USING VIDEO MODELING TO TEACH COMPLEX PLAY SEQUENCES TO
CHILDREN WITH AUTISM

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Overcoming social skill deficits in children with autism is a challenge faced by educators and caregivers. Video modeling is a method of training that can promote generalization. This study extends the literature by investigating effects of video modeling on repetitive motor and vocal responses and skill generalization to other settings for children with low-functioning autism/developmental disabilities. A multiple baseline across 3 play sequences was implemented with 3 males. Results indicate that 2 acquired vocal and motor responses and 1 acquired imitative noises and motor responses using video modeling alone. Generalization occurred with 2 participants. These findings have important implications for the field showing that video modeling can enable educators and caregivers to help children with autism overcome social skill deficits.
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A good versus poor prognosis has been associated with the presence or absence of play skills in the repertoires of children with autism (Tryon & Keane, 1986). As Tryon and Keane explain, the high rates of self-stimulatory behaviors children with autism often engage in during free play interfere with their ability to learn appropriate behaviors, isolate the children from their environment, and prevent expression of appropriate behaviors. Children with autism do not spontaneously engage in "the richly imaginative and social nature of play" that emerges in typically developing children during the preschool years (Wolfberg, 1995, p. 201).

Although there is considerable variation in play behaviors of children with autism (Fein, Robins, Liss, & Waterhouse, 2001; Wolfberg, 1995), their play behaviors generally include perseverative routines and stereotypical manipulation of objects, and lack both social engagement and symbolic pretense. In addition, children with autism engage in fewer advanced play skills than their typically developing peers, rarely spontaneously use sound effects, language or gestures associated with play, employ fewer functional play sequences and symbolic acts, exhibit less flexibility in play, and experience difficulty engaging in cooperative play with peers. Wolfberg explains that these deficits serve to isolate children with autism, leading them to seek refuge in the very ritualistic activities that isolate them.

A variety of learning takes place during play (Smith, 1986). This learning is so important that it is a sign of extreme abnormality when children do not engage in play
activities (Sroufe, Cooper, DeHart, Marshall, & Bronfenbrenner, 1996). Indeed, as Sroufe et al. elucidate, play functions as a type of laboratory in which children participate actively in their own development. Further, Smith states that play adds to the quality of life and is especially important for children with cognitive, emotional, physical, or social disabilities. Salkind (2002) states that play is vital to each aspect of child development. The skills learned through play enhance language, physical, cognitive, and social development. In the preschool and early childhood years, learning during play provides the foundation for the aforementioned skills, and play during school years continues to nourish and support cognitive and social development (Bronson, 1995; Caplan & Caplan, 1974), as well as providing the foundation for language building (Caplan & Caplan).

Teaching play is challenging (Charlop-Christy, Le, & Freeman, 2000; D'Ateno, Mangiapanello, & Taylor, 2003; Leaf & McEachin, 1999). Presence of inappropriate behaviors (mentioned above) must be considered, as these behaviors interfere with both instruction and learning. Children with autism do not generally learn easily from casual observation; they appear to require direct instruction (Leaf & McEachin). In addition, the importance of play with regard to the skills learned through play may not be understood by caregivers, leading to resistance to teaching play. Finally, Leaf and McEachin add, considerable flexibility is required to teach social and play skills because providing structured curricula is not feasible for these activities.

Teaching Play via Modeling

Modeling is one procedure used to teach desired skills by presenting a demonstration of the skill by a model and providing an opportunity for the participant to
practice the skill. Modeling has potential advantages in that it is cost efficient (i.e., several children may be taught at one time); it may promote generalization and maintenance; and it teaches a general approach to learning versus teaching specific responses (Ihrig & Wolchik, 1988). A combination of in vivo modeling, reinforcement, correction, and prompts was used by Egel, Richman, and Koegel (1981) to teach discrimination and "yes/no" tasks to children with autism. In this study, peers modeled correct responses. Egel et al. found that the children with autism were able to learn the tasks modeled by peers when unsuccessful in learning with adult prompts. However, using adults as models was not studied. The results have important implications for integrating children with autism into school systems.

Videotaped Modeling

The advent of video technology is providing flexibility for teaching. Combining video technology with modeling can provide a tool that may be used easily by educators and parents to teach a variety of skills via video modeling. Video modeling can be used to teach skills by presenting a model of the skill via videotape which the participant observes and then subsequently imitates (Charlop-Christy et al., 2000). Video self-modeling uses the participant as the model. Parental interactions with their children with developmental disabilities during social play and self-care tasks were taught via video self-modeling (Reamer, Brady, & Hawkins, 1998). Tapes were made of the interactions between parent and child, then viewed by the parent. The parents received feedback and rehearsed correct responding. Although the children did not view the tapes, increases in play and self-care skills occurred concurrently with changes in parental assistance patterns following viewing of the videos. Children with developmental
disabilities and behavioral disorders were taught fluent self-help skills at home using video self-modeling (Lasater & Brady, 1995). In this study, children watched videos of both correct and incorrect responses; the trainer asked questions regarding the behaviors seen; discrimination training was implemented; the correct responses were rehearsed; and then feedback was provided. Task fluency increased and generalized to untrained self-help tasks, while behaviors that interfered with performance of the tasks decreased. Wert and Neisworth (2003) used video self-modeling to teach spontaneous requesting during play to children with autism. The children watched the tapes at home before school and then data were collected at school. High rates of investigator prompts were necessary to teach the children to engage in the responses. Prompts were edited out of the tapes so that only appropriate responses were shown.

Although successful in the aforementioned studies, several concerns are associated with the use of video self-modeling. First, it would not be feasible for behaviors or skills that were not exhibited or were emitted at very low rates, as the participant must emit the behavior at a high enough rate to create the video. Second, high rates of prompts may have to be used to ensure the participant engages in the behavior. This may be problematic as children with autism are often prompt dependent (Lasater & Brady, 1995). A decrease in prompting occurred in these studies, but the potential for prompt dependence associated with this procedure must be considered. Third, the participant must be able to understand and respond to feedback when it is provided. It may not be possible to use this procedure with children who function at low levels. Finally, some degree of editing skills is necessary to make the tapes. While self-
modeling can be a valuable tool, training and taping a non-autistic model may be less time consuming.

Charlop-Christy et al. (2000) compared in vivo to video modeling. A variety of skills were taught to children with autism including expressive labeling of emotions, spontaneous greetings, conversational speech, self-help skills, oral comprehension, and play skills. Video modeling was shown more effective than in vivo modeling for generalization, speed in skill acquisition, and cost. Peers or adults may serve as models in videos. Ihrig and Wolchik (1988) used a combination of in vivo modeling, reinforcement, and correction to teach expressive language tasks to children with autism in a study comparing peer versus adult models. Few differences were found in learning between the models. This finding is important as many children with autism do not have ready access to peer models and adult models may be faster and easier to train.

Video modeling may help children with autism generalize the skills taught to other areas. Charlop and Milstein (1989) trained conversational speech to children with autism and found that the skills generalized and maintained over a 15-month period. They suggested video modeling may enhance generalization due to multiple exemplars in the videos and the use of common stimuli and natural contingencies. Variable results with generalization occurred in studies that taught perspective-taking skills (Charlop-Christy & Daneshvar, 2003; LeBlanc, Coates, Daneshvar, Charlop-Christy, Morris, & Lancaster, 2003). Charlop-Christy and Daneshvar reported more generalization than past studies and attributed these results to the use of multiple exemplars. In addition, speed of skill acquisition was ascribed to compensation for overselectivity (due to the
nature of videos), the intrinsic reinforcement found in television viewing, and stimulus novelty. Although skill acquisition was demonstrated, LeBlanc et al. reported mixed generalization results and suggested a problem with stimulus control also noted in typically developing children when teaching this particular skill.

Kinney, Vedora, and Stromer (2003) combined an interest in computers with video modeling and play videos to teach generative spelling to a child with autism. A Microsoft® PowerPoint® slide show (Microsoft Corporation, Redmond, WA) was created with digital photographs and videos inserted into the slide show. Correct responses were followed by short play videos in which the model manipulated objects and toys in a playful manner incorporating the correctly spelled word into a play script. Generalization to words sharing the same endings did not occur until modifications were made to the procedure, leading Kinney et al. to suggest that explicit programming for generalization may be necessary. In addition, they suggested that learning generative spelling may have facilitated oral reading skills as the child was able to read the words upon completion of the study. An unexpected finding occurred when the child began to spontaneously imitate the content of the play videos and then design her own play videos for new words encountered in school. Creation of the slide show required time and some technical expertise but the authors suggested that the same results may be possible by using noncomputer alternatives such as standard videos.

With the exception of Charlop-Christy et al. (2000), participants in all of the studies cited above were children with high-functioning autism. The studies included variations of experimenter-implemented reinforcement contingencies or error-correction procedures, in addition to the video, and they did not teach play skills. In the Charlop-
Christy et al. study, 2 of 5 children had low-functioning autism. The children who were high-functioning were taught two of the following tasks, dependent on individual need: spontaneous greetings, oral comprehension, conversational speech, cooperative play, self-help skills, or social play. The children who were low-functioning were taught either expressive labeling of emotions or independent play. Two separate tasks were taught within each category, one using in vivo modeling and one with video modeling, to compare the procedures. Prompts were provided for on-task behavior and reinforcement delivered contingent on attending to the video or model. Although children with varying levels of functioning were included in their comparison, the children with low-functioning autism were not taught complex behavior chains or play sequences.

*Video Priming*

This procedure was used to show videos of future events which decreased disruptive transition behavior in children with low-functioning autism by providing predictability (Schreibman, Whalen, & Stahmer, 2000). The authors explained that they capitalized on the visuo-spatial skills found in many children with autism. Videos were made of events or activities associated with disruptive behaviors and then shown to the children prior to participation in the activities or events. Reinforcement was provided for watching the videos. Schreibman et al. pointed out that the routes followed during the events or activities did not have to exactly match the routes shown in the videos to decrease disruptive behavior. They further stated that priming required potential sources of reinforcement (i.e., that each video end with known reinforcing events or
activities). Specific skills were not taught with this method as behaviors were not modeled.

*In vivo Modeling with Reinforcement*

Tryon et al. (1986) combined in vivo modeling and reinforcement to teach play skills to children with low-functioning autism. Peers modeled toy skills in vivo with a toy. Results indicated increases in toy play with concurrent decreases in self-stimulatory behavior. Tryon et al. suggested that maintenance of the skills learned could be attributed to the stimulating visual and auditory sensory components of the toys. In addition, inappropriate self-stimulatory responses may have been replaced with socially acceptable forms of self-produced stimulation provided by the sensory components of the toys. Results indicated that it was possible for children with low-functioning autism to learn basic toy skills (e.g., spinning a top) by observation. Complex play sequences were not taught. As accessibility to peers is often problematic and since it may be difficult for peers to model a complex sequence in the exact manner each time, this procedure might not be feasible for training more complex play sequences.

*Video Modeling without Experimenter-implemented Contingencies*

In the only study relying solely on video modeling to effect behavior change, complex play sequences were taught to 1 child with high-functioning autism (D'Ateno, Mangiapanello, & Taylor, 2003). Following a script, an adult modeled verbal and motor responses for each play scene (shopping, baking, and a tea party). Three videos were shown in their entirety rather than using a forward chaining procedure as the authors stated had been done in the past to teach complex sequences. While increases in both scripted verbal and modeled motor play skills occurred for each play scene, rate of
novel responding remained low. The lack of novel responding was attributed, in part, to
the strict criterion in their study as well as to a lack of sufficient exemplars. D'Ateno et al.
recommended that future research consider these issues. These authors also stated
that their data collection procedures were not sensitive to detecting repetitive patterns of
motor or speech as may have occurred with the modeled or scripted response (a
concern for children with autism). In addition, other than appropriate statements and
responses included as the dependent variables, no data were collected on any other
type of verbal or motor responses or statements made by the participant. Although not
discussed in the D'Ateno et al. study, children with autism often emit inappropriate
responses or statements during play. It would seem relevant and interesting to record
these types of responses to determine the effect of video modeling on the
emission/duration/novelty of these types of inappropriate verbalizations and motor
responses not typically present in the vocabularies or repertoires of typically developing
children. Generalization was not probed in the D'Ateno et al. study.
CHAPTER 2

EXPERIMENT

The present study extended D'Ateno et al. (2003) by using video modeling with 3 children with low-functioning autism. The experimental question underlying this research was: How will video modeling affect acquisition of complex verbal and motor play sequenced skills in children with low-functioning autism? Specifically investigated were the following: 1) effects of video modeling on acquisition of play skills in children with low-functioning autism, 2) effects of video modeling on vocal response acquisition, 3) effects of video modeling on perseverative vocal behaviors, 4) effects of video modeling on perseverative toy manipulation during play, and 5) effects of video modeling on generalization of learned behavior to other settings.

Method

Participants

Three male children attending The Shape of Behavior, Inc. (TSOB), a private clinic-based facility providing behavior analytic services to children with autism and/or developmental disabilities, participated in the study. Participants were chosen because of their determination of low-functioning autism, which, in turn, was based on their low rates of verbal and play skills as well as their slow progress during discrete trial training at TSOB. Each participant was diagnosed with autism by outside agencies. Access to privately obtained diagnostic test results was not available to the principal investigator. Numbers were assigned to identify each participant for purposes of this study to protect confidentiality.
Participant 4-19. This child was 4 years old at the time of the study and had begun applied behavior analysis training at the clinic 3 months earlier. He was able to match pictures or objects to pictures but did not display receptive or expressive skills such as spontaneously labeling objects or identifying objects by feature, function, or class. Although he did not destroy toys, typical behaviors during free play included running around the room in circles or spinning, pica (eating plastic or rubber from toys and pencils or eating carpet fibers), holding toys close to his eyes while squinting, and engaging in non-goal-directed play behavior. He made few vocal responses (i.e., there was no tacting and he emitted few mands). Two languages were spoken in his home. He could imitate preschool songs, but his verbalizations were usually unintelligible and consisted of a mixture of English, another language, and unrecognizable verbalizations.

Participant 13-6. He was 8 years old at the time of the study and had been attending the clinic for 2 years. He could match identical pictures, could replicate visual patterns (ABCABC), complete 7-step block-building imitations, and respond receptively when asked to point to basic features of pictures. He could imitate signs when prompted but generally did not verbalize or sign independently except to mand for a toy in a whisper, "tuh," with or without the sign. Typical motor responses consisted of self-stimulatory behaviors such as spinning, toe-walking, pacing, hand-flapping, eye-squinting, head-shaking, shoulder-shrugging, throwing toys or objects, and hitting or kicking objects and/or people. Oral responses included humming, repeating "la-la" in a monotone voice, unintelligible vocal sounds, and screaming. Usually, he emitted several of these types of behavior simultaneously. When there was noise in his environment he placed his fingers in his ears or screamed and hit people. He rarely
exhibited even the most basic appropriate play responses. During free play typical responses included repetitively shaking toys or objects.

Participant 13-1. He was 4 years old and had been attending TSOB for 7 months when the study began. He had few imitative skills, a short attention span, but was beginning to match identical pictures. Spontaneous vocalizations consisted of 1- to 3-word poorly articulated mands, unintelligible vocalizations, and yelling. His high-frequency typical motor responses consisted of toe-walking, clapping, jumping or pacing across the room, self-injurious behavior (SIB) (hitting his head with his hand or an object), spitting, staring out of the window, elopement, and hitting/kicking objects and/or people. Play behaviors were generally destructive and included: dumping tubs of toys on the floor, scratching paint or stickers off toys, smelling and mouthing toys, spinning or twisting toys between his fingers, bending small plastic toys until broken, throwing objects or sweeping them off tables, putting small toys in his ears or poking them into his eyes, banging toys on tables or his hand, and stomping on toys until the toys broke.

Setting

The study was conducted at TSOB. Baseline, video viewing, and intervention took place in a 10-ft x 6-ft room containing one rectangular-shaped table for toy play, one small square table for the 13-in. TV/videocassette recorder combination, three chairs, the toys, a doll used in the video, and prerecorded tapes of the play scenes.

Apparatus (Materials)

During baseline and intervention, the toys and doll used for each specific play scene were placed on the table. Three play scenes were used and included toys from Toys "R" Us® Fast Lane Construction Set® toy (Geoffrey, Inc., Wilmington, DE), Fisher-
Price® Imaginex Buccaneer Bay® set (Fisher-Price, Inc., Aurora, NY), and play food and utensils. The doll was Woody®, a figure from the Disney® movie, "Toy Story" (Disney Enterprises, Inc., Burbank, CA). Three separate videos were taped using the same adult model (unknown to the children) for each play sequence. In each video the model spoke to the doll by reading a script and physically manipulated the materials according to the script. Each script consisted of 10 to 12 motor responses (e.g., cutting play food with a fork and knife, walking the pirate around the island, or dumping rocks from the bulldozer into the dump truck) with corresponding verbal statements (e.g., "Cut with the knife," "Find the treasure," or "Load the rocks") ranging in length from 2 to 5 words. (See appendix for complete list of verbal statements with corresponding motor responses.) Duration of the videos were 3 min 16 s (eat), 3 min 56 s (pirate), and 4 min 6 s (construction).

**Dependent Variables**

Dependent variables included number of 1) scripted verbal statements and/or vocalizations, 2) unscripted novel verbal statements, 3) modeled motor responses, and 4) novel non-modeled motor responses. For all appropriate responses, the chain did not have to be imitated in exact order to be counted as correct. Responses/statements were recorded on data sheets when these occurred. If appropriate responses/statements occurred more than once, only the first instance counted toward criterion. The definitions were based upon those provided in the D'Ateno et al. (2003) study. These dependent variables are defined as follows:

*Scripted verbal responses.* Examples included a participant’s statement that matched statement(s) made in the video, allowing for the omission, substitution, or
addition of one word (e.g., for the modeled statement, "Find the treasure" a correct response was scored for, "Find the chest," "Find treasure," or "I find the treasure"). Truck sounds emitted by the participant that matched those made by the model during the construction sequence were scored as correct.

*Unscripted novel verbal responses.* These included statements emitted by the participant that did not match the scripted criterion, but were in context for the play scene (both the object manipulated and the situation, such as "Want milk" or "Push the dozer") or statements not modeled but made by the participant with or without manipulating an object but appropriate in the situation ("Go to McDonald's" or "Come on, let's go"). Criteria for counting a statement as "novel" included statements in which more than object labels or articles of speech were changed (e.g., "Find the treasure" versus "Look for the chest").

*Modeled motor responses.* These were defined as motor responses matching motor sequences modeled in the video (i.e., these responses had the same impact on the environment as did the videotaped motor sequences). For example, if the video-modeled response was stacking the food and utensils on the plates, then picking everything up together and placing the items in the bucket to clean up, a correct response would include the participant placing the plates and utensils in the bucket, and then putting each item of food separately into the bucket.

*Non-modeled novel motor responses.* These responses were defined as any motor response, not meeting the definition of a modeled motor response, but in context for both the situation and the object. For example, when the modeled response was loading rocks in the dump truck, the addition by the participant of placing the doll in the
dump truck and driving the truck around the table was recorded as a non-modeled motor response. Responses also included any motor response not meeting the preceding criterion but appropriate to the situation, or a demonstration of appropriate object manipulation (e.g., pretending to feed the doll when this response was not modeled).

Although inappropriate verbal and/or motor responses did not affect criterion, these responses were recorded as a collateral measure. Children with autism often emit inappropriate responses or statements during play. These types of responses were recorded to determine whether or not video modeling had an effect on the emission, duration, and/or novelty of these types of atypical responses. Such responses are generally not present in the vocabularies or repertoires of typically developing children. These data included numbers of: 1) inappropriate verbal statements, verbalizations and/or vocalizations, 2) inappropriate motor responses, and 3) self-stimulatory behaviors. Response definitions are included below.

**Inappropriate verbal responses.** Responses included any vocalized responses not meeting the preceding criteria for appropriate responses (e.g., inappropriate vocalizations such as yelling, monotone humming, making inappropriate noises—barking, or inappropriate verbalizations including making out-of-context statements in response to the situation). Singing or humming preschool songs, when recognizable by the data collector, were not included as typically developing children often sing or hum while playing.

**Inappropriate motor responses.** These were defined as motor responses not fitting the preceding criteria for appropriate responses (e.g., throwing toys or destructive
acts such as hitting objects or stomping on toys) and that were inconsistent with appropriate toy play. Corrective actions, including picking up dropped toys or repositioning a toy to place it in the area where the toy was situated in the video, were not scored as responses.

Repetitive motor responses. These responses were scored as inappropriate, and defined as manipulation of a toy in a repetitive manner inconsistent with appropriate manipulation of the toy during play (e.g., shaking a maraca is appropriate; shaking a hamburger back and forth rapidly for 5 s or longer is not inappropriate).

Self-stimulatory responses. These involved non-goal-directed repetitive behavior that did not involve an object (e.g., hand-flapping, rocking, or pacing back and forth) or SIB (e.g., hand-biting or head-banging).

Experimental Design

The experimental design was a multiple-baseline across videotaped modeled play sequences. Order of play sequences was random. Criterion for introducing the next treatment condition was a combination of 5 appropriate verbal and/or motor responses (either modeled, scripted, novel non-modeled, or novel unscripted) per session across 2 consecutive intervention sessions. Modeled responses were tallied each time they occurred but only the first occurrence of any one response counted toward criterion. When appropriate novel responses occurred, each specific response was noted on the data sheet and then tallied in the same manner as modeled responses with only the first occurrence of specific responses counting toward criterion. This data collection method was used to detect perseverative patterns of responding and to prevent criterion from being reached by repetition of a single response.
Procedures

Baseline. This phase consisted of presenting the toys from one play scene at a time to the participant with the one-time instruction, "Play _____ (construction worker / let's eat / pirates)" for a 5-min maximum period. The session was terminated prior to the maximum time if the participant left the play area for longer than 15 s. The data collector remained in the room to hear verbal responses or observe physical responses. Videos were not shown to the participants during this phase. If a response was emitted that matched what the participant would see in the video during intervention, it was recorded as a modeled response. This method was employed to ensure that participants did not exhibit skills before intervention. The data collector did not interact with the participant unless a participant manded for help or emitted a dangerous or destructive response requiring intervention.

Intervention. This phase consisted of the participant viewing a video depicting one play sequence. The experimenter said, "Watch the video." No other interaction occurred between the participant and data collector although the younger participants were not prevented from spontaneously sitting on the data collector's lap to watch the video. The entire video sequence (3 min 16 s, 3 min 56 s, or 4 min 6 s) was shown. Immediately thereafter the participant had access to toys corresponding to those depicted in the video shown and was told to “Play ____.” The session was terminated after 15 min or when the participant left the play area for more than 15 s. The experimenter did not provide reinforcers, prompts, or correction procedures during intervention. A minimum of 1 and a maximum of 3 sets of sessions (up to 15 min for each play scene) were run daily, Monday through Friday. Sessions were separated by a
minimum of 15 min. When criterion was met following introduction of the first video, the second video was introduced; the third was introduced after criterion was met for the second video. If criterion was not met or no learning occurred after 20 intervention sessions in any intervention, reinforcement was introduced and provided for watching the video, imitation during the video, approximations of correct responses as well as correct responses, and for appropriate play. Reinforcement consisted of praise, tickles, access to a preferred tangible, or edibles.

**Maintenance.** The maintenance phase began if criterion was met for the third play scene. No changes were made, the procedures continued from intervention.

**Generalization probes.** Generalization to setting was probed by running the session in another room at the clinic. The room contained many distractors including tables, chairs, a large variety of toys, a computer, TSOB staff, and peers. The toys from one play scene were placed on a table in the room. The data collector employed the same procedures used in intervention in this setting. The participant was given the instruction to play with the toys from the specific scene being probed. The participant was not prevented from leaving the area with the study toys or from manipulating other objects within the room. If the participant did leave the area for 1 min, the session was terminated.

**No-tape probes.** These were conducted during intervention and maintenance sessions. During the probe, sessions were run as described for intervention except that the video tape was not shown prior to access to the play scene toys.
**Data Collection and Interobserver Agreement (IOA)**

Participants' responses were scored by the principal investigator as these occurred. During baseline, IOA was recorded by students from the University of Houston who sat in the room and recorded responses as they occurred. During intervention, IOA was scored by a student from the University of North Texas via videotape. Both the principal investigator and this second observer scored data from the videotapes. The principal investigator scored live data during sessions which was compared to video taped data after IOA. The graphs depict results from live data. IOA was calculated separately for each response category by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Independently recorded measures were obtained for 70% of baseline and 55% of intervention sessions in each play sequence. IOA averaged 96% during baseline, with a range of 94% to 98%. During intervention, both IOA and the live data comparison to videotaped data averaged 99.5% ranging from 99% to 100%/session. During the first baseline sessions, low scores occurred for individual responses within sessions. These were attributed to errors that occurred while learning to use the data sheets and to score responses under the correct category. More intensive training with a new data collector occurred at the outset of intervention to prevent this type of error.

**Results**

*Participant 4-19*

Figure 1 depicts data for modeled and novel non-modeled motor responses across each play scene. During baseline he occasionally emitted a response resembling a modeled response as discussed above. The top graph shows that he
Figure 1. Motor responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
emitted one correct response on 4 of 8 occasions for the pretend-to-eat scene. Since he had already demonstrated basic self-feeding skills, we predicted that those skills would generalize to the play scene. Intervention began after the data had stabilized with no correct response chains occurring over 8 sessions. The top graph indicates that he reached criterion in the fourth session with video modeling alone and that learning continued to occur over time. Few novel responses were emitted. With the pirate scene (middle graph), he reached criterion by the third session of intervention. In the bottom graph, he again reached criterion in the third session of the construction scene. Novel responses were not stable but did occur. In both the eating and construction scenes, he emitted the complex modeled chains in correct sequence. During play with the pirate scene, he emitted parts of the chain in a randomized order and interspersed the modeled responses with novel responses.

Figure 2 illustrates data from scripted and novel non-scripted verbal responses across each play scene. Throughout all play sequences, verbal statements did not increase significantly until after criterion had been met for all 3 play scenes and data were collected during generalization or maintenance probes. In fact, the top graph of Figure 2 shows that few statements were emitted until session 25. During these sessions, these statements increased from 0 during session 24 to 15 statements during session 25. These were correct imitations of the statements modeled in the video and corresponded with the motor responses. Novel statements were sporadic but did occur. Novel responding in both the middle and bottom graphs was variable, and a late increase occurred in scripted statements.
Figure 2. Verbal responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 3 presents data for inappropriate motor and self-stimulatory responses. Although self-stimulatory responses in the top graph occurred at a low rate before intervention, clear decreases were seen for both types of responses after intervention. For the pirate scene (middle graph), variability in rates of inappropriate responses are seen. An increase in both types of inappropriate responses occurred at the onset of intervention. Inappropriate motor responses decreased steadily with the exception of session 28 and dropped to 0 during the last 3 sessions. Self-stimulatory responses remained variable and generally consisted of 4-19 holding a toy close to his eyes and squinting or watching himself dance in front of the TV. Although the latter response may be viewed as appropriate, it was counted as inappropriate during this study as he was not engaged with the play scene. In the bottom graph both classes of response showed clear decreases after intervention with inappropriate responding remaining at 0 responses for the last 10 sessions. In both the eating and construction scenes, he completed the chain in an ordered sequence and put the materials away with few or no inappropriate responses. Then 4-19 manded to play with the pirate scene. These actions generally took less than 2 min for him to complete. By contrast, he always played with the pirate scene for the full 15 min in a way that more closely resembled a typical child’s free play. However, also during this time more inappropriate responding occurred.

Data in Figure 4 depict inappropriate verbal responses. These data correlate with the data from Figure 3 in that fewer inappropriate statements were made when he quickly ran off the chains correctly during the eating and construction scenes, but inappropriate verbalizations occurred more frequently during the pirate scene. It is
Figure 3. Inappropriate motor and self-stimulatory responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 4. Inappropriate vocalizations/verbalizations across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
possible that some appropriate verbalizations were scored as inappropriate because his speech was often garbled and was a mixture of another language and English.

Data from Figure 5 report totals of appropriate responses with totals of inappropriate responses across all play sessions. The top graph shows an increase in inappropriate responding with the onset of intervention but responding then decreased to near 0 rate. A slow but steady increase in appropriate responses occurred concurrently. The bottom graph shows the same type of pattern with an increase in inappropriate responding followed by a decreasing trend and a concurrent increase in appropriate responses. Variability in inappropriate responding is seen in the middle graph along with an increase in appropriate responding.

**Participant 13-6**

Figure 6 reveals the data for modeled and novel non-modeled motor responses. Intervention began with session 24 for the pirate scene (middle graph) although criterion had not been met for the construction scene (top graph). This decision was made as 13-6 had emitted 8 appropriate responses during session 22 but usually refused to play with the construction set at all. He did play with the pirate set. As he did not appear to be interested in the construction toys, intervention was implemented with the pirate scene, with plans to introduce reinforcement for playing during the construction scene if, after 5 more sessions, he still had not played with the construction materials. He met criterion for both play scenes in session 27, and in the top graph (construction scene), modeled responses reached and maintained a fairly high, steady rate. He emitted the response chain in the exact order it was modeled within 1 min. Novel responding was sporadic, occurring in only 11 of 65 intervention sessions. Sessions were terminated
Figure 5. Total number of appropriate and inappropriate responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 6. Motor responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
when he stopped playing. Zero rate of responding occurred when he lay on the floor and refused to play with the toys for 1 min, leading to termination of sessions.

The middle graph shows a mixture of novel and modeled responses. He manipulated toys in the pirate scene for more than 5 min and up to the entire 15-min period during 35 of 49 intervention sessions, rather than emitting the chain within 1 min as with the construction scene. Appropriate novel and modeled responses occurred in an unordered sequence and were interspersed with inappropriate responses. In the bottom graph, reinforcement was added in session 47 as no learning had occurred and aggression had increased. Interest in this play scene was not shown by 13-6. Except for picking up a piece of food to smell it in the first intervention session, he never touched the toys again until reinforcement was introduced and used to shape appropriate responding. Up to 3 appropriate responses/session occurred after reinforcement was added but criterion was never met.

Scripted and novel verbal responses are represented in Figure 7. In 7 of the construction scene sessions, he emitted some of the truck noises modeled in the video as shown in the top graph. Modeled phrases were not imitated. Scripted verbal statements were not emitted during the pirate or eating scenes (middle and bottom graphs). Novel statements occurred during 2 sessions in each of these play scenes and consisted of 13-6 signing and/or whispering "Want toy" or "All done."

Figure 8 depicts data for inappropriate motor and self-stimulatory responses. The top graph shows an increase in inappropriate motor responses upon the onset of intervention followed by a gradual decrease to 0 rate in both types of responses. When 13-6 began quickly emitting the chain in an ordered manner, inappropriate responses
Figure 7. Verbal responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 8. Inappropriate motor and self-stimulatory responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
decreased gradually to 0 rate of occurrence. Inappropriate responses consisted of holding and shaking the doll; however he did not shake the construction toys.

Variability and even some increases in inappropriate responding are seen in the middle graph (pirates). When 13-6 was not shaking the doll, he did hold and shake toys from this play scene. The graphs were not able to show that during the times that he was playing appropriately with the toys from this scene, his inappropriate responses decreased or stopped. These periods were interspersed with his inappropriate responses. The bottom graph shows an increase in inappropriate responses following the onset of intervention followed by a decrease in inappropriate motor responses. High variable rates of self-stimulatory behavior continued throughout intervention. Generally, after reinforcement was introduced, he engaged in self-stimulatory behavior and emitted an appropriate response approximately every 10 - 15 s or sat near the toys without touching them. Higher levels of inappropriate responding occurred during baseline and intervention as he held and shook the doll throughout most of the sessions not touching the toys from the scene.

The doll was removed from the room for all play scenes on session 53 as his violent and/or destructive behavior had increased in frequency and intensity. In addition to hitting and kicking the principal investigator and destroying toys and equipment throughout the sessions when the doll was removed for video viewing, he had begun displaying this behavior outside of sessions with other people. When access to the doll was no longer allowed, aggression decreased and he did begin to touch the toys from the eating scene. The principal investigator also stopped saying, "Watch the video" on
session 24 as 13-6 found this aversive and kicked and/or hit her each time she repeated the instruction.

Figure 9 represents inappropriate verbal responses. The top graph shows that inappropriate verbalizations decreased to near 0 rate during the construction scene. The higher levels occurred during the beginning of intervention and were correlated with noises made while shaking the doll. When he learned to emit the chain as modeled, all classes of inappropriate responses decreased. High variability was seen in the middle graph and was associated with noises made while holding and shaking the toys or engaging in self-stimulatory behaviors. He also emitted monotone humming or noises while playing appropriately with these toys. However, there were several sessions with 0 rate of inappropriate verbalizations during play. The bottom graph notes an increase in inappropriate verbalizations that occurred while 13-6 shook the doll or screamed at the data collector. A variable decrease was seen when reinforcement was introduced. Higher levels of verbalizations (such as monotone humming or making trilling sounds) occurred when he engaged in self-stimulatory responses.

Participant 13-1

Figure 10 provides data for modeled and novel non-modeled motor responses. Although baseline data indicate variability and some responding for the construction and eating scenes, most responses were novel and could be made during basic exploration of the toys. Response chains were not emitted, so intervention was implemented for the pirate scene. The top graph shows criterion was reached at session 27 with a combination of modeled and novel responses. Due to a mistake by the principal
Figure 9. Inappropriate vocalizations/verbalizations across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 10. Motor responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
investigator, the second intervention was begun on session 24 before criterion was met in the first intervention (middle graph).

The top and middle graphs show that reinforcement was added in session 32. Although criterion had been met for the pirate scene and 20 sessions without criterion (or no learning) had not occurred for the construction scene, the decision was made based on the increased level of destructive responses made by 13-1. The majority of his responses was destructive and, on a daily basis, resulted in broken toys in each play scene as well as attempts to destroy equipment or other objects in the room. As all the participants used the toys and it was not feasible to continue to replace toys, reinforcement was provided for appropriate responses to determine if destructive responses would decrease and appropriate responses increase. Destructive responses were ignored. An increase in appropriate responding occurred with a slight decrease in destructive responses. Criterion was met in session 38 for the construction scene.

In the bottom graph, intervention began in session 39. Although reinforcement was added to the other play scenes in session 32, reinforcement was not added for this play scene until session 50 to allow time to examine results of using video modeling alone. Because destructive responses did not decrease and appropriate responding remained stable at 0 to 1 response/session reinforcement was added before 20 sessions without learning or reaching criterion had occurred. Appropriate responding increased briefly but then dropped to 0 responses/session. Criterion was not met until session 78 after the participant's behavior intervention plan (BIP) protocols had been added to the intervention package. This participant's BIP in therapy included blocking destructive responses and using a correction procedure for dumping or throwing toys.
(i.e. having him pick up the toys). The BIP had not been implemented during video modeling to assess the use of video modeling alone. When an increase in these behaviors was noted during therapy, the BIP was implemented during video modeling in session 67 for all play scenes.

Basic eating skills were not emitted by 13-1 before intervention began; all foods were eaten with his fingers. The bottom graph shows that he did learn to emit these basic skills as modeled on the video. The highest level of appropriate responding occurred during the final session to probe generalization in another setting. Although not shown on the graphs, it was noted on individual data sheets that appropriate responding increased dramatically as any single type of appropriate response that occurred could only be counted the first time it occurred in that session and approximations that were shaped with reinforcement were not counted. During each session, he emitted the same appropriate response several times throughout the session and manded for a reinforcer. Each response was noted on the data sheet but only the first occurrence of each individual response was counted for graphs. Individual data sheets also note an increase in duration of appropriate play with this participant indicating an increase in his attention span. Across all play scenes, 13-1 did not usually emit the play chains in the order modeled. Individual data sheet notes indicate that in 2 sessions he did emit a 3-step chain in order during the construction scene.

Figure 11 shows scripted and novel non-scripted verbal responses. Only 1 scripted statement occurred in the pirate condition as shown in the top graph in the last session. Novel responses were emitted in 11 of 76 sessions of the pirate scene. As shown in the middle graph, 1 novel statement was emitted in session 82 by 13-1, but no
Figure 11. Verbal responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
scripted statements occurred. Both types of appropriate statements increased in the eat condition near the end of intervention as shown in the bottom graph. This participant occasionally emitted statements from this play scene during the other play scenes when emitting reinforced responses. Frequent imitations of statements during video viewing not repeated during play were noted on daily session data sheets.

Figure 12 represents 13-1’s inappropriate motor and self-stimulatory responses. Each graph shows variability in responding with few trends occurring across time. It was not possible to show the decreases in destructive behaviors on the graphs as all inappropriate responses were scored as a class and occurred at such a high rate that individual types of responses could not be tracked. Individual daily session sheets note inappropriate responding decreased during appropriate play and fewer inappropriate responses with toys occurred over time. The participant continued to bang on or kick chairs, tables, or walls throughout each session and those types of responses represent the majority of data shown on the final third of each graph. Inappropriately banging objects on the table or on his hand decreased noticeably and on several occasions he began to emit this type of inappropriate response and then spontaneously stopped himself after his BIP was included in the intervention package. All 3 graphs show that both types of inappropriate responding occurred at near 0 rate during the final generalization to setting probe.

Figure 13 shows data for inappropriate verbal statements for 13-1. These inappropriate verbalizations/vocalizations typically occurred simultaneously with inappropriate motor responses and/or self-stimulatory behaviors (e.g., vocal noises were emitted while the participant jumped across the room and simultaneously clapped
Figure 12. Inappropriate motor and self-stimulatory responses across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
Figure 13. Inappropriate vocalizations/verbalizations across each session. Black arrows denote within session probes without viewing videos. Dashed arrows denote generalization to setting probes.
his hands). As this participant did not learn the chains in order, concomitant decreases in inappropriate responding were not seen during emission of appropriate responding as were shown with 13-6 and 4-19. Some of the higher rates of all types of inappropriate responding may be attributed to increased amounts of time spent in the sessions. During baseline and when intervention began, 13-1 typically left the play scene within a few minutes, thus ending the session early. Increases in duration of remaining near the play scene or engaging in appropriate responses occurred over time, also providing more time for inappropriate responses to occur as well. Video modeling did not appear to decrease inappropriate verbalizations/vocalizations for this participant.
CHAPTER 3

DISCUSSION

This study demonstrated that video modeling could be used to teach complex verbal and motor play sequences to children with low-functioning autism with challenging behaviors (e.g., destruction of objects, kicking/hitting others, and repetitively shaking toys). Each participant learned, to varying extents, to imitate the sequences. Patterns of inappropriate repetition of learned motor and verbal responses were not detected. 4-19 acquired both motor and verbal responses from all 3 videos. Participant 13-6 reached criterion via video modeling alone for 2 play scenes. Motor response imitation and appropriate play vocalization occurred, but scripted statements were not imitated. Reinforcement was added to the final play scene, and although learning was occurring, criterion was not met before the study was terminated. Participant 13-1 acquired modeled and novel motor responses for 1 sequence with video modeling alone. The addition of reinforcement and/or blocking of destructive responses was required for motor imitation to occur reliably in 2 play scenes. Verbal response imitation occurred in 1 scene.

Participant 4-19 imitated the sequence in exact order for the eat and construction videos and for most of the pirate video. Exact sequence order was shown by 13-6 with the construction toys while novel responses were interspersed with unordered modeled responses in the pirate scene throughout intervention. By contrast, 13-1 emitted 1-step imitations in all play scenes with the exception of rare 3-step chains.

Results for 13-6 varied. He did not touch the toys from this play scene and did not appear to watch the video as he walked around the room humming with his fingers
in his ears. After the video he emitted inappropriate motor responses by walking around the room shaking the doll. He did seem to be interested in the pirate scene so intervention was begun before adding reinforcement to the construction scene. Interestingly, he met criterion for both play scenes 3 sessions later. As he had not appeared to be watching the construction video, it was surprising when he suddenly emitted many parts of the chain in order. He continued to add steps to the chain until all steps were mastered. When he began imitating this chain correctly, he also began watching this video intently. During appropriate play with this scene, inappropriate and self-stimulatory behaviors dropped to 0 rates. While 13-6 learned the construction sequence in order and made truck noises appropriately during 9 sessions, he did not emit ordered chain responses for the pirate and eat scenes.

It was hypothesized that it might not be possible for the participants to imitate the sequences from the pirate video as the toys were smaller and the motor responses harder to discern on the video. Participant 4-19 took longer to emit the pirate chain in order than with the other 2 play sequences. While he did emit several steps of the chain in order at first, he interspersed these steps with novel responses. It was not until the final maintenance probes that he emitted most steps of the chain in order. While 13-6 and 13-1 did not emit this chain in order, both appropriate novel and modeled responses occurred. These results verified that it was possible to see the modeled responses clearly enough for imitation to occur, but these responses did require higher levels of fine motor skills than in the other scenes.

Although the purpose of the study was to determine if video modeling could be used to teach a complex modeled response chain, appropriate novel play responses
were included and tracked. Both classes of learning were considered important, as the ability to emit an ordered complex chain is a necessary skill for mastering sequences of activities of daily living, while interspersing novel and imitated responses is more representative of appropriate free play exhibited by typically developing children (but lacking in children with autism). Whereas D'Ateno et al. (2003) noted a lack of novel responding, the present study indicated that each participant engaged in more novel than modeled responses during the pirate scene. Higher rates of novel responses than modeled responses also occurred for 13-1 in the construction scene. The higher rates of novel responses may be associated with his lower level of imitation skills. Participant 13-6 occasionally watched the pirate video and engaged in more novel than modeled responding. This finding is important as toys from this scene were the types that he typically held and shook repetitively. These types of responses continued to occur but were interspersed more often with appropriate novel responses. He did not emit the steps of this chain in order but did emit several modeled steps together toward the end of intervention. He did not appear to watch this video throughout the study but usually manipulated the toys for the entire 15-min session.

Participant 4-19 learned all 3 sequences rapidly without the addition of reinforcement or correction or prompting procedures, replicating the D'Ateno et al. (2003) results. Skill acquisition via video modeling alone occurred in 2 sessions for 13-6 and in 1 session for 13-1. Some learning occurred with the addition of reinforcement in the play scene for 13-6. The addition of reinforcement resulted in increases in skill acquisition in 2 scenes for 13-1; however, stable response increases occurred only after reinstating his BIP during intervention.
Participant 4-19 exhibited higher levels of skills and engaged in much lower rates of inappropriate responses than the other 2 participants at the onset of the study. While 4-19 played most appropriately with toys before the study began, the play was not goal directed and did not resemble that exhibited by typically developing peers. The other 2 participants did not imitate siblings, peers, or adults with regard to toy play and rarely exhibited even the most basic appropriate play responses. The higher level of imitation skills and lower rates of inappropriate responses for 4-19 may be associated with his faster acquisition rate and ability to learn skills from all 3 scenes without the addition of experimenter-implemented contingencies. Although 13-6 had some imitative motor skills before the study began, he did not appear to spontaneously imitate motor responses seen on home videos. The results of the study show that he was able to learn a complex chain via video modeling (the construction scene) without adding reinforcement. As he reached criterion within 3 sessions for the pirate scene, rapid acquisition is also possible. This may have been due to his preference for this toy.

From the beginning, 13-6 seemed uninterested in the toys from the eating scene. He smelled the plastic food one time when intervention was started, then did not touch the toys again until reinforcement was added. Responses were shaped first by providing reinforcement for glancing at the video or going near the toys and then increasing the criterion for delivery of reinforcement. It is possible that continued shaping with reinforcement would have led to reaching criterion but the study was ended before this occurred due to the length of the study and because the room used for intervention was needed for clinic business.
Before the study began, 13-1 demonstrated the lowest level of imitative skills of the 3 participants (which may have accounted for the number of sessions required to achieve criterion). Although he learned some of the modeled motor responses from each scene and criterion was attained, he did not emit the chains in order or learn all of the responses. Despite these facts, the results are promising as he had learned to imitate fewer than 10 basic motor skills using conventional methods during the previous year of therapy. With video modeling, he learned at least 18 modeled responses in several months and learned to emit even more novel responses appropriately. He emitted 2 to 3 steps of the chain occasionally in the construction video which was also important as he had been unable to follow even 1-step directions or imitate more than 1-step responses during therapy prior to this study. He did reach criterion using video modeling alone in the pirate scene. It is not known if criterion would have been attained with video modeling alone for the construction set as reinforcement for appropriate responding had to be added due to his increasing levels of toy destruction.

D'Ateno et al. (2003) was the only study found that did not include some type of reinforcement, prompt, or correction procedure in conjunction with video modeling. They were successful in teaching complex play sequences to 1 child with high-functioning autism without the addition of experimenter-implemented contingencies. The mixed results of the present study suggest that video modeling alone could be used successfully as indicated by all tasks for 4-19, in two tasks for 13-6, and one task for 13-1. However, reinforcement and/or other procedures may need to be employed as a package with video modeling in other cases as was found with the final task for 13-6 and for two tasks with 13-1.
Generalization to other settings, objects, and with other people occurred. Generalization to setting was shown in all 3 scenes for 4-19 and 13-1 without specifically preprogramming generalization strategies, paralleling results found in D'Ateno et al. (2003). Learned behaviors did not generalize for 13-6 but only one probe was performed. As he often refused to play with the toys during regular video modeling sessions, it is possible that he may have emitted the responses if more probes had been conducted. 4-19 was observed using phrases from the eating scene correctly during lunch and also using different toys in a clinic play room to mimic motor responses from the pirate scene while repeating the statements related to the particular scene imitated. During generalization probes to other settings, he chose to play with toys from the videos rather than any of the other toys in the room and ignored distractions from peers and adults in the room while emitting the responses appropriately.

The most surprising finding for 13-1 occurred during the final generalization probe. Before the study began, 13-1 stood by the window and stared outside. He engaged in this response for long durations unless redirected by a therapist. When given free access to toys in a room, he generally chose to dump a tub of toys on the floor then jump or run around the room while engaging in self-stimulatory behaviors (rather than playing with a toy). These behaviors did not occur during the generalization probe despite the high number of distracters in the setting (e.g., a wall of windows and tubs of toys). Instead, he pulled a chair up to the table and sat down to play with the toys from the video modeling sessions. He was distracted on several occasions and looked toward the window for a few seconds but spontaneously re-engaged in appropriate toy play.
During the pirate scene generalization probe, 13-1 played appropriately for 12.5 min with near 0 rate of inappropriate behavior. His attention span was quite short when the study began. He did not sit quietly and watch the videos for more than 5 s without engaging in inappropriate behavior. After reinforcement was added for watching the video, the duration of sitting quietly increased up to 1 min. He also began laughing during the videos and verbalizing statements from the videos before they were modeled or imitating them after they were made. His increased attention span generalized spontaneously to therapy.

It should be noted that when this study began, 4-19 did not generally spontaneously imitate adults or peers without prompts or provision of reinforcement but he did spontaneously imitate phrases or songs from videos he viewed at home. In addition to possessing the skills to imitate, some type of reinforcement contingencies related to videos were in effect for this participant and possibly contributed to his acquisition of the responses in this study. For example, some of the responses generalized from home videos to the pirate scene. Initially, the principal investigator and IOA collectors hypothesized his action of lining up several of the toys around the doll was a type of stimulatory behavior often exhibited by children with autism and counted it as an inappropriate response. However, later in the study, the principal investigator and an IOA collector discovered that those actions were, in fact, correct imitations of responses from scenes modeled on a home video and had generalized to intervention in an appropriate novel manner.

Interestingly, 4-19 also continued to emit correct responses when toys broken by the other 2 participants were replaced with similar, but not identical, toys. When the doll
was removed due to destructive behavior by the other participants, the principal investigator forgot to return the doll for sessions with this participant. He proceeded to emit the responses as if the doll were there on several occasions and substituted a toy for the doll on other occasions. This type of responding was unexpected. The results of the study indicate it is highly likely that video modeling could be used with this participant to facilitate acquisition of a variety of skills including manding and tactual which he had been slow to acquire with conventional methods.

The effectiveness of reinforcement procedures was problematic for both 13-6 and 13-1. A functional behavior assessment (FBA) was conducted with 13-6 prior to the study. The results indicated that verbal praise and physical touch were aversive for him and he often emitted violent behavior even when given a preferred tangible without praise. His BIP included no praise when providing a tangible and removal of the tangible upon incidences of violent behavior. In addition, a preference assessment indicated that he preferred to bounce on a large ball or shake small stuffed toys to consuming edibles.

It was not possible to use the ball for reinforcement due to the size of the room and 13-6 engaged in violent and destructive behavior over the removal of stuffed toys after 1 min of consumption time. A variety of edibles were offered and, while they appeared to be effective, it was discovered that clinic therapists had begun using edibles frequently during therapy (although asked not to do so during the course of this study). This may have lessened the effect edibles might have had during study sessions. If more effective reinforcers had been discovered, it is possible that this participant could have learned the chain for the eating scene. 13-6 appeared uninterested in the food scene but this skill was included as he was 8 years old and did
not eat with utensils. It was hoped that he would learn the chain and that the skills would then generalize to mealtimes.

For 13-1, a preference assessment showed that few toys were preferred and satiation on edible reinforcers occurred rapidly, which contributed to difficulties in using reinforcement. Although edibles were highly preferred, he was on a severely restricted diet so food choices were limited. In addition, edibles were used during therapy and he had noncontingent access at home. Despite these limitations, he manded for edibles during sessions. When directed to play, he would emit a response and mand an edible.

Delivery of reinforcers and other procedures were also problematic. The principal investigator had to work alone as other staff were not available to assist. Thus, the principal investigator had to take data on multiple behaviors occurring at high rates simultaneously while providing reinforcers quickly when appropriate behaviors occurred. All data could not be scored from videotape as the participants continuously moved around the room and the principal investigator had to take data and deliver reinforcers instead of following movement with the camcorder. Despite these challenges, the principal investigator rarely missed occurrences of behaviors as indicated when both IOA was scored and live data was checked against videotaped data.

Variable results occurred for vocal articulation acquisition. 4-19 did learn the verbal statements for each sequence, novel statements occurred, and his inappropriate verbalizations decreased. The cause of his sudden acquisition during maintenance is unclear. Reliable indications of verbal acquisition were shown by 13-1 near the end of intervention. It is possible that, due to his lower level of imitative and functional skills he may need more time to acquire verbal skills. In contrast, 13-6 did not exhibit verbal
acquisition except for the basic truck sounds during the construction scene. His mother reported that he had been diagnosed with an unspecified "language delay."

Conventional methods used to teach verbal/sign acquisition over the past few years had proven unsuccessful. Observations unrelated to this study of this participant's oral motor responses during meals and therapy indicated he displayed "red flag" behaviors of apraxia. A recommendation was made for further assessment of his language delay to determine whether a specific language development delay existed that may have contributed to his difficulties in acquiring verbal and motor skills (National Institute of Neurological Disorders and Stroke [NINDS], 2004; Williams, Whiten, & Singh, 2004).

Mixed results were shown for inappropriate responding. Participant 4-19 exhibited the lowest rates of inappropriate responses at the onset of the study, and showed the clearest decreases in those responses for each scene after intervention. In contrast, 13-1's behavior did not show appreciable decreases and results for 13-6 were quite variable. For 13-6, all inappropriate responses decreased during the construction scene, inappropriate motor responses decreased during the food scene, and increases occurred in the pirate scene. Thus, the effect of video modeling on these behaviors was unclear for this participant.

The highest levels of appropriate responding by 13-1 did not occur until his BIP protocols were implemented in addition to video intervention and reinforcement. Due to the high levels of inappropriate behaviors that continued to occur, undetermined reinforcement contingencies were in effect for these responses. It may be possible that ignoring his inappropriate behaviors did not teach him that these responses were unacceptable. (The same might have occurred for 13-6.) Another variable may be
related to the lack of interaction by the data collector. Typically developing children interact frequently with parents/caregivers during play. Lack of stimulation inherent in interaction with the data collector might be associated with self-stimulation found in inappropriate behaviors exhibited by these participants. Future video modeling studies could look at differences in inappropriate responding by comparing adult interaction during play with no interaction.

Higher rates of pre-existing inappropriate responses at the onset of the study for both 13-1 and 13-6 may be correlated with the variable results shown. Future studies could focus on differences in pre-existing rates of inappropriate behaviors to determine if any relationship exists. Although individual session notes indicated a decrease in destructive behaviors for 13-1 this could not be shown in the graphs as all inappropriate behaviors were scored as a class. Availability of a second data collector would enable tracking of specific inappropriate responses by type rather than class to determine the effect intervention may have on these types of responses.

Some uncontrollable variables may have affected 13-1’s outcome as well (e.g., potty training and biomedical treatments). It is unknown what effect the biomedical change made during the study could have had. Potty training was implemented after the study began. It was noted that when a potty accident occurred between watching the video and playing with the toys (preventing play immediately after viewing of the video), fewer appropriate responses occurred.

The order of introduction of interventions should have been changed for both 13-1 and 13-6. While 13-1 played more appropriately with the construction and food toys in baseline than with pirate toys, 13-6 played with the pirate toys but did not touch toys
from the other scenes. When each participant showed an interest in a specific toy, intervention should have been started with that play scene first. The results of this study indicate that when a choice of teaching modeled skills is feasible (i.e., teaching a chain of play skills), it would be advisable to conduct a preference assessment first and make the video with the preferred toys. Due to the cost of buying separate toy sets for each participant and replacing toys if broken, three toy scenes were chosen for use by all participants and were based on types of toys that were considered to be age appropriate. The eating scene was not age appropriate for 13-6 but was chosen for reasons cited previously and was believed to be a possibly fun way for him to learn the skills he lacked. When a choice of teaching modeled skills is not feasible, the use of baseline data may be used to determine intervention order.

Different results may have occurred if videos had been made with toys indicated in a preference assessment rather than those used in the study. Charlop and Milstein (1989) made videos based upon toy preference to teach conversational skills to children with autism. Future studies could determine if teaching appropriate play skills with a preferred toy first would lead to acquisition/generalization during training with a less preferred toy later.

Interest in videos may also be a factor. Participant 13-6 was reported to enjoy videos at home but did not appear to watch the videos during the study, except for the construction video after criterion was met. Participant 4-19 spontaneously imitated statements or songs from videos before the study began and showed interest in all videos used in the study. On the other hand, 13-1 showed the least interest in the videos before the study began but interest increased for all videos when reinforcement
was added contingent on watching videos. A substantial increase in interest in the video when reinforcement was added did not occur with 13-6 warranting further study on the differences between the videos he preferred to watch and those used in the study to determine if these differences (i.e., the inclusion of music or the use of cartoon characters versus live models) could have accounted for his disinterest. It may be possible to create videos that he would be more interested in and, if so, that higher levels of imitation might ensue. For 4-19, it is possible that videos, in general, provided naturally occurring reinforcement contingencies that were correlated with his high rate of acquisition.

Future studies may also investigate possible differences related to the types of toys used and the results obtained. Three different types of toys were chosen for the present study. The eating toys were viewed as common stimuli as each participant had exposure to eating utensils and food within their home environments. The construction toys were deemed less common but exposure to construction equipment in the environment was possible (i.e., participants may have seen construction equipment resembling the toys while riding in the car). Finally, the pirate toys were categorized as novel or "fantasy" related as pirates are not real and exposure within the environment was less likely. It is possible that this novelty or fantasy nature of the pirate toys contributed to the higher rates of novel responding or to the less consistent emission of an ordered chain of responses exhibited by the participants in this study with the pirate scene when compared to the construction and eating scenes. Further study could determine any effect the type of toys used may have on response acquisition.
Except for the D'Ateno et al. (2003) study, a variety of reinforcement, prompting, or correction procedures were used with video modeling, including prompting participants to pay attention to the videos or praising attending to the videos (Charlop-Christy et al., 2000; Lasater & Brady, 1995; LeBlanc et al., 2003; Schreibman et al., 2000). Reinforcers were not provided for watching the video in the present study except where reinforcement was added to the intervention. Increased task fluency was accompanied by concomitant decreases in task interfering behaviors (Lasater & Brady) with causes for the decreases attributed to increases in task accuracy and speed; however, the inappropriate behaviors were not destructive or aggressive as in the present study. Schreibman et al. successfully used video priming to decrease disruptive transition behaviors (including aggression). The responses did not generalize until substantial reductions in disruptive behaviors had occurred during intervention and causes for the decreases were unclear. Variance in these results indicate avenues for future research including differences in acquisition dependent upon when/if reinforcement is included in intervention, in interest levels in video viewing, and in types of inappropriate behaviors to determine if these variables could affect intervention results.

The use of a forward chaining video modeling procedure (Taylor, Levin, & Jasper, 1999) may be more effective with children who have lower levels of imitative skills. The chains used in each video of the present study contained at least 12 motor steps and 12 verbal statements (as well as other verbalizations appropriate to the scenes). Participant 13-1 typically emitted 1-step imitations with occasional 3-step modeled responses rather than emitting the entire chain as 13-6 and 4-19 did. It is
plausible that shorter chains may be acquired more rapidly. As a section of the chain is mastered, the next section could be added. In addition, the difficulty level of longer chains may be associated with the inability (we found) to achieve substantial decreases in inappropriate behaviors. Lasater and Brady (1995) suggested a correlation between the presence of maladaptive behaviors and task difficulty. Future research could address this issue when training children with lower imitative skills.

An interesting development occurred toward the end of the study. Participant 13-1 was observed to spontaneously imitate a peer's play behavior during natural environment training (NET) at the clinic. This had not happened previously as he did not imitate peers even when prompted. In fact, he did not interact with peers at all except to occasionally take a toy from a peer. Charlop and Milstein (1989) found mixed, yet promising results when teaching conversational speech with video modeling. Future studies could look at the use of video modeling to increase interactions with peers during play after basic response chains had been acquired.

Results indicated that video modeling with our adult model was successful with each participant to varying degrees. This contradicts Varni, Lovaas, Koegel, and Everett (1979) who found that children with low-functioning autism were able to acquire only small portions of responses modeled by adults, Egel et al. (1981) who found that peer models were more effective than therapists, and Tryon and Keane (1986) wherein the participants failed to acquire appropriate complex play skills when demonstrated by in vivo peers or adults.

However, in a study comparing the effectiveness of peer versus adult models when teaching children with autism, Ihrig and Wolchik (1988) found no differences in
acquisition. They reported that modeling was less expensive than one-to-one discrete trial techniques, facilitated generalization and maintenance, and provided children with autism a more general approach to response or information acquisition. An unknown adult model was used in this study for several reasons. First, Egel et al. (1981) suggested that novelty could enhance skill acquisition and increase attentional skills. The results of the present study appear to support this. Second, finding an age appropriate typically developing peer and training that child to emit the chains correctly would be more difficult than training an adult model. Finally, in light of the results found by Ihrig and Wolchik of no differences between using an adult or peer model, an adult model was deemed acceptable. The outcomes of the present study validate this choice.

Mixed results have occurred with regards to generalization in previous studies. Charlop-Christy et al. (2000), Lasater and Brady (1995), Reamer et al. (1998), Schreibman et al. (2000), and D'Ateno et al (2003) found generalization occurred without specific programming. However, skills did not generalize for LeBlanc et al. (2003). Charlop-Christy and Daneshvar (2003) used a multiple exemplar approach to enhance generalization. Two of three participants' behavior generalized consistently. Charlop and Milstein (1989) indicated that preplanned generalization strategies involving a combination of programming common stimuli, natural contingencies, and multiple exemplars led to successful generalization results. Kinney et al. (2003) disclosed that generalization occurred after modifying their procedure and suggested that for generalization to occur it may sometimes be necessary to preprogram specific strategies. Specific generalization strategies (e.g., training multiple exemplars or using stimuli common to several environments) were not preprogrammed in this study to
determine if video modeling alone would lead to generalization in children with low-functioning autism. Our results indicate generalization occurred for 4-19 and 13-1 but not for 13-6. As only one generalization probe was done with 13-1 and generalization did occur, but did not in the single probe with 13-6, future studies could look into possible causes or correlates of the differences in participants that led to the varying results found in this and previous studies.

In summary, the efficacy of video modeling as a tool was shown as each participant was able to reach criterion in at least one task without reinforcement. Many variables could account for the differences found in levels of skill acquisition attained, as well as speed of acquisition. Some of the variables include a possible disinterest in the toys used, length of the response chain being taught, level of pre-existing imitative skills and attention span, and uncontrollable outside variables such as the introduction of potty training during the study. We were unable to achieve control with reinforcers used at home or in therapy, and we encountered problems with finding effective reinforcers—both of which may have decreased reinforcer effectiveness when reinforcement was added. In addition, the level of pre-existing basic exploratory play skills may contribute to the results. For instance, during 1 baseline session 4-19 spent over 4 min trying variations of rolling and unrolling the string on the crane in the pirate scene. He engaged in this type of basic exploratory play during several other sessions and was observed to do the same during free play at TSOB. This type of behavior was not observed with the other 2 participants and could be related to the differences we found in rate and level of skill acquisition.
Pre-existing high levels or strong reinforced histories of self-stimulatory or destructive behaviors with toys may have contributed to the slower acquisition rates found with 2 participants. Naturally occurring reinforcement contingencies associated with maintaining high levels of self-stimulatory or destructive responses may have competed with the toys used as these toys did not appear to provide naturally occurring reinforcers for interactions. Tryon and Keane (1986) suggested that the decreases in self-stimulatory behaviors could be attributed to replacement of inappropriate stimulation by appropriate forms of stimulation found in the toys used or by the sensory components inherent in the toys. The toys we provided may not have provided appropriate replacement stimulation. In the future, consideration of the sensory components of the toys used or factors of competing with strong histories of inappropriate responses could possibly result in lower rates of inappropriate behaviors or ameliorate the need for additional reinforcement strategies.

The use of video modeling in this study was successful in teaching complex play sequences to the participants when in vivo modeling had not been (during the course of therapy or at home). One theory posited during the course of this study was that children with autism may view video models as objects rather than people. As children with autism often attend to objects more readily than people, this avenue warrants further investigation. At the time this study began, no studies on complex chains taught with video modeling to children with low-functioning autism could be found. Thus, this study was a preliminary step in determining whether or not video modeling would be a viable treatment option for children with low-functioning autism. These preliminary results suggest that video modeling can be used successfully as a
tool to help children with low-functioning autism acquire complex motor and/or verbal sequences, decrease inappropriate behaviors, and achieve skill generalization. Our results add to the literature and have implications for educators and caregivers for teaching vital social play skills lacking in children with autism, as substantial gains had not been achieved prior to the study using conventional methods but were attained with video modeling. Minimal video skills were required; costs were feasible; several children were able to learn from the same videos; and implementation skills can be easily learned.
APPENDIX

VERBAL AND MOTOR SCRIPTS
Pirates

(Model begins tape by holding doll and saying, "C'mon Woody, let's play pirates", then places doll on table.)

<table>
<thead>
<tr>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Get out of boat.&quot;</td>
<td>Pirate climbs out of boat</td>
</tr>
<tr>
<td>&quot;Look out, alligator!&quot;</td>
<td>Pirate runs from alligator</td>
</tr>
<tr>
<td>&quot;Shoot the cannon!&quot;</td>
<td>Pirate loads/shoots cannon</td>
</tr>
<tr>
<td>&quot;Dig a hole.&quot;</td>
<td>Pirate digs hole with shovel</td>
</tr>
<tr>
<td>&quot;Find the treasure.&quot;</td>
<td>Pirate looks for treasure</td>
</tr>
<tr>
<td>&quot;Open the chest.&quot;</td>
<td>Chest is opened</td>
</tr>
<tr>
<td>&quot;Wow, look!&quot;</td>
<td>Model shows coins in chest</td>
</tr>
<tr>
<td>&quot;Lift the chest.&quot;</td>
<td>Pirate picks up chest</td>
</tr>
<tr>
<td>&quot;Walk over here.&quot;</td>
<td>Pirate carries chest to dock</td>
</tr>
<tr>
<td>&quot;Lower chest into boat.&quot;</td>
<td>Crane used to lower chest</td>
</tr>
<tr>
<td>&quot;Climb in boat.&quot;</td>
<td>Pirate climbs into boat</td>
</tr>
<tr>
<td>&quot;Sail the boat.&quot;</td>
<td>Model pushes boat around</td>
</tr>
</tbody>
</table>
## Construction

(Model begins tape by holding doll and saying "C'mon Woody, let's play construction worker", then places doll on table.)

<table>
<thead>
<tr>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Climb out of truck.&quot;</td>
<td>Worker climbs out of truck</td>
</tr>
<tr>
<td>&quot;Walk over here.&quot;</td>
<td>Worker walks to rock pile</td>
</tr>
<tr>
<td>&quot;Break up the rocks.&quot;</td>
<td>Worker jackhammers rocks</td>
</tr>
<tr>
<td>&quot;Move dozer over here.&quot;</td>
<td>Model rolls dozer on table</td>
</tr>
<tr>
<td>&quot;Push the rocks.&quot;</td>
<td>Dozer used to push rocks</td>
</tr>
<tr>
<td>&quot;Pick up the rocks.&quot;</td>
<td>Dozer picks up rocks</td>
</tr>
<tr>
<td>&quot;Push the dump truck.&quot;</td>
<td>Model rolls dump truck on table</td>
</tr>
<tr>
<td>&quot;Back up.&quot;</td>
<td>Truck backs up between cones</td>
</tr>
<tr>
<td>&quot;Load the rocks.&quot;</td>
<td>Put rocks from dozer into truck</td>
</tr>
<tr>
<td>&quot;Dump the rocks.&quot;</td>
<td>Manipulate truck to dump rocks</td>
</tr>
<tr>
<td>&quot;Dig a hole.&quot;</td>
<td>Backhoe used to dig hole</td>
</tr>
<tr>
<td>&quot;Mix and pour cement.&quot;</td>
<td>Model manipulates cement mixer</td>
</tr>
</tbody>
</table>
Eat

(Model begins tape by holding doll and saying, "C' mon Woody, let's eat", and places doll on table.)

<table>
<thead>
<tr>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Set the table.&quot;</td>
<td>Model sets table for two</td>
</tr>
<tr>
<td>&quot;Get some food.&quot;</td>
<td>Model puts food on plates</td>
</tr>
<tr>
<td>&quot;Cut with the knife.&quot;</td>
<td>Model cuts with knife &amp; fork</td>
</tr>
<tr>
<td>&quot;Stab with the fork.&quot;</td>
<td>Model stabs food with fork</td>
</tr>
<tr>
<td>&quot;Blow on it.&quot;</td>
<td>Model blows on fork</td>
</tr>
<tr>
<td>&quot;Take a bite.&quot;</td>
<td>Model takes bite from fork</td>
</tr>
<tr>
<td>&quot;Chew it up.&quot;</td>
<td>Model chews food</td>
</tr>
<tr>
<td>&quot;Scoop with the spoon.&quot;</td>
<td>Model uses spoon</td>
</tr>
<tr>
<td>&quot;MMM, it's good.&quot;</td>
<td>Model takes bite from spoon</td>
</tr>
<tr>
<td>&quot;Take a drink.&quot;</td>
<td>Model drinks from cup</td>
</tr>
<tr>
<td>&quot;Wipe your mouth.&quot;</td>
<td>Model wipes mouth with napkin</td>
</tr>
<tr>
<td>&quot;Clean up.&quot;</td>
<td>Toys placed in bucket</td>
</tr>
</tbody>
</table>
REFERENCES


