TEACHING OBSERVATIONAL LEARNING TO CHILDREN WITH AUTISM: AN IN-VIVO AND VIDEO-MODEL ASSESSMENT

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Observational learning (OL) occurs when an individual contacts reinforcement as a direct result of discriminating the observed consequences of other individuals' responses. Individuals with autism spectrum disorder (ASD) may have deficits in observational learning and previous research has demonstrated that teaching a series of prerequisite skills (i.e., attending, imitation, delayed imitation, and consequence discrimination) can result in observational learning. We sequentially taught these prerequisite skills for three young children with ASD across three play-based tasks. We assessed the direct and indirect effects of training by assessing OL before and after instruction across tasks and task variations (for two participants) during both in-vivo and video-model probes using a concurrent multiple-probe design. All participants acquired the prerequisite skills and demonstrated observational learning during probes of directly-trained tasks. Generalization results varied across participants. Observational learning generalized to one untrained task for one participant. For the other two participants, observational learning generalized to variations of the trained tasks but not to untrained tasks. Generalization additionally occurred during the in-vivo probes for both participants for whom we assessed this response. Implications of these findings, as well as directions for future research, are discussed.

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Introduction

Observational learning (OL) is an important skill as it allows a person to learn novel behaviors without direct experience with contingencies (Catania, 1998). One class of OL involves individuals accessing reinforcement as a direct result of first discriminating the reinforced and nonreinforced responses of others, and subsequently engaging in behaviors that result in reinforcement, while refraining from behaviors that do not. For example, a child may learn to label previously unknown pictures as a result of discriminating the reinforced and nonreinforced tacting responses of a peer, rather than imitating all peer responses regardless of the consequences produced (DeQuinzio & Taylor, 2015). Observational learning expands the number of learning opportunities because an individual can indirectly acquire new stimulus-response relations through the observation of others. Therefore, OL may also be conceptualized as a behavioral cusp, which "exposes the individual's repertoire to new environments, especially new reinforcers and punishers, new contingencies, new responses, new stimulus controls, and new communities of maintaining or destructive contingencies" (Rosales-Ruiz & Baer, 1977, p. 534; Delgado & Greer, 2009).

Unfortunately, observational learning is often deficient for children with autism and may restrict treatment progress as a child transitions from a one-to-one instructional format to a group setting (Taylor & DeQuinzio, 2012). OL is necessary because most group instructional formats do not provide multiple direct learning opportunities and many learning opportunities are available by observing peer responses. Thus, if a child enters school with a deficient OL repertoire, they are likely to miss a multitude of learning opportunities (Sutherland & Wehby, 2001; Greer, Dudek-Singer, & Gautreaux, 2006). Previous research suggests that OL is one of the leading indicators of success in educational settings (Delgado & Greer, 2009; Greer, 2002; Greer, Singer-Dudek & Gautreaux, 2006).

To remediate deficits in OL, researchers have evaluated methods to teach this complex repertoire to individuals with ASD. Taylor & DeQuinzio (2012) noted that observational learning is comprised of several prerequisite skills. An individual must, “attend to and observe the modeler, make complex discriminations of another person’s actions and their outcomes, and after a delay in time, match some properties of the modeled behavior (or not)” (p. 344). This implies that teaching: (a) attending to the responses of others, (b) imitating, (c) imitating actions after a delay, and (d) identifying and discriminating contingencies in an instructional sequence may promote observational learning.

Observational learning, like most discrimination learning situations, requires that the learner attends to the discriminative stimuli or the modeled response. Instructional programs that require attending to instructional stimuli increase the probability that the learner is exposed to the discriminative stimulus and therefore increases the opportunity to learn (Wyckoff, 1952). Therefore, it is crucial that a child acquire a generalized attending repertoire in order to learn novel skills via observation.

Once the learner attends to the model, the next instructional step is to teach imitation of the model. Generalized imitation is present when previously untrained behaviors come under the instructional control of demonstration (Baer, Peterson, & Sherman, 1967). Some children with developmental disabilities do not imitate others, which creates difficulty with the development of basic skills (Sturmey & Fitzer, 2007). Additionally, given that not all opportunities to engage in imitative responding occur immediately following the model, the ability to imitate a response after a time delay is also vital for observational learning. The length of the time delay varies in an observational learning framework, as the opportunity to imitate the model can occur within minutes, hours, days, weeks, and so on, following the demonstration.

While imitation often results in access to reinforcement, not all imitation is advantageous. For example, it would be problematic if a child imitated the yelling of a peer, especially if the peer was sent to the principal's office for being disruptive (Taylor & DeQuinzio, 2012). By contrast, observational learning may be conceptualized as "selective imitation", which involves a learner determining which responses to include in his repertoire and which to exclude, based on observing others (Taylor, 2017). It implies a controlling relation from the consequence the behavior of the first produced to the consequence of the behavior of the second. In other words, imitation implies point-to-point correspondence between models and responses, while observational learning implies correspondence between responses and consequences. Thus, although at the foundation of observational learning is imitation, OL additionally requires the discrimination of consequences.

For example, if a teacher asks the students in his class, "What is two plus two?" and a particular student does not know the answer, it is possible for the student to acquire the correct response after observing the consequences that peer responses receive. If a peer provides the correct response (i.e. "four") and the teacher replies, "That's right!" the student may then provide the correct response when asked the same question in the future. However, if the peer provides an incorrect response (e.g. "five) and the teacher says, "No that's not right" the student would not repeat (i.e., imitate) the incorrect response and may simply say "I don't know" if asked the same question in the future. These responses together produce opportunities for an individual to learn new responses without direct instruction.

While there is extensive support in the literature that attending, imitation and delayed imitation are skills that can be trained, few applications of observational learning have specifically instructed consequence discrimination as a component. This is problematic, as discrimination of contingencies distinguishes OL from generalized imitation. By contrast, some studies have focused solely on consequence discrimination through discrimination training of the reinforced and nonreinforced responses of others, sometimes referred to as peer-monitoring (DeQuinzio & Taylor, 2015; Delgado & Greer, 2009). Given the positive implications of acquiring a generalized OL repertoire, as well as the lack of generalized observational learning for children with autism, the need for research to determine effective teaching strategies, particularly in relation to lacking prerequisite skills, is evident.

One study has provided empirical support for teaching prerequisite skills to establish observational learning (MacDonald & Ahearn, 2015). The authors sought to produce a generalized performance of OL using a variety of tasks and task variations. The tasks included a hidden item, computer, academic, construction toy and building toy task, each with 2-3 variations. A known adult served as the model. Participants observed the adult engage with items required for that session, with some responses resulting in neutral consequences and one response resulting in reinforcement. After the observation period, the participant was permitted to engage with the items. If the participant emitted the one response that previously resulted in reinforcement for the adult model, s/he also obtained reinforcement. If observational learning did not occur for any task (i.e., the participant imitated the unreinforced response of the model), the authors taught attending, imitation, delayed imitation and consequence discrimination to the deficient task using least-to-most prompting. The results showed the emergence of observational learning to untrained tasks and task variations following training of a specific task for five out of the six participants. Some concerns regarding asserting functional control over responding were raised due to the experimental design selected. The results did not show an increase in correct performance when and only when the independent variable was introduced. Therefore, the suggestion to strengthen experimental control using a concurrent multiple-baseline design across subjects was provided.

For children, observational learning of both adult and peer models is important for accessing new contingencies of reinforcement. Adult models are commonly used in experimental evaluations of observational learning, due to the difficulty of controlling for the arrangement of the correct and incorrect responses of a peer (DeQuinzio & Taylor, 2015; MacDonald & Ahearn, 2015). A peer confederate participated in Delgado & Greer (2009) and the opportunities for reinforced and nonreinforced responses varied. The authors alleviated this limitation by continuing each session until 20 incorrect and correct responses occurred. However, while the same minimum number of incorrect and correct responses occurred, the total number of both responses, as well as their arrangement, was not controlled for. Therefore, no studies to date have sufficiently controlled for the reinforced and nonreinforced responses of a peer-model during observational learning training. This gap in the literature requires further evaluation, as opportunities to engage in observational learning in educational settings most commonly involve peer models. Teaching observational learning via video-modeling of a peer may be useful to accomplish systematic control of modeled responses.

Although extensive literature has validated video-modeling as a tool for teaching skills to children with autism across a variety of skills (MacDonald et al., 2015), it has not yet been validated in previous literature as an effective tool for teaching observational learning of peers to children with autism. Video-modeling typically involves a child observing a video of a model engaging in a target behavior, or a sequence of behaviors, and subsequently imitating the observed response(s) (Charlop-Christy and Freeman, 2000). Thelen and colleagues (1979) noted four primary advantages of video versus in-vivo modeling for instruction. First, videos can be taped to display naturalistic settings that may be difficult to create in-vivo. Second, control over the modeling procedure is heightened with video-based instruction because the videos may be altered or recreated to produce the desired scene. Third, there is the convenience of the model not needing to be present, as the same video-model may be used repeatedly. Finally, videotapes may be reused across children and settings, which means more clients have the opportunity to benefit from the intervention. Video-models may then be an efficient technique for teaching observational learning across stimulus exemplars, models (i.e., peer or adults), settings, and so on. This is critical to explore, as observational learning is most advantageous when it is established as a repertoire.

Fortunately, all studies aimed to teach observational learning via the discrimination of contingencies have recognized this importance of establishing an OL repertoire and have, therefore, included procedures to test for generalization. These procedures include assessing generalization to novel stimuli, such as to labeling untrained pictures (DeQuinzio & Taylor, 2015) and completing untrained tasks (MacDonald & Ahearn, 2015), as well as generalization to novel models, such as to a novel peer (Delgado & Greer, 2009). These studies provide a crucial beginning to an empirical understanding of how observational learning as a behavioral cusp may be established.

The purpose of the current study was to add to the growing body of literature in this area by replicating and extending the results of MacDonald & Ahearn (2015). We assessed observational learning for three children diagnosed with autism spectrum disorder (ASD) across three tasks and within task variations under in-vivo and video-model conditions using a concurrent multiple-probe embedded in a multiple-baseline design across subjects. A same-aged typically-developing peer served as the model across in-vivo and video-model conditions. If an observational learning repertoire was not present, we taught attending, imitation, delayed imitation, and consequence discrimination using video-models of a peer and task-specific materials. Thus, four primary extensions of MacDonald & Ahearn (2015) are included: (a) the use of a similar-aged peer for demonstrating target behaviors, (b) the use of video-modeling to teach OL component skills, (c) the addition of in-vivo probes for OL with a peer and (d) the use of a concurrent multiple-probe embedded in a multiple-baseline design across subjects to verify and replicate the effects of the independent variable, as well as to demonstrate the emergence, or lack thereof, of generalized observational learning.

Method

Setting

All sessions took place at the University of North Texas, Kristin Farmer Autism Center (KFAC), where all participants received full-time early intensive behavior intervention (EIBI) services under the supervision of a Board-Certified Behavior Analyst. All participants had been students at the KFAC for at least two years prior to the onset of the evaluation. All sessions, apart from trials during the vocal-response variation task, took place in the same room at the center, which was designated specifically for research sessions of all kinds. Therefore, all participants had some exposure to the research environment prior to the onset of the evaluation, but no familiarity with our materials in conjunction with the current procedures. The vocal-response variation trials took place outside of the KFAC's gym door. With three total access points, the door that was selected was the one the participants rarely used, as it was in a client-restricted section of the building near the lobby.

Participants

Three children diagnosed with autism-spectrum disorder (ASD), who were all five years of age, were included in this study. All participants demonstrated strong attending, imitation, and delayed imitation skills prior to participation. None of the participants had previous experience following instructions via video-models.

River was 5 years and 10 months of age and had been receiving full-time behavior-analytic services at the KFAC for 2 years and 6 months prior to participation. She reliably requested using 4-5 word simple sentences and demonstrated strengths in the areas of expressive and receptive language.

Aspen was 5 years and 9 months of age when his involvement in the current study began. He communicated using 2-3 word simple sentences and presented strengths in the areas of expressive and receptive language, as well as play skills.

Forrest was a 5-year, 8-month old male who had been a student at the autism center for 3 years and 2 months prior to participation. Forrest communicated using 2-3 word simple sentences and presented strengths in visual performance. He also demonstrated several barriers, as identified by the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) (Sundberg, 2008). The most severe barriers included impaired social skills and self-stimulation in the form of vocal and motor stereotypy. He scored a three (i.e., persistent problem) for both the impaired social skills and self-stimulation categories. He also occasionally engaged in some obsessive-compulsive behaviors which resulted in minor problem behaviors if he was not able to complete the routine.

Autumn was a typically-developing five-year old female who served as the peer-model throughout this evaluation. None of the participants had experience with Autumn prior to participation.

Sessions

Sessions took place, on average, two times per day, four days per week for River and Aspen, and one time per day, four days per week for Forrest. Sessions lasted approximately 10-25 minutes, depending on the condition. If two sessions were conducted on the same day, we ensured that a minimum of two hours occurred between sessions. This was done in an effort to maintain the motivation for obtaining the task-specific reinforcement provided during sessions so that a true measure of observational learning was captured. In other words, we would not expect the child to engage in observational learning after receiving substantial access to a specific reinforcer, possibly due to satiation for that item or activity. Probe sessions were sometimes conducted on the same day that mastery-criterion for the consequence discrimination phase was met during training.

Task Descriptions

For all tasks and task variations during the consequence discrimination and probe sessions, the participant observed the peer-model (in-vivo or via video-model) engage in three different responses, with one response resulting in reinforcement. The order in which the peer-model responded was counterbalanced across sessions for each task. It is important to clarify that because the peer-model was always allotted three attempts to engage in the correct response, and these attempts were counterbalanced across sessions, there were some instances when she responded correctly on the first attempt or second attempt. In these cases, she then attempted incorrect responses immediately following a correct response. While it is not ideal that the participant observed the model respond incorrectly following a correct response, we determined it was crucial that the last attempt not always be the correct response. This ensures that the participant responded to the reinforcement contingency, rather than the order of the peer-model's responses.

Motor-Response Task (T1)

This procedures for this task were derived from procedures described by MacDonald & Ahearn (2015) involving an item necessary for reinforcement hidden in one of three possible places. The participant watched the peer-model look under three identical turned-over boxes, under one of which a container of bubble solution was hidden. One box was placed on top of a table, one box on the floor under the table, and one box was placed on a chair next to the table. When the peer-model found the bubbles, the teacher poured the solution into a bubble machine and turned it on. After each observation, the teacher picked up the bubble machine and said to the participant, "Find the bubbles". During all subsequent trials, the teacher hid the bubbles under the box that was designated to be correct next while the participant watched the video-model. Because the table and chair were systematically facing away from the boxes, the participant did not see the teacher hide the container. In the probe conditions, correct locations were counterbalanced across three trials so that each box was systematically correct once. In the imitation, delayed imitation and consequence discrimination conditions of the training phase, correct locations were counterbalanced across nine trials (i.e., one session) so that each position was systematically correct three times.

Motor-Selection Task (T2)

This task involved the selection of one of three possible one-digit numbers resulting in access to a preferred video on the computer. For this task, a code-board was created, which lay over the computer's keyboard displaying the numbers, “1”, “2”, and “3”. The participant watched the peer-model press each of the three possible numbers. When the correct button was selected, the teacher played a video on the computer via a wireless mouse. After each observation, the teacher said to the participant, “Put in the code” and presented the code-board. During the probe sessions, correct digits were counterbalanced across three trials so that each digit was systematically correct once. In the imitation, delayed imitation and consequence discrimination conditions of the training phase, correct digits were counterbalanced across nine trials (i.e., one session) so that each digit was systematically correct three times.

Vocal-Response Task (T3)

The objective for this task was to assess observational learning with a vocal-verbal response. The participant observed the peer-model say three nonsense words (i.e., “pox”, “zing”, and “wam”), with one word resulting in access to an iPad® inside of a closed box. Nonsense words were selected to control for a history of reinforcement and were determined to be easily distinguishable when heard. Furthermore, all nonsense words were one-syllable. Preferred iPad® games were determined via a preference assessment and were uploaded to the device prior to the onset of evaluation. After each observation, the teacher presented the box with the iPad® inside and provided the instruction, “Say the word”. In the probe conditions, correct words were counterbalanced across three trials so that each word was systematically correct once. In the imitation, delayed imitation and consequence discrimination conditions of the training phase, correct words were counterbalanced across nine trials (one session) so that each word was systematically correct three times.

Task Variations (Aspen and Forrest Only)

We added task variations to evaluate the generalization of observational learning within tasks. For each task variation, the response mode remained the same, while some stimulus attribute of the response, as well as the reinforcement provided contingently, was modified. For the motor-response task, the size and color of the boxes were changed and the reinforcer acquired was a preferred toy (i.e., piggy-bank for Aspen, bus for Forrest). For the motor-selection task, the numbers on the code-board were changed to shapes and correct responding resulted in access to a preferred application on the laptop (i.e., camera for Aspen, music for Forrest). For the vocal-response task, the nonsense words were changed to, “boc”, “fib”, and “yet”, and the preferred activity obtained was access to the gym, which had a swing, scooters, bikes, a trampoline, a slide, and other highly preferred items.

Materials

The materials required for each session were condition-specific, except for two tables, two chairs, a laptop, a wireless mouse, a clipboard for data collection, a tripod and a camera, which were present for all sessions. A white laminated cover was created and taped over the keyboard prior to all sessions. The participants did not receive access to any of the experimental items outside of sessions.

The materials for the motor-response task (Appendix A.1) included three medium-sized black-and-white striped boxes, a bubble machine, and a container of bubble solution. Prior to the onset of the study, the teacher measured the amount of bubble solution that could be poured into the machine to generate bubbles for approximately 30-s. The bubble solution container was always full prior to sessions but was marked with a permanent marker so that the teacher knew how much to pour into the machine after a correct response. This was done to increase the value of finding the bubbles in subsequent trials. If the participant could see that the machine was full of solution at the end of a trial, the value of finding more solution might decrease. For the motor-response variation task (Appendix A.2), large, red boxes and a highly preferred toy were used (i.e., singing piggy-bank for Aspen, musical bus for Forrest).

For the motor-selection task (Appendix A.3), we developed a code-board, which was white, laminated, and the same size as the cover placed over the laptop's keyboard. On the code-board was the number 1, the number 2, and the number 3, all evenly spaced apart and with a black box bordering them. Highly-preferred videos were determined via parent and staff report and were downloaded onto the laptop prior to sessions. The code-board used for the motor-selection variation task (Appendix A.4) was identical, with the exception that a circle, a square, and a triangle replaced the numbers 1, 2, and 3. Additionally, correct responses resulted in access to the camera on the laptop (Aspen) or music played via the laptop (Forrest).

For the vocal-response task (Appendix A.5), a transparent box large enough to hold an iPad® and a matching lid were used. Highly-preferred games were determined via parent and staff report and downloaded onto the iPad® prior to sessions. For the vocal-response variation task (Appendix A.6), an identification badge, which when swiped at an access point near the gym unlocked the door, was used.

The materials required for each probe session were identical to those used in the training sessions, with the exception of a few materials for the in-vivo probes: A Bluetooth® earbud was used so that the experimental assistant could communicate with the peer-model from outside of the research room. The peer-model wore a headband to avoid the earbud falling out mid-session. Additionally, an extra chair was present for in-vivo probes for the peer-model's use.

Setup

The general setup in the experimental setting remained constant throughout probe and training conditions (Appendix A.1-A.8). In some cases, the selected setup aided in maintaining treatment integrity. For example, because the table and chair faced away from the area with the boxes during the motor-response task sessions, the teacher could hide the bubble container between trials without the participant seeing. The task-specific materials were the only variables to change within the setup of the room. This was done to exert stimulus control over the reinforcement contingency available across conditions. In other words, we wanted the participant to be able to predict what reinforcement was obtainable (i.e., bubbles, videos, or games) when they entered the room.

Measures

In the probe conditions, the dependent variable was the number of correct, independent performances for each observational learning task across tasks. A correct OL performance was defined as imitating the reinforced response of the peer-model. We also collected data on two categories of errors: incorrect responses and nonresponses. An incorrect response was scored if the participant imitated the nonreinforced response of the peer or engaged in a different response topography following the model. A nonresponse was scored if the participant did not respond within 5-s of the model.

During training conditions, the dependent variable was the percentage of correct, independent performance of each component skill. Attending was scored as correct if the participant's gaze oriented to the computer screen for the entirety of the video-model. An incorrect response was scored if the participant's gaze shifted from the screen at any point during the video-model. Imitation and delayed imitation were scored as correct if the participant performed an identical response to that of the peer-model. An incorrect response was recorded if the participant engaged in any response other than that of the peer. The definitions of correct and incorrect responses during consequence discrimination training were identical to those during the in-vivo and video-model probes. Additionally, nonresponses were scored during all component skills training and were recorded if the participant did not respond within 5-s of the model. We calculated the percentage of correct responses by dividing the number of correct responses by the total number of trials in the session, multiplied by 100. The independent variable during attending training was corrective feedback, while a variation of peer-monitoring prompting (DeQuinzio & Taylor, 2015; Delgado & Greer, 2009), provided in a least-to-most framework, was used to train imitation, delayed imitation, and consequence discrimination. During training, we set mastery-criterion at two consecutive sessions at or above 83% (5/6) correct for attending training, and 89% (8/9) correct for imitation, delayed imitation, and consequence discrimination training. Additionally, mastery of a component skill was met only if repeated error patterns (e.g., incorrect to the same response) were not observed across sessions.

Experimental Design

We used a concurrent multiple-probe embedded in a multiple-baseline design across participants to assess the emergence, or lack thereof, of generalized observational learning during in-vivo and video-model probes pre- and post-component skills training. We assessed generalization from untrained to trained tasks (i.e., across tasks), from trained tasks to untrained task variations (i.e., within tasks), and from video-model to in-vivo conditions.

One of the hallmarks of applied behavioral science is the use of single-subject designs to systematically evaluate the effects of an intervention for an individual while demonstrating experimental control. According to Baer et al. (1968), "an experimenter has achieved an analysis of behavior when he can exercise control over it" (p. 94). The multiple-baseline (MBL) design is one such design that repeatedly demonstrates the effects of the independent variable on the dependent variable across individuals, settings, or responses. Experimental control is sufficiently demonstrated in a three-part process. First, repeated measures during baseline conditions allow for the prediction of a data path. Second, the effects of the independent variable are verified by demonstrating that the independent variable violates the baseline prediction by producing a change in behavior *and* change does not occur across the other individuals, settings, or responses. Finally, with sequential introduction of the independent variable, the effects of the independent variable are replicated (Carr, 2005). The MBL design primarily protects against two threats to internal validity, historical events and participant maturation (Kazdin, 1982). That is, the independent variable is introduced at different points in time which protects against historical events and behavior change does not occur over time until the independent variable introduced (i.e., participant maturation). Additionally, the MBL design is likely appealing to applied researchers because it does not require removal of the independent variable, which is advantageous when systematic removal of the independent variable is not practical or possible (Baer et al., 1968; Byiers et al., 2012; Carr, 2005; Watson & Workman, 1981).

Horner and Baer (1978) introduced a variation of the multiple-baseline design, called the multiple-probe design, which combines multiple-baseline and probe techniques. This results in a discontinuous baseline measure, which is particularly useful when extended baseline measures may prove reactive, such as in the current study. In other words, because reinforcement was provided contingently upon correct responses during baseline conditions, the probe technique potentially reduced the impact of repeated exposure to reinforcement during the pre-training sessions.

Data Collection

Each data sheet included a section for reporting the session number, date, child, teacher, skill, and task(s). The teacher always filled out this information prior to sessions. During each trial, the teacher recorded the child's response, whether that response was correct, incorrect, or a nonresponse, and any relevant notes. While nonresponses were counted as errors for our data analysis, we determined that it was important to record when these responses occurred due to the implications of responding incorrectly versus not responding at all. Because patterns of both errors and nonresponses can be very helpful in determining what the relevant barriers to skill acquisition are, the notes section was included.

Prior to each session, with the exception of the attending training sessions, the teacher filled out the section on the data sheet designated for the peer-model's correct response, based on the video-model session to be used. This was done for three reasons. First, for all motor-response trials, the item required for a correct response (i.e., the bubble solution) needed to be put into place (i.e., under the correct box) prior to the participant's response. It was crucial that the teacher know which position was correct next to ensure that reinforcement occurred contingent on a correct response. Second, the additional data was useful in case the teacher missed the correct response during the video-model due to recording data, watching the participant to ensure s/he was attending, etc. Third, it was much more efficient to complete an error analysis if all the relevant information was reported per trial. Rather than have to refer to the session scripts, video-models, etc., the teacher could see patterns of errors in relation to the corresponding video-models at once.

Interobserver Agreement

A second observer scored a minimum of 30% of all training and probe condition sessions per participant for interobserver agreement (IOA). We calculated trial-by-trial IOA by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. An agreement was defined as both observers recording the same response (i.e., correct, error, non-response) per trial. A disagreement was defined as the observers recording different responses during a trial. The secondary observer used the same data sheet template as the teacher when taking IOA measures and designated whether data collection occurred via direct observation or via taped videos of the session. For River, mean agreement was 87% (range, 80% to 100%) for attending training, 100% for imitation, delayed imitation and consequence discrimination training, and 100% for probe sessions. For Aspen, mean agreement was 100% for attending, imitation, delayed imitation, and consequence discrimination training, and 100% for probe sessions. For Forrest, mean agreement was 90% (range, 80% to 100%) for attending training, 100% for imitation, delayed imitation, and consequence discrimination training, and 100% for probe sessions.

Procedural Integrity

The second observer also collected treatment integrity data on at least 30% of all training and probe condition sessions per participant. Treatment integrity data were collected on data sheets created for each condition. For each session, the total number of trials implemented correctly was divided by the total number of trials conducted and multiplied by 100. For River, mean treatment integrity was 87% (range, 80%-100%) for attending training, 100% for imitation, delayed imitation, and consequence discrimination training, and 100% for probe sessions. For Forrest, mean treatment integrity was 100% for attending imitation, delayed imitation, and consequence discrimination training, and 100% for probe sessions. For Forrest, mean treatment integrity was 90% (range, 80% to 100%) for attending training, 100% for imitation, delayed imitation, and consequence discrimination training, and 100% for probe sessions.

Procedure

Video-Models

Video-models were produced prior to the onset of the study. All video-models were filmed in the same room and with the same setup as that of the participants' sessions. The peer-model stood in the same place during the onset and offset of each video per task to ensure that the participant was attending to the response, rather than the starting or ending position, of the peer. Additionally, all videos were taped from a third-person perspective (Rayner, Denholm, & Sigafoos, 2009). This was done to reflect the same view the participants had of the peer during in-vivo probe sessions. The videos for the consequence discrimination conditions lasted approximately 30-s in length and showed the peer-model attempt three different responses for a given task, with one response resulting in reinforcement. These videos were also used for training during the attending condition because we wanted the participant to attend to the entire sequence of the peer's responding. The videos for the imitation and delayed imitation conditions were each approximately 5-s and showed the peer-model performing a single response. Videos for each component skill were filmed for all three tasks because training was always conducted task-specific.

In-vivo Pre-Training Probes

The purpose of this phase was to assess the presence of observational learning in a naturalistic-play session with a peer-model. The teacher created three different sessions, which each counterbalanced the three correct responses per task across nine total trials. Two scripts were produced with this information; one script for the teacher (i.e., inside of the room) and one for the experimental assistant (i.e., outside of the room). Before the start of the session, the peer-model inserted the Bluetooth® earbud and tested its functionality. At the start of each in-vivo probe session, the teacher entered the room with the participant and the peer-model. The teacher used the script to guide the children through the activities, while the experimental assistant used the script to instruct the peer-model via the Bluetooth® how to respond to each trial. For example, the teacher said, "Let's play with the bubbles! Autumn, you get three tries. Find the bubbles!" The experimental assistant then instructed Autumn through the Bluetooth® to lift each box in the previously determined order, with one box resulting in access to the bubbles. When the bubbles were found, the teacher poured the solution into the machine and turned in on, providing access to both the peer-model and the participant for approximately 30-s. During the reinforcement period, the teacher waited for a moment when the participant's back was turned to the boxes and hid the bubbles under the previously correct box. Immediately following the reinforcement period, the teacher picked up the bubble machine and said, "Your turn (participant), you get one try. Find the bubbles!" If the participant responded correctly, the reinforcement period ensued again. Reinforcement, therefore, occurred contingent on correct responding during all probe sessions. If the participant responded incorrectly, the teacher said, "Good try!" and moved on to the next trial. Procedures were put in place to avoid the participant responding to a previous trial. For example, we did not want the participant to find the bubbles underneath a box during a vocal-response or motor-selection task trial. For the motor-response task, the teacher kept the bubbles in a sweater pocket. The teacher also kept the bubble machine, the code-board, and the closed box with the iPad® inside on a high shelf between trials. These procedures permitted a "free operant" setting. In other words, we did not have to block responses, such as turning on the bubble machine, opening the box with the iPad®, and so on. The teacher reset each motor-response trial (i.e., hid the bubbles) immediately preceding its next occurrence in the session.

Video-Model Pre-Training Probes

The purpose of this phase was to assess the presence of observational learning via video-models of a peer-model. Procedures were identical to those in the in-vivo pre-training probes condition, with the exception that the participant observed the peer-model via video-model, rather than in-vivo. Furthermore, upon a correct peer response, the participant observed the peer obtain access to the task-specific reinforcer via video. Therefore, the participant only received reinforcement for the peer's correct response during the in-vivo probes.

Component Skills Training

We taught four skills, identified as component skills for observational learning by previous literature (MacDonald & Ahearn, 2015). Across all components, participants received 30-s access to reinforcement for correct unprompted and prompted responses.

We trained attending first, which was defined as the participant's gaze oriented to the computer screen. Prior to attending training, we ensured that each participant could label Autumn on the video-model. The teacher began each session with the instruction, "Watch Autumn" and played the video-model. If at any point during the video the participant looked away from the screen, the teacher stopped the video and provided feedback (e.g., "Oh no, you looked away") and started the video again.

The second skill taught was imitation. The teacher began each session with the instruction, "Do what Autumn does" and played the video-model. Imitation was recorded as correct if, after watching the peer-model engage in a response, the participant engaged in an identical response. For example, during the motor-response task, if the peer-model selected the box on the floor, the participant should also select the box on the floor. If an incorrect response occurred, the teacher provided a peer-monitoring prompt by playing the video again and asking the participant to label the correct response of the peer. For example, during the motor-selection task, the teacher asked the participant, "What number did Autumn pick?" If the participant responded correctly the teacher said, "Great! Touch the same number". If the participant responded incorrectly, the teacher replayed the video. After the second viewing of the video, the teacher provided the peer-monitoring prompt, as well as a direct vocal prompt, such as, “What number did Autumn pick? Three!” If the participant responded incorrectly again, the teacher repeated the previous prompt and added a model prompt (e.g., pointed to the correct number). Following an error-analysis of River’s second session of imitation training on the motor-response task, we added a step for all participants prior to beginning imitation and delayed imitation training to show the participant that the task-specific reinforcer was not available. For the motor-response task, the teacher turned over all the boxes and said that there were no bubbles to find. For the motor-selection task, the teacher showed the participant that the video clips, which were usually visible on the computer’s desktop, were gone. For the vocal-response task, the transparent box which usually held the iPad® was gone. A rationale for this procedural modification is provided in the discussion section.

Delayed imitation was the third skill taught. Delayed imitation was defined as, engaging in an identical response to that of the peer-model after a 30-s delay. A 30-s delay was selected because it was the average length of the consequence discrimination video-model videos. The procedures for this condition were identical to the imitation condition, with the exception that the teacher started a timer for 30-s at the offset of the video-model. The participant could see the numbers on the timer count down from 30 during the delay. When the timer went off, the participant was allowed to make a response.

The last skill trained was consequence discrimination. Consequence discrimination was considered correct if, after viewing the video-model, the participant engaged in the one response that resulted in reinforcement. For example, the participant watched a video of the peer-model say the words, “pox”, “zing”, and “wam”, with emittance of the word, “zing” resulting in the teacher opening the box and providing access to the iPad® inside. After viewing the video, the teacher said, “Say the word” and presented the same closed box. If the participant said the word, “zing”, he/she received 30-s access to the iPad®. If the participant did not say the correct word, the teacher replayed the video. Immediately following the correct response during the second presentation of the video, the teacher said, “What word opened the box?” If the participant responded correctly, the teacher said, “Great! Say the same word.” If the participant responded incorrectly the teacher replayed the video and provided the additional direct vocal prompt, “What word opened the box? Zing!” If the participant did not repeat the correct word, the teacher repeated the previous prompt and included an additional instruction (e.g., “Say, zing”).

Video-Model Post-Training Probes

The purpose of this phase was to assess the generalization of observational learning from trained to untrained tasks under video-model conditions. Procedures for this phase were identical to those described in the video-model pre-training probes section.

In-vivo Post-Training Probes (Aspen and Forrest Only)

The purpose of this phase was to assess the generalization of observational learning from video-model post-training to in-vivo post-training conditions. Procedures for this phase were identical to those in the in-vivo pre-training probes section.

General Procedure

A flow chart of the general procedures is provided in Figure 1. All participants’ involvement in the study began with three in-vivo pre-training probes, followed by video-model pre-training probes. If a participant responded below 100% for one or more tasks, tasks were selected for training in the following order: motor-response, motor-selection, and vocal-response. Tasks performed reliably at 100% during the probe sessions were not trained. Component skills were always trained in the following order: attending, imitation, delayed imitation, and consequence discrimination. Following mastery of the four component skills for a given task, a video-model post-training probe was conducted. If responding across all tasks did not meet 100% accuracy, the training sequence was initiated again with the next task. Three-trial probes were conducted for each component skill for subsequent training sequences. If any component skill was not performed at 100% accuracy during the three-trial probe, training on that skill began. Once the participant performed all tasks at 100% during the video-model post-training probes, the in-vivo post-training probes were scheduled and conducted. For Aspen, the in-vivo post-training probe did not occur immediately following mastery of the video-model post-training probes due to scheduling conflicts. However, this limitation was addressed by conducting a video-model probe immediately preceding the in-vivo probe to ensure maintenance of correct responding before assessing generalization.

Results

Figure 2 represents observational learning across tasks pre- and post-training during in-vivo and video-model conditions for three participants. Table 1 includes the number of training sessions required for mastery of each component skill per task for each participant.

During the in-vivo pre-training probes, River demonstrated some correct responding to the motor-response task and no correct responding to the motor-selection or vocal-response tasks. Similar responding was demonstrated in the video-model pre-training probes condition. A total of 22 training sessions occurred for the motor-response task. Within eight sessions, River reliably attended to the video-model across trials. Nine and two sessions were conducted for imitation and delayed imitation, respectively. Consequence discrimination was mastered within three sessions. Following training on the motor-response task, correct responding for both the motor-response and vocal-response tasks reached 100% accuracy. Additionally, a few correct responses for the motor-selection task occurred following the first training sequence, but performance did not meet 100%. Therefore, training on the motor-selection task was initiated. River did not require training on attending, imitation, or delayed imitation skills with any task other than the motor-response task. In other words, consequence discrimination was the only component skill that required task-specific training for both the motor-response (i.e., three sessions) and motor-selection tasks (i.e., six sessions). A total of 28 training sessions occurred for River across all tasks. Following the second training sequence, correct responding across all tasks reached and maintained at 100% accuracy during the video-model post-training probes. A one-month follow-up probe was included and demonstrated maintenance of correct responding. The in-vivo post-training probes were not conducted with River as she was graduated from the autism center and was no longer available for further assessments.

Aspen demonstrated some correct responding across both the motor-response and motor-selection tasks and no correct responding for the vocal-response task during the in-vivo and video-model pre-training probes. Following the video-model pre-training probes, training began for the motor-response task. Attending was trained in three sessions. Imitation reached mastery-criterion within six sessions and delayed imitation was taught in three sessions. Consequence discrimination was mastered in two sessions. This performance maintained in the subsequent video-model post-training probes but did not generalize to the untrained tasks. Therefore, training on the motor-selection task began. Delayed imitation was the first component skill that required training and was mastered in four sessions. Consequence discrimination was mastered in two sessions, with each requiring prompting for one trial. Aspen returned to video-model post-training probe conditions and correct performance, again, did not generalize to the last untrained task. During the task-variation probes, generalization was observed to the variations of the tasks that had previously been trained (i.e., motor-response and motor-selection), but not to the untrained task. Therefore, training on the vocal-response task was initiated. Consequence discrimination was the only component skill which required training and was mastered within three sessions. Therefore, a total of 23 training sessions occurred for Aspen. Following the completion of the training sequence, Aspen's correct performance per task and task variation maintained at 100% accuracy. During the in-vivo post-training probes, Aspen performed more correct responses across tasks (i.e., 17) than in the in-vivo pre-training probe condition (i.e., 8), but none of the sessions conducted reached 100% accuracy for all tasks.

The motor-response task was the only task in which Forrest engaged in correct responses during the pre-training conditions. Across ten video-model pre-training probe sessions, Forrest engaged in six correct responses to the motor-response task (and one task variation) out of a possible 30. During training on the motor-response task, Forrest required four sessions for teaching attending, two for imitation, six for delayed imitation, and two for consequence discrimination. Because correct responding did not generalize to the untrained tasks during the video-model post-training probes, training on the motor-selection task was initiated. Consequence discrimination training was the only skill that required teaching following the first training sequence and was mastered in three sessions. Generalization was then observed to the motor-selection task variation, but not to the vocal-response task or task variation. Therefore, training on that task ensued. Attending, imitation and delayed imitation were performed at 100%

accuracy during the three-trial probes, and consequence discrimination met mastery-criterion within three sessions. Following the third training sequence, all tasks and task variations were performed at 100% accuracy. During the in-vivo post-training probes, Forrest engaged in more correct responses (i.e., eight) than in the pre-training probe condition (i.e., one), but none of the tasks reached 100% accuracy.

Discussion

Our replications of the procedures in MacDonald & Ahearn (2015) involved assessing the observational learning skills of three children with ASD across three play-based tasks (i.e., motor-response, motor-selection, and vocal-response) and within task variations. If observational learning was not present for any task, we taught attending, imitation, delayed imitation, and consequence discrimination under the conditions of the deficient task using least-to-most peer-monitoring prompting.

Although some correct responses occurred for the motor-response and motor-selection tasks for all participants pre-training, none of the children reliably engaged in observational learning for any task. The data indicate that teaching attending to the model, imitation, delayed imitation and consequence discrimination for a specific task was successful for achieving and maintaining 100% correct responding for the trained task and the corresponding task variation during subsequent probe sessions. Although consequence discrimination training taught what was to be evaluated in the probe conditions, it was conducted task-specific during training. Therefore, the data demonstrate that mastery-criterion performance maintained when other tasks, sometimes not at mastery-criterion, were conducted in the same nine-trial session.

All participants required training on all four component skills for the first task introduced (i.e., the motor-response task). The data show that, following the first training sequence, two of the participants (i.e., River and Forrest) demonstrated generalized attending, imitation, and delayed imitation repertoires when assessed with subsequent tasks. Aspen's results were identical, except that he required four delayed imitation training sessions to meet mastery-criterion on the motor-selection task. However, consequence discrimination training was required for every participant as a new exemplar was introduced. Therefore, while generalized attending, imitation, and delayed imitation repertoires were present, it is not the case that a generalized consequence discrimination repertoire was acquired.

We additionally extended the results of MacDonald & Ahearn (2015) by assessing observational learning of a similar-aged typically-developing peer across in-vivo and video-model probe conditions. Furthermore, we used video-models of a peer to teach the series of OL component skills.

All participants performed some tasks correctly during the pre-training observational learning probes for both in-vivo and video-model conditions. It is possible that more correct responses for the motor-response task occurred during pre-training conditions, relative to the other tasks, because the participants engaged in the correct topography of the response prior to training. In other words, River and Aspen turned over a box each time. Therefore, there was no confusion as to *what* response was reinforced (i.e., turning over a box), the error was a result of not knowing *which* response was reinforced (e.g., turning over the box on the table). This rendered a 33% chance to respond correctly without the target skill (i.e., consequence discrimination). Forrest, on the other hand, only sometimes turned over a box when provided the opportunity to respond, even after reinforcement occurred for correct selections pre-training.

Aspen was the only participant who engaged in some correct responding for the motor-selection task during pre-training conditions. In contrast, River and Forrest engaged in various non-target response topographies. River consistently picked up the code-board and set it back down on the laptop, while Forrest touched multiple numbers consecutively (i.e., scrolled). The vocal-response task was the only one in which no correct responding occurred during pre-training conditions. Additionally, this was the only task for which none of the participants responded with the correct response topography (i.e., saying a nonsense word) when provided the opportunity. This is possibly because we were competing with a well-established history of reinforcement for mands such as, “open the box”, “iPad®, please”, etc., which were responses commonly emitted prior to vocal-response training. This provides support for the use of nonsense words, as correct responding pre-training may have been due to an extra-experimental history of reinforcement (i.e. turning over boxes), rather than observational learning.

Both participants who participated in the post-training in-vivo probes engaged in correct responses for every task. Prior to training, Aspen engaged in four correct responses to the motor-response and motor-selection tasks, and no correct responses to the vocal-response task. Following training, Aspen performed seven correct responses to the motor-response task, five to the motor-selection task, and five to the vocal-response task. Forrest performed the correct response once prior to training and engaged in no correct responding for the motor-selection or vocal-response tasks. Following training, Forrest engaged in four correct responses to the motor-response and motor-selection tasks, and one correct response to the vocal-response task. Therefore, both participants engaged in more overall correct responses post-training than pre-training during the in-vivo probes. Aspen engaged in a total of eight correct responses across three sessions pre-training and 17 correct responses post-training. Forrest engaged in one and eight correct responses, respectively. Therefore, the data indicate that some generalization of observational learning occurred following video-modeling training to in-vivo conditions.

Given that the establishment of observational learning is most advantageous when it expands an individual's repertoire (Rosales-Ruiz & Baer, 1977), it is important to consider how to promote generalization of consequence discrimination across observational learning opportunities and contexts. Stokes & Baer (1977) differentiate between two types of generalization: passive and active. *Passive* describes generalization which occurs as a "natural outcome of any behavior-change process", while *active* generalization is "produced by procedures specific to it" (p. 349). Fortunately, much of the recent literature exploring observational learning has taken an active generalization approach. However, no studies have successfully engineered what we may all agree is a generalized observational learning repertoire. Therefore, the question that remains is: how does one program for this outcome?

The use of multiple exemplars is often used to promote generalization of instruction. However, it is often insufficient to train using multiple exemplars if the exemplars are not systematically selected based upon the diversity of the possible contexts in which the desired behavior will occur. It then seems appropriate to recruit techniques used to establish concept formation and apply them to the formation of an observational learning repertoire. According to Layng (2013), "every example of a concept shares certain *must have* features with all other examples of the concept. In addition to these *must have* features, the examples have other *can have* features, which other examples of the concept may or may not have" (p. 2). Listing the *can have* features, or *variable attributes* (Tiemann & Markle, 1990), of observational learning can be helpful to systematically determine sufficient sets of training and teaching exemplars. Stokes & Baer (1977) expand on this notion in their discussion of active generalization by saying the “diversity of exemplars seems to be the rule to follow in pursuit of the maximum generalization. Sufficient diversity to reflect the dimensions of the desired generalization is a useful tactic” (p. 357). Here, the term *dimensions* can be applied to each of the three defining components of a contingency: antecedents, responses, and consequences.

The antecedents in an observational learning contingency include the observed model, the modeled response, and the discriminative stimulus (S^D) signaling the availability to respond. In the current study, a similar-aged peer served as the model and always engaged in three distinctive, but similar, responses. The S^D was the teacher picking up the bubble machine (i.e., motor-response), presenting the code-board (i.e., motor-selection), picking up the box (i.e., vocal-response), and providing the task-specific vocal prompt (e.g., “Find the bubbles”). In other circumstances, the observed model could be familiar or unfamiliar, as well as a single person or a group of people. The modeled response(s) could vary from a few simple responses, such as in the current study, to a multitude of complex responses. The S^Ds also alter depending on the context and may take the form of instructions (e.g., “Your turn”), cues (e.g., being next in line), and so on.

There are also numerous types of responses that may occur within an observational learning contingency. These classes of responses include motor, vocal, receptive, social, leisure and other academic responses (Taylor, 2017; MacDonald & Ahearn 2015). A motor-response, motor-selection, and vocal-response were evaluated and trained in the current study and generalization to an untrained task occurred for one task (i.e., vocal response) for one participant (i.e., River). It is possible that more robust generalization to untrained tasks would have been observed had we continued to introduce novel exemplars that involve different types of responding.

The observed consequences for responding are important to consider, as well. While the current study targeted reinforcement versus neutral contingencies, other consequences, in isolation or in combination with others, exist. For example, an individual may engage in observational learning to avoid punishing contingencies, rather than to access reinforcement. Additionally, not only is it important to consider the observed consequences in observational learning, but it is equally important to consider the consequences produced as a result of observational learning. In some situations, engaging in the reinforced response of another does not access reinforcement. For example, a student who has been taught to imitate the correct responses of others would not receive reinforcement if s/he were caught cheating on a test. Not only does observational learning not yield reinforcement in this scenario, it would likely produce punishment in the form of the teacher scolding the student.

Other dimensions of observational learning contingencies to explore include the temporal latency between the model and the response (e.g., responding to an observational learning opportunity minutes, hours, days, weeks, etc. after a model) and the setting (e.g., playground, classroom, home, etc.)

Given the focus on training across exemplars, it is critical to emphasize that "…diversity may also be our greatest enemy: too much diversity of exemplars and not enough (sufficient) exemplars of similar responses may make potential gains disproportional" (Stokes & Baer, 1977, p. 357). This illustrates the purpose of the task variations we added to our procedures for Aspen and Forrest. It is critical to balance the number of novel exemplars with the variations of each exemplar introduced. For both participants for whom we measured responding to the untrained task-variation following training on the corresponding task, generalization was observed.

Our recommendation for future research for promoting generalization of observational learning is to compile a sample of OL exemplars which sufficiently addresses the possible dimensions of OL contingencies. Future research should also determine at what point robust generalization of consequence discrimination occurs. We also recommend that other suggestions for facilitating generalization provided by Stokes & Baer (1977) are programmed for, such as to loosen experimental control over the stimuli and responses involved in training by training different examples concurrently.

As mentioned, the data indicate that teaching attending, imitation, delayed imitation, and consequence discrimination of a specific task was successful in maintaining observational learning to that task during the video-model post-training probes and, to a lesser but still observable extent, the in-vivo post-training probes. We would, however, like to provide some thoughts on how to teach these components in order to facilitate an OL repertoire, based on the current findings.

Our definition of attending involved the participant's gaze staying within the boundaries of the computer screen. Therefore, as per our definition, the participants were trained to *look* at the screen, but not to *watch* the peer-model. According to Patten & Watson, 2011, attending within an OL framework includes the following features: physically orienting towards a stimulus, sustaining attention to a stimulus, and shifting attention from one stimulus to another. Our definition lacked the third feature of shifting attention amongst stimuli, which is required for an observational learning repertoire. Criteria for establishing attending using video-models within this context in future studies should include not only sustaining attending to the screen but also attending to the responses of the peer observed on the video. For example, during training on the motor-response task, the teacher could require a differential observing response, such as asking the participant to tact the location of the boxes as the peer picked them up. This would ensure that the participant tracked the movement of the peer, rather than attended to an irrelevant aspect of the screen (e.g., the play button). This is particularly relevant for participants diagnosed with ASD, as some research suggests that children with autism attend less to the movement of an adult and child engaged in play and more to background stimuli than their typically developing peers (Taylor & DeQuinzio, 2012; Shic, Bradshaw, Klin, Scassellati, and Chawarska, 2011). While it is true that success in future training conditions (e.g., imitation) was contingent upon attending to the responses of the peer, it would not be ideal if the participants inadvertently learned during this condition that the peer's demonstration in the video was irrelevant because accessing reinforcement was not contingent upon directly responding to the peer's model.

Another recommendation involves the materials used during the training of imitation and delayed imitation. After watching the video-model during the imitation condition for the motor-response task, River commonly said things like, "Where are the bubbles?" and "Find the bubbles" immediately prior to an incorrect response. We suspected that River was possibly responding away from the response of the peer-model intentionally because the bubbles were absent from the video-model during this condition. Procedurally, this was done so the consequence discrimination training and probe conditions were the only ones in which the task-specific reinforcement was provided. However, each participant had exposure to the task-specific reinforcement contingencies during the probe sessions, which occurred prior to training. It is possible that River engaged in a different type of observational learning (i.e., respond away from neutral consequences) than what was measured in the current study (i.e., imitate the reinforced responses of others). Because River did not see the peer-model access the bubbles, she may have excluded that response and engaged in another, which was counted as incorrect during this condition. Once we discovered the pattern of River's incorrect responding, we included a step in our procedures to show each participant that, although the task materials were present, the task-specific reinforcement was not available in attending, imitation and delayed imitation training. Therefore, we recommend that future researchers train attending, imitation, and delayed imitation using similar, but non-task-specific, materials. Training stimuli should only be introduced after these generalized component skills are established. Additionally, we recommend that researchers, as well as practitioners, first train attending, imitation, and delayed imitation to a generalized state. Once the initial prerequisite skills are at strength, consequence discrimination training should be implemented with our recommendations for training across multiple exemplars considered.

One potential limitation of the current study is that we did not conduct reinforcer assessments of the tasks or the task-specific consequences prior to the onset. While highly preferred activities, videos, and games were identified via parent and staff report and used in the current evaluation, it could be said that any lack of observational learning was due to lack of motivation for the programmed consequence. However, this seems unlikely, as all participants were eager to come to sessions. The staff reported that the children asked for the teacher and to go to the research room (i.e., Room 8) throughout the day. Additionally, each participant approached the teacher and asked to go to Room 8 without prompting whenever she entered the room. Although this limitation did not seem problematic for the current study, this assumption is based on anecdotal information. Future research should conduct reinforcer assessments for both tasks and task-consequences to ensure that a true measure of observational learning is captured.

It may be argued that reinforcement provided contingently upon correct responding during the probe conditions is a limitation of our study. However, we determined that providing reinforcement for correct responses captured a more accurate depiction of whether observational learning was present for a given participant. In other words, we did not want extinction for correct responding to influence future responses to observational learning tasks in our study. Additionally, because all the participants contacted varying degrees of reinforcement during pre-training probes and still did not reliably engage in observational learning, we can conclude with confidence that the participants did not present an observational learning repertoire prior to evaluation

In summary, observational learning is an important skill for the acquisition of new skills without direct instruction. The current results demonstrate the utility of video-modeling for teaching prerequisite skills of observational learning, as well as for assessing the presence of OL in subsequent probe conditions. Additionally, while robust generalization across OL tasks was not observed, generalization from video-model conditions to in-vivo conditions was demonstrated for both participants for whom we measured this response. All opportunities to engage in observational learning occurred following the model of a similar-aged typically-developing peer. Based on the current results, we recommend that future endeavors to teach an observational learning repertoire place emphasis on selecting exemplars that are exhaustive in terms of OL dimensions, while also ensuring that sufficient exemplars within each dimension are introduced. We also recommend that if generalized attending, imitation, and delayed imitation repertoires are not present prior to training, teach these skills using similar, but different, stimuli than those used during probes for observational learning. Third, the addition of peer-monitoring measures might be useful in training the participant to observe the peer’s responses, as well as the consequences of those responses. Additionally, we recommend that future research conduct reinforcer assessments of both task responses, task materials, and task consequences prior to evaluating the presence of observational learning. These recommendations may prove useful for developing programs that teach a generalized observational learning repertoire.

Table 1

Number of Training Sessions Required for Mastery of Each Component Skill per Task

Number of Training Sessions Required for Mastery of Each Component Skill Per Task						
Participant	Task	Attending	Imitation	Delayed Imitation	Consequence Discrimination	Total
River	T1	8	9	2	3	22
	T2	0	0	0	6	6
	T3	0	0	0	0	0
	Total	8	9	2	9	28
Aspen	T1	3	6	3	2	14
	T2	0	0	4	2	6
	T3	0	0	0	3	3
	Total	3	6	7	7	23
Forrest	T1	4	2	6	2	14
	T2	0	0	0	3	3
	T3	0	0	0	3	3
	Total	4	2	6	8	20

Note. T1 = Motor-response, T2 = Motor-selection and T3 = vocal-response.

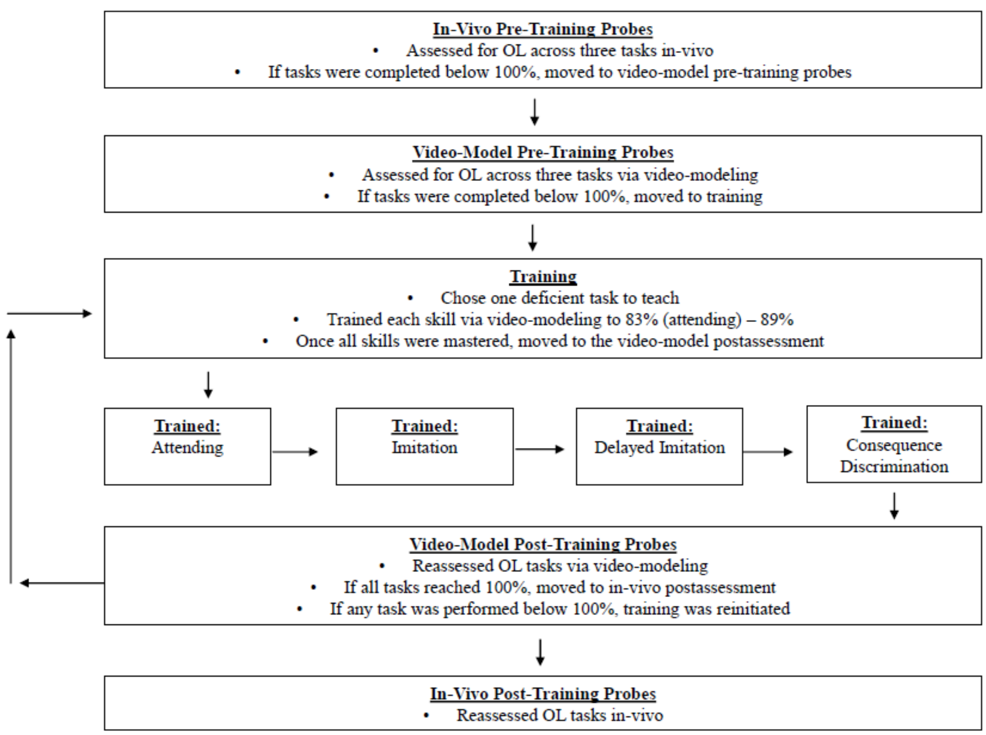


Figure 1. Flow chart of general procedures (based on MacDonald & Ahearn, 2015).

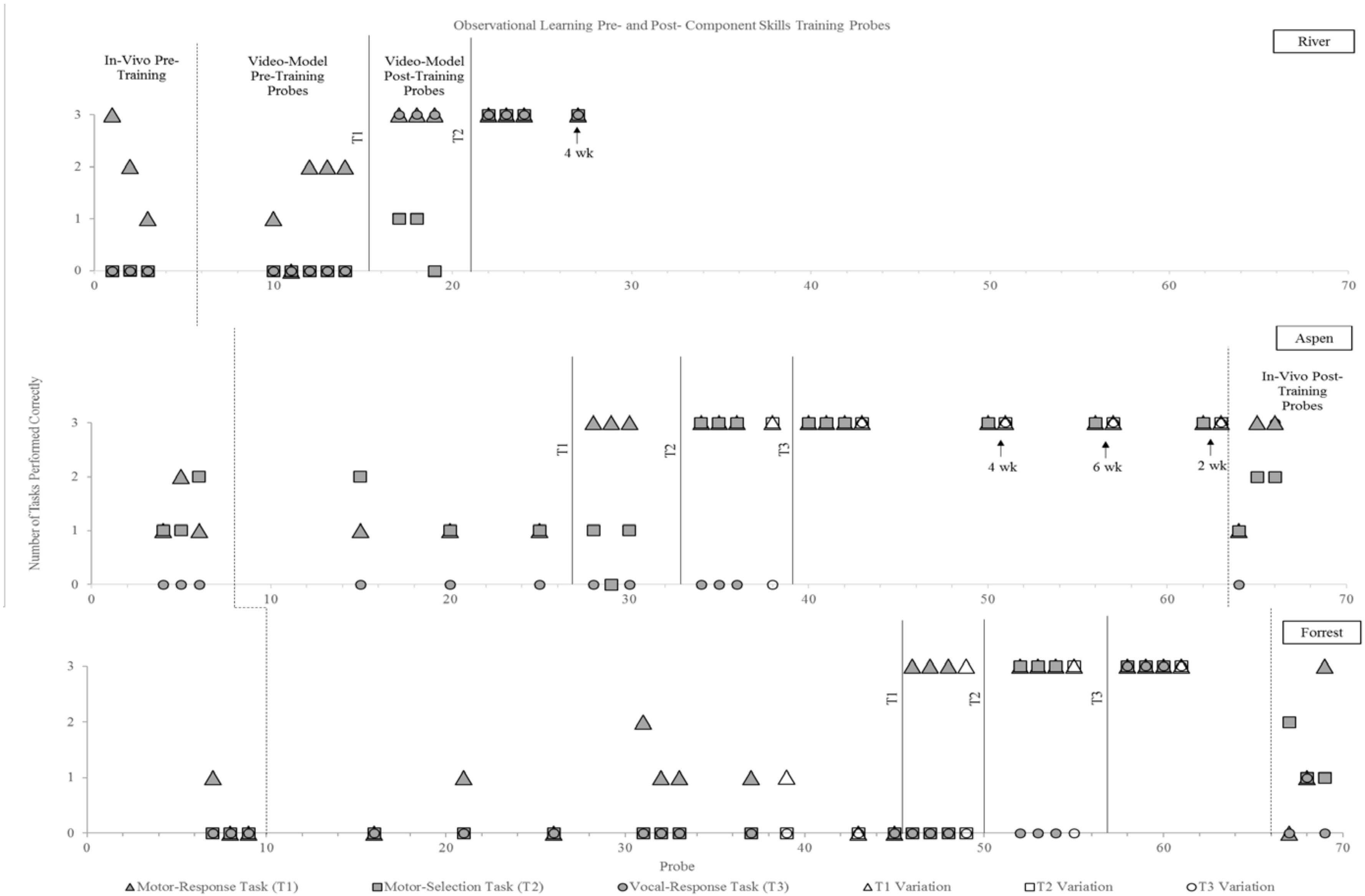
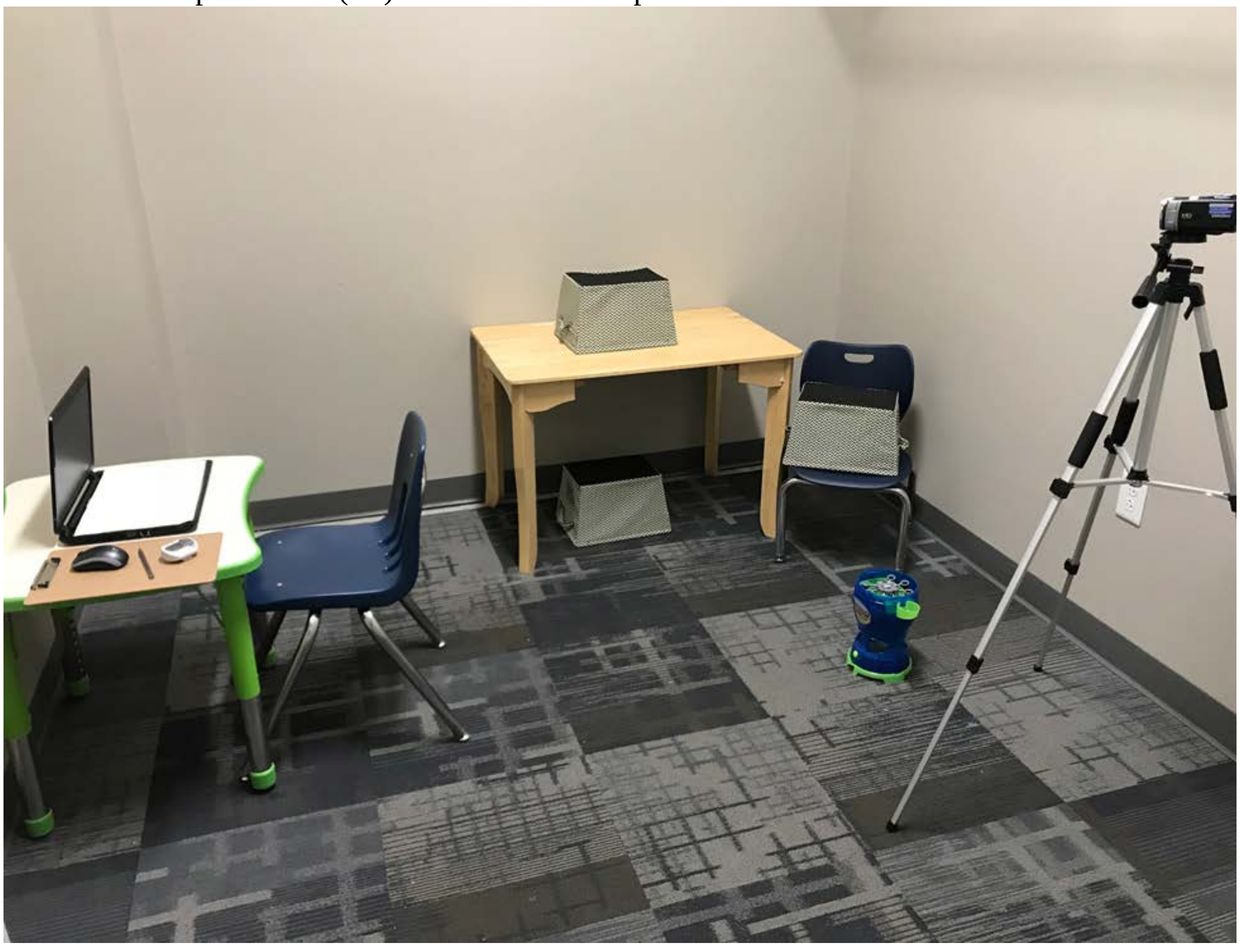


Figure 2. Number of observational learning tasks performed correctly during in-vivo and video-model conditions pre- and post-component skills training across participants

APPENDIX

TASK SET-UPS

A.1: Motor-response task (T1) materials and setup



A.2: Motor-response variation task materials and setup

A.3: Motor-selection task (T2) materials and setup

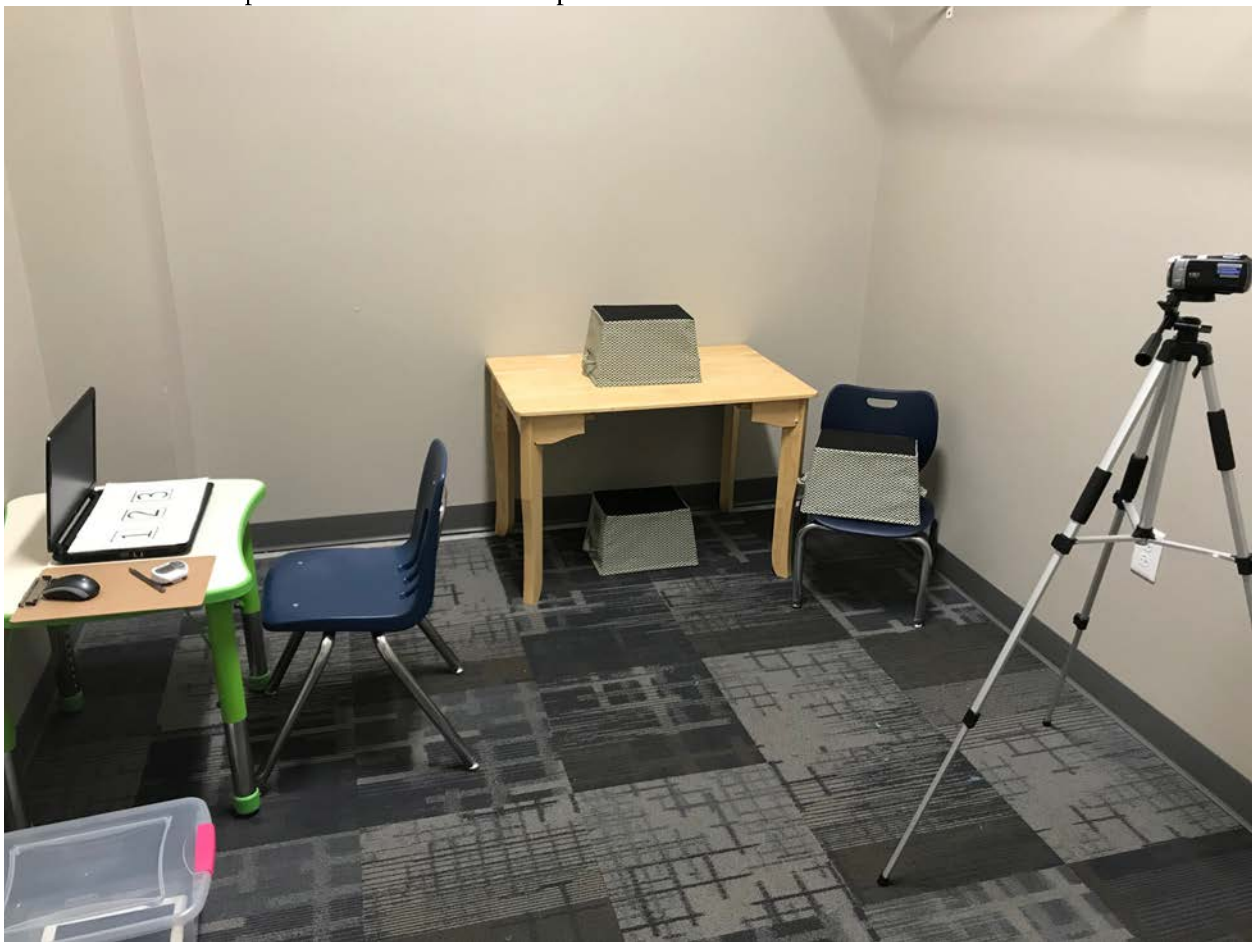
A.4: Motor-selection variation task materials and setup

A.5: Vocal-response task (T3) materials and setup

A.6: Vocal-response variation task materials and setup

A.7: In-vivo probe materials and setup

A.8: Video-model probe materials and setup



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