A Comparison of In-Vivo and Video Modeling Procedures for Teaching Functional Response Chains to Individuals with Developmental Disabilities

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# Table of Contents

A Comparison of In-Vivo and Video Modeling Procedures for Teaching Functional Response Chains to Individuals with Developmental Disabilities

A. Abstract……………………………………………………………… 2

B. Introduction
   1. Modeling................................................................. 3
   2. Video Modeling......................................................... 4
   3. Teaching Independent Living Skills with Video Modeling..... 4
   4. Comparing In-Vivo Modeling and Video Modeling.......... 7
   5. Purpose................................................................. 10

C. Method
   1. Participant.............................................................. 10
   2. Setting and Materials............................................... 11
   3. Dependent Measure.................................................. 12
   4. Procedures........................................................... 13

D. Results........................................................................ 17

E. Discussion.................................................................... 21

F. References.................................................................... 26

G. Tables.......................................................................... 29

H. Figure Captions.......................................................... 31

I. Figures.......................................................................... 33
Abstract

The present study evaluated the effectiveness of in-vivo modeling with video modeling for teaching functional response chains, such as independent living skills, to two individuals with developmental disabilities. Each participant was taught two sets of response chains. In each set, one response chain was taught using video modeling and one response chain was taught using in-vivo modeling. A parallel treatments design across participants and modeling procedures was utilized to evaluate the efficacy of each modeling procedure. In the in-vivo condition, at the start of each trial the participant watched the therapist model the response chain twice. The video modeling condition was the same except the participant viewed a recorded video model of the response chain completed by the same therapist. Throughout all experimental conditions there were no scheduled consequences or prompts. Results are discussed in terms of the overall effectiveness of each modeling procedure in facilitating skill acquisition, and promoting generalization and maintenance of each response chain. In the current study, both the in-vivo and video modeling procedures were effective at promoting skill acquisition, maintenance and generalization.
A Comparison of In-Vivo and Video Modeling Procedures for Teaching Functional Response Chains to Individuals with Developmental Disabilities

According to the Center for Disease Control (CDC), and the Research Triangle Park International (RTI), the long-term supportive care cost for persons born in 2000 alone, with mental retardation, will be $51.2 billion dollars (Honeycutt et al., 2004). Treatment packages that teach individuals with developmental disabilities to complete functional living skills independently may decrease the cost associated with the direct-care needed for that person (Canella-Malone et al., 2006) and are the long-term goal of behavioral interventions (MacDuff, Krantz, & McClannahan, 1993). Given the high cost of direct behavioral support, efforts should be made to direct research and practice efforts toward procedures that are most cost efficient, effective at teaching skill acquisition, and effective at maintaining responding after the termination of the treatment. Video modeling is one research-supported procedure for teaching functional living skills to individuals with developmental disabilities (Bidwell & Rehfeldt, 2004; Charlop-Christy, Le, & Freeman, 2000; Haring, Kennedy, Adams, & Pitts-Conway, 1987; Murzynski & Bourret, 2007; Rehfeldt, Dahman, Young, Cherry, & Davis, 2003; Shipley-Benamou, Lutzker, & Taubman, 2002).

In modeling procedures, the participant views a response topographically identical to the desired response. If the participant emits this behavior after viewing the model, he or she is said to have imitated the behavior. This is a form of observational learning (Cooper, Heron, & Heward, 1987). In early modeling research with individuals with developmental disabilities, participants successfully learned simple discrimination tasks after the behavior had been modeled by typically developing peers (Egel, Richman, & Koegel, 1981). In a similar study,
Werts and colleagues (1996) found that in-vivo demonstrations of academic tasks such as spelling and simple addition led to improved performance in children with developmental disabilities. More recently, research has been conducted with video modeling. In video modeling, behavior chosen for improvement or correction is recorded and later presented to the child, in an attempt to teach the child to imitate the desired behavior (Mulstay-Muratore, 2003). Video modeling interventions often facilitate rapid skill acquisition, maintenance, and generalization across therapists and settings (Delano, 2007).

Research supports the use of video modeling as an effective method of teaching a myriad of skills to children with autism. Skills taught using video modeling include play skills (Charlop & Milstein, 1989; D’Anteno, Mangiapanello, & Taylor, 2003; MacDonald et al., 2005) social skills (Charlop & Milstein, 1989; Charlop-Christy et al., 2000) and response chains of independent living skills (Bidwell & Rehfeldt, 2004; Charlop-Christy et al., 2000; Haring et al., 2003; Murzynski & Bourret, 2007; Shipley-Benamou et al., 2002). In some studies, the behavior change resulting from the video modeling intervention occurred without the use of scheduled consequences and prompts (Charlop-Christy et al., 2000).

*Teaching Independent Living Skills with Video Modeling*

Teaching independent living skills, such as snack making, daily hygiene routines and leisure skills to individuals with developmental disabilities promotes independence and may decrease some of the time and energy required in providing direct care (Rehfeldt et al., 2003; Shipley-Benamou et al., 2002). One method of teaching functional response chains to individuals with developmental disabilities is through the use of a task analysis (TA), in which a long chain of responses is broken down into smaller behavioral units. The response chain is then taught by reinforcing small successions of behavior, until the entire unit is linked together as one
response sequence. In a response chain, each step of the task functions as a conditioned reinforcer for the completion of the preceding step as well as a discriminative stimulus for the succeeding step (Cooper et al., 1987).

It has been consistently demonstrated in research studies that video modeling procedures can be effective for teaching functional response chains to individuals with developmental disabilities. For example, Rehfeldt and colleagues (2003) used a video modeling procedure to teach a 17-step chain for making a peanut butter and jelly sandwich. In the study, three individuals with developmental disabilities, were initially exposed to a multiple-opportunity baseline, in which they were presented with all the needed materials and instructed to ‘make a sandwich’. If the participants were unable to complete the next step in the chain, the therapist completed it for them. Following the conclusion of baseline, the video modeling intervention was implemented.

The video modeling intervention was identical to baseline except that the participants viewed a video clip of an adult with a developmental disability correctly completing the steps of the chain. After viewing the model, the participants were instructed to imitate the model. If the participant was able to successfully complete the next step in the chain, verbal praise was provided contingently and if the participant did not correctly complete the next step, the therapist completed it for him or her and no feedback was provided. The video modeling intervention was terminated after the participant completed the sandwich-making task across three consecutive sessions. All three participants mastered the chain in 22 or fewer sessions and during generalization probes, two out of three participants completed the chain in a different setting with 100% accuracy. In addition, all three participants completed the response chain with 100% accuracy and independence during a one month follow-up probe.
In a similar study, Bidwell and Rehfeldt (2004) replicated the video modeling procedures of Rehfeldt et al. (2003). In the replication, three individuals with developmental disabilities were taught a 23-step chain for making coffee that included a social initiation. The participants initially were exposed to a multiple-opportunity baseline and a succeeding video modeling intervention. After viewing the video model, the participant was instructed to ‘make coffee.’ Verbal praise was delivered contingent upon correct responses to the chain and no feedback or prompts were delivered contingent on incorrect responses. Identical to Rehfeldt and colleagues (2003), the intervention concluded once the participant completed the steps of the coffee making task with 100% accuracy and independence across three consecutive sessions. As a result of the video modeling intervention, all three participants completed the steps in the coffee making chain and generalized the skill across a different setting. In addition, two of the three participants completed all of the steps with 100% accuracy and independence in a maintenance probes conducted approximately one month after the intervention.

Another method for using video modeling, instructional video modeling, is reported in the literature. In instructional video modeling the video segment is recorded from the participant’s point of view. Using instructional video modeling, Shipley-Benamou, and colleagues (2002), successfully taught three children with autism to make orange juice, mail a letter, care for a pet, and set a table. In the study, all three participants completed the response chains independently after five or fewer exposures of the instructional video modeling procedure. After the participants completed the response chains across two consecutive sessions, no-video probes and 1-month follow-up probes were conducted. In the no-video probes, all three participants completed the response chains with 100% accuracy. In 1-month follow-up probes,
two participants completed the tasks with 100% accuracy and one participant completed the tasks with 80% accuracy.

**Comparing In-Vivo Modeling and Video Modeling**

The few studies that have compared video modeling with in-vivo modeling procedures have found video modeling to be as effective as or more effective than in-vivo modeling at facilitating response acquisition, generalizing skills taught across settings and stimuli, maintaining skills over time (Charlop-Christy et al., 2000; Gena, et al., 2005). This research has also provided evidence that video modeling is less expensive than in-vivo modeling (Charlop-Christy et al., 2000).

**Acquisition.** Charlop-Christy and colleagues (2000) used a multiple baseline across participants, skills and modeling conditions (in-vivo or video modeling) to examine the effects of the modeling procedures on response acquisition. During both in-vivo and video modeling conditions, no scheduled consequences or prompts were delivered. In both conditions, a model of the desired response was presented twice. Following two initial in-vivo models, the participant was told to “Do the same, just like they did”. The video modeling condition was conducted in the same manner as the in-vivo modeling condition, except that the participant initially watched two video-model demonstrations and was later told to “Do the same as in the video”. The investigators concluded that for four of five participants, the video modeling instructional format led to faster acquisition of expressive labeling, independent play, scripted conversation, cooperative play, social play and self-help skills (Charlop-Christy et al., 2000). In total, the skills taught using video modeling were acquired in 27 fewer presentations than the skills taught using in-vivo modeling.
Another study that compared the rates of response chain acquisition with or without video modeling yielded similar results. Murzynski and Bourrett (2007) successfully taught two boys diagnosed with autism four daily-living skills using video modeling and least-to-most (LTM) prompting. In the study, each participant was taught four skills; two using LTM prompting and two using LTM prompting in conjunction with a video modeling procedure. For both participants, all skills taught with the LTM prompting in combination with video modeling were mastered in fewer trials. The first participant mastered the skills taught with video modeling and LTM in 50 trials, and mastered the skills taught with LTM only in 95 trials. The second participant mastered all skills taught with video modeling and LTM in 50 trials, and mastered the skills taught with LTM alone in 70 trials.

**Generalization.** More research is needed to ascertain if video modeling is effective at promoting generalization of response chains. Charlop-Christy and colleagues (2000) compared generalization of skills taught using a video modeling procedure to generalization of skills taught using in-vivo modeling. The results of their study indicated that all eight of the skills taught using video modeling were generalized across settings, persons and stimuli. Furthermore, generalization was not observed for any of the eight skills taught using in-vivo modeling. It has been hypothesized that video modeling is successful at promoting generalization of skills because video-based interventions provide more facilitators of generalization such as common stimuli, because the model is identical in all trials. In addition, Charlop-Christy and colleagues (2000) proposed that during in-vivo modeling procedures, the model is part of the environment and thus connected to that environment, which may make generalization to novel settings more difficult. In another study that compared generalization of skills taught using video modeling to those taught using in-vivo modeling, generalization of responding to novel therapists and to
untrained scenarios, regardless of which modeling procedure was implemented was observed for all participants (Gena, Couloura, & Kymissis, 2005).

**Maintenance.** More research is needed to determine whether the response chains taught using video modeling are maintained over more time than those taught using in-vivo modeling procedures. To date, very little research has been conducted examining maintenance of long response chains taught using video modeling. Shipley-Benamou and colleagues (2002) used instructional video modeling to teach independent meal skills and domestic tasks to three participants with autism. After the participants viewed the instructional video model, correct responding on acquisition tasks increased dramatically. In addition, the skills taught through the video modeling procedure were maintained during follow-up probes conducted one month after the termination of the video model. Maintenance of meal skills taught via a video modeling procedure was also reported by Rehfeldt et al. (2003). Three individuals successfully maintained a 17-step chain for making a peanut butter sandwich one month after the conclusion of the study (Rehfeldt et al.).

**Cost Effectiveness.** Research analyzing the costs associated with video and in vivo modeling suggests that video-based modeling procedures are more cost efficient and may actually cost less than in-vivo modeling procedures (Charlop-Christy et al., 2000). Charlop-Christy and colleagues (2000) reported the total cost of video modeling was $58 compared to $127 for in-vivo modeling. This cost difference is a result of payment of the teachers who served as models; in the video modeling condition, the models only had to be paid for one taped session, whereas in the in vivo modeling condition they were paid for each appearance. The total time models were needed for in-vivo modeling procedure was 635 min versus the 170 min required for the video modeling procedure (Charlop-Christy et al., 2000).
In addition to being time efficient, another factor in the cost-effectiveness of video modeling is that the behavior change occurred without the use of scheduled consequences and prompts (Bidwell & Rehfeldt, 2004; Charlop-Christy et al., 2000; et al., 2005; Rehfeldt et al., 2003). According to Rehfeldt and colleagues (2003), video modeling procedures might save teaching institutions and adult habilitation programs time and money because staff may not be required to receive specialized training on fading a prompting hierarchy.

Although both in-vivo and video modeling procedures have been found to be effective in teaching individuals with developmental disabilities to complete response chains, few studies have been conducted comparing the efficacy of the modeling methods. More specifically, it is important to identify which modeling procedure is more effective at maintaining response chains over time so that individuals with developmental disabilities will benefit over time from the intervention. By identifying which teaching procedure requires fewer trials to mastery, which method allows for generalization while maintaining responding over time, and which procedure is less expensive, future efforts may be directed to the implementation of teaching procedures that are the most efficient and effective in promoting functional response chains for individuals with developmental disabilities. In the current study, functional response chains, such as snack making and leisure skills were taught using video and in-vivo modeling. The purpose of the study was to compare the effects of an in-vivo modeling procedure with a video modeling procedure on acquisition, maintenance and generalization of functional response chains.

Method

Participants
Two male students enrolled in a residential program for children with developmental disabilities participated in the study. John (13 years old) and Jason (15 years old) communicated vocally and spoke in short sentences. The participants were selected for the study because they
both had previously acquired response chains taught with a task analysis (TA) and both participants frequently watched DVDs during leisure time.

Setting

All training sessions and maintenance probes for John were conducted at his residence in a large room that contained a table, chairs, treadmills, a television and a sofa. Generalization probes during baseline and after training for John were conducted in his school setting, in a small room that contained a small table and two chairs. All training sessions and maintenance probes for Jason were conducted at his residence. Two of Jason’s response chains (making nachos and making toast) were taught at his residence in a kitchen that contained a stove, microwave, sink, and a large table with six chairs and two response chains (snail toy construct and table setting) were taught at his residence in the dining room that contained a large table with six chairs. For two of Jason’s response chains (making nachos and making toast) generalization probes during baseline and after training were conducted in a school cafeteria, in an area that contained a microwave, sink, toaster and a large table with 10 chairs; for the other two response chains (snail toy construct and table setting) generalization probes were conducted in a small room in his school that contained a small table and two chairs.

Materials

During all baseline, training, generalization and maintenance sessions, participants were provided with all materials necessary to complete the response chain. Materials used during training sessions for both participants included a portable DVD player and a DVD containing the video models. The four different toy constructs (fish, triceratops, alien and anteater) that were taught to John were made of Dragon Bonz® from Curious Toys. The fish and triceratops toy constructs each contained seven pieces. The pieces needed to complete the fish toy were: a torso
functional response chains

piece, head, tail, two wings, a fin and an eye. The pieces needed to compete the triceratops toy were: a spine piece, head, tail and four foot pieces. The alien and anteater toy constructs each contained eight pieces. The pieces needed to complete the alien toy were: a torso piece, head, two feet, two claws, and two eyes. The pieces needed to complete the anteater toy were: a torso piece, head, four feet, and two eyes (See Figure 1).

The sequences taught to Jason were toast making, nacho making, table setting and one toy construct. The materials needed for toast making included: a plate, a bag of bread and a toaster. The materials needed for nacho making included: a plate, a small bag of chips, a small container with cheese and a microwave. The materials needed for table setting included: a place mat, plate, napkin, fork, spoon, knife, cup and a napkin. The snail toy was constructed using the Dragon Bonz® construction toys. The snail toy consisted of seven pieces: a snail shell, a foot, two claws, two tentacles and an eye piece (See Figure 2).

Each participant was taught four response chains; two using video modeling and two using in-vivo modeling. The four response chains were divided into two sets, with each set having one chain taught with video modeling and chain taught with in-vivo modeling. For John, the response chains taught in set one were the triceratops toy and fish toy constructs and the response chains taught in set two were the alien toy and the anteater toy constructs. For Jason, the response chains taught in set one were toast making and nacho making and the response chains taught in set two were the snail toy construct and table setting.

**Dependent Measure**

The dependent variable was the percentage of each response chain the participant completed correctly and independently. This was measured during each phase of the study: baseline, training, maintenance, and generalization. These values were calculated by dividing
the number of steps completed independently by the total number of steps in the response chain and then multiplying the quotient by 100. Steps of the response chain were scored as correct if the participant completed the step independently and incorrect if the participant did not complete the step as it was modeled or if the participant did not respond within the allotted time. For John, the response chains in set one had eight steps and the response chains in set two had nine steps. The steps in each response chain for John are shown in Table 1. For Jason, the response chains in set one had nine steps and the response chains in set two had eight steps. The steps in each response chain for Jason are shown in Table 2. For all response chains the order in which they were completed was irrelevant, as long as the final product was identical to the model.

Procedure

The effects of each modeling procedure were examined using a parallel treatments design in conjunction with a multiple-baseline design across tasks. A parallel treatments design consists of two simultaneous multi-element designs and controls for the effects of extraneous variables through counterbalancing and replication (Gast & Wolery, 1988; Murzynski & Bourret, 2007). One to four sessions were conducted daily, approximately one to three days a week. Each session consisted of one response chain taught with in-vivo modeling and one response chain taught with video modeling. The response chains paired together in each set were always assessed on the same day.

Initially, baseline probes were conducted to assess each participant’s responding prior to the intervention. Training sessions, in which the specific model was presented to the participant, were conducted until the participant completed the entire response chain with 100% independence across two consecutive sessions. Next, a mastery probe was conducted to assess responding in the absence of a model. Response chain mastery was achieved when the
participant completed the entire response chain in the absence of a model. After the participant’s performance met mastery criteria, maintenance and generalization probes were conducted to assess performance after three weeks and across settings.

**Baseline.** In baseline sessions, the response chain was not modeled for the participant and no scheduled consequences or prompts were delivered. Baseline sessions were conducted in the training and generalization probe settings for both participants and all tasks. Participants were presented with all relevant stimuli and instructed to respond. John was told to play with the specific toy. For example, during sessions with the triceratops toy, John was told to “Play with your triceratops toy”. Jason was told to make the specific food item, for example, “Make nachos”, or to complete a specific task, for example, “Set the table” or “Play with your snail toy. Baseline sessions were terminated when the participant stopped interacting with the materials for more than 30 s or after 2 min had elapsed.

**Training: In-Vivo Model.** During in-vivo modeling sessions, no scheduled consequences or prompts were delivered. At the beginning of each session, the experimenter slowly modeled the entire response chain twice, as in the video modeling sessions. In all in-vivo modeling sessions, the model was presented to the participant within 1 m of all necessary materials. After watching the model twice, the participant was given the same cue as in baseline in addition to being told to “Do it like me”. For example, after viewing the in-vivo model, Jason was instructed to “Make toast. Do it like me”. In-vivo modeling sessions were terminated once the participant stopped interacting with the materials for more than 30 s, after 4 min had elapsed or until the participant emitted the entire response chain. Training sessions for both the in-vivo and video modeling conditions were conducted until the participant completed the entire response chain with 100% independence across two consecutive sessions.
Training: Video Model. During video modeling sessions, no scheduled consequences were delivered. Prompts were provided only to direct the participant to attend to the video model. At the beginning of each session, the participant was presented with a video clip of the experimenter slowly modeling the response chain twice. In all video modeling sessions, the model was presented to the participant using portable DVD player located within 1 m of all necessary materials. After watching the model twice, the participant was given the same cue as in baseline in addition to being told to “Do it like the video”. For example, after viewing the video model, Jason was instructed to “Make nachos. Do it like the video”. Video modeling sessions were terminated once the participant stopped interacting with the materials for more than 30 s, after 4 min had elapsed or until the participant emitted the entire response chain. Training sessions were conducted until the participant completed the entire response chain with 100% independence after viewing the model, for two consecutive sessions.

Mastery Probes. In mastery probes, no scheduled consequences or prompts were delivered. Mastery probes were conducted in the same setting as training sessions however no models were presented. The participant was presented with all relevant stimuli and cued to complete the response chain. For example, Jason was instructed to “Make nachos” or “Make toast”. Mastery criteria were met when the participant completed the entire response chain with 100% independence. If the participant did not complete the entire response chain independently, the participant returned to training sessions with the video or in-vivo. This was repeated until response chain mastery was met without the presentation of a model. Mastery probes were terminated once the participant stopped interacting with the materials for more than 30 s, after 4 min had elapsed or until the participant completed the entire response chain.
Maintenance Probes. Maintenance probes were held three weeks after the participant met the mastery criterion and were procedurally identical to mastery probes.

Generalization Probes. Generalization probes were held in a second setting within one week after maintenance probes and were procedurally identical to mastery probes. Generalization probes for John were conducted in his school and generalization probes for Jason were conducted in a cafeteria and at his school.

Interobserver Agreement

A second observer scored the sessions from a video recording and interobserver agreement was calculated for all phases of the study. This observer calculated the percentage of steps completed independently for all response chains for both participants. The percent agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and then multiplying the quotient by 100.

For John, interobserver agreement was calculated in 33% of baseline sessions, 35% of training sessions and 33% of probe sessions for the fish toy (100%, 100% and 100%); 33% of baseline sessions, 32% of training sessions and 33% of probe sessions for the triceratops toy (100%, 100% and 100%); 33% of baseline sessions, 36% of training sessions and 33% of probe sessions for the anteater toy (100%, 100% and 100%); 33% of baseline sessions, 38% of training sessions and 33% of probe sessions for the alien toy (100%, 96% [range 77-100%] and 100%, respectively).

For Jason, interobserver agreement was calculated in 25% of baseline sessions, 60% of training sessions and 33% of probe sessions for nacho making (100%, 100% and 100%, respectively); 25% of baseline sessions, 60% of training sessions and 33% of probe sessions for toast making (100%, 100% and 100%, respectively); 40% of baseline sessions, 33% of training
sessions and 33% of probe sessions for table setting (100%, 93.4% [range 77-100%] and 100%, respectively); 40% of baseline sessions, 35% of training sessions and 33% of probe sessions for the snail toy (100%, 98.2% [range 87.5-100%] and 100%, respectively).

Results
As a result of the modeling procedures, both participants completed all four response chains independently. Both the in-vivo modeling and video modeling procedures led to response chain mastery and both procedures led to maintenance and generalization of the response chains. The separate effects of each modeling procedure on response acquisition, maintenance and generalization were not replicated across sets of response chains for either participant. In this comparison study, no reliable effect was observed for the in-vivo modeling or video modeling procedures.

John

Set One. John’s data for set one are displayed in the top panel of Figure 3. In the fish toy baseline, John completed 12.5% of the response chain in both settings and in the triceratops toy baseline, John completed 25% of the response chain in both settings.

The response chain taught with the video model (fish toy) was acquired in eight fewer sessions than the response chain taught with the in-vivo model (triceratops toy). In the video modeling component, John’s percentage of response chain completion did not initially increase for the fish toy. John’s performance met criteria for a mastery probe, following the 20th video modeling session. In the in-vivo component, John’s percentage of response chain completion responding gradually increased and John’s performance met criteria for a mastery probe following the 26th session. After returning to the training condition, John’s performance met criteria for a mastery probe again, following the 28th presentation of the in-vivo model.
The video modeling procedure led to a higher percentage of response chain completion in mastery and maintenance probes. However, both modeling procedures were found to be equally effective in generalization probes. In the first mastery probe for the response chain taught with video modeling, John completed 100% of the response chain and in mastery probes for in-vivo modeling, John completed 87.5% of the response chain. After returning to in-vivo training, John completed 100% of the response chain in a second mastery probe. In three-week maintenance probes, John completed 100% of the response chain taught with video modeling and 50% of the response chain taught with in-vivo modeling. In generalization probes, John completed 75% of both response chains.

*Set Two.* John’s data for set two are displayed in the bottom panel of Figure 3. In the anteater toy baseline, John completed 11.1% of the response chain in both settings and in the alien toy baseline, John completed 11.1% of the response chain in the training setting and 22.2% in the generalization setting.

The response chain taught with the in-vivo model (alien toy) was acquired in nine fewer sessions than the response chain taught with the video model (anteater toy). In the video modeling component, John’s percentage of response chain completion increased and he met criteria for a mastery probe following the 22nd session. In the in-vivo modeling component, John’s percentage of response chain completion increased and he met criteria for a mastery probe following the 13th session.

Both modeling procedures were equally effective at maintaining responding over time and generalizing responding across settings. John completed 100% of both response chains in mastery probes. During three-week maintenance probes, John completed 77.7% of both response chains. In generalization probes, John completed 77.7% of both response chains.
Jason

Set One. Jason’s data for set one are displayed in the top panel of Figure 4. In the nacho making baseline, Jason completed 11.1% of the response chain in the training setting and 0% of the response chain in the generalization setting. In the toast making baseline, Jason completed 11.1% of the response chain in both settings.

Jason completed 100% of the response chain taught with in-vivo modeling (toast making) and 100% of the response chain taught with video modeling (nacho making) after an equal number of modeling sessions. In both in-vivo and video modeling components, Jason’s percentage of response chain completion increased. Jason met criteria for a mastery probe following the fifth in-vivo and video modeling sessions.

Both modeling procedures were equally effective at maintaining responding in the absence of a model, over time and at generalizing the response chain across settings. In mastery probes, Jason completed 100% of both response chains. In maintenance and generalization probes, Jason completed 100% of both response chains.

Set Two. Jason’s data for set two are displayed in the bottom panel of Figure 4. In the table setting baseline, Jason completed 0% of the response chain in both settings and in the snail toy baseline, Jason completed 0% of the response chain in both settings.

The response chain taught with the in-vivo model (snail toy) was acquired in four fewer sessions than the response chain taught with the video model (table setting). In the in-vivo modeling component, Jason’s percentage of response chain completion increased to 75%. Jason’s performance met criteria for a mastery probe following the 20th in-vivo modeling session. In the video modeling component, Jason’s percentage of response chain completion
remained low. Jason’s performance met criteria for a mastery probe following the 24th video modeling session.

The video model led to a higher percentage of steps completed in both maintenance and generalization. In the mastery probes, Jason completed 100% of both response chains. In maintenance probes, Jason completed 50% of the response chain taught with the video model and 25% of the response chain taught with the in-vivo model. In generalization probes, Jason completed 50% of the response chain taught with video modeling and 25% of the response chain taught with in-vivo modeling.

The differences between the effects of in-vivo modeling procedure and the effects of video modeling procedure were not replicated across sets of responses for either participant. For John, the skill taught with video modeling in set one was mastered in eight fewer presentations of the model than the skill taught with in-vivo modeling, however in the second set, the skill taught using in-vivo modeling met mastery in nine fewer presentations than the video model. Across all response sets, the in-vivo model was presented 41 times to John and the video model was presented 42 times. The total number of modeling presentations required for response chain mastery, across all response sets for John are displayed in Figure 5. For Jason, the effects of both modeling procedures were identical in set one. Jason acquired the skill taught using in-vivo modeling in four fewer presentations than the video model. Across all response sets, in-vivo model was presented 25 times to Jason and the video model was presented 29 times. The total number of modeling presentations required for response chain mastery, across all response sets for Jason are displayed in Figure 6.

Only once was a difference observed in mastery probes for one participant. John completed 87.5% of the triceratops toy response chain taught with the in-vivo procedure in
mastery probes. John completed 100% of all other response chains in mastery probes. Jason completed all response chains taught with both modeling procedures with 100% independence in mastery probes.

In maintenance probes, both participants completed one response chain taught with the video modeling procedure with a higher percentage of independent responding, compared to the response chain taught with the in-vivo modeling procedure. However, this effect was not replicated across the other set of responses, for either participant. For all other response chains, no differential responding was observed as a result of either modeling procedure.

In generalization probes, one participant completed one response chain taught with the video modeling procedure with a higher percentage of independent responding, compared to the response chain taught with the in-vivo modeling procedure. For all other response chains, no differential responding was observed as a result of either modeling procedure.

Discussion

The purpose of the current study was to teach functional response chains, such as living skills (making a snack and setting a table) and leisure skills (constructing a toy) to two individuals with developmental disabilities; and to examine which modeling procedure was more effective at facilitating response chain acquisition, maintenance and generalization. Both modeling procedures were effective in teaching the participants to complete the response chains and both procedures led to responding in maintenance and generalization. For both participants, similar effects were observed for both procedures across all experimental phases.

These findings are in contrast with a similar study comparing the effects of in-vivo modeling and video modeling procedures on response acquisition. Charlop-Christy and colleagues (2000) concluded that the video model was more effective at facilitating response
acquisition. In their investigation, the video modeling procedure led to response acquisition in fewer sessions for four out of five participants. For one participant, there was no difference in the number of sessions for response acquisition. Across all participants, 23 video modeling sessions were conducted, which led to response acquisition for all tasks taught to all participants, while the in-vivo model required 50 sessions for the same effect. In the current study, the in-vivo modeling procedure led to response mastery in fewer sessions for one response chain taught to each participant, while the video modeling procedure was more effective in acquiring one response chain for one participant. In total, the video model was presented a total of 71 times and the in-vivo model was presented a total of 66 times throughout all phases of the study. The differences in the amount of training required to complete the response chains may be due to differences in difficulty between the response chains.

The current investigation compared the number of modeling presentations needed to complete functional response chains such as leisure skills and independent living skills, while Charlop-Christy and colleagues (2000) compared a variety of skills such as play skills and discrimination skills. Both response chains in each set had the same number of steps. For John, all of the response chains taught with video modeling and in-vivo modeling procedures were novel toy constructions. The response chains in set one both had eight steps and the response chains in set two both had nine steps. For Jason, the response chains in set one both had nine steps and the response chains in set two both had eight steps. In addition, both of the response chains in set one for Jason involved making food with small appliances. It is possible that certain response chains were more difficult than others. For example, John met mastery criteria in the fewest sessions for the alien toy and the fish toy, which had two claws and two feet or two wings and a fin, respectively, while the other two toy constructs both had four feet. The
discrimination between four feet versus two feet and two claws might have resulted in response chain acquisition in fewer sessions. Ideally, the materials used in each response chain should be consistent across modeling conditions and across all participants.

In addition, the number of exposures to the response chain, prior to the investigation, might have had an effect on the rate of acquisition for Jason. Although response chain mastery was met after an equal number of sessions for set one, it should be noted that Jason was more likely to have observed someone at his residence making toast as opposed to observing someone make nachos. Although one of the goals of the current study was to teach functional response chains, such as snack making, the use of novel response chains such as the toy constructs, eliminate a possible confound with previous exposure and in addition, leisure skills are also functional for individuals with developmental disabilities (MacDonald et al., 2005).

Results of the current study indicate that both modeling procedures were effective at promoting response chain generalization across settings. In this study, the video model led to a higher percentage response chain completion in generalization probes for one participant with one response chain. For all other response chains taught to both participants, the response chains were generalized with at least 75% independence across settings, regardless of the modeling procedure. The results of this study on response generalization are similar to a comparison study conducted by Gena et al. (2005). In their investigation, Gena and colleagues (2005) concluded that affective responding was generalized across novel therapists and scenarios regardless of the modeling procedure implemented. In another comparison study of video and in-vivo modeling, Charlup-Christy and colleagues (2000) concluded that eight out of eight skills taught with video modeling were found to be generalized across settings, while zero of the eight skills taught with in-vivo modeling were generalized across settings. In this investigation, only one skill taught
with video modeling (table setting) was completed with a higher percentage of independence in
generalization probes. All other response chains were completed with an equal percentage of
responding in the generalization probes for both participants. One factor that may have led to the
difference in generalization findings was the time elapsed before generalization probes.
Generalization probes in Charlop-Christy et al. (2000) were conducted 3 to 5 days after response
mastery, while generalization probes in the current study were conducted approximately three
weeks after response mastery.

Two factors that may have decreased the time associated with response chain acquisition
in the current study are reinforcement and prompting. Reinforcement may have decreased the
number of modeling presentations needed for response mastery and thus decrease the overall
time associated with modeling interventions. Bidwell and Rehfeldt (2004) and Rehfeldt and
colleagues (2003) provided reinforcement contingent upon correct responding when using video
modeling to teach independent living skills to individuals with developmental disabilities. Both
studies concluded that video modeling led to rapid acquisition of response chains when verbal
praise was provided contingently. Reinforcement of correct responding may have decreased
some of the variability in responding in the current study and may have led to response mastery
in fewer presentations of the model.

In this investigation, all the response chains were mastered without the use of physical
prompting. In a study comparing LTM prompting used in conjunction with a video model to
LTM prompting alone, the intervention using physical prompting and video modeling was found
to be more effective than the LTM alone (Murzynski & Bourret, 2007). Physical prompting may
have decreased the time associated with response mastery in this study. In addition, future
research should examine the effects of video and in-vivo modeling when used in conjunction with and without physical prompting.

The separate effects of each modeling procedure were not replicated across response chain sets for either participant, thus no consistent differences in effects were observed. The differences observed in acquisition, maintenance and generalization may have been the result of differences in response chain difficulty and previous exposure to the response chains. In addition, procedural differences such as scheduled consequences and physical prompting may decrease the total number of sessions needed for response mastery, and increase the percentage of independent responding in maintenance and generalization. In this investigation, both modeling procedures were effective at facilitating response chain acquisition, maintenance and generalization. In conclusion, both the in-vivo and video modeling procedures were effective at teaching functional response chains to individuals with developmental disabilities in this study.
References


Table 1.
Response chains taught to John.

<table>
<thead>
<tr>
<th>Fish Toy</th>
<th>Triceratops Toy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dump bag</td>
<td>1. Dump bag</td>
</tr>
<tr>
<td>2. Find spine (pick up)</td>
<td>2. Find torso (pick up)</td>
</tr>
<tr>
<td>3. Put head on correctly</td>
<td>3. Put head on correctly</td>
</tr>
<tr>
<td>5. Put in side fin</td>
<td>5. Put in foot</td>
</tr>
<tr>
<td>7. Put in top fin</td>
<td>7. Put in foot</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anteater Toy</th>
<th>Alien Toy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dump bag</td>
<td>1. Dump bag</td>
</tr>
<tr>
<td>2. Find torso (pick up)</td>
<td>2. Find torso (pick up)</td>
</tr>
<tr>
<td>3. Put head on correctly</td>
<td>3. Put head on correctly</td>
</tr>
<tr>
<td>5. Put in foot</td>
<td>5. Put in foot</td>
</tr>
<tr>
<td>7. Put in foot</td>
<td>7. Put in claw</td>
</tr>
</tbody>
</table>
Table 2.
Response chains taught to Jason.

<table>
<thead>
<tr>
<th>Making Nachos</th>
<th>Making Toast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Get plate</td>
<td>1. Get plate</td>
</tr>
<tr>
<td>2. Get chips</td>
<td>2. Get bread</td>
</tr>
<tr>
<td>3. Get cheese</td>
<td>3. Open bag</td>
</tr>
<tr>
<td>4. Dump chips</td>
<td>4. Get out slice of bread</td>
</tr>
<tr>
<td>5. Dump cheese</td>
<td>5. Put in toaster</td>
</tr>
<tr>
<td>6. Put in microwave</td>
<td>6. Put bag of bread down (on counter)</td>
</tr>
<tr>
<td>7. Push start</td>
<td>7. Push down toaster button</td>
</tr>
<tr>
<td>8. Wait</td>
<td>8. Wait</td>
</tr>
<tr>
<td>9. Remove plate</td>
<td>9. Remove toast</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Snail toy</th>
<th>Setting a Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dump bag</td>
<td>1. Put mat on table</td>
</tr>
<tr>
<td>2. Pick up shell</td>
<td>2. Put other materials on table</td>
</tr>
<tr>
<td>3. Put in foot</td>
<td>3. Put plate in center of mat</td>
</tr>
<tr>
<td>4. Put in claw</td>
<td>4. Put napkin to the left of plate</td>
</tr>
<tr>
<td>5. Put in claw</td>
<td>5. Put fork on napkin</td>
</tr>
<tr>
<td>6. Put in tentacle</td>
<td>6. Put spoon to the right of plate</td>
</tr>
<tr>
<td>7. Put in tentacle</td>
<td>7. Put knife to the right of plate</td>
</tr>
</tbody>
</table>
Figure Captions

Figure 1. Dragon Bonz® toy structures used during video and in-vivo modeling for John.

Figure 2. Dragon Bonz® toy structure used during in-vivo modeling for Jason.

Figure 3. Summary data of all experimental phases for John. In set one, the triceratops toy was taught with the in-vivo model and the fish toy was taught with the video model. In set two, the alien toy was taught with the in-vivo model and the anteater toy was taught with the video model. The open squares represent video modeling sessions and the closed triangles represent in-vivo modeling sessions. Open diamonds represent video modeling maintenance probes and the closed diamonds represent in-vivo modeling maintenance probes. Open circles represent video modeling generalization probes and closed circles represent in-vivo modeling generalization probes.

Figure 4. Summary data of all experimental phases for Jason. In set one, toast making was taught with the in-vivo model and nacho making was taught with the video model. In set two, the snail toy was taught with the in-vivo model and table setting was taught with the video model. The open squares represent video modeling sessions and the closed triangles represent in-vivo modeling sessions. Open diamonds represent video modeling maintenance probes and the closed diamonds represent in-vivo modeling maintenance probes. Open circles represent video modeling generalization.
Figure 5. Summary data of the total number of model presentations needed for response chain mastery for John. The shaded bars represent response chains taught with video modeling. White bars represent response chains taught with in-vivo modeling.

Figure 6. Summary data of the total number of model presentations needed for response chain mastery for Jason. The shaded bars represent response chains taught with video modeling. White bars represent response chains taught with in-vivo modeling.
Snail Toy
Sessions Until Response Chain Mastery

Set One
- Fish (WM)
- Triceratops (IV)

Set Two
- Anteater (WM)
- Alien (IV)
Sessions Until Response Chain Mastery

Set One
- Nachos (VM)
- Toast (IV)

Set Two
- Table (VM)
- Small (IV)