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A Comparison of Picture and Video Prompts to Teach Daily Living Skills to Individuals With Autism

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Abstract

This study was conducted to compare the effectiveness of video prompting and picture prompting when used as antecedents for teaching daily living skills to two adolescents with autism. Participants were taught two different skills, and the effects of the instructional conditions were compared and evaluated using an adapted alternating-treatments design. The results can be interpreted to conclude that video prompting was slightly more effective in terms of independent correct responding, fewer external prompts for task completion, and fewer prompts to use instructional materials. In addition, when efficiency scores were calculated by considering the ratio of each participant's growth (from pretest to posttest) to the measured "cost" of minutes required to create instructional materials, video prompting was considerably more efficient than picture prompting.

Keywords

autism, picture prompting, video prompting, daily living skills, efficiency

Individuals with autism spectrum disorders (ASD) frequently use visual supports to make sense of the environments in which they function (Rogers, 2005). Visual supports may include text, line drawings, photographs, or video-based materials that are used to assist individuals become more independent. The use of visual supports to teach individuals with ASD typically results in positive outcomes for a broad range of learners and is considered to be an evidence-based practice (Myles, Grossman, Aspy, Henry, & Coffin, 2007; Odom et al., 2003). Learners can use visual supports to help them communicate, establish predictability in carrying out daily routines, acquire new skills, and become more independent in and across a variety of environments.

Some of the most widely used visual supports include photographs or line drawings (Lancioni & O'Reilly, 2001, 2002). Photographs or illustrated pictures are relatively easy to create and often are used to teach or prompt individuals with ASD or other developmental disabilities to complete complex or multistep skill sequences. For example, photographed and/or illustrated task analyses have been used effectively to teach food preparation skills (Bergstrom, Pattavina, Martella, & Marchand-Martella, 1995; Book, Paul, Gwalla-Ogisi, & Test, 1990; Johnson, & Cuvo, 1981; Martin, Rusch, James, Decker, & Tritol, 1982; Singh, Oswald, Ellis, & Singh, 1995), vocational skills (Martin, Mithaug, & Frazier, 1992; Wacker & Berg, 1983), daily living skills (Pierce & Schreibman, 1994), and community skills (Alberto, Cihak, & Gama, 2005; Cihak, Alberto, Taber-Doughty, & Gama, 2006). When used in this way, skill sequences are typically task analyzed and pictures are used to represent each step. For example, Pierce and Schreibman (1994) used multistep pictures based on task analyses to teach daily living skills such as making lunch, getting dressed, and setting the table to three young children with autism. Each step in the task analyses was represented with picture prompts and was used while the participants completed the tasks. The authors reported that each child acquired the targeted skill and was able to complete the tasks independently by following the picture prompts, even when the order of pictures was changed. In another study, Copeland and Hughes (2000) taught two high school students vocational skills in a hotel using a two-part picture prompt strategy. Participants were expected to touch a picture to initiate tasks and to turn pages to indicate task completion. Both participants increased their number

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of independent task initiations, but only one of the participants improved his ability to complete tasks.

Although picture prompting strategies have been shown to be effective for teaching or prompting complex behaviors, many researchers also have investigated the efficiency and effectiveness of using video-based instructional materials to prompt responses. Much of the research that has been conducted on video-based instruction involves *video modeling*. Video modeling refers to an instructional approach whereby learners view an entire video skill sequence prior to engaging in a task. This also has been referred to as "video priming" (Schreibman, Whalen, & Stahmer, 2000) or "video rehearsal" (Van Laarhoven & Van Laarhoven-Myers, 2006). *Video prompting*, on the other hand, is an instructional approach that involves showing each *step* in a skill sequence on video, followed immediately by task engagement with that particular step (Sigafoos et al., 2005). This requires that learners have access to a television, computer, or handheld device in the environment where the skill is being practiced so that they can watch a clip, go perform the step, and then return to the television or computer to complete the remainder of the steps. Several researchers have successfully used a combination of video modeling and video prompting to teach skill sequences to individuals with developmental disabilities (Graves, Collins, Schuster, & Kleinert, 2005; Norman, Collins, & Schuster, 2001).

In a comparative study, Van Laarhoven and Van Laarhoven-Myers (2006) used three different video-based instructional methods (video modeling alone, video modeling plus in vivo picture prompting, and video modeling plus video prompting) to teach three daily living skills to three high school–aged participants with moderate intellectual disabilities. All three methods were effective for increasing independent correct responding, but the video modeling plus video prompting and video modeling plus picture prompting conditions resulted in quicker acquisition and in higher independent correct responding, suggesting that the addition of in vivo antecedent prompting techniques resulted in more efficient and effective skill acquisition. Cannella-Malone et al. (2006) had somewhat similar findings when they compared video modeling with video prompting to teach six adults with developmental disabilities how to set a table and put away groceries. They found that video prompting was much more effective than video modeling for five of the six participants, which also suggests that in vivo prompting may be necessary for promoting rapid skill acquisition. Although it has been demonstrated that video prompting can be a very powerful instructional method, some researchers have suggested that it can be even more effective when used in conjunction with video feedback (referencing) error correction procedures (Goodson, Sigafoos, O'Reilly, Canella, & Lancioni, 2007; Martin et al., 1992; Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009). Video referencing or feedback, when used as an error correction procedure, involves having participants refer back to video clips in the event of an error or no response during task engagement.

A few researchers have conducted studies to compare picture versus video prompts. For example, Alberto et al. (2005) and Cihak et al. (2006) compared the effectiveness of static picture prompts and video models or video prompts, respectively, but the instructional prompting strategies were used by individual students in a simulated setting approximately 90 min before the participants engaged in community-based skill sequences. Alberto et al. concluded that both techniques were effective and were not functionally different when independent correct responses and the number of sessions to criterion were considered. Cihak et al. provided instruction to groups of students in simulated settings in the classroom. They also found no functional differences between the two conditions. Although there were no functional differences between the conditions when independent correct responding and number of sessions to criterion were considered, both groups of researchers indicated that students with attention difficulties seemed to perform better with static picture prompts.

The purpose of this study was to compare the effectiveness of in vivo picture prompting and video prompting strategies on the independent functioning of two adolescents with autism who were learning daily living skills. Unlike the comparative studies conducted by Alberto et al. (2005) and Cihak et al. (2006), the picture and video prompts were used as antecedent prompts during in vivo task engagement rather than as simulation techniques that were temporally distant. In addition, the prompting systems were manipulated by the participants and data were collected on the number of prompts needed to use the technologies to determine if the participants could use them independently. Cost-benefit or "efficiency" analyses of the amount of time required to develop each set of instructional materials were measured to assess the practical utility of each intervention. The conditions that were compared included (a) picture prompts presented in a booklet and (b) video prompts presented on a laptop computer. The prompting strategies were used in conjunction with error correction or feedback procedures that included picture feedback (Martin et al., 1992) and video feedback procedures (Goodson et al., 2007; Van Laarhoven, Van Laarhoven-Myers, & Zurita, 2007; Van Laarhoven, Johnson, et al., 2009) by having the participants refer back to the visual systems if they made errors.

Method

Participants

Participants were recruited from a special education cooperative located in the suburbs of Chicago. An e-mail was sent to special education teachers employed in the cooperative to inform them of the research study. A questionnaire was sent to the teachers who volunteered to (a) identify specific skills for instruction, (b) determine availability of the participant, and (c) obtain personal information for the students who were eligible to participate. A description of the study was sent home to those parents to obtain informed consent and assent. Participants were selected from the pool of respondents on the basis of the level of intellectual functioning (i.e., mild or moderate), skills requiring instruction (indicated on a survey from parents and teachers), and scores on pretests that were given to the initial pool of participants to determine daily living skills to be targeted for instruction. All intelligence testing had been conducted by school psychologists hired by the special education cooperative.

Two male students with autism and mild to moderate intellectual disabilities participated in the study. Both participants were enrolled in a public middle school where they received educational programming in both self-contained and integrated classrooms. The program in which they were enrolled provided academic, functional, and community-based educational programming. Both participants had similar skills requiring instruction, including and daily living skills as well as vocational skills, which were identified as instructional priorities by their teacher and parents.

At the time the study was conducted, Marvin was 13 years old. He was a very pleasant young man who liked to move quickly. He was verbal and spoke in short sentences to communicate his wants and needs. He also engaged in some echolalic speech and often recited scenes from movies or lyrics from songs when he was not engaged in tasks. On the basis of the Stanford–Binet Intelligence Scale, Marvin's full-scale IQ score was 39, which placed him in the low moderate range of intellectual disability. Scores on the Woodcock–Johnson test of achievement indicated that he was at the readiness or early first grade level in reading and had some letter recognition and sight word vocabulary. Marvin had previous exposure to using the Picture Exchange Communication System and also used picture schedules and other visual supports within the structure of his day. He had some experience using picture-based task analyses but primarily used visual supports to prompt changes in schedules or to promote communication. He used the computer in the classroom independently to navigate educational software used primarily for drill and practice; however, he had no previous experience with video-based instruction.

Gary was 14 years old at the time of the study and was in the same classroom as Marvin. He also was a very pleasant young man who spoke in short sentences using a slow rate of speech with unique intonation and stress patterns. His previous full-scale IQ score on the Wechsler Intelligence Scale for Children was 52, while a more recent test, the Kaufman Brief Intelligence Scale, resulted in a composite score of 65, placing him in the mild to moderate range of intellectual functioning. Scores on the Woodcock–Johnson test of achievement placed him at the first to second grade level in reading. His teacher indicated that Gary knew approximately 65 sight words and performed better with reading tasks when pictures were paired with text. Gary used picture schedules and other visual supports throughout the day and enjoyed using the computer in the classroom, but he had no prior exposure to video-based instruction.

Skills Selected for Instruction

Each participant was taught two different skills in each of the instructional conditions (i.e., one skill taught with picture prompts and one taught with video prompts). The targeted skills fell within the vocational or daily living domains (folding laundry and meal preparation). The skill sequences were selected on the basis of parent and teacher priorities, the students' preferences, and participants' pretest scores. First, teachers and parents were provided with a list of potential tasks to be taught and asked to indicate which tasks were high priorities. Tasks that did not share any common features with each other were selected to ensure that the responses across the skill sequences were mutually exclusive and independent of one another to prevent any carryover effects from one condition to the next. Marvin and Gary were taught the same two skills: making microwave pasta and folding laundry using a flip-and-fold. The two tasks were similar in difficulty and length or number of steps (i.e., 22 steps for pasta and 23 steps for folding clothes)

Setting

Instructional sessions were conducted in the faculty lounge at the middle school. The room had a sink with a long countertop that held the microwave, cabinets above and below the counter, and a refrigerator along the adjacent wall. The room had several round tables scattered around the center of the room and one long table that was pushed against a wall near the sink and microwave. The sessions took place at the long table that was located near the sink.

Generalization sessions, which were only conducted during pre-, post-, and maintenance sessions, were conducted in another area of the school that was located behind the stage or in a faculty office that was not being used. In addition to being conducted in different settings, the materials that were used in the instructional and generalization conditions differed across stimulus dimensions. For example, different pasta dishes (i.e., microwave spaghetti vs. microwave lasagna), utensils that varied in size and color, and different microwaves, laundry baskets, clothing items, and flip-and-folds were used in instructional versus generalization sessions. No video- or picture-based prompting systems were developed for generalization sessions.

Design

A within-subject adapted alternating-treatments design (Wolery, Bailey, & Sugai, 1988) was used in this study. In an adapted alternating-treatments design, the treatments are applied to different but equally difficult, independent behaviors or skills, whereas in the alternating-treatments design, the treatments are applied to the same behavior or skill. In the adapted alternating-treatments design, two or more treatment conditions are introduced in a rapidly alternating fashion with a randomized order of presentation. Each participant was taught a different skill within each condition, and the skills were counterbalanced across conditions and subjects to control for task difficulty. Marvin was taught to fold clothes using picture prompts and to make microwave pasta using video prompts. Gary was taught to cook microwave pasta using picture prompts and to fold clothes using video prompts.

Data Analysis

Experimental control was determined primarily through visual inspection of the data and through comparisons of means for each condition. With the adapted alternating-treatments design, experimental control is demonstrated by a consistent level and/or trend difference between the interventions (Wolery et al., 1988). At a quick glance, one can determine if one intervention is better than the other if there is little or no overlap between the data paths. In addition, although baseline measures are not necessary with the alternating-treatments design, the pretest and posttest scores for each condition were compared using both instructional and generalization materials.

Independent Variables

All video-based and picture-based materials were created by the first author, who had experience with all of the technologies, in the setting where instructional sessions took place (i.e., the faculty lounge). A man who was a teaching assistant in the classroom acted as the model in both of the tasks, and the photos and videos displayed him engaging in the skill sequence using both zoom and wide-angle shots (i.e., combination of "other" model and subjective or first-person viewpoint for zoom shots). To create the materials, the model engaged in each skill sequence twice; the first time through, video segments of each step were shot, and the second time through, photographs were taken of each step, and the number of seconds required to gather the shots under both conditions was recorded. Both video segments and photographs were shot with a combination of wide-angle (full view of the model) and a few zoom shots (showing the arm of the model setting the microwave). Zoom shots for both the picture- and video-based materials were used to ensure that participants attended to the critical aspects of the steps (e.g., setting the microwave for 4 min). In addition, some text was added to both prompting conditions to encourage sight reading, but the text was treated as nontargeted information and not measured.

Condition 1: picture prompts. After the photographs were taken, they were captured using the built-in scanner and camera wizard loaded on the laptop. They were cropped if necessary and saved in a folder on the desktop. Sometimes more than one picture was needed to depict a step. For example, to demonstrate the step for "Fold," it was necessary to show three pictures: (a) fold in side A, (b) fold in side B, and (c) fold up C using the flip-and-fold. Or, for "Gather Materials," it was necessary to show pictures of each needed item. After saving the pictures to the desktop, they were imported into Microsoft PowerPoint, with one step in the task analysis per slide. A short description of each step was placed on the top of each slide (e.g., "Set Microwave"), and the picture(s) was placed below. When more than one picture was presented on the slide, a text box with a sequenced number was placed on each picture to indicate the correct order of substeps. The PowerPoint presentation was then printed, with one slide per page. After the materials were printed, they were laminated, sequenced, hole-punched in the top left corner, and held together with a notebook ring to create a booklet. A stopwatch was used to calculate how long it took to create the materials (including photography, capturing, cropping, creating the PowerPoint presentation, printing, laminating, etc.). During the intervention, the participants looked at the picture(s) on one page, engaged in the step, went back to the booklet, turned the page, engaged in the next step, and so forth until the skill sequence was completed.

Condition 2: video prompts. After videos were filmed, they were captured, and each segment was edited using Pinnacle Studio 10.1. Skill sequences (e.g., making microwave pasta) were broken into short video segments (for each step). Photos of the most salient feature of the steps (e.g., a still shot of "4:00" on the microwave) were "grabbed" out of the video and placed at the beginning of each video segment. Voiceover narrations were then added to each segment to describe the actions being depicted in each segment and to cover the background noise that was present in the setting during filming (e.g., the bell ringing, announcements over the intercom). Each step of the task was edited and saved as a separate file and placed in a PowerPoint presentation. Each slide in the PowerPoint presentation had a short description of the step on the top of the screen and the grabbed photo visible in the middle of the screen. The slide show was set so that the participants had to move the cursor to the photo and use a mouse click to view the video prior to completing the step. After completing the step, the participants clicked on a hyperlinked "Next" button at the bottom right of the screen to advance to the next slide. Again, a stopwatch was used to determine how long it took to create the materials, including videotaping, capturing, editing, narrating, creating PowerPoint presentations, and burning presentations to CDs. During intervention, participants viewed the video segment of each step on a laptop computer prior to engaging in each step until the task was completed.

Procedures

Pretests. During the pretesting phase, several tasks were selected as potential skills to be targeted for instruction. Task analyses were written and evaluated by four veteran teachers (each had been teaching for at least 5 years), who rated the task analyses according to complexity and difficulty (easy, moderately difficult, or difficult) and then ranked the steps within each difficulty level to verify that the skills were equivalent in terms of complexity. During the 1st week of the study, initial pretests using instructional materials were given to potential participants (i.e., those with consent who had given assent) in the setting where instruction was to take place. Potential participants were tested without the use of video or picture prompts to determine their current levels of independent functioning with various tasks.

For pretest sessions, participants were brought to the instructional area and were told what task they were going to perform. They were asked to do their best and told that if they did not know what to do at any point, they could ask the researchers to complete the step for them. Each participant was given an instructional cue, such as "fold clothes," "cook the spaghetti," "wash the dishes," and so forth; the verbal cue was used throughout the session. If participants made errors during the testing phases or did not respond within 10 s, the experimenter asked them to turn away or close their eyes, and the step with the error was completed for them. The researcher then gave the next instructional cue to get the participant to continue with the task. This protocol was repeated until the task was completed, and no feedback related to task performance was given; however, praise statements were delivered for staying on task and working hard.

All potential participants were pretested again the following week using generalization materials and settings for the same tasks. The assessment protocol was delivered in the same format as the original pretests. Potential participants who scored 50% or less on both pretests were included in the study. To control for participant skill level prior to instruction, the scores for instructional pretests and generalization pretests were averaged and ranked. Each participant's task with the highest score was randomly assigned to one of the different conditions. Intervention began 2 weeks after the pretesting phase to allow time for training the participants to use the technologies and to create the instructional materials.

Training participants to use technology and photos. Prior to engaging in instructional sessions, each participant was taught to use each of the prompting systems via a model-lead-test format until he could use the prompting systems independently to complete a task that was unrelated to the instructional tasks (i.e., cleaning a desk). They were taught to use a picture booklet and taught to operate the laptop to navigate through the PowerPoint presentation until they could independently use the materials to prompt responses for three consecutive sessions. The first author taught both participants to operate the prompting systems during initial training sessions and also taught a teaching assistant (another certified teacher) to conduct the training sessions on days when she could not be present. Although it may take more time, we believe that training participants to use the technologies independently is important, because it can result in true independence during task engagement and result in less reliance on caregivers or staff.

Instructional sessions. During instruction, the picture prompting booklet or laptop was placed on the long table next to the counter in the faculty lounge. When the participants entered the faculty lounge, they were told which task they were going to do for the day and shown the prompting system. They were then given the instructional cue of either "fold clothes" or "cook pasta." Participants used the prompting devices by looking at the picture in the booklet or playing the video segment on the laptop prior to performing each step in the skill sequence. They then returned to the booklet or computer to prompt the next step until the entire sequence was completed. Researchers intervened only if participants made an error or needed a prompt to use the technology. Praise statements were delivered to reinforce correct responding during task engagement, and high fives or knuckle bumps were given following the completion of the tasks. In addition, participants were allowed to eat the pasta dishes or give them to peers or faculty of their choosing.

Posttests. One week after participants met criteria in the intervention (i.e., three consecutive sessions with 85% correct responding or higher with both tasks), they were given a posttest using materials used during instruction. Posttests were given in the same manner as the pretests to determine if the participants could independently complete the tasks without the use of video or picture prompts. Two days later, they were given posttests in different environments using different materials to determine if they could generalize their skills to different settings and materials. The generalization posttests were conducted again 6 weeks later to determine if skills were maintained.

Data Collection Procedures

During pre- and posttesting, instruction, and generalization testing, task analytic data were collected with correct and incorrect performance being reported on each step of the skill sequence. A"+" was recorded for independent correct responses, a"–" was recorded for incorrect attempts, "N–" was recorded for no attempt, and "S–" was recorded for a sequence error. Data were collected on prompt levels during instruction; a check mark was recorded for each prompt given at each step (with a maximum of two per step). To obtain data on prompt levels, a two-level prompting hierarchy was used. In the event of an error or no attempt within 8 s of seeing the step, participants were instructed to refer back to the visual prompt (booklet or computer) and review the step. If this did not result in a correct response, a gestural or physical prompt was provided (depending on what was necessary for the particular step) to ensure correct responding. Data also were collected on prompts necessary for the participants to use the technologies to determine if they could use the technologies independently during task engagement. In the event that the student did not refer to the prompting system prior to performing the step, he was reminded to "look at" the picture or video clip, and the prompt to use the technology was recorded by circling the step on the data sheet.

Dependent Measures

Percentage of independent correct responses. Participants were assessed on how independently they performed the skills selected for instruction prior to engaging in the instructional sequences (pretest), during instruction, and following instruction (posttest). The score was determined by dividing the number of steps with independent responding by the total number of steps in the skill sequence and multiplying by 100%.

Percentage of error correction prompts. Participants were assessed on the number of external prompts needed to complete the skill sequence during the instructional phase of the study. The score was determined by dividing the number of prompts given by the total number of prompts possible (i.e., two per step) and multiplying by 100%.

Percentage of prompts to use technology. Participants were assessed on the number of prompts they needed to use the booklet or computer. The score was determined by dividing the number of prompts given by the total number of steps in the skill sequence and multiplying by 100%.

Number of sessions to reach criterion. The acquisition criterion for each skill sequence was a score of 85% independent correct responses for three consecutive sessions. The number of instructional sessions required for the participant to reach criterion was counted to determine if either of the instructional conditions resulted in faster acquisition. Participants engaged in skill sequences until criteria were met on both tasks.

Percentage of independent correct responses on measures of generalization. Prior to and following instruction (at 1 and 6 weeks), participants performed the skills in novel environments, using different stimulus materials, without the aid of prompting systems to determine if their skills generalized to untrained environments and novel materials following instruction.

Efficiency measures. It is important in comparative studies to assess the amount of time and effort expended in preparing materials, teacher and student preferences for intervention strategies, and student outcomes. Van Laarhoven, Zurita, Johnson, Grider, & Grider (2009) did this when they compared the effectiveness of self-, other-, and subjective-video (i.e., first-person) modeling packages on teaching daily living skills to three students with disabilities. The authors reported that all models were effective in terms of student outcomes, but the amount of time required to develop the self-modeling materials was almost double the time required to develop the other- and subjective-modeling materials. As a result, the other- and subjective-model videotape packages were more efficient in addition to being somewhat more effective. The authors recommended that future comparative researchers evaluate the cost-effectiveness of interventions in terms of time needed to create materials and student outcomes.

In this study, an efficiency score was computed by considering the ratio of each participant's growth (from pretest to posttest) to the measured "cost" of minutes required to create instructional materials (i.e., [posttest – pretest]/minutes of preparation) to get a score representing the percentage increase per minute of preparation. To determine the number of minutes of preparation, a stopwatch was used to calculate the number of minutes required to prepare the picture books and video-based instructional sequences.

Reliability

The first or second author and/or the instructional assistant simultaneously collected data for 28% of all sessions (including pre- and posttests and instructional sessions). The percentage agreement index (i.e., the number of agreements divided by number of agreements plus disagreements times 100%) was used to calculate interobserver agreement. Agreement for independent correct responses averaged 99%

(range = 99%–100%). Agreement for error correction prompts and prompts to use technologies resulted in a mean score of 96% (range = 88%–100%). In addition, the second observer collected procedural reliability data (Billingsley, White, & Munson, 1980). These measures included the following: (a) checking to ensure that the correct condition was being applied to the intended task for each participant, (b) checking to determine if the order of tasks were presented as stated in the research protocol, (c) checking to make sure that the correct materials were used, and (d) checking that the prompting system was delivered as intended. Procedural reliability was calculated by dividing number of correct measures by the total number of assessed variables and multiplying by 100%. Procedural reliability agreement was 100%.

Results

Both of the instructional procedures were effective in increasing independent responding and/or decreasing external prompts and prompts to use technology during instruction for both participants, but some differentiated effects were observed between the conditions. Video prompting appeared to be somewhat more effective than picture prompting across most dependent measures, especially when efficiency measures were analyzed.

Percentage of Independent Correct Responses

When the percentage of independent correct responses was measured across conditions and tasks, the data were interpreted to conclude that both conditions and prompting systems were effective in increasing independent responding for both participants. During the instructional phase, both students engaged in more independent correct responding with the video prompting condition, with Marvin having the clearest results (see Figure 1). Gary engaged in more independent correct responding when the video prompting condition was used ($M = 91\%$) than with the picture prompting condition ($M = 83\%$), but there was some overlap in his data paths, suggesting that there was no functional relation between conditions. Marvin also had higher independent correct responding when the video prompting materials were used ($M = 90\%$) than in the picture prompting condition ($M = 76\%$), and there was a clear separation in data paths, suggesting the presence of a functional relation. When the change in the level of data was analyzed from the pretest scores to the first instructional session, both participants demonstrated much steeper increases in independent responding with the video prompting condition, suggesting that it may be a more powerful intervention, particularly during initial sessions.

During posttest phases, participants no longer used the prompting materials during task engagement. This was done to determine if the participants improved their independent correct responding without antecedent prompting supports. They were tested using instructional materials in the initial posttest 1 or 2 days after reaching criterion on both tasks ("Inst. Post" in Figure 1). They were given a generalization posttest ("Gen. Post" in Figure 1) 1 week later and again at 6 weeks ("6-wk Maint." in Figure 1). Both of the participants demonstrated that they could independently perform the skill sequences without technology supports after reaching criterion as measured by the postinstruction tests. Using 85% as the criterion, they were able to generalize their skills to untrained settings with novel materials as measured by the postgeneralization tests that were conducted 1 week after the instructional phase ended, with both doing better with the skill taught via video. Six weeks after instruction ended, Marvin demonstrated generalization and maintenance of his skills with both prompting techniques, but Gary only maintained the skill that was taught with video prompting (i.e., his score was above 85% correct).

Percentage of Error Correction Prompts

As seen in Figure 2, participants received fewer error correction prompts in the conditions in which they had the most independent correct responding, which was the video prompting condition. Gary had a mean of 6% of external prompts for the video prompting condition and a mean of 14% for the picture prompting condition. Marvin had similar findings, with a mean of 9% external prompts for the video prompting condition and a mean 17% for the picture prompting condition.

Percentage of Prompts to Use Technology

Figure 3 presents the percentage of prompts needed for the participants to use the technology across sessions and tasks. Because the prompting systems were not used during baseline or posttesting phases, only the instructional data are presented. Although there was some variability in the percentage of prompts to use the different technologies, there was a steady decrease in prompts across prompting systems for both participants, with the exception of Gary's last two sessions. Both participants required fewer prompts to use the technologies when the video prompting condition was in place. For Gary, the mean percentage of prompts to use technology across conditions was as follows: $M = 7\%$ for video prompts and $M = 13\%$ for picture prompts. Marvin also required fewer prompts to use the technologies with the videos ($M = 2\%$) compared with the pictures ($M = 7\%$).

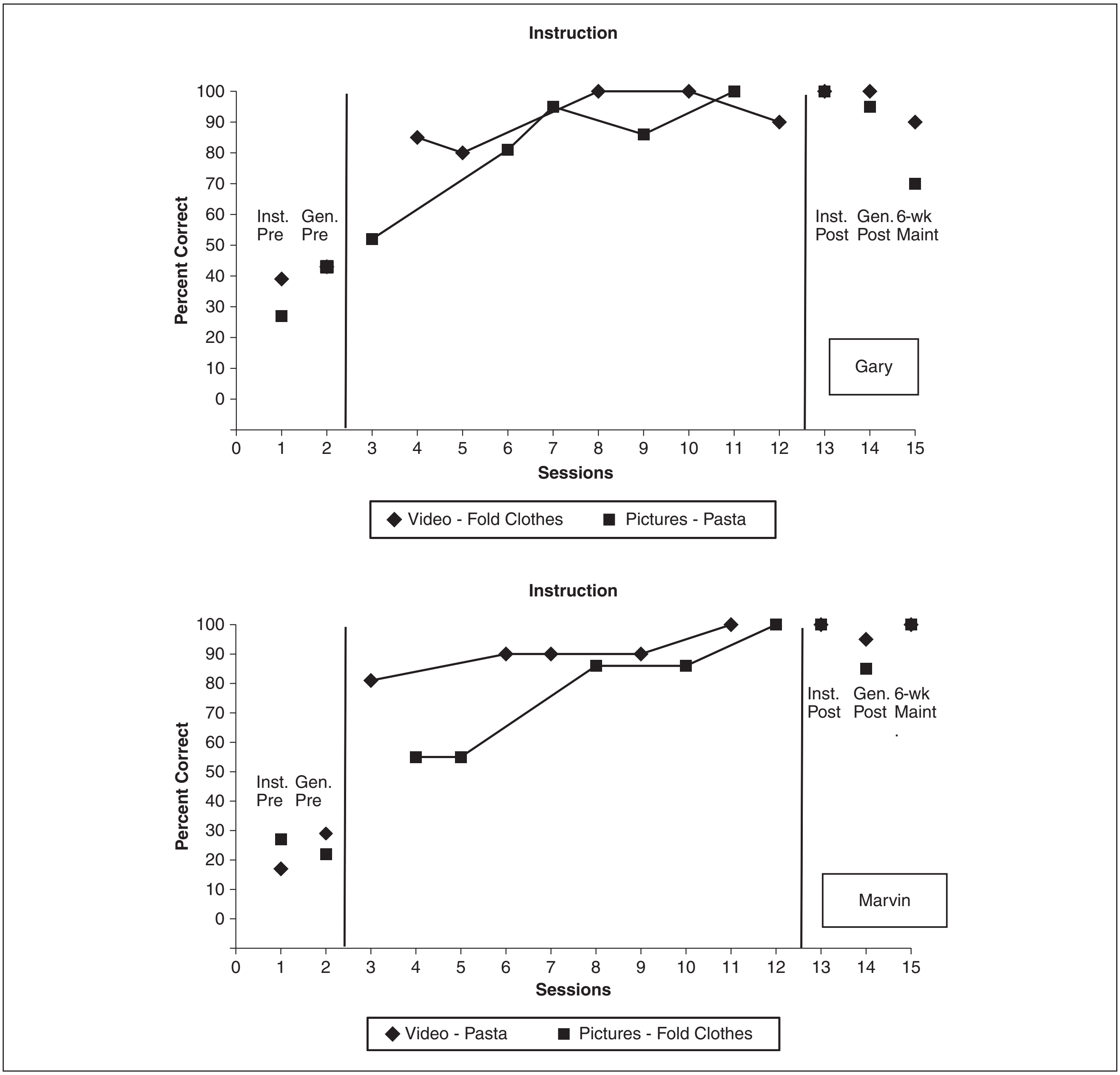

Figure 1. Percentage of independent correct responses in the task analyses.
Note: Gen. = generalization; Inst. = instructional materials; Maint. = maintenance.

Number of Sessions to Criterion

Gary reached criterion on both tasks within five sessions, while Marvin reached criterion within four sessions when the video prompting condition was in place and five sessions when the picture prompting condition was in place. In terms of efficiency related to number of sessions to criterion, there was very little difference between the two prompting systems.

Efficiency Measures Related to Time to Create Materials

When the growth from pre- to posttest was considered across instructional, generalization, and maintenance measures, the video prompting condition was more efficient for each participant across all measures (see Figure 4). Gary had efficiency scores of 2.03 for the video prompting condition and 1.38 for the picture prompting condition

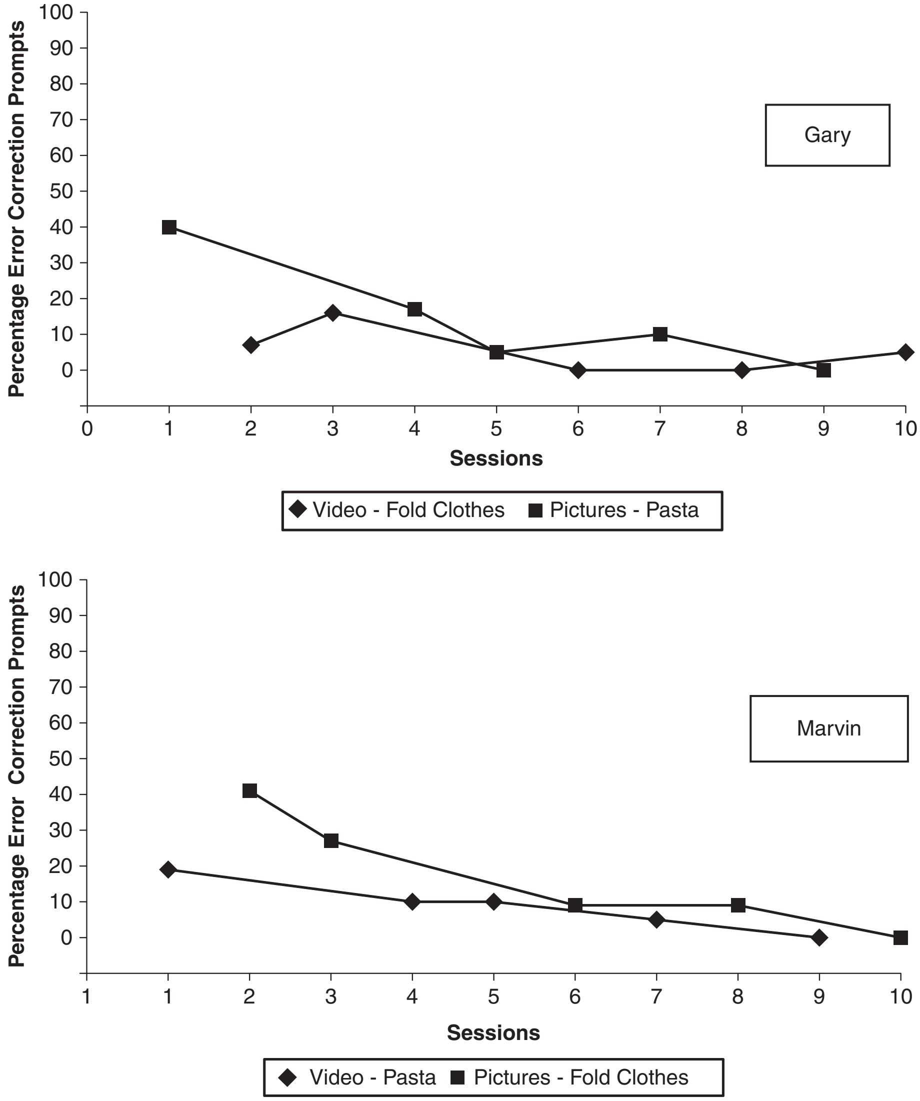

Figure 2. Percentage of error correction prompts used during instruction.

when the instructional materials were used. When the generalization materials were used, Gary had efficiency scores of 1.9 for video prompting and 0.98 for picture prompting for the 1-week tests and 1.7 for video prompting and 0.81 for picture prompting at the 6-week tests. Marvin had similar results. When efficiency scores were calculated for instructional materials, he had efficiency scores of 2.44 for the video prompting condition and 1.38 for the picture prompting condition. When the generalization materials were used, Marvin had efficiency scores of 1.94 for video prompting and 1.19 for picture prompting at the 1-week tests and efficiency scores of scores of 2.15 for video prompting and 1.57 for picture prompting at the 6-week tests. When the means were combined across measures, conditions, and participants, the video prompting condition was more efficient. In essence, each minute of time spent creating the materials "bought" an average increase of 2.03 percentage points for the video prompting condition and an average increase of 1.22 percentage points for the picture prompting condition, indicating that the video prompting condition was the most efficient in terms of amount of growth from pre- to postmeasures relative to the time needed to create the instructional materials.

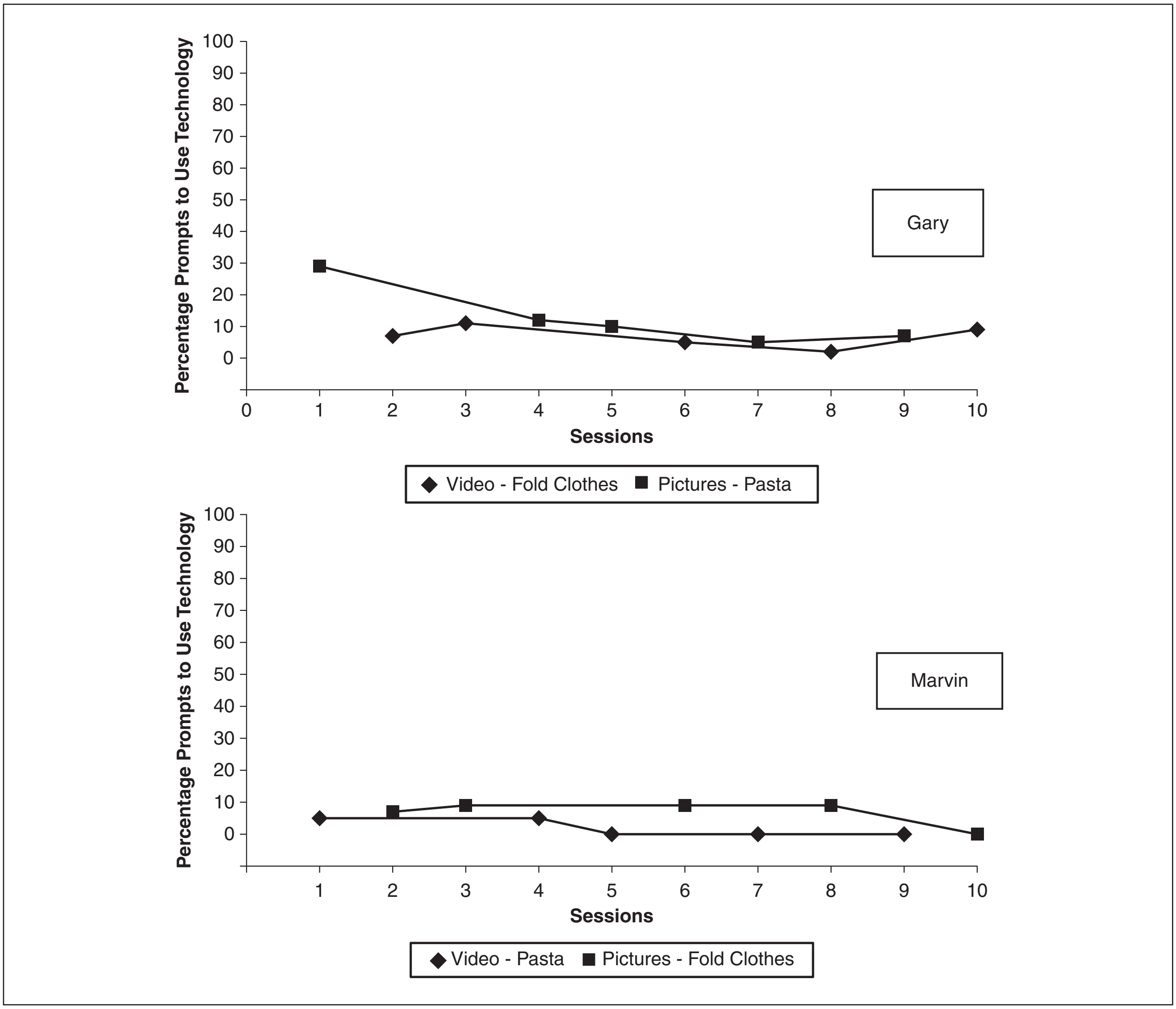

Figure 3. Percentage of prompts to use technology during instruction.

Social Validity

Informal interviews were conducted with the participants and some of the school staff members following the intervention. During their interviews, Marvin and Gary were asked (a) if they liked using the pictures and videos during instruction, (b) if they thought the pictures and videos were helpful in assisting them to perform tasks, (c) if they preferred using pictures or videos, and (d) to indicate what prompting system they would like to use in the future. Both Marvin and Gary indicated that they liked using both of the prompting systems and that they found them to be helpful for learning the different tasks. When asked which system they preferred and which system they would like using in the future, both indicated that they preferred using the videos and would like to use them again in the future.

At the conclusion of the study, the results were shared with the teacher and one of the teaching assistants, who were asked which prompting system they would be most likely to use in the future. Although both agreed that the video prompts were somewhat more effective, they indicated that they would be more likely to use picture prompting systems because they were more familiar with using them. They also indicated that they would probably use pictures because they were more portable than the laptop. However, they were impressed with the effectiveness of video-based instruction and indicated that they would like more information or instruction on how to develop video-based instructional prompts.

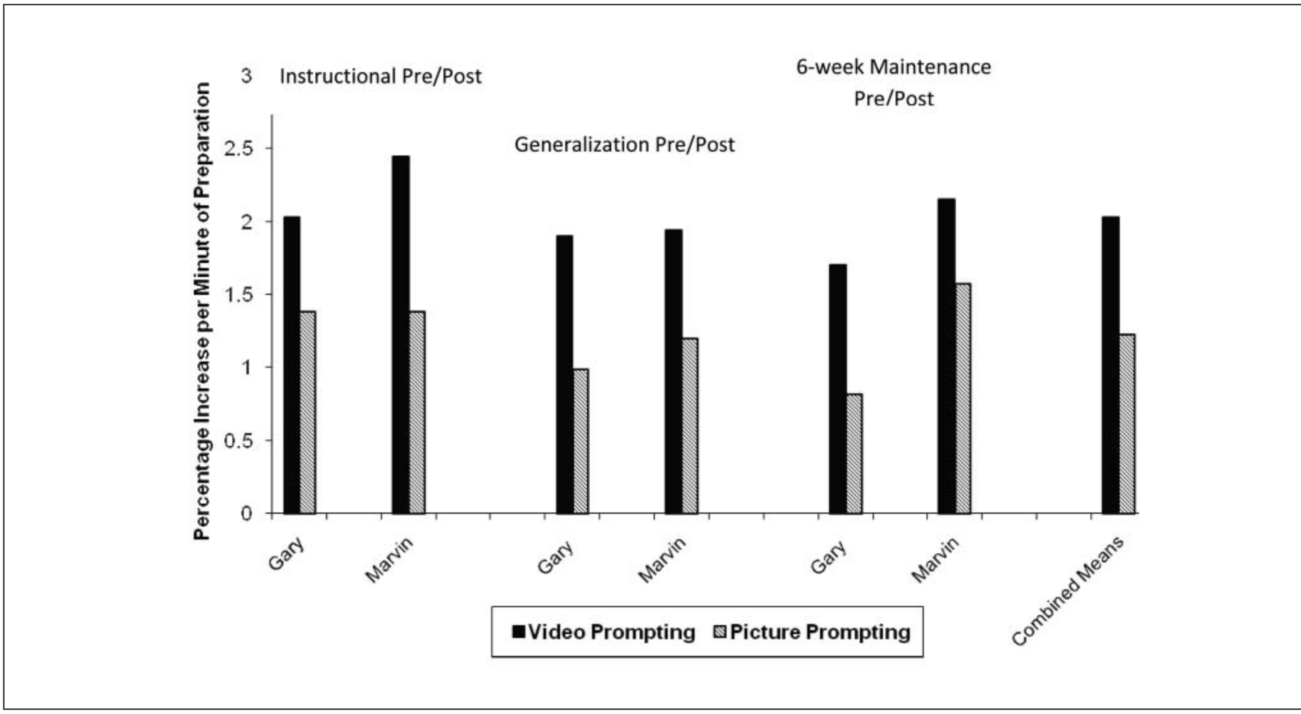

Figure 4. Efficiency measures for independent variables.

Discussion

The purpose of this research was to compare the effectiveness and efficiency of picture versus video prompting in teaching daily living skills to two adolescents with ASD. The effectiveness of the interventions were measured by comparing the percentage of independent correct responses during the instructional phase and growth from pre- to post-measures using instructional as well as generalization materials and settings. The efficiency of the interventions was measured by comparing the number of sessions to criterion and the "cost" of minutes required to create the instructional materials relative to growth. In addition, to determine if the prompting procedures promoted independence while reducing reliance on practitioners, the percentage of external prompts, and prompts to use the technology were measured. In summary, both of the prompting systems were effective at increasing independent correct responding for both participants, but the video prompting system appeared to be somewhat more effective and efficient than the picture prompting system across all dependent measures, with clearer results being present for Marvin. The video prompting condition was associated with the highest percentage of independent correct responding, fewer external prompts, and fewer prompts to use technology for both participants. When the efficiency related to the time required to create materials (relative to growth) was measured, the video prompting strategy was more efficient in terms of the percentage increase obtained relative to the number of minutes required for material preparation.

Although the results are promising, there were several limitations to this study. First, the generalizability of the findings is limited, because there were only two participants. The results would have been strengthened if another replication could have been conducted through the addition of two additional participants and counterbalancing across tasks. Additionally, the results may have been stronger if an extended baseline phase had been conducted to establish low levels of student responding prior to instruction. Although a baseline phase would have been preferable, a relatively low level of correct responding was demonstrated for both participants as they had two pretests, or baseline probes, with one pretest involving materials presented during instruction and the other pretest using materials used during generalization sessions. Although it would have been preferable to have an extended baseline, it was still possible to demonstrate a change in the level of the data when the pretest scores were compared with the 1st day of instruction for both conditions. When independent correct responding was considered, there was a much steeper change in the level of data when the video prompting condition was in place for both participants, indicating that video prompting may have been more powerful than picture prompting during initial instructional sessions.

However, a possible limitation in this comparison is related to the voiceover narration that was added to the video prompts. It cannot be stated that the video alone was responsible for the rapid increase in independent correct responding, because students may have been responding to the auditory prompts.

Overall, the most substantial finding of this research was in relation to the cost-effectiveness of each prompting strategy when the ratio of growth per minute of preparation was considered. Considering the efficiency of instructional methods is very important, especially in relation to the rate of skill acquisition and teachers' or caregivers' willingness to prepare the instructional materials. The time required to create instructional materials is a very real concern because teachers have many other responsibilities that demand a great deal of their time. Although many teachers and/or direct care providers often operate under the assumption that working with video requires too much time, it can actually be comparable with or require less time than creating picture-based visual supports. Creating picture sequences often requires extensive printing, cutting, and laminating, which not only adds time needed to create the materials but also can add monetary cost over time. Taking the actual pictures can take longer than videotaping, because the "model" or person who is performing the skill sequence has to stop and pose for each step, whereas with video, the steps can be performed more fluidly, and there is less starting and stopping, which reduces the amount of time needed to videotape. In many cases, more pictures need to be taken to communicate the response requirements of various steps that easily could be represented by one short video clip. For example, at least three pictures were needed to demonstrate folding laundry and setting the time on the microwave for the pasta task. Each of these steps was easily demonstrated with one video clip, which made it easier to model the fluidity of the response requirements. We believe that is why the participants may have needed more external prompting when the picture prompting strategies were in place. Perhaps the pictures did not provide enough information for the participants, and it was necessary to provide additional supports to teach the response requirements, whereas with the video prompts, more complete models were provided to allow the participants to perform the steps more independently.

Although video prompts with this study resulted in increased student independence and less reliance on direct care providers, in many cases, the teacher or direct care providers will be the ones to determine which instructional materials will be used. For example, when the teacher in Alberto et al.'s (2005) study was asked which prompting system he preferred, he indicated that he preferred creating the video-based materials because they took less time to develop. The teachers in Cihak et al.'s (2006) study, however, indicated that they preferred the picture prompting strategies because they believed that pictures took less time to develop. Maybe the preferences indicated by the teachers were related more to their comfort level with using the technologies rather than the actual time required to create the instructional materials. Picture prompting strategies have been used for more than two decades, whereas video-based strategies are relatively new, and there are not as many people adept at using this technology. It is possible that with more training or professional development opportunities, teachers, parents, and direct care providers will be more likely to integrate video-based instruction into skills training.

Although the time required to create the materials is important in terms of teacher or caregivers' willingness to create various prompting systems, the most important consideration is the student and his or her ability to gain independence using methods that are effective. Video prompting was somewhat more effective than picture prompting for both of the participants in this study, and these findings are closely aligned to those found by Mechling and Gustafson (2008). However, another variable that must be considered is the students' preference for the various technologies. When the students in this study were asked which type of prompting system they preferred, both indicated that they preferred the video prompts. Marvin, in particular, seemed to enjoy viewing the videos and would often mimic the voiceover narrations while he was completing the task, essentially using self-prompting while engaged in the skill sequences. Perhaps students who have preferences for watching videos or who frequently recite lines to movies perform better or are more interested in video-based models. Gary, on the other hand, had a preference for quieter settings and often wore earplugs to reduce the noise in his environment. Because of this, it was somewhat surprising that he preferred the video-based prompting system, because it introduced more "noise" into the environment than the picture prompting system. Maybe there are certain student characteristics, student preferences, or task requirements that influence the effectiveness of the various interventions. For example, Alberto et al. (2005) and Cihak et al. (2006) suggested that students with attentional difficulties may perform better when static picture prompts are used. This makes sense because students with attentional difficulties may miss some of the relevant stimuli that are presented in video-based materials if their attention is diverted.

Although the video-based prompting systems appeared to be somewhat more effective for these participants, the bottom line is that all students are different. Different individuals will have different preferences across the types of instructional materials being used, how the instructional materials are presented (e.g., video prompts vs. video models), as well as the types of tasks that are being taught. In addition, the feasibility of using various prompting systems in vocational and/or community-based environments must be considered.

In this study, a laptop computer was used to present video prompts; however, as the practitioners involved in this study expressed, more portable systems may need to be used to make the presentation of videos possible in vocational or community-based settings. There currently is very limited research available regarding the use of handhelds or portable systems for delivering video-based instructional materials (Taber-Doughty, Patton, & Brennan, 2008; Van Laarhoven et al., 2007; Van Laarhoven et al., 2009), and much more research needs to be done in this area. Future researchers should investigate methods for training personnel and caregivers to use video technology so that it is used more widely in applied settings, and cost-benefit analyses should be conducted to determine if handheld devices can reduce costs associated with hiring additional personnel, particularly in employment settings. Hopefully, with additional research and increased professional development opportunities for teachers, parents, and preservice educators, video-based instruction can become a more common educational tool for promoting independence among individuals with autism and other developmental disabilities.

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