that color preference did not confound card selection for the preference of different teaching strategies. The three cards were randomly assigned to each teaching strategy and then held constant for each participant for the duration of the training phase.

**Echoic assessment.** A nine trial echoic assessment was conducted to see if the child could imitate one to five syllable words. The assessment started with the main investigator providing the SD “Say” with a one syllable word. If the child correctly echoed the one syllable word the main investigator moved onto a two syllable word. This procedure continued until the main investigator presented the five syllable words. If a child responded incorrectly or did not echo the main investigator within 5 s of the SD at any point in time, the main investigator presented the SD “Say” with a one syllable fewer word. For example, if the main investigator presented the SD “Say Party,” and the child correctly echoed the word, the main investigator presented the next SD of “Say
elephant.” If the child did not correctly echo the word “Party,” the main investigator presented the SD “Say Cat.” A brief praise statement was given for correct responding and no correction procedure was conducted for incorrect responses or lack of responses. All participants correctly echoed a 5 syllable word. Participant R and L echoed every word presented to them correctly while Participant E incorrectly echoed one 5 syllable word.

**Intraverbal assessment (baseline).** To ensure the pre-existing repertoire of intraverbals did not include any targets that may be in the training procedures, intraverbal assessments were conducted. These intraverbal assessments also served as preliminary baseline measures for the study. The first assessment the main investigator went through a list of intraverbals (Appendix A) with the child. The child was positioned in front of the main investigator and asked questions like “How does a turtle move”. No praise was given for correct responding and no correction procedure was conducted for incorrect answers or lack of an answer within 5s of the delivery of the SD. However, descriptive praise, for example, “I like how you’re sitting” was given every other trial. The same procedure was conducted multiple times (differing by participant). The pretest was given on different days prior to the start of the training phase. There was no correct responding to targets during the pre-tests for all participants.

**Training procedures.** Following the pre-assessments, the efficacy of the training procedures was assessed in an alternating treatments design embedded in a multiple baseline across participants. The 12 targets for the training phase were randomly chosen from the list of targets the child got incorrect in the pre-tests. The 12 chosen targets were then randomly assigned four to each teaching strategy. Only one
session block was conducted a day with each participant. A session block was made up of three sessions, each session utilizing one type of teaching strategy. Thus, a child came into contact with all three teaching strategies within a session block. The main investigator provided attention in every 15-s interval so that the child was receiving the same amount of attention in all three teaching strategies. The kind of attention differed between strategies. In the discovery teaching strategy the main investigator mostly provided descriptive praise. In the embedded teaching strategy and phase 1 of the direct instruction strategy the attention came in the form of presenting SD’s and correction procedures. Attention was provided in phase 2 of the direct instruction strategy in the same way as the discovery teaching strategy.

**Discovery teaching.** Before the beginning of every session of the discovery teaching strategy all the target responses were modeled by the main investigator, e.g., holding up the bear and saying “Bears hibernate.” Then the main investigator provided the SD “Tell me what the animals do.” Once the session began all the interactions were child-led and the role of the main investigator was to provide an active environment for the child and to praise correct responses. Approximately every 30s (VI 30) the SD “Tell me what the animals do” was represented, to ensure that vocal behavior was under the control of the verbal SD and thus qualified as an intraverbal. Appropriate amounts of attention were given during the 15-s intervals in forms of descriptive praise, e.g., “nice playing,” but play was not interrupted and no prompting of target responses was given by the main investigator. Also, if the child engaged with the target toy and did not give a target response there was no correction procedure conducted. During the discovery teaching strategy the main investigator only provided praise for correct responding, e.g.,
if the child engaged with the cow and said after the presentation of an SD “cows moo.” The main investigator praised the response by saying “That’s right! The cow does moo.” All of the sessions were conducted with a specific colored poster card in the room. This color was correlated with the teaching strategy and the color of the card chosen to enter the session.

*Embedded prompting.* In the embedded teaching strategy no exposure to the targets was given to the children prior to the beginning of the session. There was also a different colored poster card in the room that correlated with the teaching strategy. In the embedded teaching strategy, all interactions were child led. When a child initiated a learning opportunity (i.e., touching a toy for 2 s) the main investigator delivered an SD, (e.g., “What does a monkey do?”). If the child responded correctly praise was given. If the child did not respond to the SD within 5 s or responded incorrectly, a correction procedure was conducted. The corrective feedback was a teach transfer procedure where the vocal SD was re-presented and immediately following the SD the correct answer was recited by the main investigator. The vocal SD was then re-presented to give the learner an opportunity to independently answer. For example, if the SD of “What does a monkey do?” was presented to the child and the child did not answer, the SD “What does a monkey do?” was represented and immediately following the SD the main investigator stated the correct answer “hang.” The SD “what does a monkey do” was then immediately represented for a third time. If the learner did not answer correctly the teach transfer procedure was started over. Praise was given for correct responding during the correction procedure whether it was an echo or an independent statement. All sessions in this strategy were 5 min long.
**Direct instruction.** The direct instruction strategy consisted of two different phases. The first phase contained direct teaching elements including a contrived environment, main investigator initiated interactions, prompt delay, correction procedures, and differential reinforcement. The main investigator and student sat across from each other on the floor while trials were being conducted. The main investigator directed trials by holding up a target toy and presenting an SD (e.g., what do bears do in the winter?). The main investigator used a progressive prompt delay with a terminal delay of 5 s. Meaning that, the first session of each strategy 0 s was given between the SD and the verbal prompt to establish acquisition. Each subsequent session increased the prompt delay 1 s until the delay reached 5 s. Once the delay of 5 s was reached the 5 s delay was be kept for 3 sessions. However, if mastery was not met within those three sessions, the delay was started back at 0 s with two sessions needed to extend the delay by 1 s. Each session consisted of eight trials. Each intraverbal was presented twice throughout the main investigator-directed session. For every independent correct response the main investigator delivered high magnitude verbal praise. For every correct response gained through the error correction procedure, the main investigator delivered praise, but not as high of a magnitude for an independent correct response. This first phase of the direct instruction strategy took on average 1 min or less, and the entire session was 5 min long.

The remaining 4 min of the session was spent in the second phase of the direct instruction strategy. This phase used the same procedures as the discovery teaching strategy. The two different phases were conducted to analyze the effect of direct teaching on child play.
**Preference assessment.** The preference assessment and training procedures were conducted simultaneously using a concurrent-chains arrangement to determine child preference. Prior to the beginning of the training procedures the three colors chosen in pre-assessments were presented to the children and the children were asked to “pick a card.” Once a card was chosen, it was not replaced and the children picked until no cards were left. This process occurred three times to serve as a baseline for preference. This step was taken to ensure that differentiated preference could be determined from before and after the colored cards were associated with a teaching strategy. During the training phase, only one session block (containing three sessions, one from each teaching strategy) occurred a day for each participant. Every other session block alternated between free choice and forced choice. At the beginning of the session block the child was brought to the door of the room where the sessions were conducted. On the door were three color cards arranged randomly for each session block. During the free choice session blocks the children were told “Please pick a card.” After picking a card, the card was not replaced on the door during the session block. The children then immediately entered the session of the teaching strategy associated with the colored card (color/teaching strategy associations were held constant throughout the duration of the study). After the end of the session the child was taken into the hallway to play for 30 to 60 s. The child was then led through the same procedures with the remaining cards until all the sessions of the session block were completed.

Forced choice card selection was also utilized to establish and maintain the contingency between card selection and the associated teaching strategy. During the forced choice session blocks the children were brought to the door of the room where the
sessions were conducted in. There were three colored cards associated with each teaching strategy on the door arranged randomly for each session block. The children were instructed “Please give me the (color) card”, once the card was taken off the door it was not replaced during the session block. Then the child was led into the session associated with the card color. After the session the children were taken into the hallway to play for 30 to 60 s. The procedures were repeated until all the sessions in the session block were completed and all the cards had been taken off the door. The order of selection by the main investigator was randomized for each session block.

**Posttests.** Two posttests were given after the end of the training phase and preference assessments. The first assessment happened directly after the end of the training phase and preference assessment and the second assessment took place two weeks after the end of the training phase and preference assessment. Each posttest contained 12 trials in direct teaching format and contained one presentation of each intraverbal targeted in the teaching sessions.
Results

Figure 1 displays the percentage of correct responding for all three participants within baseline and the training phase. All participants had zero levels of correct responding during the baseline condition and then showed a substantial increase in level of correct responding upon implementation of the training procedures. Within strategies there was variability of responding and each participant responded differently to each of the teaching strategies. Participant R demonstrated the highest percentage of correct responding during the embedded prompting strategy. Participant R also demonstrated a higher stability of rate acquisition and responding under the embedded strategy contingencies, compared to variable rates under direct and discovery learning contingencies.

The percent of correct responding for participant L was highly variable and clear level differentiation between strategies was not evident during the beginning of the training procedures. However, following session 12 there was more differentiation between levels of responding across strategies, with the contingencies of the direct instruction and embedded teaching strategy showing a higher percentage of correct responding than the discovery learning strategy.

Participant E showed differentiated levels of responding during the various teaching strategies from the beginning of the training procedures. Throughout the first three sessions of the training phase the highest percentages of correct responding occurred during the direct teaching strategy. However, following session 11, percentage
of correct responding was highest in the embedded prompting strategy and the direct teaching strategy.
Figure 1. This graph demonstrates percent of acquisition across sessions for three different teaching strategies.
Figure 2. This graph demonstrates percent of acquisition of intraverbal targets across sessions for three different teaching strategies. This graph depicts only data from phase 1 of the direct teaching strategy in the direct condition.
Figure 1 displays the percentage of correct responding for the full duration of every session, however, figure 2 displays the percentage of correct responding under only the contingencies that do not overlap with another given teaching strategy. The difference between figure 1 and figure 2 lies in the direct teaching strategy. During the direct instruction strategy the time spent in the session was divided into two phases; the first phase was held under direct instruction contingencies and the second phase was conducted under discovery learning contingencies (which were then repeated in the discovery learning strategy). The data in figure 2 show the percentage of correct responding in only phase 1 of direct, or only under the direct instruction contingencies. The data for the embedded prompting and discovery learning strategies remain the same because the whole session was conducted under one set of contingencies. The graph demonstrates that at the conclusion of the training procedures the direct contingencies evoked the highest percentage of correct responses for all participants, while the embedded contingencies evoked the second highest percentage of correct responses and discovery the least percentage of correct responses when level differentiation occurred at the end of the training procedures.

It was observed during the training phase that the discovery learning contingencies allowed for more than one correct answer for a single learning opportunity and that the percentage of correct responding to a learning opportunity may not completely capture the acquisition of targets during the discovery learning strategies. For this reason, frequency of correct responses was also recorded. Although frequency of correct answers allows more scoring opportunities during the discovery learning strategy, this strategy evoked a lower level of correct responding than the other strategies for R
and E. This is in addition to lower levels of responding than the direct teaching strategy for participant L by the conclusion of the training phase (figure 3). The number of correct responses during the discovery learning strategies initiated an upward trend, hit a high point, and then decreased throughout the remaining sessions.

Play was scored to determine if the contingencies of one teaching strategy led to more interaction with toys than other strategies. Figure 4 shows the percentage of intervals containing play for all participants. The results are highly variable with no discernable level differentiation between strategies for all participants.

The number of learning opportunities was held constant in the discovery teaching phase and fairly constant in the direct teaching strategy. Data collected to determine how embedded prompting varied from the other two teaching strategies (figure 5). For participant R the number of learning opportunities in the embedded teaching strategy was always the same as or higher than the discovery learning strategy. In five out of the eight sessions the frequency of learning opportunities in the embedded prompting strategy was the same or higher than the direct instruction strategy for participant R. Participant L demonstrated dissimilar responding from Participant R with all but three sessions having fewer learning opportunities in the embedded prompting strategy than both direct and discovery strategies. In only one session Participant L produced the same number of learning opportunities in the embedded prompting strategy as the direct teaching strategy. Participant E demonstrated varied responding. In 4 of the 8 sessions Participant E had more learning opportunities in embedded prompting than the discovery learning strategy. However, the direct strategy for Participant E always had the most learning opportunities.
Figure 3. This graph depicts frequency of correct responding across sessions for three different teaching strategies.
Figure 4. This graph depicts the percentage of intervals containing play across sessions for participants R, L, and E.
Figure 5. This figure depicts the frequency of learning opportunities across sessions of the training phase for all three participants.
Data from Pretests and Posttests were also scored. Participants responded at zero percentage correct on the pretests for targets in all three teaching strategies. The participants all demonstrated 100% correct responding for the three strategies in the posttest and demonstrated 100% correct responding on targets in the three teaching strategies 2 weeks after the conclusion of the training phase.

Preference ranking of strategies was collected via card selection when the colored cards were associated with a given teaching strategy. A one is indicative of the participant picking the strategy first, a two as a second choice and a 3 indicated choosing the strategy third. Baseline was taken to show card selection before the colored cards were associated with teaching strategies. Before the cards were paired with teaching strategies, there was undifferentiated card selection completed by all the participants. After strategy pairing with the colored cards, two of the participants showed differential results. Participant R consistently selected the embedded prompting strategy first during free choice conditions. For the first two sessions of free choice conditions during the training phase, Participant R chose the direct instruction strategy second and the last two sessions of free choice conditions Participant R chose the discovery learning strategy second. Participant L demonstrated more variability in her card selection; she chose direct instruction first during 4 of the 6 free choice sessions but was not consistent in her second or third choices. Participant E showed differentiated selection during the last three free choice sessions by selecting the discovery teaching strategy first, the direct teaching strategy second and the embedded teaching strategy third.
Figure 6. This graph depicts the preference ranking of strategies across free-choice sessions for all three participants. A ranking of 1 demonstrates that the participant chose the colored card correlated with the given teaching strategy first. A ranking of two demonstrates that the participant chose the card correlated with the given teaching strategy second and a ranking of 3 means that the participant chose the colored card associated with the given teaching strategy third.
Discussion

This study sought to identify which teaching strategy (discovery teaching, embedded prompting, or direct teaching) produced higher rates of acquisition for intraverbals. It was found that under the direct instruction contingencies participants responded with the highest percentage of correct responding. However, participants responded at 100% correct in the posttest for targets in all three teaching strategies in spite of less than 100% correct during the training phase.

Within the training phase correct responding was highly variable and sometimes occurring at low levels. Figure 1 demonstrates that only Participant R displayed 100% correct responding. However, 100% correct responding only occurred with Participant R in one learning strategy in only 2 sessions. The majority or correct responding for the three participants seemed to occur with 50% to 60% of learning opportunities. In the posttests all the participants responded correct to 100% of the learning opportunities in all learning strategies. This difference in levels of responding between the posttests and the learning strategies demonstrates that the dependent measure for this study was not acquisition, but rather performance. Thus, the data did not conclude rate of acquisition but rather rate of responding.

Rate of correct responding is an important variable for consideration and in this study the direct instruction contingencies led to the highest rate of correct responding. In addition, secondary measures of child preference, number of learning opportunities, and percentage of intervals containing play were included to extend Heal and Hanley’s (2011)
research to determine if embedded prompting might be punishing to the acquisition of intraverbals as this was found to be the case with the tact. This study demonstrated that embedded prompting did not appear to be punishing on play or learning opportunities as participants did not engage in play and learning opportunities at a lower level in the embedded prompting strategy compared to the other learning strategies. In addition, the number of play and learning opportunities did not decrease over time.

One of the primary goals of this study was to determine under what conditions acquisition of intraverbals was most efficient. If focus is put on the first three sessions to examine acquisition, differing results between participants is seen. Participant R shows more correct responding within the embedded prompting strategy with mild differentiation between strategies. Participant L shows highest rates of correct responding under the discovery learning strategy with no clear differentiation between strategies. Participant E had the highest percent of correct responding in the direct teaching strategy with mild differentiation between strategies. However, upon analysis of posttest and generalization probe data it was determined that 100% acquisition occurred during all three learning strategies. However, in each learning strategy correct responding was rarely at 100%. This finding supports the conclusion that the dependent variable of percent of correct responding was measuring performance and not acquisition. To clarify how the targets were acquired, conducting probes after each session block within the training phase might have provided acquisition information. In addition, if a preference assessment was conducted prior to the beginning of the training phase and high magnitude reinforcers were delivered upon correct responding, responding could have been higher and represented acquisition levels.
All three participants demonstrated highest rates of correct responding under direct instruction contingencies (teacher directed, differential reinforcement, and correction procedure) by the end of the training phase. The second highest percentage of correct responding occurred under embedded prompting contingencies while discovery learning was the lowest. These differences in level of correct responding between learning strategies is hypothesized to have occurred in accordance with contingencies of positive and negative reinforcement. This finding would correspond with findings from Worsdell et al. where negative reinforcement and positive reinforcement led to higher correct responding for sight words than positive reinforcement alone. The addition of an error correction procedure led to higher acquisition of sight words and Worsdell et al. found that this result could be due to avoidance of the error correction procedure.

For example, discovery learning contingencies only operated under positive reinforcement as praise was only provided for correct responding. Once the participants contacted the positive reinforcement, percent of correct responding increased. However over time, percentage of correct responding decreased for all participants. This finding leads to the hypothesis that positive reinforcement leads to acquisition, though when looking at responding over time, negative reinforcement may assist in maintaining correct responding. The use of a preference assessment to identify higher magnitude reinforcers that could have been delivered contingent upon correct responding may have resulted in differentiated outcomes compared to verbal praise alone.

The embedded prompting strategy and phase 1 of the direct teaching strategy included both positive and negative reinforcement contingencies. If a correct response was not given, additional demands were presented until a correct response was given. By
giving a correct response upon the initial delivery of the discriminative stimulus, negative reinforcement may have occurred to avoid additional demands. Under direct and embedded contingencies, increased stability of correct responding was seen in both participants R and E and correct responding demonstrated upwards trends. It is hypothesized that with positive reinforcement provided throughout this study, negative reinforcement may have also played a role in correct responding. Direct teaching contingencies could have led to a higher percentage of correct responding than the embedded prompting strategy in the later sessions because the environment during the correction procedure was more aversive than during the embedded teaching strategy. During the direct teaching contingencies the participant was not allowed to engage with target stimuli during the error correction procedure, while during the embedded teaching strategy the participant was able to engage with target stimuli during the correction procedure. This variable could have made the condition more aversive during the correction procedure of the direct teaching contingencies and thus made avoiding the correction procedure through responding correctly more reinforcing.

Another variable of focus within this study was whether embedded prompting was punishing on learning opportunities and play as was hypothesized to be the case in the Heal and Hanley (2011) study. Heal and Hanley (2011) found that in the embedded prompting strategy there was no acquisition of the tact, there was a decreasing trend of play, and it was the least preferred strategy within one of the relations taught. They hypothesized that this was due to a contingency within embedded prompting where a demand was placed contingent upon play, which could have been punishing on play and thus acquisition. Within this study embedded prompting led to full acquisition for all
participants; there was no decreasing trend in play, in fact play was undifferentiated in level from the other two teaching strategies, and embedded prompting was the most preferred strategy of one participant. The embedded prompting strategy was the least preferred strategy for participant E and was not highly preferred by participant L. However, for both of these participants play stayed at at a stable level that was undifferentiated from the other teaching strategies and the frequency of learning opportunities stayed at a stable level across sessions as well. If there was a punishing effect on learning opportunities or play, a decreasing trend should have been observed.

Behavior within the embedded prompting strategy could be determined through past reinforcement histories as participant R engaged in more play and learning opportunities during the embedded teaching strategy than the other participants. She also preferred the embedded prompting strategy over the other strategies where the other participants had a lower preference for the embedded prompting strategy. It is possible, as participant R’s mother is a teacher, that she has previously obtained high magnitude reinforcement through answering questions during play. In addition, the developmental levels of the children could have contributed to the rate of their responding. Participant R seemed to have the most advanced verbal repertoire and was also the oldest. This difference could have added to her higher rate of correct responding within the embedded learning strategy when compared to the other participants.

**Future Directions**

Future studies might consider including a preference assessment for participants as this could have added to the accuracy of the results, as responding under contingencies where only positive reinforcement was given could have been strengthened with a high
magnitude reinforcer. This study does have social validity in the fact that only praise would be typically given as a reinforcer in the classroom setting.

Conducting an entire 5 min session under direct contingencies to evaluate percent of correct responding would be valuable for determining the level of responding under direct contingencies alone. Within this study the direct learning strategy had two phases, Phase 1 contained only direct teaching contingencies but occurred in approximately the first minute of the teaching session. Although percent of correct responding was higher under these contingencies there is no data to confirm that the participants were simply performing better in the first minute in all strategies. A full 5 min under direct contingencies alone would allow for a better understanding of rate of responding under longer durations.

In the future this methodology may find valuable results in different populations such as children diagnosed with autism or individuals diagnosed with intellectual disabilities. The methodology may also be applied to other verbal operants such as the mand or repeated to see if punishing effects from Heal and Hanley (2011) are evoked as results regarding the punishing effects of embedded prompting are inconclusive.
References


Appendices
## Appendix A – Pretest

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<td>Gallop</td>
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<td>What do pigs do?</td>
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<td>What do cows do?</td>
<td>Moo</td>
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<td>What do frogs do?</td>
<td>Leap</td>
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<td>What do chickens do?</td>
<td>bock</td>
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<td>What do dogs do?</td>
<td>Bark</td>
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<td>What do cats do?</td>
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<td>What do fish do?</td>
<td>Swim</td>
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<td>What do turtles do?</td>
<td>Hide</td>
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<td>What do rabbits do?</td>
<td>Hop</td>
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<td>What do scorpions do?</td>
<td>Sting</td>
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<td>What do tigers have?</td>
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<td>What do birds do?</td>
<td>Fly</td>
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<td>What do bears do?</td>
<td>Hibernate</td>
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<td>What do pandas do?</td>
<td>Eat bamboo</td>
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<td>What do elephants do?</td>
<td>Move trunks</td>
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<td>What do jellyfish do?</td>
<td>Sting</td>
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<td>What do kangaroos do?</td>
<td>Jump</td>
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<td>What do pelicans do?</td>
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<td>What do skunks do?</td>
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<td>What do lions do?</td>
<td>Roar</td>
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<td>What do monkeys do?</td>
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### Appendix B - Data Collection

Date of session: ________________
Date of data collection: ________________
Participant: ________________
Observer: ________________
Card Selection color: ________________
Free/Forced: ________________

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Appendix C - Procedural Fidelity

Date:_________________ Observer:__________________
Date of session:_________________ Participant:__________________

Card Selection Steps 1
1. Did the main investigator state “pick a card” in a free choice condition?
   Y    N    N/A
2. Did the main investigator state “pick the _____ card” in the forced choice condition?
   Y    N    N/A
3. Did the main investigator not replace the colored card after the selection was made?
   Y    N
4. Did the main investigator go straight into the teaching strategy associated with the chosen card?
   Y    N

Card Selection Steps 2
1. Did the main investigator state “pick a card” in a free choice condition?
   Y    N    N/A
2. Did the main investigator state “pick the _____ card” in the forced choice condition?
   Y    N    N/A
3. Did the main investigator not replace the colored card after the selection was made?
   Y    N
4. Did the main investigator go straight into the teaching strategy associated with the chosen card?
   Y    N

Card Selection Steps 3
1. Did the main investigator state “pick a card” in a free choice condition?
   Y    N    N/A
2. Did the main investigator state “pick the _____ card” in the forced choice condition?
   Y    N    N/A
3. Did the main investigator not replace the colored card after the selection was made?
   Y    N
4. Did the main investigator go straight into the teaching strategy associated with the chosen card?
   Y    N

Discovery teaching Steps
1. Did the main investigator model all the correct responses for the selected targets prior to the beginning of the session?
   Y    N
2. Did the main investigator state the SD “Tell me what an animals does” at the beginning of the session?
   Y   N
3. Did the main investigator provide the SD “tell me what an animal does” on a VI 30 schedule?
   Y   N
4. Did the main investigator deliver praise at every occurrence of a correct target response from the child?
   Y   N
5. Did the main investigator never present an SD following a child-initiated learning opportunity?
   Y   N

**Embedded Promping Steps**
1. Did the main investigator NOT model the correct responses prior to the beginning of the session?
   Y   N
2. Did the main investigator state the SD “What does a ______ do?” after every child-initiated learning opportunity?
   Y   N
3. Did the main investigator provide praise for every occurrence of a correct target response from the child?
   Y   N
4. Did the investigator initiate the correction procedure for every incorrect or lack of response from the child after the presentation of an SD? (Represents SD with correct answer, then represents SD again to test for independent responding)
   Y   N

**Direct Instruction Steps**
Phase 1
1. Did the main investigator NOT model the correct responses prior to the beginning of the session?
   Y   N
2. Did the main investigator state the SD “What does a _____ do?” after every teaching-initiated learning opportunity?
   Y   N
3. Did the main investigator provide praise for every occurrence of a correct target response from the child?
   Y   N
4. Did the investigator initiate the correction procedure for every incorrect or lack of response from the child after the presentation of an SD? (Represents SD with correct answer, and then represents SD again to test for independent responding)
   Y   N
5. Did the main investigator provide 2 tokens for independent response at the first presentation of the target SD?
   Y   N
6. Did the main investigator provide 1 token for an independent response created through the error correction procedure?
7. Did the main investigator state the SD “Tell me what the animals do” at the beginning of the session?  
Y  N

8. Did the main investigator provide the SD “tell me what an animal does” on a VI 30 schedule?  
Y  N

9. Did the main investigator deliver praise at every occurrence of a correct target response from the child?  
Y  N

10. Did the main investigator never present an SD following a child-initiated learning opportunity?  
Y  N
Looking for volunteers in a research study!

Needed: Children willing to participate in a study examining the preference and acquisition of three different teaching strategies

Musts:
- Children be 24-36 months old
- Children have parents willing to give consent.

Why do it?
- Only 15 minutes per day time commitment that will occur during school hours. (for approx. 1-2 months)
- Children will learn new information.
- Help practitioners and researchers learn more about how children learn!

Interested?
- Contact Victoria Smith at (727)251-1328 or vsmith2@usf.edu
- Fill out attached sheet and return to teacher
Child’s name:___________________________
Name of parent:_______________________
Way to contact
parent:_____________________________

Thank you!!!!
Appendix E- Session information

R
**Discovery Learning- Teal**
What do horses do?- Gallop
What do Chickens do?- Bock
What do rabbits do? hop
What do Pandas do? eat bamboo

**Embedded Prompting- Brown**
What do frogs do?- leap
What do bears do? Hibernate
What do elephants do? move trunks
What do fish do?- swim

**Direct Instruction- Blue**
What do turtles do? hide
What do birds do? fly
What do dogs do? bark
What do tigers do? Crouch
L
Discovery Learning- Teal
What do horses do? Gallop
What do frogs do? leap
What do fish do? Swim
What do pandas do? Eat bamboo
Embedded Prompting- Yellow
What do pigs do? Oink
What do tigers do? Crouch
What do birds do? Fly
What do bears do? hibernate
Direct Instruction: Orange
What do chickens do? Bock
What do elephants do? Move trunks
What do turtles do? Hide
What do dogs do? bark
E
Discovery Learning: Teal
What do horses do? Gallop
What do pigs do? Oink
What do frogs do? Leap
What do chickens do? Bock

Embedded Prompting- Red
What do dogs do? Bark
What do cats do? Meow
What do fish do? Swim
What do turtles do? Hide

Direct teaching- Light green
What do tigers do? Crouch
What do birds do? Fly
What do lions do? Roar
What do monkeys do? hang