THE EFFECTS OF AN INSTRUCTIONAL PACKAGE ON THE EMERGENCE OF NOVEL INTRAVERBALS IN CHILDREN WITH AUTISM

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We evaluated the effects of an instructional package on the emergence of novel intraverbals in children diagnosed with autism. Participants were two boys with a diagnosis of autism who had tact and listener repertoires for common objects and events, some intraverbal responses, and showed an ability to learn new intraverbal responses through direct instruction prior to participating in the study. Tact training, listener training, sorting training, and mixed training (listener and tact training) were conducted with each participant, with a probe to test for emergent intraverbals following each training step. If some emergence was seen during a probe following a training step, probes were conducted with the remaining sets to test for emergence in those sets as well. Multiple-exemplar training was conducted following the training steps if all targets within a set did not meet the criterion for emergence during probes. Results showed that for one participant, all four training steps, in addition to multiple-exemplar training, were needed to see emergence in all targets during probes for two sets, with the last two sets requiring only tact training before all targets had emerged during probes. The second participant required only tact training during three sets, with listener training required for one target in one set before all targets in all sets emerged during probes.
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CHAPTER 1
INTRODUCTION

According to the *DSM 5* (2013), autism spectrum disorder (ASD) is a disorder characterized by persistent deficits in social and communication domains across multiple contexts. Deficits are seen within an individual’s nonverbal communicative behaviors, in social-emotional reciprocity, as well as their ability to develop, maintain and understand relationships (Filipek et al., 1999; Finkel & Williams, 2001; Fodstad & Matson, 2009; Landa, Holman, & Garret-Mayor, 2007). Severity is based on the amount of social communication impairments seen, as well as the severity of the individuals restricted and repetitive behaviors. Currently, about 1 in 59 children is estimated to have ASD (CDC, 2018).

Verbal behavior involves the behavioral analysis of language by both its functional and formal properties that provides a classification system to identify functionally different types of language. It focuses on a functional analysis of language, rather than behavior in general. The purpose of verbal behavior is to teach individuals to use words within their repertoires effectively in a variety of situations. This is necessary as just because an individual has the ability say to use certain words, does not mean that they are able to functionally use the word. For example, a child may be able to say the word “water.” That does not mean that they will reliably say “water” when they want water (mand), that they will be able label water when they see a glass of water (tact), or that they will be able to reply to the question “What do you want to drink?” with “water” if water is not present (intraverbal).

Some methods used with verbal behavior problems that have been found to be efficient in promoting high rates of responding and cooperation include immediate delivery of
reinforcement (Vallinger-Brown & Rosales, 2014), mixing and vary task types presented (Sidener et al., 2010), interspersing mastered tasks with acquisition tasks (Allan, Vladescu, Kisamore, Reeve, & Sidner, 2015; Ingvarsson), using most to least prompts, and the fading of prompts across trials (Ingvarsson & Hollobaugh, 2010; Vallinger-Brown & Rosales, 2014).

In his taxonomy of verbal behavior, Skinner (1957) analyzed language using its functional properties to classify what he referred to as verbal operants (e.g., tacts, intraverbals, mands). According to his taxonomy, Skinner defined tacts as instances of verbal behavior that are evoked by a nonverbal antecedent stimulus and maintained by generalized conditioned reinforcement (e.g., in the presence of a ball, the child says “ball” and the adult says, “that’s right!”). Listener behavior is defined as an individual’s response to a speaker’s verbal behavior (e.g., when presented with three pictures and told to touch the one you eat, the individual touches the picture of food). Speaker and listener repertoires are often initially independent (Skinner, 1957). Thus, acquiring a response under tact control does not necessarily result in the emergence of the corresponding tact, or vice versa. However, with typical language development, these repertoires eventually become interdependent (Frampton, Robinson, Conine, & Delfs, 2017). If they remain completely functionally independent, the individual’s verbal capabilities will be limited.

Another important category of speaker behavior is intraverbal behavior. It occurs when verbal stimuli evoke a verbal response that does not have point-to-point correspondence with the preceding verbal stimulus (e.g., the child is asked, “What color is the sun?” and responds, “Yellow” and the adult says, “That’s right, it is yellow!”). A large part of an individual’s day-to-day verbal interaction is likely to involve intraverbal control. A functional intraverbal repertoire
is vital because these skills provide the foundations needed for more advanced communication skills with others and can also lead to opportunities for social reinforcement in a variety of settings (Allan et al., 2015).

Because conversations between individuals heavily rely on the intraverbal repertoires, it would be virtually impossible to have any type of meaningful conversation if an individual only had echoic, mands, and tacts in their repertoire (Sundberg & Sundberg, 2011). Just as tacts and listener responses are needed for a functional verbal repertoire, acquiring a simple intraverbal repertoire is the foundation for attaining more complex and advanced communication skills. For example, if a child is unable to respond to simple questions (e.g., “What is your name?”; “What is it?”), using more complex intraverbal skills would be severely impacted (e.g., answering difficult questions, staying on topic within a discussion).

In early behavioral intervention for children with autism, interventionists typically teach intraverbal responses using transfer of stimulus control procedures. For example, when presented with the verbal stimulus “dog,” the child might be able to echo the word “dog” and tact a picture of a dog; however, when presented with the question, “You walk a...” the child might be unable to complete the phrase. Using a transfer of stimulus control procedure, the child would then be presented with the antecedent, “You walk a...” while also simultaneously being presented with a picture or vocal prompt (i.e., a picture of a dog or the word “dog”) to evoke the target response. Over subsequent trials, the prompt would be faded until only the verbal statement, “You walk a...” reliably evoked the response “dog.” Several studies have evaluated the effectiveness of these types of prompting procedures and shown them to be
According to Aguirre, Valentino, and LeBlanc (2016), emergent intraverbal responses are those in which the response is not directly taught. Instead the response comes about as the result of training with a different set of conditional relations or on a different operant. One reason the study of emergent intraverbals is important is that in everyday verbal interactions, many intraverbal response are not directly modeled or otherwise prompted. Rather, it is very likely that they emerge from other verbal operants with overlapping topographies. For example, a child may learn to tact and respond as a listener both to the name of an item (e.g., a chair) and the function of the item (sitting). As a result of this learning history, the item name and function might become intraverbally related in the child’s repertoire, and the child might therefore be able to answer questions about item function in the absence of the item (e.g., “What do you sit in?”). Additionally, by identifying efficient methods that lend themselves to the emergence of intraverbals, time is saved as intraverbal responses do not have to be taught one-by-one.

Pétursdóttir, Carr, Lechago, and Almason (2008) looked at the effects of intraverbal (IVT) and listener training (LT) to teach categorization skills to five typically developing preschool children. Participants first underwent pretesting using two exemplars from two familiar categories (e.g., dog, shoe, flower) to ensure that participants were familiar with the experimental procedures (i.e., name tact and LT, category-name intraverbal and LT, and pre-and post-testing). Participants were then trained to tact and respond as listeners to previously unknown stimuli (i.e., six maps and six foreign characters).
A tact training (TT) trial consisted of the experimenter asking, “What is this?” followed by the presentation of a visual stimulus (e.g., the experimenter asks “What is this?” and presents a picture of Mali and the participant responds with “Mali”). During LT, the participant would be presented with “Which one is ___“ followed by the presentation of three stimuli to evoke the target response (i.e., touching the correct picture). For example, when presented with “Which one is Seni?” and the presentation of the three stimuli, the participant touches “Seni.” During IVT the participant received only the instruction. For example, when presented with “Mali is ___” the participant was given 10 s to provide the response “north."

After participants learned the item names as tacts and listener responses, they were assigned to either TT or LT. Participants were then taught category labels (e.g., north, south, Greek, Cyrillic), either through listener or intraverbal training. The experimenters then probed for emergence of other untrained skills (i.e., listener skills following intraverbal training, and intraverbal responses following listener training). Results showed that for four out of the five participants there was no emergence for any of the untrained relations. It is possible that the lack of emphasis on tract training played a part in the lack of emergence seen during probes for the untrained relations.

In another study, Pétursdóttir, Ólafsdóttir, and Aradóttir (2008) found some effects when looking at the emergent responses of typically developing preschoolers, although those results were smaller and less reliable than seen in other studies (Dounavi, 2014; Pétursdóttir & Hafliðadóttir, 2009). In their study, two participants received TT and two participants received LT to determine what effects, if any, TT and LT might have on the emergence of bidirectional intraverbals when teaching Icelandic-Spanish and Spanish-Icelandic responses to children with
Icelandic as their native language. Results showed that those participants who received tact training performed with higher accuracy than those who received listener training.

Miguel, Pétursdóttir, and Carr (2008) examined the effects of multiple-tact training (MTT) and receptive-discrimination training (RDT) to teach typically developing preschool children thematically related intraverbals. Both MTT and RDT contained two phases. In phase one, participants were taught to either tact each exemplar (MTT) or to select a picture from among three comparisons given item name (RDT). In phase 2, they were either taught to tact both the exemplar and its category (MTT) or to select the exemplar that belonged to the stated category (RDT). An IVT condition was also included, in which the children were taught to emit the appropriate response to a given category question. Results showed that both MTT and RDT had a very minor effect on the emergence of thematically related intraverbals, with direct intraverbal training being required to see any substantial increase in intraverbal responding. It is interesting to note that despite being run with typically developing children, there was less emergence seen in this study than in studies conducted with children with a diagnosis of ASD (Frampton et al., 2017; Shillingsburg, Frampton, Cleveland, & Cariveau, 2017; Smith et al., 2016). Some possibilities as to why this might be are the age of the children within the study, as well as the fact that the response required participants to state multiple exemplars of a category, which is a relatively more difficult task than to provide a single answer to a question.

Similar to MTT, multiple exemplar training (MET), is a form of instruction that involves the use of a variety of response topographies (e.g., a subset of targets) meant to not only ensure that the desired response form is acquired, but that also produces emergent responding when new targets are presented (Cooper, Heron, & Heward 2007). Thus, it results in one
response producing the stimulus for another response (e.g., a tact response may produce the stimulus for a listener response) with the original stimulus eventually coming to evoke both responses (Greer & Longano, 2010). It is commonly used to help teach intraverbals to typically developing children, as well as children with ASD to establish derived relations. MET involves directly teaching the correct intraverbal responses, usually one at a time, mixed with previously mastered targets to ensure that individuals are able to contact high levels of reinforcement. Several studies have found success using MET (Byrne, Rehfeldt, & Aguirre, 2014; Lechago, Carr, Kisamore, & Grow, 2015; Rosales, Rehfeldt, & Lovett, 2011).

Frampton, Robinson, Conine, and Delfs (2017) evaluated TT and LT on the emergence of skills (i.e., the acquisition of tact and listener responses), trials to criterion, and the maintenance of acquired skills over time for eight participants between the ages of 2 and 15 with a diagnosis of ASD. During training, participants were assigned six sets each (three for TT and three for LT) and were taught item names. The experimenters found that emergence of novel intraverbals was seen for all participants, and that for six of the eight, TT was found to be a more efficient instructional method. Additionally, the experimenters found that TT was more likely to lead to the emergence of listener skills for participants rather than conducting LT first.

Smith et al. (2016) also looked at the effects of LT on the emergence of intraverbal behavior with children with a diagnosis of ASD. The dependent variables consisted of correct responding during intraverbal probes, as well as correct responding during listener training. Participants were initially taught six target questions using discrimination training and discrete-trial teaching during LT, with two additional untaught intraverbals serving as control questions. During trials, participants were presented with an array of stimuli and then taught to select the
correct picture when presented with the question (e.g., the participant would select a bird when asked “What’s an animal that flies?”). Upon mastery (i.e., 90% correct responding in a block of 10 trials, as well as mastery of all six questions in the listener training phase), intraverbal probes were conducted (e.g., “What animal is nocturnal?” An “Owl”). If the participant answered more than one question incorrectly following two intraverbal probe session, LT combined with a verbal model was used. If the participant continued to answer more than one question incorrectly, LT plus TT was conducted.

Results showed that following LT, four out of five participants demonstrated emergence during intraverbal probes. The fifth participant required LT with TT to demonstrate emergence. It is important to note that the antecedent stimulus was identical for both the emergent intraverbal response and during listener training, with only the response differing (i.e., touching the correct picture during LT vs. a vocal response during the intraverbal probes). It is possible that both conditions sharing the same antecedent stimulus resulted in greater intraverbal emergence following listener training compared to previous studies.

Shillingsburg, Frampton, Cleveland, and Cariveau (2017) looked at the effects of teaching feature or function as listener vs. tacts and bi-directional intraverbals on the emergence of intraverbals in six participants with a diagnosis of ASD. During the study, one relation at a time was targeted (e.g., tact feature/function), for all targets within a set. Following mastery for each trained relation, within set probes were conducted for all relations (trained and untrained) to test for emergence of untrained relations. Results showed that emergence of untrained intraverbal relations was seen for all six participants, including some emergence in sets that had not yet received any training. Four of the six participants required
more than the initial listener feature/function training in order for emergence to be seen during probes. One participant demonstrated emergence in probes for one relation (AE) following training in the tact feature/function relation. The other three participants did not demonstrate any emergence during probes until following training in all relations for Set 1 and beginning training in Set 2. That is, each relation within Set 1 were individually taught (with each relation having three classes) for Set 1 without any emergence being seen during probes. It was not until after training began on the relations for Set 2 that emergence of intraverbals was seen for those three participants. It is important to note that similarly as with Smith et al. (2016), Shillingsburg et al. (2017) incorporated overlapping antecedent stimuli between various relations (i.e., CB and CD; BE and AE) with one relation pair sharing an identical vocal component (CB and CD) and the other being similar, with only the name of the target stimulus being omitted (BE and AE).

Some research has suggested that match-to-sample (MTS) training in the form of a sorting task may facilitate the emergence of intraverbal responding. Grannan and Rehfeldt (2012) taught two children diagnosed with autism to tact pictures according to category, and then to match to sample by having the participants sort pictures according to categories. In posttest probes following training, both participants demonstrated the emergence of untrained intraverbal responses (i.e., items within assigned categories). While the experimenters requested four items be listed for each category, participants listed more than four items for some categories and less in others. It is possible that the inclusion of the match to sample component was a contributing factor to the increase in intraverbal responding. This might be because sorting training sharpens the auditory stimulus control of the category label.
In an unpublished study conducted by Ingvarsson, Anderson, Petursdottir, and Macias (2018), the experimenters looked at the effects of LT and IVT on the emergence of novel intraverbals, with the main dependent variable being responding during intraverbal probes. TT, LT, and IVT were conducted. During TT, participants were asked “What’s that?” when presented with a picture of an item. TT was conducted until the participants reached mastery. LT consisted of the presentation of four stimuli. The participant was then presented with either the demand “Point to [item name]” or “Point to [item function],” depending on the current target. Booster listener training was conducted if the participant emitted multiple errors during listener probes. Additionally, multiple listener training was conducted, in which participants were taught to respond as listeners with item names and functions interspersed. During IVT, participants were taught intraverbal responses one by one, with those responses that had not reliably occurred during probes targeted for training. It is important to note that participants only received direct intraverbal training if emergence did not occur in probes following LT. Results found that one untrained intraverbal response emerged and maintained for each participant. Additionally, while additional emergence was seen for both participants, it did not maintain for either participant and intraverbal training was required for the remaining targets.

There are few limitations worthy of note found within the study. One is that LT was conducted immediately prior to intraverbal probes, while TT was only conducted at the beginning of the study. Interspersing LT and TT, or otherwise emphasizing TT to greater extent, might have led to greater emergence. Additionally, there may have been too many probes (both of intraverbal and listener behavior) conducted under extinction. It is possible that this led to general suppression of responding over the course of the experiment. Additionally, the
participants within the study had more severe language impairments and competing behaviors (i.e., vocal stereotypy) than participants in most previously published studies.

Given the mixed findings of previous research, researchers have yet to understand fully under what conditions emergent intraverbal responses may occur in children with autism. This is of concern, as children with autism are less likely to learn intraverbal behaviors without direct instruction. Yet, previous research does provide hints as to what an effective treatment package might entail. These previous studies have told us that intraverbal categorization (i.e., responding by listing multiple members of a category) may be a relatively difficult task, which may reduce the probability of emergence. Intraverbal responding may be more likely to emerge when more than one response is taught under the control of one antecedent stimulus. Another major finding is that tact training and sorting training may help promote the emergence of novel intraverbals.

Thus, the purpose of this current study was to evaluate an instructional package to help promote emergent intraverbals in children with autism. The instructional package included TT, LT, sorting training, and mixed training (LT and TT). We modified the procedures of the previous study (Ingvarsson et al., 2018) by (a) including participants that had fewer behavioral challenges, (b) emphasizing tact training, (c) conducting fewer probes under extinction, and (d) using the same syntactic frame. Further, we evaluated the effects of this treatment package with individuals who had previously acquired intraverbals using direct training but failed to show reliable emergence of novel intraverbals.
CHAPTER 2

METHODS

Participants

Two children with a diagnosis of ASD participated in this study. Both participants received their diagnosis of ASD from a trained, qualified professional who was independent of the study. Jack attended a full-time day program that provided behavior analytic services to children with ASD and other developmental disabilities between the ages of three and twelve. Henry attended a school for children with developmental disabilities and delays, located within the same center. Both participants were nominated for the study by behavior analysts who worked in the day program or school that they attended. Jack was a 6-year-old boy and Henry was an 8-year-old boy at the beginning of this study. Their behavior analysts reported that they had tact and listener repertoires for common objects and events, some intraverbal responses, and showed an ability to learn new intraverbal responses through direct instruction prior to the study. Additionally, language ability varied for both participants. Jack was able to hold simple conversations, however, he often repeated words/phrases and required some prompting during conversations. Henry had a more robust language repertoire and was able to engage in more detailed conversations, although he too occasionally repeated words and phrases.

Setting

Sessions took place in either a small treatment room in a behavior clinic located within the center or in a medium sized staff break room. The small treatment room contained a table, three chairs, and a box with toys that participants could earn access to. The room had
previously been used as an audiology room and contained one see-through window to the adjoining room. The adjoining room was rarely used, but participants were seated with their back facing the window to limit any possible distractions. The break room contained a refrigerator, a coffee pot, cabinets, and three microwave ovens along one wall. A medium sized trashcan was located next to the cabinets. The opposite wall contained a bulletin board in the middle of the wall. The other two walls were empty, except for a clock near the ceiling of one wall. There were two long tables running parallel to each other in the middle of the room, with 10 chairs at each table. The experimenter would sit at the head of table farthest from the door facing the microwaves, with the participant sitting at the end of the table directly to the left of the experimenter, facing an empty wall to limit distractions from any items within the room. Teaching materials consisted of data sheets, a timer, a pencil, a clipboard, and picture cards. Pictures on the stimulus cards varied for each participant.

Stimulus Sets

Four stimulus sets were created for each participant. Each set consisted of three targets. For example, one set might consist of four houses, four boats, and four ladders. The pictures would then be used to teach the participant to tact or respond as a listener to item name (i.e., house, boat, or ladder) and item function (i.e., you live in, you sail a, or you climb a) when in the presence of the pictures. The intraverbal responses required were represented by the pictures (e.g., “You live in a house”; “You sail a boat”; “You climb a ladder”). All picture cards were approximately 14.6 cm x 8.7 cm, in color, and laminated. Pictures were found using a variety of on-line sources. The sets for each participant contained the same grammatical frame. That is, if
a participant was assigned “You walk a...,” all other targets from within and across sets would be similar (e.g., “You mow...,” “You turn on a...,” “You live in a...”). The stimuli for each participant’s sets were chosen based on a list of those stimuli that were answered incorrectly during both intraverbal pretests (see below), with all targets within each set having roughly the same level of difficulty as estimated by the experimenter.

Response Measurement

Data were collected using pencils and data sheets that were specifically prepared for each session. Data sheets could be scored in one of three ways: (a) CI for correct independent, (b) P for prompted, or (c) I for incorrect.

During intraverbal trials, correct intraverbal responses were defined as those that vocally completed the experimenter’s statement and occurred within 5 s of the question being presented (e.g., when presented with the statement, “You walk a...” the participant responded with, “Dog”). Incorrect responses were defined as anything other than the defined correct response, or responses that did not occur within 5 s of the question being presented. Instances in which the participant failed to provide an answer were also scored as incorrect. During each trial, observers made narrative recordings of all incorrect answers. Answers were defined as prompted if the participant provided the correct answer following a vocal prompt from the experimenter.

During listener trials, correct answers were defined as those in which the participant touched the target item within 10 s without touching any other item card first. Incorrect answers were defined as those in which the participant touched/pointed to an item card other
than the one specified in the instruction, touched/pointed to an item after 10 s had passed, or if the participant failed to touch/point to any item card at all. For incorrect responses, the observers also scored which stimulus the participant touched. Scorers also made narrative recordings of any vocal responses that occurred. Answers were defined as prompted if the participant touched the correct stimulus following a gestural prompt. If the participant touched multiple cards simultaneously, that response was not scored, and the trial was re-presented. During listener trials, participants were given 10 s to respond to allow enough time to scan the array of stimuli.

During tact trials, correct answers were defined as those in which the participant provided the correct vocal response following the presentation of a picture and the corresponding question (e.g., a picture of grass is presented along with the question “What is it?” or “What do you do with it?”) without saying any other word first. Incorrect answers were defined as those in which the participant provided an incorrect response or failed to provide any response at all within 5 s of the presentation of the picture and the corresponding question. For incorrect responses, scorers also made a record of the response topography in the space provided. Answers were scored as prompted if the participant provided the correct response following a vocal prompt.

During sorting trials, correct responses were defined as those in which the participant placed a picture in the correct pile (e.g., a picture of a lamp was placed in the pile with other lamps, a picture of a dog was placed in the pile with other dogs, a picture of a house was placed in the pile with other houses) within 2 minutes of the participant beginning to sort the pile of 12 pictures. Each picture was scored individually, with the requirement that 11 out of 12
pictures be placed correctly for mastery to occur during that trial block. Incorrect answers were defined as those pictures that were placed in the incorrect pile (e.g., a picture of grass was placed in the pile with drawers) or if the participant otherwise failed to place a card in the correct pile. Answers were scored as prompted if the participant provided the correct answer following the vocal/gestural prompt.

Inter-Observer Agreement and Procedural Integrity

Sessions were video-recorded and scored at a later time by independent observers to obtain inter-observer agreement (IOA). We obtained IOA for 37% of sessions for Jack and 50.8% of sessions for Henry. Agreement was scored if all data during a trial were identical across the two observers. Because narratively recorded answers were secondary data, used only for error analysis, these data were not included in the IOA calculation. Disagreement was said to have occurred if all scoring was not identical for a given trial. IOA was calculated by dividing the number of agreements by the total number of trials in each session and multiplying by 100. IOA was 100% for Jack and 100% for Henry.

Using the same video-recorded sessions, the independent observers also collected procedural fidelity data during 37% of sessions for Jack and 50.8% of sessions for Henry to ensure that procedures were correctly followed. A procedural aspect was viewed as correct if the experimenter implemented it according to protocol (e.g., the correct trial was implemented, stimuli were placed in the correct position). It was scored as incorrect if the experimenter failed to complete it according to protocol (e.g., the experimenter incorrectly placed a target during a listener probe or implemented the wrong trial). Procedural integrity
(PI) was calculated by dividing the number of steps implemented correctly by the total number of steps in each session and then multiplying by 100. Overall PI was 99.65% for Jack and 99.56% for Henry.

We also obtained IOA for PI during 29.25% of sessions for Jack and 30.16% of sessions for Henry. Agreement was said to have occurred if both trained observers scored a procedural step the same way. Disagreement was said to have occurred if both observers did not score a procedural step in an identical manner. We calculated IOA for PI by dividing the total number of agreements by the total number of steps in each session and then multiplying by 100. IOA for PI was 100% for Jack and 99.91% for Henry.

Procedures

Intraverbal Pretest

The purpose of the intraverbal pretest was to evaluate which of the possible intraverbal targets were already in the participants’ repertoires prior to beginning the study. During the intraverbal pretest, all target stimuli were presented two times, over two consecutive days. Participants were given 10 s to respond. All correct answers were praised, and all incorrect answers were ignored. No prompts were used during the intraverbal pretests, and maintenance tasks requiring vocal-verbal responses were interspersed to ensure that sufficient reinforcement was delivered during the session. Any stimuli that participants answered incorrectly during both intraverbal pretest sessions were eligible for selection for the participants’ stimulus sets.
Tact Pretest

The purpose of the tact pretest was to evaluate whether the participants could tact the stimuli that had been identified in the intraverbal pretest and were to be included in their stimulus sets. The experimenter showed the participant a picture of each item (e.g., broom, shovel, paper) and asked, “What is it?” The participant was given up to 10 s to respond. All correct answers were praised, and all incorrect answers were ignored. As with the intraverbal pretest, no prompts were used and maintenance tasks requiring vocal-verbal responses were interspersed. Maintenance tasks were interspersed based on the needs of each participant. For example, a maintenance task was used if the participant provided two to three incorrect responses in a row. Additionally, maintenance tasks were also implemented to establish on-task behavior.

Listener Pretest

The purpose of the listener pretest was to evaluate whether the participants could respond as listeners to the stimuli that had been identified in the intraverbal pretest and were to be included in their stimulus sets. During the listener pretest, items were presented in an array of three. The position of the stimuli was systematically counterbalanced, ensuring that each stimulus appeared roughly the same number of times in each position. When placing the stimuli on the table in front of the participant, the experimenter always placed the stimuli in the same order, starting on the participant’s left and ending on their right.

Once the array was presented, the experimenter secured the participant’s attention – if the participant was not already looking at the experimenter – by providing the instruction,
“Look at me,” and then waited for the participant to orient towards the experimenter with their eyes open. The experimenter then presented the instruction, “Touch ____.” The participants were given up to 10 s to respond. As with the previous two pretests, all correct answers were praised and incorrect answers were ignored. No prompts were used during the listener pretest and maintenance tasks requiring vocal-verbal responses were interspersed based on the needs of each potential participant.

Sorting Pretest

The purpose of the sorting pretest was to evaluate whether the participants were able to sort the stimuli included in their stimulus set based on common characteristics (i.e., things with wheels, things you live in, things you smell). Prior to beginning the sorting pretest, the experimenter conducted a short task to ensure that the participant understood what “sorting” meant. Using previously mastered categories of stimuli (e.g., shapes, colors), the participant was presented with the stimuli and asked to, “Sort.” If the participant was able to sort, the experimenter began the sorting pretest. If the participant was unable to sort, the experimenter modeled how to sort using a different set of known stimuli. The participant was then given a different set of novel stimuli and again asked to sort the pictures. If they were then able to sort the known stimuli, they continued with the sorting pretest. Both participants needed the sorting model but were able to sort known stimuli following the demonstration.

During the sorting pretest, the stimuli that had been identified in the intraverbal pretests were placed into groups of three (e.g., door, lamp, dog). The participant was then given set of pictures that contained 12 pictures. These pictures included four topographically
different pictures of each of the three items in the set, for a total of 12 stimuli (e.g., four doors, four lamps, four dogs). The stimulus cards were randomly intermixed prior to each trial. The participant was then presented with the instruction, “Sort.” They had up to 10 s to initiate the task. Once the participant began to sort, they had up to two minutes to complete the task. If the participant stopped sorting and began to engage in off-task behavior (i.e., looking around the room, laying their head down, playing with the pictures, etc.) for more than 15 s, or they indicated that they were done (e.g., “All done,” “Finished”), the pictures were to be removed and the experimenter would then have moved on to the next trial, however, this never happened. No prompts were used during the sorting pretest, but on-task behavior was praised.

Intraverbal Probes

Responding in intraverbal probes was the primary dependent variable in the current study. Intraverbal probes began with the securing the participant’s attention, if needed, by presenting the instruction, “Look at me.” The experimenter then waited for the participant to orient towards her with their eyes open. Once the experimenter had the participant’s attention, the current trial was presented (e.g., “You walk a...”). The participant was given up to 10 s to respond. All correct answers were reinforced using descriptive praise and all incorrect answers were ignored. No prompts or error correction were implemented. Each item in the current stimulus set was presented three times during a probe session in quasi-random order, for a total of nine intraverbal trials. Criterion for mastery of intraverbal probes during training was answering at least the last two out of three probes correctly for each target in the set, with
100% correct during repeated probes or 100% correct during the initial post probe to move on to the next set. If the participant answered the last two out of three questions correctly for each target during the set in probe following a training step but did not get 100% correct for all targets in the repeated probe, or answered more than four questions incorrectly during the post probe, the participant moved on to the next training step for that set.

Token reinforcement for correct responses was used for Jack during the first 20 sessions. This was suggested by his therapy team to help increase his responding. Once a highly preferred reinforcer was found (i.e., opening a door and watching it close), his responding rapidly improved. Thus, the token board was faded out over the course of three sessions and was no longer used. Maintenance tasks were interspersed based on individual needs as in previous conditions. Maintenance tasks were also used if the participant began to engage in off-task behavior.

Multiple Listener Pretest

The purpose of this condition was to evaluate whether emergent intraverbals would occur during intraverbal probes following minimal training. Multiple listener training was considered minimal training, because it could potentially establish indirect relations between the elements of the intraverbal relation under control of the visual stimulus with a simple response (i.e., touching a picture card). If emergent intraverbals had reliably emerged following this minimal intervention, the participants would not need the remaining conditions. However, this did not occur. During this condition, a unique set of stimuli (i.e., a set not used in any subsequent condition) was used to conduct multiple listener training in which item name and
item function were both taught to mastery. This was followed by trial blocks in which both trial types (i.e., item name/function) were randomly interspersed and presented until criterion was met. The criterion was 90% correct responding over two consecutive sessions.

In each trial, the stimuli were presented in an array of three. The four different exemplars for each stimulus item were randomly varied across trials. The position of the stimuli in the array was counterbalanced in the same way as in the listener pretest and the stimuli were presented in the same way. When the experimenter had secured the participant’s attention, she presented the instruction, “Point to (item name/item function)” and allowed 10 s for a response to occur. All correct answers were praised. An error correction procedure was implemented following all incorrect responses. This involved the experimenter immediately re-presenting the trial and using a controlling prompt (gestural). Once the participant responded correctly following the prompt, the experimenter re-presented the trial without the controlling prompt. Once the participant showed 90% accuracy or higher for two consecutive sessions for both item name, item function, as well as trial blocks in which item name and item function were interspersed, the experimenter conducted an intraverbal probe with the same stimuli to test for the emergence of novel intraverbals. Participants who failed to show reliable emergence of intraverbal responding during the probe (i.e., did not answer any of the target questions correctly) continued in the study.

Tact Training (Training Step 1)

In this step, participants were first taught the name of each item in the set (i.e., “What is it?”), followed by item function (“What do you do with it?”). During a trial, the experimenter
would present the designated picture. The participant would then be presented with the question “What is it?” or “What do you do with it?” and be given 5 s to respond. All correct responses were reinforced using descriptive praise. The mastery criterion was 90% or higher over two consecutive sessions. As before, all four exemplars of each item were targeted. All items had to occur before any of them were repeated. Each stimulus within the set was targeted three times per block, for a total of nine trials per block in a quasi-random order. For each type of training, the first 2 trials for each stimulus were immediately prompted during the first trial block. The error correction procedure was identical to that used during multiple listener pretraining, with the exception that an echoic prompt was used. Participants were given 5 s to respond following the presentation of the question. Following mastery of item name and item function, the experimenter implemented MTT in which tact trial types were randomly interspersed (i.e., item name and function). Each trial type was presented six times, with three trials for each item targeted, for a total of 18 trials. To ensure that sessions during tact training continued at nine per trial block, a session of 18 was created, with the first nine creating one trial block and the final nine creating a second trial block.

Listener Training (Training Step 2)

Listener training was conducted the exact same way as MLT, with two exceptions. The first exception was that the current stimulus set (i.e., the same stimulus set targeted in tact training), rather than a unique stimulus set, was used. The second exception was that, as with tact training, the first two trials for each stimulus were immediately prompted during the first trial block. Additionally, unlike during tact training, each stimulus within the set was targeted
four times per block, for a total of 12 trials per block. All correct responses were reinforced using descriptive praise.

Sorting Training (Training Step 3)

Sorting training (ST) was identical to the sorting pretest, with three exceptions. First, there was no short task conducted to evaluate comprehension of the concept “sort,” because this had already been accomplished. The second exception was that only the current stimulus set was presented. The final exception was the presentation of the instruction. During sorting training the participant was presented with the instruction “Sort the pictures by what you do with them,” rather than just the instruction, “Sort.”

Differential reinforcement was used for all correct answers. During the sorting task, this included praise for on-task behaviors (e.g., “Good job sorting the pictures”). Once the participant had completed the task, the experimenter delivered descriptive praise for correct sorting (e.g., “Good job, these are the ones you mow”; “That’s right, these are the ones you live in”). An error correction procedure was used for all pictures that were sorted incorrectly. The experimenter waited until the participant had completed the sorting task before the error correction procedure was implemented. Error correction involved removing all incorrectly sorted pictures and handing the participant one picture that was sorted incorrectly. The experimenter would then point to the correct pile and say, “This goes here.” If the gestural prompt did not result in correct responding, the experimenter modelled the correct response (i.e., placing the card in the correct pile). Once the participant placed the picture in the correct pile, the experimenter repeated the error correction procedure with the next incorrect stimulus.
card (if any). This continued until all incorrect pictures had been correctly sorted. Mastery criterion was 90% or higher correct responding over two consecutive opportunities.

Mixed Training (Step 4)

Mixed training (MT) consisted of interspersed trials of previously implemented LT and TT (i.e., tact name, tact function, touch item name, touch item function) for the current training set. For TT, the participant was given 5 s to respond. For LT, the participant was given 10 s to respond. Trial blocks included three trials for each trial type, for a total of 12 trials per block, and the exemplars used for each item were randomly varied across blocks. Trial types for each target in the given set were interspersed in quasi-random order, with two exceptions: There were no more than two trials in a row for given target item, and no more than two trials in a row for a given trial type (e.g., three sorting trials in a row for various targets would not be allowed). As with the other training steps, mastery criterion was 90% or higher correct responding over two consecutive sessions.

Multiple-Exemplar Intraverbal Training (Jack Only)

Multiple-exemplar intraverbal (MET) training was implemented novel intraverbal responses did not reliably emerge in intraverbal post-probes following the previous training steps. This meant that if any of the targets did not reach mastery (i.e., all targets mastered during probes) during the previous training steps, MET was to be conducted. During MET, intraverbal responses for the entire set were directly taught, with previously mastered intraverbal targets presented in random order. The targets within the set were presented in
quasi-random order, with one to two previously mastered intraverbal targets randomly presented following every second or third presentation (e.g., “You dry your...”; “You mow the...”; “Where do you go to school?”; “What color is the grass?”; “You dry your...”). Differential reinforcement was used for correct responses, and an error correction procedure like that used during TT was used with incorrect responses, or if the participant failed to provide a response. A trial began with the experimenter presenting the question (e.g., “You live in a....” The participant had 5 seconds to respond. If the participant gave an incorrect answer or failed to give an answer, the error correction procedure was implemented until the participant gave the correct answer to the question without prompting. The experimenter then moved on to the next question. Mastery criterion was 90% or higher correct responding over two consecutive sessions.

Experimental Design

We evaluated the effects of an instructional package on the emergence of novel intraverbals (the percentage of correct independent intraverbal responses during intraverbal probes) using a within subject multiple probe design across stimulus sets. An initial baseline probe was conducted for all sets, prior to introducing the intervention package for each set, with additional probes being conducted following every step within the instructional package once the mastery criterion was met for that step. During training this required participants to have 90% correct or higher responding over two consecutive sessions (for each part of the step) before probing for emergence. During intraverbal probes, mastery required participants to meet the previously described mastery criterion.
Each participant began with the intraverbal pretest. They then underwent the tact pretest, the listener pretest, and the sorting pretest in that order. These were followed by multiple listener pre-test with a unique stimulus set, followed by an intraverbal probe. The purpose of this condition was to evaluate whether emergence of novel intraverbal responses was likely to occur following minimal training. The participants would not have continued in the study had intraverbals emerged reliably in this condition.

Next, TT conducted. Upon mastery for the current set, an intraverbal probe was conducted. If any emergence was seen (i.e., higher than baseline), the remaining sets were probed (e.g., if emergence was seen in Set 1 showed emergence, sets 2-4 were probed. If emergence was seen in Set 3, Set 4 was probed). If criterion-level emergence occurred during an intraverbal probe, each of the following sets would be probed. If the participant did not reach 100% for all targets during the repeated probe, they would move on to the next training step for the current target set. This sequence continued through LT, ST, MT, and MET, or until the participant demonstrated criterion emergence for the current stimulus set. Once a set was mastered, the experimenter waited two days (to evaluate retention) and then probed all four sets. Training was then implemented with the next stimulus set that did not reach the emergence criterion. This sequence continued until all four had been either mastered through MET or emerged in intraverbal probes following one of the training conditions.
CHAPTER 3

RESULTS

Results during the tact and listener pretest were similar for both Jack and Henry. Overall percentage correct during the tact pretest was low for both at 24.27% for Jack and 44.44% for Henry. Overall percentage correct was higher for both during the listener pretest with 69.90% correct responding from Jack and 93.83% correct responding from Henry. During the multiple listener pretest, both participants reached mastery of the listener relations within 8 to 9 trials blocks. However, neither participant showed emergence of intraverbal responses, with both scoring 0% during the intraverbal probe. Thus, neither participant showed evidence of emergence of intraverbal responses following minimal listener training of item name and function.

Figure 1 depicts Jack’s percentage of correct responding during training and probes. During baseline probes, Jack’s responding was at 0% for all four sets. Jack required all four training conditions, as well as MET, to reach 100% during the post-intervention intraverbal probe for Set 1. Some emergence of novel intraverbal responses was seen for Set 3 (33.33%) and Set 4 (66.67%) after training for Set 1, but Set 2 remained at 0%. During training for Set 2, limited emergence of untrained intraverbal responses was seen in probes (for one target) following MT with an overall percentage correct of 33.33%. However, like with Set 1, all four training conditions and MET were required before emergence met criterion for all targets within the set. When the probes were repeated, responding for sets 1 and 2 maintained. Percentage correct maintained at 33.33% for Set 3 and 66.67% for Set 4. Only sets 1 and 2 required all training stages and MET for all targets to emerge.
During the intraverbal probe following TT for Set 3, correct responding increased to 77.78%. This was due to the participant getting the first response to two of the targets incorrect the first time they were presented. The following two presentations were correct. When the probe was repeated, Jack scored 100% on the probe for Set 3; however, criterion was not reached for Set 4. Therefore, training was conducted with Set 4. Percentage correct maintained at 100% for sets 1-3. As with Set 3, percentage correct rose to 100% for Set 4 during the intraverbal probe following TT. During the final probes following training for all four sets, percentage correct maintained at 100% for sets 2-4, but fell to 66.67% for Set 1. Only one target (“You turn on the...”) was incorrect, with the participant responding by saying “water” during each presentation.

Figure 2 depicts Henry’s percentage correct responding during training and probes. As with Jack, Henry’s percentage correct during baseline probes was 0% across all four sets. Unlike Jack, Henry only required TT before 100% intraverbal emergence was seen for Set 1. During probes for the remaining three sets, percentage correct rose to 11.11% for Set 2 and to 77.78% for Set 3. No emergence was seen for Set 4. When the probes were repeated, the percentage correct rose to 33% correct for Set 2, fell to 66.67% for Set 3, and remained at 0% for Set 4.

Following TT for Set 2, percentage correct in the intraverbal probe increased to 66.67%; however, the criterion for emergence was not met. We therefore implemented LT next. The percentage correct increased to 100% for all targets in the set during the probe following LT; however, percentage correct for Set 3 remained at 66.67% and Set 4 remained at 0%. When the probes were repeated, responding maintained for sets 1 and 2, and percentage correct
remained the same for sets 3 and 4. As with Set 1, Henry only required TT for sets 3 and 4 for criterion-level intraverbal emergence to occur.

The number of training sessions required to reach criterion for each set for Jack and Henry is presented in Tables 1 and 2. The number of training sessions required to reach criterion for Jack ranged from 8 to 33 (not including probes), with more training required initially. The number of sessions to mastery ranged from 7 to 15 (not including probes) for Henry. A total of 75 sessions was required for emergence to be seen for all targets in all four sets for Jack, and a total of 38 sessions was required for emergence to be seen for all targets in all four sets for Henry.

Table 1

<table>
<thead>
<tr>
<th>Target</th>
<th>Set Designation</th>
<th>Sessions to Mastery</th>
<th>Trials to Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>You turn on the...</td>
<td>1</td>
<td>33</td>
<td>337</td>
</tr>
<tr>
<td>You dry your...</td>
<td>1</td>
<td>33</td>
<td>337</td>
</tr>
<tr>
<td>You mow the...</td>
<td>2</td>
<td>26</td>
<td>249</td>
</tr>
<tr>
<td>You blink your...</td>
<td>2</td>
<td>26</td>
<td>249</td>
</tr>
<tr>
<td>You walk the...</td>
<td>2</td>
<td>26</td>
<td>249</td>
</tr>
<tr>
<td>You smell the...</td>
<td>2</td>
<td>26</td>
<td>249</td>
</tr>
<tr>
<td>You live in a...</td>
<td>3</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You sail a...</td>
<td>3</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You wrap...</td>
<td>4</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You cut...</td>
<td>4</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You zip your...</td>
<td>4</td>
<td>8</td>
<td>72</td>
</tr>
</tbody>
</table>
Table 2

*Targets, Set Designation, Sessions to Mastery, and Trials to Criterion for Henry*

<table>
<thead>
<tr>
<th>Target</th>
<th>Set Designation</th>
<th>Sessions to Mastery</th>
<th>Trials to Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>You sheer a...</td>
<td>1</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You stir a...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You tow a...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You harvest...</td>
<td>2</td>
<td>15</td>
<td>156</td>
</tr>
<tr>
<td>You fly a...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You zip a...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You sail a...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You frost a...</td>
<td>3</td>
<td>7</td>
<td>63</td>
</tr>
<tr>
<td>You cut...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You sew...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You toast...</td>
<td>4</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>You hit...</td>
<td></td>
<td></td>
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</tbody>
</table>
**Figure 1.** Percentage correct responding for Jack during training and probes.
Figure 2. Percentage correct responding for Henry during training and probes.
CHAPTER 4

DISCUSSION

An instructional package to help promote emergent novel intraverbals in children with a diagnosis of autism was evaluated. The instructional package included four training steps (i.e., TT, LT, ST, and MT) that had been evaluated in previous research, with an additional component (i.e., multiple-exemplar intraverbal training) for those sets in which all targets failed to emerge following implementation of the four training steps. During this study we found that for one participant, all four training steps in addition to MET were needed to see emergence in all targets during probes for the first two sets, with the last two sets only requiring TT before all targets had emerged during probes. For the second participant, only TT was required for three sets, with LT required for one target in Set 2 before all targets in all sets emerged during probes.

Previous research looking at whether TT and LT alone may reliably produce intraverbal responding has been mixed. In this study, results were also somewhat mixed, with Jack requiring all four training steps and MET for emergence to occur during the first two sets, but only requiring TT during the remaining two sets. However, Henry only required TT for three sets, and listener training for one set, before emergence was seen during probes. Additionally, we found that emergence was more likely to occur in this study, compared to that seen during the Ingvarsson et al. (2018) study in which the main focus was on listener training (although some tact training was conducted) and little emergence was seen during probes with only one untrained intraverbal response maintaining for each participant.
During the current study, TT led to the emergence of novel intraverbals for all but one target across all four sets for Henry. While TT was all that was required for sets 3 and 4 for Jack, it cannot be said with certainty that TT alone led to the emergence of novel intraverbals for sets 3 and 4, as some targets had emerged during probes following all training steps within the instructional package. It is important to note that all targets for all sets maintained for Henry and all but one target for one set maintained for Jack. This has applied implications, in that during TT, participants required very few sessions to mastery (i.e., approximately seven to eight sessions for Henry and eight sessions each for Jack) before emergence was seen during probes and that all but one target maintained between the two participants. This also further expands on previous research in which TT has proven to be effective in promoting the emergence of novel intraverbal responses.

Emergence being more likely to occur during this study (compared to Ingvarsson et al., 2018) may have been due to at least four aspects, which we cannot distinguish between based on these data: (a) fewer probes were conducted under extinction, (b) participants in this study had slightly more developed verbal repertoires and fewer behavioral challenges, (c) there was more emphasis placed on tact training in addition to listener training, or (d) the use of the same syntactic frame. It may be the case that all four were important in the emergence of novel intraverbals.

Previous research on whether the order in which TT and LT is conducted may affect the emergence of intraverbals is mixed. In Frampton et al. (2017) TT followed by LT was effective in promoting the emergence of novel intraverbals for all participants during probes, with TT found to be a more efficient instructional method for six out of eight participants. Likewise, during this
study, TT was found to be a more efficient instructional method for both participants. Additionally, LT during sets 1 and 2 for Jack did not lead to any emergence for either set, further expanding on the results seen in Frampton et al.

Previous research has also suggested that tact and listener training alone may not reliably produce intraverbal responding, thus a sorting component like that seen in Grannan and Rehfeldt (2012) was included in this study. In their study, using MTT, combined with MTS instruction, some success was found, with relatively high numbers of intraverbal responding seen with both participants. It is possible that the inclusion of MTS instruction was a contributing factor to the high levels of responding by the participants. However, in their study, it was impossible for the experimenters to determine if both TT and MTS training were both needed in order to see emergence occur as no probes were conducted following TT and prior to MTS training.

During our study, ST was conducted twice for one participant (Jack) for sets 1 and 2. For both sets 1 and 2, there was no new emergence noted following criterion of sorting training. However, there was some emergence seen in the probe following the next training step (MT). Because showed no emergence prior to or after sorting training, we know that it was not sufficient in these two cases.

During training for Jack, no emergence of novel intraverbals was seen for Set 1 prior to being directly taught the correct responses using MET. For Set 2, only one target within the set emerged following MT; however, Jack again required being directly taught the last two targets within the set using MET. Following mastery of Set 2, Jack only required TT for both sets 3 and 4 prior to mastering all targets within each set. It is worth noting that in the probes conducted
prior to beginning training with Set 2, emergence was seen for one target in Set 3 and in two targets in Set 4. There was no additional emergence seen for sets 3 or 4 in probes following emergence for the one target in Set 2 following MT. In fact, there was no additional emergence seen for either set until TT was conducted for each set respectively. Thus, following direct training (i.e., MET) with two sets, TT alone was sufficient for emergence to be seen during probes. These results support the relevance of MET as a treatment component in the emergence of novel intraverbals.

It is also important to note that in probes conducted throughout the study, mastered targets remained at 100% throughout for Jack, apart from the final probe for Set 1. During that probe, two targets within that set remained at 100% correct responding, with one target falling to 0% (for a total of 66.67% for the set). This was for the target, “You turn on the….” The correct response was “light.” However, during the final probe, Jack consistently responded with “water.” In speaking with those who worked with the participant in the day program, it was revealed that a new target of tooth-brushing had been introduced. While turning on the water was not a step that was being taught, it was revealed that some of those individuals who worked with the participant would narrate, “Turn on the water” while working on the target. It is possible that this led to the participant to begin giving the answer of “water,” rather than “light” in response to “You turn on the…” during the probe session.

For Henry, TT was all that was required for him to meet mastery criterion for three out of four sets. For Set 2, one target had emerged (i.e., “You zip a…”) prior to starting training on the set. An additional target had emerged (i.e., “You harvest…”) following TT for the set. Listener training was required before the final target (i.e., You fly a…”) emerged. During the first
two probes for Set 2, Henry consistently responded with “wings” when provided with the target question. During the third probe for the set starting with the second presentation, Henry switched his answer over to “airplane.” His response remained “airplane” until LT was conducted, at which point he began to respond with the correct answer “kite.” For Henry, all mastered targets remained at 100% throughout the final probe.

There are some limitations to this study that should be considered. One is the number of participants. Only two participants out of six were eligible to continue in the study following pretesting. Thus, we were unable to replicate our findings within multiple participants. During all pretests (i.e., TP, LP, and SP) stimuli that were possibly to be included within participant’s sets were used to complete each pretest. This may or may not have affected the participants learning history.

Additionally, as all correct answers were reinforced throughout the entire study, it is possible that the exposure, and subsequent reinforcement, to the stimuli prior to training may have in some way affected participants responding later during the training sessions. The main limitation with this is that only the first instance of each response can truly be said to be emergence, with all subsequent instances seen in additionally probes simply maintenance of previously reinforced responses. It is important to note that all correct answers were reinforced because during the Ingvarsson et al. (2018) study, probing under extinction seemed to result in less responding over the course of the experiment, and emergence became less probable as time went on. Interestingly, during the current study the opposite was found to be true.

The reinforcement of all correct answers can be considered a strength of the current study, rather than a limitation. As suggested by McKay (1991), if trials are conducted under
extinction, novel responses may disappear, only to reappear during training. This might lead one to mistakenly conclude that emergence is unlikely, while it may be the case that lack of reinforcement was suppressing responding. Thus, during this study we viewed the most important instance of a novel intraverbal response as the first time it occurred during probes. Thus, all novel intraverbals that occurred for the first instance during probes following the implementation of the instructional package during this study can be viewed as emergent.

In the future it would be good to replicate this study with more participants to further evaluate the generality of the findings. Future research could also examine whether testing participants for deficits in their tact and listener repertoires prior to beginning a training package might be beneficial in determining whether or not tact or listener training would be more likely to lead to the emergence of novel intraverbals for each participant. Through a more thorough evaluation of their repertoires, we might be better able to predict which participants will show emergence following TT and which one will need MET.
REFERENCES


