A Molecular Analysis of Training Multiple versus Single Manipulations to Establish a Generalized Manipulative Imitation Repertoire

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A MOLECULAR ANALYSIS OF TRAINING MULTIPLE VERSUS SINGLE MANIPULATIONS TO ESTABLISH A GENERALIZED MANIPULATIVE IMITATION REPERTOIRE

by

Breanne K. Hartley

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Advisor: Dr. Richard W. Malott

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A MOLECULAR ANALYSIS OF TRAINING MULTIPLE VERSUS SINGLE MANIPULATIONS TO ESTABLISH A GENERALIZED MANIPULATIVE IMITATION REPERTOIRE

Breanne K. Hartley, Ph.D.
Western Michigan University, 2009

This study evaluates the necessity of training multiple versus single manipulative-imitations per object in order to establish generalized manipulative-imitation. Training took place in Croyden Avenue School’s Early Childhood Developmental Delay preschool classroom in Kalamazoo, MI. Two groups of 3 children each were trained to imitate in order to determine the most appropriate number of manipulations required (per object) to establish a generalized manipulative-imitation repertoire. Three children received single-manipulations training, and 3 children received multiple-manipulations training. It was anticipated that the multiple-manipulations training group would acquire a greater amount of generalized manipulative-imitation because the training required that the children discriminate between at least 2 different manipulations for each trained object, therefore, ensuring that the children’s responding would be under imitative stimulus control rather than just object stimulus control.

The manipulative-imitation training resulted in the successful training of 6 imitative manipulations for each child, in both groups. Additionally, all children demonstrated at least some generalized manipulative-imitation. The children who received multiple manipulative-imitation training demonstrated more generalized
manipulative-imitation than those in the single-manipulations training group.

Furthermore, manipulative-imitation training resulted in some generalized physical-imitation with all children and even some generalized vocal-imitation with the three multiple-manipulations children.
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I would like to express gratitude for Carmen Jonaitis and Margaret Nichols who have graciously allowed me to conduct research in their classroom. Carmen and Margret have been enormously supportive of my dissertation and the dissemination of my research findings. In addition, the six children who participated in my dissertation, Conor, LaShanti, Brianna, William, Ashton, and Robert, warrant thanks for their hard-work and cooperation in this study. These children taught me an immense amount about effective teaching strategies.
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Breanne K. Hartley
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CHAPTER I

INTRODUCTION

Autism is characterized by deficits in the areas of socialization and communication, and by the presence of restricted behavior (Rogers & Pennington, 1991). However, children with a diagnosis of autism typically also have deficits in imitation. Imitation is an important skill taught to children with autism and occurs when “the form of the behavior of the imitator is controlled by similar behavior of the model” (Malott, 2008, p. 241). Rogers and Pennington (1991) argue that deficits in imitation have not been appropriately addressed in current theories of autism. They suggest that limits in these children’s imitative repertoires are so substantial that they may be a primary component of the social deficits that these children exhibit. It is assumed that once imitative behavior has been reinforced, children then may show a generalized imitative repertoire, that is “imitation of the response of a model without previous reinforcement of imitation of that specific response” (Malott, 2008, p. 242). In other words, when a child is shown a novel imitative response, the child will imitate that response without previous training. However, those unreinforced, generalized imitative responses will only occur if other, previously learned imitative responses have been reinforced (Gewirtz & Stingle, 1968). One theory, (Malott, 2008) of generalized imitation credits “imitative reinforcers” for automatically reinforcing generalized imitative responses and thereby maintaining those imitative responses, even though they may never receive any other sort of
reinforcement. Imitative reinforcers are "stimuli arising from the match between the behavior of the imitator and the behavior of the model that function as reinforcers" (p. 250). This match becomes a learned reinforcer because it has frequently been paired with the delivery of the extrinsic reinforcer that was contingent on correct imitative responses. The imitator sees, hears and/or feels his or her behavior match the model's behavior, and that imitation automatically produces visual and proprioceptive reinforcing stimuli.

The Importance of a Generalized Imitation Repertoire

Generalized imitation is an essential skill for children with autism to acquire. First, the ability to imitate is a pre-requisite to the development of language (Baer, Peterson, & Sherman, 1967; Harris & Weiss, 1998; Sigman & Ungerer, 1984; Stone, Ousley, & Littleford, 1997). Second, imitation often reduces the time needed to acquire new behaviors because imitation is often used in the training of those other skills. For example, modeled prompts are frequently used to teach new skills; however, modeling is not effective unless a child has a generalized imitation repertoire. Model prompts, which consist of demonstrating the target response, are critical because they allow the child to acquire skills without the intrusiveness of physical prompting (Baer et al., 1967; Burgess, Burgess, & Esveldt, 1970; McDuff, Krantz, & McClannahan, 2001). Third, an imitative repertoire allows for the establishment of social learning through peer interactions, interactions with teachers, and interactions that coincide with following along in a group.
(Harris & Weiss, 1998; Leaf & McEachin, 1999; Rogers, Hepburn, Stackhouse, & Wehner, 2003). Fourth, imitation allows for the establishment of pre-learner behaviors such as compliance, attending, and awareness of one’s environment (Leaf & McEachin, 1999).

Types of Imitation

There are three primary forms of imitation. These include vocal-imitation, which is the imitation of sounds and words, physical-imitation (also referred to as pantomime imitation or motor imitation) which is the imitation of body movements, and manipulative-imitation (also referred to as toy-play imitation) which is imitation of object manipulation. This paper will focus primarily on identifying key variables in developing a generalized manipulative-imitation repertoire in children with developmental delays, specifically autism.

Manipulative-imitation is a crucial imitative skill for all children. For example, the skill of imitating the behavior of a model will facilitate the learning of playing with toys appropriately by imitating play behavior of peers. In addition to appropriate toy-play behavior, children and adults acquire new manipulative skills through imitation, such as how to hold a hammer, and acting appropriately in new situations. It is especially important for children to establish a generalized manipulative-imitation repertoire because they must learn that objects can be used in several ways. Manipulative-imitation was chosen as the focus for this study because it is typically the first type of imitation selected to teach in the setting where the study was conducted (an Early Childhood Developmentally Delayed classroom). Additionally, there has been extensive research done with attempts to determine which imitation topography, when taught first, will
produce the greatest amount of generalized imitation. Currently, the results are inconclusive with some studies suggesting that manipulative-imitation should be taught first (DeMyer et al., 1972; Hill, 1998; Hobson & Lee, 1999; Ingersoll, Schreibman, & Tran, 2003; Snow, 1989; Stone, et al., 1999), and with other studies suggesting that physical-imitation should be taught first (Dawson & Osterling, 1996; Lovaas, et al., 1981; Young, Krantz, McClannahan, & Poulson, 1994). Several studies have found that manipulative-imitation was less impaired, in children diagnosed with autism, than was physical-imitation. A rationale for this was presented by Ingersoll and Gergans (2007) who stated that manipulative-imitation may have been easier to teach than physical-imitation because “of the limited range of movements that objects allow and because imitation of objects is more likely to result in direct response-reinforcer relationships because the modeled action involves the manipulation of the object and thus may be reinforcing in and of itself” (p. 173). Another possibility is that better results for manipulative-imitation responding may be due to behavior that is under object stimulus control rather than under imitative stimulus control. For example, in the Hill (1998) study, children were shown models of the following behaviors: brushing their teeth with a toothbrush, combing their hair with a comb, eating ice cream with a spoon, hitting a nail with a hammer, cutting paper with scissors, and writing with a pencil. There was only one response modeled for each object, and each response that was modeled was most likely a familiar response that corresponded with the object. Therefore, the participants could have been making accurate responses based on their histories with those items. Similarly, in the Ingersoll, et al. (2003) article, children were only given a model of one response
per object, and if the children did not respond correctly then they were prompted by the question, “What can you do with this?” This prompt would not elicit an imitative response; rather it would elicit an object-function response. Therefore, the research that supports training manipulative-imitation first may be confounded. On the other hand, Young, et al. (1994) found that manipulative-imitation was more slowly acquired than physical-imitation. The explanation they provided was that the children’s preservative behavior with the testing objects interfered with accurate manipulative responding.

Teaching Imitation

Research in the field of behavior analysis has contributed to the following findings regarding teaching an imitation repertoire: (a) Just as in all other behavior analytic training, the training of an imitation repertoire begins with the assessment of an individual’s baseline level of responding; (b) The techniques of shaping and fading are essential in training new imitative responses (Baer, et al., 1967; Garcia, Baer, & Firestone, 1971; Lovaas, Berberich, Perloff, & Schaeffer, 1966; Risley & Wolf, 1967); (c) Establishing a verbal discriminative stimulus, such as “Do this,” may be helpful to establish attending and stimulus control (Baer, et al., 1967); (d) If some imitative responses are directly reinforced, then other imitative responses will occur even though those responses are never directly reinforced (Baer, et al., 1967; Brigham & Sherman, 1968; Burgess, et al., 1970; Lovaas, et al., 1966; Lovaas, Frietas, Nelson, & Wahlen, 1967; Metz, 1965; Peterson, 1968; Steinman, 1970); (e) The development of generalized imitation between topographies may be difficult (Garcia, et al., 1971; Young, et al., 1994); (f) The first imitation topography to teach is still unknown (DeMyer et al., 1972; Hill,
Although the previously stated research has contributed to imitation training strategies, there is a limited amount of literature discussing methods for training generalized imitation, specifically *generalized manipulative-imitation*. However, Young, et al. (1994) conducted an experimental analysis of imitation in order to determine the influence response topography had on generalized imitation across manipulative-imitation, physical-imitation and vocal-imitation. They aimed to show that training specific imitative response types would facilitate generalization *between* imitation types. For example, they attempted to demonstrate that when they simultaneously taught manipulative-imitation, physical-imitation, and vocal-imitation, not only could they establish generalization within each response type, but that they could also establish generalization across the response types as well. They wanted to show this by simultaneously teaching nine models of each imitation type by randomly presenting models, and by reinforcing only correct matches of the model. Incidentally, prompting was never provided for trials in which the children did not make a correct match to the model. This non-prompting strategy was based on the Parrish, et al. (1986) finding that when compliance to requests was reinforced, there was an increase in compliant responding, as well as a decrease in non-compliant responding without the use of prompting.

Each training session included probe trials (trials for which reinforcers were not delivered for matching the model). These probe trials were randomly interspersed
throughout the training trials, and included all three types of imitation. Young et al. (1994) found that the children more reliably imitated probe trials if the probe trial consisted of the same type of imitation as the previous training trial. For example, if a child correctly imitated a manipulative-imitation model and received a reinforcer for doing so, then that child would be more likely to imitate a non-reinforced manipulative-imitation model than they would a physical-imitation model. It was this finding that led Young et al. (1994) to conclude that generalized imitation may be limited to only within imitation type.

This research was inspired by the conclusion of Garcia et al., (1971), that generalized imitation may not constitute one large response class, but rather that it might consist of smaller sub-classes, each with its own topography. In the Young et al. (1994) study, it was described that all three types of imitation were trained using multiple exemplars. An example of a manipulative-imitation model they used was “hugging a stuffed animal to the chest with both arms, and twisting from side-to-side”, a physical-imitation model they used was “blowing a kiss by bringing the palm to the lips, bringing the fingers downward, and blowing over an open palm”, and a vocal-imitation they used model was to imitate the phrase “my cookie”. However, the manipulative-imitation model and the physical-imitation model were both actions within a sequence of a response rather than multiple manipulations. Consider the manipulative-imitation example; typically the “hugging” response would be considered one fluid manipulation rather than an example of separate, multiple manipulations. Therefore, it could be said that this study argued against the notion that multiple-manipulations per object should be
trained in order to facilitate a generalized manipulative-imitation repertoire. Perhaps the use of actions within a sequence of responses rather than the use of distinct multiple manipulations, and the lack of prompting to assist in making the correct match to the model led to the failure to acquire generalized from one imitative type to another.

In conclusion, there are a number of components supported by the principles of behavior, used to teach children with autism to imitate. However, there is little rationale and/or research to support most of these strategies. The most frequently used components in teaching children diagnosed with autism to imitate include the establishment of pre-requisite skills, the use of a specific discriminative stimulus, the use of prompting and prompt fading, and teaching discrimination. In the present study, the teaching strategy that was investigated consisted of teaching children to discriminate between imitative models. More specifically, the question was posed regarding how to most reliably get generalized manipulative-imitation using multiple-manipulations so that the children’s behaviors were under imitative stimulus control of the model’s behavior, rather than stimulus control of the object alone.

Green’s (2001) description of discrimination is relevant to teaching children with autism to imitate manipulations of objects because, for example, when the tutor says “Do this”, along with a model of pushing the car back and forth (the discriminative stimulus), the child must match the tutor’s behavior by also pushing the car back and forth (the response) which will result in receiving a reinforcer (the consequence). If the child were to tap the car on the desk immediately after the tutor modeled pushing the car back and forth, then the child would not receive the reinforcer. In order to ensure that the child’s
imitative response is controlled by the tutor’s model of the response, and not simply by
the presence of the toy, the child should be taught at least two different manipulations
with the same toy. Teaching two different manipulative responses during the same
imitation training session, and randomly rotating the two responses, requires that the
child attend to the modeled manipulations before consistently receiving reinforcers. For
example, teaching only one manipulation when the car is presented (e.g., push the car
back and forth) may be detrimental because each pushing response will be reinforced,
regardless of the manipulative behavior of the model. Therefore, the child would never
need to attend to the model’s behavior in order to make a reinforced response. In other
words, teaching at least two different manipulations with the same object (e.g., the car)
would require the child’s responding to come under the stimulus control of the tutor’s
behavior of manipulating the car.

The Purpose of this Study

An earlier study (Hartley & Malott, submitted for publication) examined the
effects of training one versus two manipulations per stimulus object on the acquisition of
a generalized manipulative-imitation repertoire, using a within-subject multi-element
design. With some objects, two imitative manipulations were trained whereas with others
objects, single-manipulations were trained. For the two children who participated in the
study, there were no clear differences in generalization between the objects that received
single-manipulations training and those that received multiple-manipulations training.
Possibly both children acquired generalized manipulative-imitation on the basis of the
multiple-manipulations training with some objects. It may have been *that* training which
produced generalized manipulative-imitation to the novel responses that had received only single manipulative-imitation training. Once generalization occurred, manipulative-imitation generalized to all objects and manipulations therefore making it difficult to discern whether or not training more than one manipulation facilitated the acquisition of those manipulative-imitations.

Therefore that within-subject design may not have been appropriate for comparing two different ways of training imitation because the acquisition of generalized imitation may have made it impossible to discern the differential effectiveness of one training method versus another. Therefore, the study by (Hartley & Malott, submitted for publication) will be replicated using a group design.
CHAPTER II

METHOD

Participants

Six children were selected for this study (4 boys, 2 girls). The children were between the ages of 2 years and 5 years 1 month. They attended Croyden Avenue School, a school for children with developmental delays in Kalamazoo, Michigan. To participate in this study the children must have entered the classroom with a diagnosis of autism-spectrum disorder; and they must have demonstrated an attending repertoire, lacked a strong imitation repertoire as assessed through pre-testing, and not have had any previous imitation training.

The children who participated in the study were all similar in that they were non-verbal, and they were considered to be relatively low-functioning due to their lack of an imitative repertoire and their relatively low number of mastered procedures (see Appendix A for detailed information of each child). The children were randomly assigned to the multiple-manipulations training group or the single-manipulations group using a random numbers table. William and Brianna were the first two children to begin imitation training; therefore they were separated into the two different groups. Then, as more children were added to the study, the groups were evenly distributed so that each group had approximately the same number of children participating at any given time. Robert was the last child added to the study, and because the multiple manipulations
training group had three participants at the time Robert was added, he was included in the single-manipulations training group. The single-manipulations group consisted of William, Ashton, and Robert. The multiple-manipulations group consisted of Brianna, LaShanti, and Conor.

Setting

This study took place in an Early Childhood Developmental Delay (ECDD) classroom in Croyden Avenue School. The classroom was the first of three classrooms that constituted the Autistic Impaired (AI) preschool program. About fifteen children were in the classroom at any one time, and attended school year-round. Their ages ranged from 18-months to 5 years. Typically these children attended the program for three hours per day, five days per week.

The classroom was also the setting for the Autism Practicum offered through Western Michigan University’s (WMU) Psychology Department. Undergraduate and graduate students learned how to implement discrete-trial training with the children in the classroom. Typically undergraduate students from WMU implemented one-on-one discrete-trial training with the children and were supervised by experienced second-year MA students or PhD students.

Design and Procedures

This experiment was designed to evaluate the application of teaching single versus multiple-manipulations to establish a generalized manipulative-imitation repertoire. A between subjects design was used to compare the difference between the percentages of generalized imitation obtained for each child participating in the study.
One group included three of the six participants, and those three children were trained to imitate multiple-manipulations of objects. The second group included the remaining three participants, and those children were trained to imitate single-manipulations of objects.

Materials

The materials consisted of two of the following ten objects: matchbox car, plastic doll, plastic toy phone, small doll hat, story book, toy plastic drinking cup, small toy horse figurine, toy plastic hammer, two wooden square blocks, and small toy frog.

Identification of Reinforcers

Twice per week each child participated in reinforcer assessments. Objects and toys were considered “tangible” reinforcers, while food and drink were considered “edible” reinforcers. The reinforcer assessment for choosing tangible reinforcers took place in a toy area within the classroom. The toy area consisted of a wide variety of toys the child might have chosen by freely sampling the toys. The child could play with a chosen toy for approximately ten seconds, then that toy was placed in the child’s reinforcer bin (each child in the classroom had a reinforcer bin that held all of that child’s tangible and edible reinforcers). The child was then given another opportunity to sample the selection of toys until he or she chose approximately seven toys. The reinforcer assessment for choosing edible reinforcers took place in the child’s booth (work station). The child was given the opportunity to choose between several food and drink items by sampling the item for approximately ten seconds, as in the tangible reinforcer preference assessment. Then that food item was placed in a baggie and added to the reinforcer bin. Approximately, three to five edible reinforcers were typically chosen. Then, because
children’s preferences change so frequently, prior to the start of each session an array of approximately five toys and five edible reinforcers, that were identified by a previous bi-weekly “reinforcer assessment”, were put on the desk in front of the student. Next, a brief multiple-stimulus assessment without replacement (MSWO) (DeLeon & Iwata, 1996) was conducted to identify the three most highly preferred items. The item (either tangible or edible) that was selected first was used as a reinforcer for that session. If, during the procedure, the edible or tangible reinforcer lost its reinforcing value (i.e. the child pushed the tangible reinforcer away or did not eat the edible reinforcer) then another MSWO was conducted.

Procedure

Imitation Pre-Training Testing

Each child was tested to determine whether he or she demonstrated an imitative object-manipulation repertoire. All ten objects (previously listed in the Materials section) were tested with three different manipulations (for a detailed description of the manipulations see Appendix B). During pre-training testing, the experimenter modeled an action with an object (e.g., push the car across the desk) while simultaneously saying, “Do this”. The child’s response was recorded as either: (a) a “response before the model” which signified that the child made the correct response prior to the experimenter’s model of the correct response, (b) an “independent response after the model” which signified that the child made the correct response independently after the experimenter’s model of the correct response, or (c) a “prompted response after the model” which signified that after the experimenter modeled the correct response, prompting was
required in order for the child to make the correct response. A least-to-most prompting hierarchy was used throughout the testing session. The child was given 2-3 seconds to respond independently after the model was shown, then, if the child did not respond within that time period, the experimenter added a partial physical prompt while once more simultaneously modeling the action. But, if the child still did not respond with the inclusion of the partial physical prompt within 2-3 seconds, the experimenter provided a full physical prompt, while simultaneously modeling the action for the last time. Incidentally, if the children did not imitate the action that was modeled, they tended either to make no response (and simply looked at the experimenter), or they pushed the object off of the table.

The experimenter then modeled an additional two actions with the same object (e.g., jump the car on the desk and put the car on your head) while simultaneously saying, “Do this”, and again recorded the child’s response as previously described. The experimenter followed this format for all ten objects. None of the children demonstrated a strong manipulative-imitation repertoire during pre-training testing; therefore, all children who were tested were included in the study.

In addition to manipulative-imitation pre-testing, all children were also tested for a vocal-imitation repertoire, which consisted of ten basic sounds, and a physical-imitation repertoire, which consisted of ten body movements. For a full list of all the modeled physical and vocal responses see Appendix C.
Imitation Training

The three children in the multiple-manipulations training group were trained to imitate two manipulations with three objects (i.e., jump the car and push the car, hug the doll and kiss the doll, and talk on the phone and push the buttons on the phone). The three children in the single-manipulations training group were trained to imitate one manipulation with six objects (i.e., push the car, hug the doll, talk on the phone, “read” the book, drink from the cup, and walk the horse across the desk). All participants were assigned the objects used during imitation training based on their performance with those objects during imitative testing. These objects, and their corresponding manipulations, were chosen for the children because the children failed to imitate the manipulations during pre-training testing.

Before each session, the experimenter conducted a prompting probe trial for each of the manipulations, using a least-to-most prompt hierarchy to determine the level of prompting needed for the child to achieve a correct response for that session. In a probe trial, if the child initiated a response without a prompt and then completed the trial with only a partial prompt, that was the prompting level used for that entire session. In other words, the partial prompt was faded, from session to session, in terms of the duration of the prompt as well as the intensity of the prompt. During the prompting probe trial, in order to avoid extinction effects, a reinforcer was provided for both prompted and unprompted responses. Then, the experimenter conducted five trials of each manipulation using the level of prompting that was required to evoke a correct response in the initial prompting probe trial (Harris & Weiss, 1998; Leaf & McEachin, 1999; Maurice, Green, &
During each session, six prompting probe trials were run (one prompting probe trial for each of the six manipulations) and thirty training trials were ran (five training trials for each of the six manipulations). Therefore, a total of thirty-six trials were conducted during each manipulative-imitation training session.

Only independent responses were configured into the overall percentage per object. Therefore, 0% for example, may not have indicated that a child had made all incorrect responses; rather, it typically indicated that the child was being prompted to make the correct response, and therefore, did not have the opportunity to make the correct response independently. Typically, one to two sessions were ran each school day (Monday through Friday) with a break of approximately 10-15 minutes occurring between sessions. During this break the children participated in one of several activities which may have included structured playtime, toileting, snack, or a different procedure.

Correct imitative responses were considered as only responses that specifically matched the experimenter’s behavior. Combing responses, such as pushing the car half way across the desk and then lifting the car into a jumping motion, were never reinforced in order to avoid scrolling through response or blending multiple responses.

The intrusiveness of the prompting varied from child to child. For example, a full physical prompt for one child may have been more intrusive than a full physical prompt for another child. For example, with some children, when initially training the response of jumping the car, a full physical prompt may have required placing his or her fingers around the car to make a grasping response while simultaneously pulling the car into the
air to make a jumping response. On the other hand, some children may not have required additional full physical prompting to emit a grasping response and only needed it to raise the car; furthermore, the intrusiveness of the prompt generally decreased as the child acquired the imitative response.

During imitation training, it was crucial that the experimenter gained the child’s attention prior to modeling a response. Attention was defined as gaining the child’s eye contact or gaining a looking response towards the imitation stimulus (i.e., the car) used for a given trial. Strategies for obtaining a child’s attention varied depending on how the child responded. For example, attempts at gaining attention began with saying the child’s name. If the child did not attend to the experimenter upon hearing his or her name, then the experimenter held the stimulus in the child’s line of vision until the child attended to the stimulus by tracking it back and forth. Once the child looked at the stimulus, then the experimenter manipulated the object for that trial. Trials did not begin until a child demonstrated an attending response.

Additionally, the children were never given the opportunity to respond before a model was provided. For example, the experimenter would model the manipulation (pushing the car) with her car, and then the experimenter gave the child his or her car once the initial model was completed. Each child was then given three seconds to correctly imitate the model of the experimenter. There were no instances when manipulating the objects prior to the experimenter’s model was reinforced.

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1 LaShanti (a child in the multiple-manipulations training group) was given 5-7 seconds to correctly imitate the experimenter’s model starting on her 24th training session. This adjustment was made when the experimenter noticed that LaShanti frequently emitted a correct response a few seconds after the 3-second time-framed had lapsed.
Imitation training consisted of presenting only the modeled object during each trial, rather than presenting an array of objects. In other words, when push the car was modeled, the experimenter only offered the child a car to manipulate rather than presenting an array of objects to choose from (such as a car, a doll, and a phone). This was because Hartley & Malott (submitted for publication) found that children did not have trouble discriminating between the object that was modeled and the other “distracter” objects.

Generalized Manipulative-Imitation Probes

Probe trials, with novel imitative manipulations of trained objects, were used to assess generalization of the manipulative-imitation training. For the single-manipulations training group, probe trials were conducted with an object when independent responding reached 80% correct for that object. In other words, not all objects would reach 80% independent responding simultaneously; so phone, for example, may be the only object for which probe trials were conducted. On the other hand, probe trials were conducted for the multiple-manipulations training group when independent responding reached 80% for both manipulations that were modeled with one object. In other words, generalization probes were not conducted with the car until both car manipulations (jump the car and push the car) met the 80% criterion. For each stimulus probed in a generalization-probe session, the experimenter would randomly intersperse three probe trials within the 36 regular trials. Therefore, a total of nine trials were conducted for each object that had met the 80% criterion on the previous session (one prompting probe trial, five training trials, and three generalization probe trials). Once the 80% criterion had been met for a given
object, the experimenter conducted the generalization probe for that object within every training session for the remainder of the experiment.

Imitation training was considered mastered when each child met 80% criterion or greater for each manipulation simultaneously. In other words, the rate of imitative responding must have been at 80% criterion or greater for all six manipulations simultaneously in order to have met mastery on manipulative-imitation training. Once this criterion was established, the children then participated in imitation post-training testing.

Table 1
Trained Manipulations and Generalization Probes

<table>
<thead>
<tr>
<th>Object</th>
<th>Manipulations</th>
<th>Trained Manipulations</th>
<th>Generalization Probes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>Push car</td>
<td>Jump car</td>
<td>Put car on head</td>
</tr>
<tr>
<td>Phone</td>
<td>Talk on phone</td>
<td>Push buttons</td>
<td>Touch phone to mouth</td>
</tr>
<tr>
<td>Doll</td>
<td>Hug doll</td>
<td>Kiss doll</td>
<td>Dance doll on desk</td>
</tr>
<tr>
<td>Hat</td>
<td>Put hat on head</td>
<td>Put hat on tummy</td>
<td>Put hat on ear</td>
</tr>
<tr>
<td>Book</td>
<td>Read book</td>
<td>Tap finger on book</td>
<td>Tap book on desk</td>
</tr>
<tr>
<td>Cup</td>
<td>Drink from cup</td>
<td>Turn cup upside down</td>
<td>Put cup on eye</td>
</tr>
<tr>
<td>Horse</td>
<td>Walk horse across desk</td>
<td>Lay horse down</td>
<td>Raise front legs</td>
</tr>
<tr>
<td>Hammer</td>
<td>Pound hammer on desk</td>
<td>Tap hammer on hand</td>
<td>Touch hammer to forehead</td>
</tr>
<tr>
<td>Blocks</td>
<td>Stack blocks on top of each other</td>
<td>Put blocks side by side</td>
<td>Pound blocks on desk</td>
</tr>
<tr>
<td>Frog</td>
<td>Jump frog</td>
<td>Wiggle frog back and forth</td>
<td>Touch frog to elbow</td>
</tr>
</tbody>
</table>
Imitation Post-Training Testing

The experimenter ran one session of post-testing with each child to determine the percentage of generalized manipulative-imitation each child had acquired following mastery of the manipulative-imitation training sessions. The same testing that was done during imitation pre-training testing was also conducted during imitation post-training testing (the same objects and manipulations were used). As in the imitation pre-training testing, all ten objects were tested with three different manipulations. Now that the child had exposure to imitation training, some of the ten objects included in the post-testing were familiar to the child, but some objects were still novel because the child had never received training with those objects. During post-testing, the experimenter modeled an action with an object (e.g., pound the hammer on the desk) while simultaneously saying, “Do this”. The child’s response was documented as either: (a) a “response before the model” which signified that the child made the correct response prior to the experimenter’s model of the correct response, (b) “independent response after the model” which signified that the child made the correct response, independently after the experimenter’s model of the correct response, or (c) “prompted response after the model” which signified that after the experimenter modeled the correct response, prompting was required in order for the child to make the correct response (least-to-most prompting strategies in the post-testing were identical to the prompting strategies described in the pre-testing).

The experimenter then modeled the remaining two actions with the same object (e.g., tap hammer on hand and touch hammer to forehead) while simultaneously saying,
“Do this”, and again marked the child’s response as described above. The experimenter followed this format for all ten objects and their corresponding three manipulations. It was determined that a child demonstrated a generalized manipulative-imitation repertoire if the child responded correctly and independently with an accuracy of 80% or greater. In other words, the child must have responded correctly and independently on twenty-four out of thirty of the post-testing trials in order to be confident that the child had established a generalized manipulative-imitation repertoire.

Additionally, as in the imitation pre-training testing, all children received post-testing with vocal-imitation and physical-imitation, which consisted of the same models as in the pre-testing.

**Inter-Observer Agreement and Procedural Integrity**

Inter-observer agreement and procedural integrity were assessed for 20% of the imitation training sessions, for each child. In determining inter-observer agreement, an agreement was defined as occurring when two independent observers agreed on whether a child made a correct response during a discrete learning trial during an imitation training session. The agreement formula used to calculate inter-observer agreement was:

\[
\text{IOA score} = \frac{\text{number of agreements}}{(\text{number of agreements} + \text{disagreements})} \times 100\%.
\]

The mean IOA score for all sessions across all six children was 98%.

Procedural integrity measures were assessed in order to ensure that the procedural sessions were run as described in the method section. All experimental sessions were run by the experimenter of this study. The specific components of the method section monitored during procedural integrity checks were: (a) attending - was the child attending
to the experimenter while she was modeling the action?, (b) correctness of the S^D - did the experimenter give the S^D in a neutral tone and only say, "Do this"?, (c) correctness of the model - did the experimenter model each of the actions in the same way for each training trial?, (d) number of models presented - did the experimenter model the action twice (once prior to giving the child the object and once after giving the child the object)?, (e) delivery of reinforcers - did the experimenter provide an effective reinforcer immediately (within three seconds) after a correct response? The formula used to calculate procedural integrity was: number of steps completed accurately / total number of steps in the session X 100. The mean procedural integrity score for all sessions across all six children was 99%.

**Tutor-Implemented Training**

The post-imitation training-testing marked the formal end of the study. However, in accord with the practitioner model, we wanted to ensure that the children acquired an adequate manipulative-imitation repertoire. In addition, we wanted to ensure that the training procedures we were using in this study became the standard training procedures used throughout the ECDD classroom these children were attending. Therefore, their regular tutors (as opposed to the experimenter in this study) continued manipulative-imitation training with the children using multiple-manipulations, no matter which experimental group the children were originally in. The procedure was individualized for each child based manipulations the child did not demonstrate during post-testing for generalized imitation.
CHAPTER III

RESULTS AND DISCUSSION

In order to determine the most appropriate number of manipulations required (per object) to establish a generalized manipulative-imitation, two groups of three children each were trained to imitate. Three children received single-manipulations training (a single-manipulation each, with six objects), and three children received multiple-manipulation training (two manipulations on each of three objects). It was anticipated that the multiple-manipulations training group would acquire a greater amount of generalized manipulative-imitation because the training required that the children discriminate between at least two different manipulations for each trained object, therefore, ensuring that the children’s responding would be under imitative stimulus control rather than just object stimulus control (Green, 2001; Hartley & Malott, submitted). That is, it was anticipated that children in the multiple-manipulations training group would acquire better imitative stimulus control by the behavior of the model, as opposed to acquiring simple stimulus control by the objects alone. Because physical prompting was used throughout training, as is typically the case in imitation training (Harris & Weiss, 1998; Leaf & McEachin, 1999; Maurice, Green, & Luce, 1996; Sundberg & Partington, 1998), it would be possible for the children in the single-manipulations training group to be completely blind to the model’s manipulation of the object as they could potentially behave accurately, simply as a result of the stimulus
control of the individual objects. In other words, the behavior of the model could be completely irrelevant and the manipulations could be taught without providing any imitative model. However, when training multiple-manipulations per object, for the child’s behavior to be consistently reinforced, it must be under the control of the behavior of the model as well as the object.

The primary question was to determine if training multiple-manipulations with each object would produce a greater amount of generalized manipulative-imitation in comparison to training a single-manipulation per object. The second question was to determine the nature of the acquisition of generalized manipulative-imitation concurrent with the acquisition of specifically trained manipulations. The third question was to identify the molecular error patterns during the acquisition of manipulative-imitation acquisition and during generalization testing.

**Generalized Manipulative-Imitation Testing**

The manipulative-imitation training resulted in the successful training of six imitative manipulations for all of the children, in both experimental groups (see Appendices G-L). There was essentially no difference between the two groups in the number of trials required to simultaneously establish those six manipulative-imitations; the range was 330-1290 trials (Fig 1).
Additionally, and more to the point, upon mastery of imitation training, all children demonstrated at least some generalized manipulative-imitation. However, the children who received multiple manipulative-imitation training tended to demonstrate more generalized manipulative imitation than those in the single-manipulations training group (Fig. 2). Furthermore, manipulative-imitation training also resulted in almost as much physical-imitation as manipulative-imitation, for all children in the multiple-manipulations training group, but only a small amount of physical-imitation in two out of the three children in the single-manipulations training group. Not only that, it produced some vocal-imitation for the two multiple-manipulations children who did not already have a vocal-imitation repertoire (one child was at 100% before training), yet no vocal-imitation was demonstrated by the single-manipulations training group after imitation training. These data are summarized in Fig. 3, which depicts the average percentage improvement for the multiple manipulations training group and the single manipulations
training group across multiple, physical and vocal imitation. It should be noted that because Brianna demonstrated 100% vocal imitation during pre-testing, and she maintained that repertoire during post-testing, her vocal imitation data are not included in Fig. 3.

![Figure 2. Pre-Imitation Testing and Post-Experimental Imitation Training](image)
Figure 3. Average Percentage Improvement

Generalization Probes During Training

During training, within-session probe trials were used to assess generalization of the manipulative-imitation training. In a probe trial, the model did a novel manipulation of an object used during training. The child’s accuracy during these probes varied considerably across the different manipulations both within children and between children.

In some cases the children imitated with 100% accuracy from the first probe trial on. However, most frequently they made no response. But, typically when they did respond, errors consisted of either making an incorrect response (e.g., putting the object in their mouth or setting the object on the desk), or making the response trained with the object (e.g., making the trained response of pushing the car back and forth rather than making the modeled novel response of putting the car on their head). In only a few cases, during generalization probes, did the children make the error of manipulating the object
in a way that had been trained with another object (e.g., “hugging” the car, during a
generalization probe with the car, where hugging was originally trained with the doll).
For other cases, the accuracy gradually increased; and for a few, a correct response never
occurred during generalization probes.

Consider the most common case during the probes (the child made no response to
a particular novel modeled behavior); this indicated that the child’s behavior was under
tight stimulus control of the model’s behavior. The child did not respond, because no
response had ever been reinforced in the presence of that novel behavior (e.g., putting the
car on his or her head); however the child did respond, when the model made the trained
response (e.g., pushing the car back and forth). Therefore, not responding to the modeled
novel behavior indicated the emergence of discrimination between the model’s two
manipulations—probably a pre-requisite for imitating those different modeled behaviors.
On the other hand, for example, the relatively rare response of rolling the car when the
model probed by putting the car on her head indicated that the child’s behavior was only
under the stimulus control of the car and not the model’s behavior. Perhaps this was
further from generalized imitation than when a child simply did not respond.

As mentioned earlier, for each object used in training, the child received a series
of generalization probes with a novel manipulation. With 19% of those probed objects,
the children’s behavior more and more closely approximated the model’s behavior across
successive sessions. Perhaps this gradual increase in generalization was due to the match
between the behavior of the model and the behavior of the child having become an
imitative learned reinforcer. In other words, perhaps, the closer the child’s behavior was
to the model’s behavior, the stronger the reinforcer (e.g., the reinforcer of the visual similarity of the child’s behavior to the model’s). This should result in the shaping of increasingly accurate imitative behavior, because more accurate imitation may have produced a stronger imitative reinforcer, the process called *differential outcome shaping* (Malott, 2008, p. 249-250). (Incidentally, such behaviors of intermediate similarity to the model’s only occurred during the probe trials, not during the pre or post-training testing).

**Blending Manipulations**

Another indicator that imitative stimulus control was emerging was seen in a common pattern of responding for children who were trained on multiple responses with a single toy. Often these children first acquired one of the two responses; and then as they acquired the second response, it would blend with the first response. For example, by session nineteen LaShanti was reliably making the imitative response of kissing the doll every time the model did. But she was making no independent response when the model hugged the doll. However, starting on session twenty-two, her accuracy of imitating the kissing of the doll deteriorated because her responses consisted of a blend between kissing and hugging the doll, regardless of the modeled response. Then her accuracy of hugging the doll increased when the model also hugged the doll, but she continued to make the blend response when the model kissed the doll. But by session forty-three the two different responses came under accurate imitative stimulus control of the two modeled behaviors (Fig. 4). This type of responding occurred for seven of the nine manipulations that were trained across the three children who received multiple-manipulations training. (Additional examples of blending are in Appendices G-I).
Figure 4. “Blending” of Imitative Responses

Molecular Analyses

Several informal, observations showed unanticipated response patterns that lend themselves to a more molecular analysis. Though no formal numerical data were collected the observations are reported with considerable confidence, and might be followed up in future research.
Premature Responding

In looking at standard classroom procedures, it was observed that on some trials, children often made premature manipulative responses (e.g., pushing the car), before the model had made that response; and the premature response would be reinforced, even though it was not an imitative response on that trial and the tutor would not provide the imitative model. This could occur because the object was available to be manipulated before the model had provided the imitative stimulus. Also, the children were being trained with only one response for each object (e.g., only pushing and not jumping the car), and the tutors were reinforcing those premature response (Hartley & Malott, submitted for publication). However, post-testing showed no premature responding from children who did not receive the object until after the model demonstrated the appropriate manipulation for that trial, and some of the objects had two different appropriate manipulations, depending on the trial (e.g., pushing or jumping the car) (Hartley & Malott, submitted for publication). But in understanding the absence of premature responding, it was not clear how important was withholding the object until after the model’s manipulation and how important was the use of two different manipulations for some of the objects.

Therefore, the present study mimicked the training procedures from Hartley & Malott (submitted for publication) in that children never had the opportunity to respond prior to the model’s manipulation. For that reason, the children who were trained with multiple manipulations again did not respond prematurely. However, in addition, the children trained with only one manipulation per object also did not respond prematurely.
This indicates that training without the opportunity for premature responding was the crucial training component, and the multiple stimulus training is not necessary for the waiting response.

**Combination of Physical Imitation and Manipulative Imitation**

As the experimenter modeled the action of drinking from the cup, William would often form his hands around one another to make the shape of a cup, and then make a drinking motion, but in the absence of the actual cup. LaShanti frequently exhibited the same type of responding by making a hugging motion in the absence of the doll as the experimenter modeled hugging the doll. During training, as the children began reliably and independently imitating the manipulation of objects, three of the six children began occasionally making manipulations in the presence of the model’s manipulation of an object, but in the absence of an object that they themselves could manipulate, even though these responses were never reinforced in the absence of the object. The type of responding William and LaShanti demonstrated was essentially physical-imitation, the imitation of body movements, such as raising arms, stomping feet, clapping hands, touching nose, and waving goodbye. It may demonstrate the transfer of responding between manipulative-imitation and physical-imitation. In other words, these two types of imitation may develop simultaneously, because manipulative-imitation is essentially physical-imitation with an object. In both physical and manipulative-imitation, the child is largely matching the proprioceptive stimuli arising from his or her movements with the visual stimuli arising from the model’s behavior. Therefore, with manipulative-imitation training, the child was also trained on a component of physical-imitation. The children
who responded to the model prematurely in the absence of the object with which to respond may simply have been under the imitative stimulus control of the experimenter’s body movements rather than under the imitative stimulus control of the object plus the body movements. Although, making an imitative response in the absence of the object does not seem to be predictive of the amount of generalized imitation a child will demonstrate.

**Emotional Responding**

Four children, Conor, LaShanti, William, and Ashton occasionally made various emotional responses (i.e., soft crying, pushing the object away) when presented with a generalization-probe trial. The consequence for a generalization-probe trial was the spoken word “good” and nothing more, whether or not a correct imitative response occurred (For many children, relative to tangible and/or edible reinforcers, the spoken word “good” is not an effective reinforcer. Even for children who have had 1-3 years of experience with discrete-trial training where “good” has been used effusively and often paired with powerful reinforcers). For these four children, this type of responding typically occurred during 50-60% of the probe trials, though rarely during the imitation training trials (which always resulted in a tangible or edible reinforcer). For some children, the emotional responding occurred immediately after the first generalization probe was modeled, but for other children emotional responding did not occur until several generalization probe trials had been presented.

If the assumptions stated previously are correct, presumably generalized imitation is due to the reinforcing effectiveness of learned imitative reinforcers (the stimuli arising
from the match between the child’s behavior and the model’s behavior); and presumably the children responded emotionally because the imitative reinforcers were not as strong as the added tangible or edible reinforcers used during training. In other words, correct responding on a generalization probe trial produced only an imitative reinforcer, and not the more powerful tangible or edible reinforcer. For example, during generalization probes Conor frequently demonstrated emotional responding (most likely because these models became an $S^{\Delta}$ for the absence of added reinforcers), however, he continued to manipulate the object often actually imitating the behavior of the model.

**Tutor-Implemented Training**

Generalized manipulative-imitation testing at the end of training marked the end of the formal dissertation. However, because none of the children, in either group, acquired sufficient generalized manipulative-imitation to consider the skill mastered, additional manipulative-imitation training was provided by each child’s tutor. At the end of the formal dissertation the tutors trained with multiple-manipulations (no matter which group the children began in) because multiple manipulation training seems to generate more generalized manipulative-imitation. This was in keeping with our practitioner model that each of the children participating should receive the maximum benefit possible as a result of their participation.

The children were originally trained on six manipulations during the initial imitation training. Subsequently, then the three children who completed tutor-implemented training needed from two to six manipulations to establish a generalized manipulative-imitation repertoire. Furthermore, those manipulations were mastered in
fewer trials than had been required to establish the original six manipulations. Overall, the children who completed the tutor-implemented training demonstrated a high rate of generalized manipulative-imitation during the post-tutor-training testing, with nearly 100% generalization. Additionally, these children also demonstrated nearly 100% generalized physical-imitation and a high rate of generalized vocal-imitation.
CHAPTER IV

GENERAL DISCUSSION

The children in the multiple-manipulations training group acquired more generalized manipulative-imitation, physical-imitation, and vocal-imitation than the children in the single-manipulations training group. However, the children in the single-manipulations training group acquired more generalized manipulative-imitation than was expected based on earlier research (Hartley & Malott, submitted for publication). Those data, reported by Hartley & Malott, described responding by children who were generally more under stimulus control of the object than imitative stimulus control of the model’s manipulation when trained with single-manipulations. That lack of imitative stimulus control was most likely due to the fact that oftentimes children were essentially trained to appropriately manipulate objects, rather than to imitate object manipulations due to a failure to require specific attending responses. However, in the current study, both groups of children (single-manipulation training group and multiple-manipulation training group) were required to attend to the model’s manipulative behavior before they were given the object to manipulate. Thus, the model’s manipulation and the object itself might have come to exert joint stimulus control over the child’s manipulative behavior. Therefore, regardless of which group the children were placed in, all of the children tended to responded with a greater amount of generalization during post-training testing than the children who were not trained with the requirement of attending to the model.
prior to responding, as found by Hartley and Malott. For example, William who was in
the single-manipulations training group, was clearly under the imitative stimulus control
of the model’s behavior and not just the object, because he often imitated the model’s
behavior even in the absence of the object.

The present study seems to be the first to demonstrate that training on one type of
imitation (manipulative-imitation) could generalize to other types of imitation (physical-
imitation and vocal-imitation). Another study that attempted to demonstrate this (Young,
et al., 1994) did not actually use multiple examples in training manipulative-imitation.
Rather, they trained using actions within a sequence of a response (e.g., a response chain
like picking up a doll and then hugging it). This difference between the present study and
their study might account for their failure to get generalization from manipulative
imitation to physical and vocal imitation. Also, interestingly, Young et al. (1994) noted
that children demonstrated some perseverative behavior during the manipulative-
imitation training trials (such as rubbing, spinning, and squeezing the objects). That type
of behavior was not observed in the present study. This may be due to the fact that, in the
present study, prompting was provided in order for the child to match the model’s
manipulation. Therefore, the children did not have the opportunity to make perseverative
responses that would have interfered with emitting the correct response.

The most appropriate number of manipulations and objects required to establish a
generalized manipulative-imitation repertoire varies from child to child. However, this
study demonstrated that once six manipulations are mastered, it usually will not take the
mastery of many more manipulations before a child demonstrates generalized
manipulative-imitation. Generally, after the initial imitation training, the children in this study required between one and six additional manipulations to establish a generalized manipulative-imitation repertoire; and those manipulations were mastered more rapidly than the initial six.

In conclusion, it is advised that training begin with one set of manipulations that are trained to mastery. Then, once the original training set has been mastered, generalization testing should be conducted in order to determine if the child has established generalized manipulative-imitation. If not, then training with additional manipulative imitations is needed until the child demonstrates generalized manipulative imitation.

Future Directions

A generalized manipulative-imitation repertoire may facilitate the establishment of appropriate toy-play and appropriate peer-play. However, mastery of manipulative-imitation training may not directly transfer to appropriate and independent toy-play or the imitation of a peer’s appropriate toy-play. Therefore, once a child has demonstrated a generalized manipulative-imitation repertoire with adults as the model, it may be necessary to train the imitation of other children’s play-behavior. Additionally, supplemental training may be needed to ensure that the manipulations the child demonstrated in the training context are also demonstrated in a more unstructured, natural play environment with the goal of making playing with the toys reinforcing in and of themselves. As practitioners, no matter how a child’s generalized manipulative-imitation repertoire was established, we need to guarantee that the child achieves functional use of
his or her mastered skills. In addition, further training should be done, as needed, to establish generalized manipulative and physical imitation of more complex and more divergent models such as playing a keyboard, tying shoes, dressing, and playing basketball.

Conclusions

In conclusion: (a) The experimental manipulative-imitation training resulted in the successful training of six imitative manipulations for all of the children, in both experimental groups. (b) Upon mastery of the initial imitation training, all children demonstrated at least some generalized manipulative-imitation. (c) The children who received multiple manipulative-imitation training demonstrated more generalized manipulative, physical and vocal-imitation than those in the single-manipulations training group. (d) When teaching manipulative-imitation by not allowing premature responding, children will often wait for the model’s demonstration before manipulating the object, even when they have the opportunity for premature responding. (e) In order to establish generalized imitation, the child must demonstrate an attending response, by looking at the model, prior to the model demonstrating a manipulation. (f) Generalized manipulative-imitation and physical-imitation may develop simultaneously, because manipulative-imitation is essentially physical-imitation with an object. In both types of imitation, the child is largely matching the proprioceptive stimuli arising from his or her movements with the visual stimuli arising from the model’s behavior. (g) In the course of imitation training, children may demonstrate emotional responding during generalization probe trials, perhaps because the imitative reinforcers are typically not as strong as the added
tangible or edible reinforcers delivered contingent on a correct response. (h) The tutor-implemented training showed that, generally, only a few additional training sessions were needed for the children to acquire generalized manipulative-imitation and, in the process, they mastered new manipulative imitations with fewer trials than during the initial experimental training with the initial manipulations. (i) The children who completed the tutor-implemented training demonstrated a high rate of generalized manipulative-imitation during the post-tutor training testing, with nearly 100% generalization.
REFERENCES


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Appendix A

Participant Characteristics
## Participant Characteristics

<table>
<thead>
<tr>
<th>Child</th>
<th>Age</th>
<th>Length of time in classroom</th>
<th>Vineland-II survey interview data: Age Equivalency</th>
<th>Mastered procedures prior to imitation training</th>
<th>Other characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single Manipulation Training Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>William</td>
<td>5.1</td>
<td>3 months</td>
<td>Communication: 0.7 years</td>
<td>Match to sample</td>
<td>Rapid progress with procedures, with only infrequent non-compliance during transitions from preferred activities to non-preferred activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily living: 1.0 year</td>
<td>String beads</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Socialization: 0.3 years</td>
<td>8-piece puzzle</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motor skills: 1.9 years</td>
<td>Peg puzzle</td>
<td></td>
</tr>
<tr>
<td>Ashton</td>
<td>3.6</td>
<td>1 year</td>
<td>Communication: 0.4 years</td>
<td>Tracking objects</td>
<td>Increase in frequency of compliance and</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Daily living: 0.7 years</td>
<td>Activity center</td>
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<td></td>
<td></td>
<td>Socialization: 0.6 years</td>
<td>Star stacker</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Motor skills: 1.0 years</td>
<td>Come here</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Place object</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Eye contact</td>
<td></td>
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<td>Robert</td>
<td>2.9</td>
<td>1 month</td>
<td>Communication: 0.3 years</td>
<td>Star Stacker</td>
<td>Increase in attending and play</td>
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<td>Daily living: 0.3 years</td>
<td>Pegs</td>
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<td></td>
<td></td>
<td></td>
<td>Socialization: 0.5 years</td>
<td>Geo Board</td>
<td></td>
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<td></td>
<td></td>
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<td>Motor skills: 1.4 years</td>
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<tr>
<td><strong>Multiple Manipulations Training Group</strong></td>
<td></td>
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<tr>
<td>Brianna</td>
<td>4</td>
<td>2 months</td>
<td>Communication: 0.6 years</td>
<td>Occupational therapy procedure</td>
<td>Compliance with instructions during curricular procedures; frequent periods of</td>
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<td></td>
<td></td>
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<td>Eye contact</td>
<td></td>
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<td></td>
<td></td>
<td>Socialization: 0.6 years</td>
<td>Star stacker</td>
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<td></td>
<td></td>
<td></td>
<td>Motor skills: 1.8 years</td>
<td>Match-to-sample</td>
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<td>Compliance with following directions</td>
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<td>Daily living: 1.3 years</td>
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<tr>
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<td></td>
<td></td>
<td>Socialization: 0.5 years</td>
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<td>Motor skills: 2.5 years</td>
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</table>
Appendix B

Description of Manipulative Imitations
### Training Manipulations and Generalization Probes

<table>
<thead>
<tr>
<th>Object</th>
<th>Description of Manipulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>Push the car back and forth across the desk</td>
</tr>
<tr>
<td>Phone</td>
<td>Talk on the phone by placing the phone up to your ear</td>
</tr>
<tr>
<td>Doll</td>
<td>Hog the doll by pulling the doll to your stomach and swining from side-to-side</td>
</tr>
<tr>
<td>Hat</td>
<td>Put the hat on your head</td>
</tr>
<tr>
<td>Book</td>
<td>Read book by flipping the pages of the book</td>
</tr>
<tr>
<td>Cup</td>
<td>Drink from the cup by lifting the cup to your lips and tilting your head back</td>
</tr>
<tr>
<td>Horse</td>
<td>Walk the horse back and forth across the desk</td>
</tr>
<tr>
<td>Hammer</td>
<td>Pound the hammer on desk</td>
</tr>
<tr>
<td>Blocks</td>
<td>Stack two blocks on top of eachother</td>
</tr>
<tr>
<td>Frog</td>
<td>Jump the frog up and down on the desk</td>
</tr>
</tbody>
</table>
Appendix C

Physical and Vocal-Imitation Testing
<table>
<thead>
<tr>
<th>Physical Imitation</th>
<th>Vocal Imitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clap hands</td>
<td>Mmm</td>
</tr>
<tr>
<td>Touch stomach</td>
<td>Ahh</td>
</tr>
<tr>
<td>Touch head</td>
<td>Buh</td>
</tr>
<tr>
<td>Nod head (&quot;yes&quot;)</td>
<td>Duh</td>
</tr>
<tr>
<td>Shake head (&quot;no&quot;)</td>
<td>Fuh</td>
</tr>
<tr>
<td>Stomp feet</td>
<td>Oh (coat)</td>
</tr>
<tr>
<td>Tap the table</td>
<td>Eee</td>
</tr>
<tr>
<td>Open mouth wide</td>
<td>Tuh</td>
</tr>
<tr>
<td>Wave good-bye</td>
<td>Ooo (food)</td>
</tr>
<tr>
<td>Close eyes tight</td>
<td>Kuh</td>
</tr>
</tbody>
</table>
Appendix D

Manipulative-Imitation Training Procedure
Objective: The child will imitate the object manipulation behavior of the model.

Mastery Criteria: The child demonstrates a generalized manipulative imitation repertoire (80% or 24/30 on the generalized manipulative imitation post-training test).

Step 1: Pre-testing: Prior to beginning training, conduct manipulative imitation pre-testing to determine whether the child has an imitation repertoire. If the child has a manipulative imitation repertoire (24/30 or 80%), then do not continue with manipulative imitation training. If the child does not have a manipulative imitation repertoire (less than 24/30 or 80%), then continue with manipulative imitation training.

A. Collecting Data (for each of the 30 manipulations):
   a. Place the object in front of the child for 3 seconds (do not say anything or model any responses). If the child manipulates the object as indicated, then record the response “response without a model” by placing a check mark in the box.
      i. If the child responds without a model, then move on to the next object.
      ii. If the child does not respond without a model, then move to step b.
   b. Place the child’s object out of his/her reach. Model the appropriate response using your object (i.e. doll #1), then place the child’s object (i.e. doll #2) in front of the child. Give the child 3 seconds to respond. If the child independently manipulates the object as indicated, then record the response “independent response with a model” by placing a check mark in the box.
      i. If the child responds independently, then move on to the next object.
      ii. If the child does not respond independently, then move to step c.
   c. Prompt the child to make the correct response and record this as a “prompted response with a model” by placing a check mark in the box. Then, move on to the next object.

B. Continue this process for all 30 manipulations.

Step 2: Training:

A. Materials: Select six manipulations the child did not imitate during pre-testing (3 objects-2 manipulations each for the multiple manipulations training group, and 6 objects-1 manipulation each for the single manipulation training group). Two of each of these objects will be required. For example; 1). two cars, 2). two dolls, 3). two phones.

B. Prompting probes: Prior to each session, conduct one “prompting probe” for each object/manipulation.
   a. Prompting probes are conducted using least-to-most prompting. Indicate on the data sheet (under “prompt probe”) the level of prompting required for the child to emit a correct response.
      i. F - Full physical prompt
      ii. P - Partial physical prompt
      iii. I - Independent response

C. Training: Conduct 5 trials for each object/manipulation using most-to-least prompting.
   a. Correct response: A response that requires the level of prompting identified in the prompting probe (or a less intrusive prompt). Reinforce with social praise and tangible/edible reinforcers.
   b. Incorrect response: A response that requires a more intrusive prompt than the prompting probe. Remove the object and turn away from the child for 3 seconds. Then, begin the next trial.

D. Probe Sessions: Once the child meets 80% criteria (4/5 correct responses) for any of the object/manipulations, then (during the next training session) conduct 3 probe sessions interspersed with the 5 training trials.

Step 3: Post-testing:

A. Generalized Manipulative Imitation Post-Testing: Conduct the post-testing just as described for the pre-testing data (in Step 1).
   a. If the child responds at 80% (24/30) or greater, then manipulative imitation training is complete.
   b. If the child does not respond at 80% or greater (fewer than 24 correct responses) then continue with the tutor-implemented training.
Appendix E

Inter-Observer Agreement and Procedural Integrity Form
Multiple Manipulations

Inter-observer Agreement

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Probes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>1.) Push Car</td>
<td></td>
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<tr>
<td>2.) Jump Car</td>
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<tr>
<td>3.) Drink from cup</td>
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<td>4.) Turn cup upside-down</td>
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<tr>
<td>5.) Walk the lion</td>
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<td>6.) Lay the lion down</td>
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</tbody>
</table>

Generalization Probes (+ or - No reinforcement)

| 1.) Put car on head | | | | | | |
| 2.) Touch photo with mouth | | | | | | |
| 3.) Dance doll on desk | | | | | | |

Procedural Integrity

Place a checkmark through any step that is completed incorrectly or that is omitted from the session.

Trials 1-18

<table>
<thead>
<tr>
<th>Attending</th>
<th>1</th>
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<tr>
<td>&quot;Do that, neutral&quot;</td>
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Trials 19-36

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<tr>
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55
Appendix F

HSIRB Approval Letter and Proposal
Date: November 26, 2008

To: Richard Malott, Principal Investigator
   Breanne Hartley, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number: 08-11-28

This letter will serve as confirmation that your research project entitled “Croyden Avenue School Practice: Continuous Quality Improvement” has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: November 26, 2009
Protocol Outline

Project Title:
Croyden Avenue School Practica: Continuous Quality Improvement

Abstract
The purpose of this study will be (1) to evaluate an intensive behavioral treatment provided in a preschool for children diagnosed with autism and, based on these evaluations, (2) to continuously improve aspects of the treatment and assessment procedures provided to the children. This program evaluation and treatment/assessment adjustments are part of the standard continuous quality improvement efforts of the classroom where the study will be conducted. The study will be documented through direct observation and video recordings, which will capture the children’s behavior. The study will take place in the Early Childhood Developmental Delay (ECDD) preschool classroom at Croyden Avenue School, where the treatment is provided by undergraduate and graduate practicum students. We are asking permission to use these evaluation, training, and assessment data in Doctoral dissertations, Master’s theses, presentations, and publications to document the effectiveness of this continuous quality improvement effort.

Purpose/Background Information
I (Richard Malott) am training BA, MA, and PhD students to be human-service practitioners, generally with a specialty in preschool autism and early childhood developmental delays, not to be either basic or applied researchers. I am not using the researcher/practitioner model. However, I am training my students to continuously evaluate the effects of their work with the children and to modify their treatment/training procedures accordingly. So our first criterion in any practicum, thesis, or dissertation is that the children directly involved in those projects will immediately benefit from their involvement, not just that their involvement will contribute to the long-term betterment of the treatment of subsequent children, though we also have that as a goal, of course.

The current project will involve a case study objectively evaluating the performance of children diagnosed with autism. The study will examine the background of the children (e.g., pre-intervention assessments, medical conditions, behavioral history), the behavioral treatment provided to the children, the measurement and data collection process, performance results, and problem behavior.
Participant Recruitment

All participants will be preschool-aged children who are currently enrolled in the Early Childhood Developmental Delay (ECDD) Classroom at Croyden Avenue School. As part of the continuous quality improvement standard within the classroom, all the children will be involved in the evaluation and improvement process. The students whose parents decide not to provide permission for Dr. Malott’s graduate students to use their data will not have their data included, however they will still be part of all evaluation and training improvements. The student age range in the classroom is from 12 months to 5 years of age. Before data are presented, used in publications, or used in theses an informed consent form will be sent home to the parents asking for permission to use their child’s data. The parents will be assured that neither names nor any other identifying information will be used in publications, presentations, or in the theses. Whether or not the parents consent for our use of the data for the theses, publications, and presentations their children’s performance will still be closely monitored and their children will receive any improved training programs that are developed. Undergraduate and graduate student tutors record daily performance data for each child and will not be asked to perform any additional tasks not included as a regular part of their practica.

Informed Consent Process

All data collection methods that involve the children participating in this study are used as a regular part of the undergraduate and graduate practica during which this study will take place. All parents participating in the use of their child’s data will receive two copies of an informed consent document asking permission for their data to be used confidentially for theses, publications, and/or presentations. They will have the opportunity to sign and return one copy and keep the other copy for their records. As stated earlier, all results will be displayed confidentially for each participant. The consent forms will be returned to Dr. Richard Malott. The focus of our data collection process will be the performance of the children, not the performance of the tutors. The tutors and classroom teacher will only be asked to perform the duties already required as part of their regular obligations. For HSIRB protocols concerning the practicum students, see the section below, though data concerning their performance will not be part of this study.

Research Procedure

As part of standard classroom procedure Richard Malott, his graduate students, and the Early Childhood Developmental Delay (ECDD) classroom staff are constantly working to improve all aspects of the treatment provided to the children to improve each individual child’s performance. This standard procedure involves an initial Pre-primary Evaluation Team assessment (PET), yearly IEP goal-setting meetings between Croyden staff and parents, parent meetings, data collection, data analysis, changes made to the training system based on the data analyses, and continuous quality improvement of all procedures, data collection methods, and treatment methods. Specifically, data collected
include the percentage of correct responses for each child for the procedures assigned to
him or her as part of enrollment in Croyden Avenue School, the occurrence of problem
behaviors, and skills obtained throughout their time at Croyden Avenue School.
Examples of areas that may be addressed in this study include prompting strategies, skill
maintenance, generalization, transfer of training, and revisions of skill acquisition
procedures. All improvements made to classroom training procedures are part of
standard continuous quality improvement designed to constantly improve the service
provided to the children in the classroom. All data sources are already part of the
undergraduate and graduate practica through Western Michigan University. These
projects and their approved HSIRB Project Number are as followed:

- Pre-Practicum: 06-12-12
- Intermediate/Advanced Practicum: 08-11-15
- Language Facilitation Training System: 06-12-09

Methodology
The model for this study will be an intensive case study model (Green, Brennan,
& Fein, 2002) that includes continuous empirical assessment and improvements made
based on these assessments, as well as based on the goals of the parents and the
classroom teacher. Performance data for the children involved in the study are collected
and evaluated as part of the normal duties of the Croyden Avenue Early Childhood
Developmental Delay (ECDD) preschool classroom.

Risks and Costs to and Protections for Participants
There are no known risks to the participants.

Benefits of Research
A primary objective of this study is to thoroughly evaluate the performance of the
children involved in this study and work to continuously improve their instructional
procedures and their skill acquisition as well as the other children in the classroom.

Confidentiality of Data
The data collected will be stored on a computer disk for at least three years. The
computer disk will be filed and locked in Richard Malott’s lab. Once all paper data have
been analyzed and compiled for presentation, the original copies of the data will be stored
in a box, and locked in a psychology lab at Western Michigan University. The only
person who will have access to the disk and paper data will be Richard Malott.
References
Appendix G

Conor: Skill Acquisition (Multiple-Manipulations Group)
Pre-Training

Imitation Training

Post-Training

- Push the car
- Jump the car
- Drink from cup
- Cup upside down
- Generalization Probe

- Walk the horse
- Lay the horse down
- Generalization Probe

Sessions

Percentage Correct
Appendix H

LaShanti: Skill Acquisition (Multiple-Manipulations Group)
Appendix I

Brianna: Skill Acquisition (Multiple-Manipulations Group)
Pre-Training | Imitation Training | Post-Training

- Push the car
- Hug the doll
- Talk on the phone
- Read the book
- Drink from the cup
- Walk the horse

Generalization Probe
Appendix J

William: Skill Acquisition (Single-Manipulations Group)
Pre-Training

Imitation Training

Post-Training

Push the Car

Jump the Car

Generalization Probe

+—Hug the Doll

Kiss the Doll

Generalization Probe

Talk on the Phone

Push Phone’s Buttons

Generalization Probe

Percentage Correct

Sessions

69
Appendix K

Ashton: Skill Acquisition (Single-Manipulations Group)
Pre-Training

Imitation Training

Post-Training

- Push the Car
- Generalization Probe

- Hug the Doll
- Generalization Probe

- Talk on the Phone
- Generalization Probe

- Drink from the Cup
- Generalization Probe

- Walk the Horse
- Generalization Probe

- Pound the Hammer
- Generalization Probe

Percent Correct
Appendix L

Robert: Skill Acquisition (Singe-Manipulations Group)
Pre-Training | Imitation Training | Post-Training

- Jump the Car
- Hug the Doll
- Drink from the Cup
- Tap Hammer on Hand
- Put hat on head
- Lay the Horse Down

Percent Correct

Sessions

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Appendix M

Conor: Pre-Test and Post-Test Results
Appendix N

LaShanti: Pre-Test and Post-Test Results
Appendix O

Brianna: Pre-Test and Post-Test Results
<table>
<thead>
<tr>
<th></th>
<th>Pre-Test</th>
<th>Post-Experimental Training</th>
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</thead>
<tbody>
<tr>
<td>Novel Man. Im.</td>
<td>1/30</td>
<td>10/10</td>
</tr>
<tr>
<td>Novel Phys. Im.</td>
<td>2/10</td>
<td>1/10</td>
</tr>
<tr>
<td>Novel Vocal Im.</td>
<td>2/6</td>
<td>2/24</td>
</tr>
<tr>
<td>Trained Man. Im.</td>
<td>10/22</td>
<td>5/10</td>
</tr>
<tr>
<td>Novel Phys. Im.</td>
<td>2/24</td>
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</tr>
<tr>
<td>Novel Vocal Im.</td>
<td>10/10</td>
<td>10/10</td>
</tr>
</tbody>
</table>

- Correct response before the model
- Correct response after the model
Appendix P

William: Pre-Test and Post-Test Results
Appendix Q

Ashton: Pre-Test and Post-Test Results
Appendix R

Robert: Pre-Test and Post-Test Results
Correct responses before and after the model:

- Novel Man. Im.
- Novel Phys. Im.
- Novel Vocal Im.
- Trained Man. Im.
- Novel Phys. Im.
- Novel Vocal Im.

Pre-Test

Post-Experimental Training

Percent Correct
Appendix S

Status of Tutor-Implemented Training: Ashton, Brianna and Robert
As with all of the other children, upon the completion of the experimental imitation training, Ashton, Brianna and Robert began the tutor-implemented imitation training. These three children are currently at various stages of that tutor-training:

Ashton completed the experimental imitation training on June 10, 2009. The classroom was then closed for summer break for ten days, from June 12 to June 22. The remainder of the summer program lasted for eight weeks; however, Ashton’s attendance during the summer program was extremely poor. On average, Ashton attended school during this span of time for one day per week (out of a four day week). Because of his truancy, very little imitation training could be conducted during the summer months. Currently, Ashton is more reliably attending school and the tutor-implemented training is continuing.

During tutor-implemented imitation training, Brianna began to demonstrate skill regression with all of the procedures that were in her schedule at that time. She was simply not responding to procedural S^D^s, whereas she had been reliably responding to those same S^D^s in the past. In order to determine the level of Brianna’s skill regression, an assessment of all of her previously mastered procedures was conducted. Those assessments concluded that she had maintained all of her previously mastered procedures. In an attempt to increase the rate of reinforcement, all of Brianna’s previously mastered procedures were re-introduced into her schedule and all of the procedures that she was not responding to were temporarily taken out of her schedule. Then, once her rate of responding increased with the mastered procedures, each of the other procedures was re-
introduced, one at a time. Additionally, a portable DVD-player was re-introduced which had been identified as an effective reinforcer. Currently, Brianna’s responding has increased with the combination of slowly re-introducing difficult procedures and delivering a more effective reinforcer contingent on correct responding. However, manipulative-imitation is not yet one of the procedures that has been re-introduced. Currently, Brianna is transitioning out of the ECDD classroom in order to participate in a classroom that more specifically meets the needs of a child with visual impairments.

Robert completed the experimental imitation training on July 28, 2009. The classroom was then closed for a summer break for three and a half weeks (August 13 through September 8). Then, at the beginning of the Fall semester, Robert missed approximately a week and a half of school due to illness. Therefore, because Robert missed a significant amount of school, very little imitation training could occur. However, currently Robert’s tutors are implementing imitation training as part of his regular schedule and programming.
Appendix T

Additional Information on Imitation Curricula
Generally, behavior analytic strategies to train an imitation repertoire are fairly similar and are outlined in behavioral curricula (e.g., Harris & Weiss, 1998; Leaf & McEachin, 1999; Maurice, Green, & Luce, 1996; Sundberg & Partington, 1998). These curricula begin with an imitation assessment that identifies the child's imitation skills and deficits. Then, if necessary, pre-requisite skills are established which include sitting in a chair and attending to a tutor. It is especially important that the child is able to attend to the tutor when the tutor is modeling an imitation response. Generally, these curricula advise training children in a highly structured environment, with as few distractions as possible, and with the child and the tutor sitting across from one another face-to-face.

Specific, one-step, physical-imitation and manipulative-imitation responses are identified, and then broken down into discrete sub-skills that are taught systematically. Manipulative-imitation responses are often taught first, based on the assumption that children tend to have more success with these imitations. However, curricula vary between initially advising teaching manipulative-imitation and physical-imitation. Oftentimes the type of imitation training first introduced will depend on the child and his or her specific strengths and weaknesses. The acquisition of these initial imitation responses are facilitated by using prompting, prompt fading and systematic reinforcement. More specifically, it is crucial to immediately reinforce any correct response, or approximations to a correct response, with powerful reinforcers. In addition, once imitation behaviors begin to emerge, the recommendation is to fade out the prompts as soon as possible (Martin & Pear, 1995). Instructions are typically given with the verbal
discriminative stimulus, “Do this,” with the simultaneous model of the imitative response. These curricula note that extra vocabulary is unnecessary, and some children may not need any verbal discriminative stimulus paired with the imitative model. Each imitation sub-skill is typically trained in a block of ten trials; however, maximizing the number of trials per day to include as many trials as possible is advised. Then, as the child begins to imitate simple, one-step models, a tutor should begin to model more complicated two- and three-step models.