Evaluation of a Personal Digital Assistant as a Self-Prompting Device for Increasing Multi-Step Task Completion by Students with Moderate Intellectual Disabilities

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Abstract: The purpose of this study was to evaluate whether the use of a personal digital assistant (PDA), with picture, auditory, and video prompts, would serve as a portable self-prompting device to facilitate independent task performance by high school age students with moderate intellectual disabilities. A multiple probe design was used across three cooking recipes and replicated across three students to evaluate the effectiveness of the self-prompting program. Results indicate that students were able to independently use a PDA to self-prompt completion of the three cooking recipes without the need for external adult prompting, to maintain use of the device over time, and to self-adjust the levels of prompts used within and across recipes.

Researchers continue to investigate use of self-operated prompting systems, operated by persons with intellectual disabilities, as tools for increasing independence and decreasing reliance on external prompts delivered by adults or peers. Self-operated prompting systems may be used to prompt: completion of tasks with multiple steps (i.e., washing dishes); a sequence of tasks such as following a daily schedule; or transitioning independently between activities (MacDuff, Krantz, & McClannahan, 1993). Traditionally self-prompting systems for completion of multi-step tasks have been in the form of picture-based materials (Lancioni, O’Reilly, & Oliva, 2001; Mechling, 2007) whereby students look at a static picture depicting a step of a task analysis, complete the step, return to the system, mark off the picture corresponding to the completed step or turn a page in a book, proceed to the next picture and so forth. Static picture prompting has been used to prompt: food preparation (Singh, Oswald, Ellis, & Singh, 1995); assembly tasks (Martin, Mithang, & Frazier, 1992); dusting, setting tables, and vacuuming (Steed & Lutzker, 1997); packaging (Johnson & Miltenberger, 1996); taking customer orders and preparing sack lunches (Agran, Fodor-Davis, Moore, & Martella, 1992), and daily living skills (i.e., setting a table, making a bed) (Pierce & Schreibhan, 1994). Auditory-based systems have also been used as self-prompting devices whereby students operate a portable cassette player (Davis, Brady, Williams, & Burta, 1992; Grossi, 1998; Taber, Seltzer, Heflin, & Alberto, 1999), and MP3 player (Taber-Doughty, 2005) by listening to a description of how to complete a step, or cluster of steps, of a task analysis, complete the step, and advance the system to the next step.

Researchers have further evaluated use of video based prompting systems to support independent task completion by persons with intellectual disabilities. Similar to picture or auditory based systems, students watch a video segment of a step of the task being completed, pause the video tape, complete the step, and return to the prompting device to watch the next step. Video prompting has been used effectively to teach a range of multi-step tasks...
(Mechling, 2005) including: self-help skills (Norman, Collins, & Schuster, 2001); cooking (Graves, Collins, Schuster, & Kleinert, 2005; Mechling, Gast, & Fields, 2008); microwave oven use (Sigafoos et al., 2005); putting away groceries (Cannella-Malone et al., 2006); and setting a table (Cannella-Malone et al.; Goodson, Sigafoos, O'Reilly, Cannella, & Lancioni, 2007). Unlike picture or auditory based systems, video prompting devices hold the advantage of offering the student both visual and auditory cuing. In addition, video can provide animated, real-life simulations of the task (Mechling). Although Cihak, Alberto, Taber-Doughty, and Gama (2006) found no significant differences between static picture prompting and video prompting when teaching use of an ATM and debit card machine to six students with moderate intellectual disabilities, Mechling and Gustafson (2009) found that six young adults with moderate intellectual disabilities independently completed a greater number of tasks when using video prompting compared to static pictures. Mechling and Gustafson (2009) report similar findings in favor of video prompting in their study with six young men with a diagnosis of autism. Tasks evaluated in each study were component steps of recipes (i.e., opening crescent rolls), whereby Mechling and Stephens (2009) included multiple step cooking recipes in their study. Results of the study support video prompting over static picture prompting for increasing independent performance of tasks for four students with moderate intellectual disabilities.

In addition to investigating differences in skill acquisition using different self-prompting devices (picture, audio, video), an area of interest concerning self-prompting systems is portability. Although a paper-based picture system can be portable (i.e., small notebooks or flip cards) some researchers have found that students lose their place with such systems (Lancioni, O'Reilly, Seedhouse, Furniss, & Cunha, 2000; Mechling & Stephens, 2009) and they do not provide auditory feedback. To address these concerns and keeping abreast with developing technologies, research is being conducted on the use of personal digital assistants (PDAs) by persons with disabilities. These hand held systems, referred to by Tomasino, Doubek, and Ormiston (2007) as mobile technologies, have incorporated text (Ferguson, Smith-Myles, & Hagiwara, 2005) and text and auditory prompts (Davies, Stock, & Wehmeyer, 2002a) to teach time management and task completion. Pictures and auditory prompts, presented on a small hand held digital display, have also been used to teach completion of vocational and independent living tasks (Cihak, Kessler, & Alberto, 2007; Riffel et al., 2005); transitioning between vocational tasks (Cihak, Kessler, & Alberto, 2008); and packaging and assembly tasks (Davies, Stock, & Wehmeyer, 2002b; 2003; Furniss et al., 1999).

Presentation of video-based instruction within the realm of portable systems is also beginning to receive research attention. Mechling et al. (2008) used a portable DVD player to deliver video prompts to three young adults with moderate intellectual disabilities when the system was placed on a kitchen counter. Video displayed on portable PDA systems was also explored in two recent studies (Taber-Doughty, Patton, & Brennan, 2008; Van Laarhoven, Van Larrhoven-Myers, & Zurita, 2007). Both Taber et al. and Van Laarhoven et al. used video modeling procedures to present information to students on hand held systems. Video modeling differs from video prompting by requiring the individual to watch an entire video recording followed by immediate performance of the entire task or performance of the skill at a later time. Limited research exists comparing the two procedures, however Cannella-Malone et al. (2006) found video prompting more effective than video modeling in promoting acquisition of table setting skills and putting away groceries by six adults with developmental disabilities. Although video prompting has been shown to be an effective tool for presenting information and instruction to students with moderate intellectual disabilities (Cannella-Malone et al.; Graves et al., 2005; Mechling et al.; Mechling & Stephens, 2009; Norman et al., 2001; Sigafoos et al., 2005), to date no research has been reported in the literature evaluating the effects of video prompting on a PDA system.

The purpose of the current study was to evaluate the effectiveness of a PDA self-prompting system which combined the use of video, picture, and auditory prompts. While previous research has shown these individual
components to be effective prompting systems, no study has evaluated a system using a combination of these three components nor has research addressed presentation of a combination system on a portable hand-held device. Advantages for combining the systems have been noted by researchers. Van Laarhoven and Van Laarhoven-Myers (2006) found that combination systems (video modeling paired with photographs and video modeling paired with video prompting) resulted in more independent correct responses and were more efficient in terms of sessions to criterion than video modeling alone when teaching community daily living skills to young adults with developmental disabilities. Van Laarhoven and Van Laarhoven-Myers found that students, although not permitted to do so in the study, tried to self-fade and rely on picture prompts rather than use of video prompts as they learned tasks. Similarly, Taber-Doughty et al. (2008) found that students began to rely only on auditory prompts and self-faded looking at video models on a PDA system that provided both video models and auditory cues. Based on their findings, Van Laarhoven and Van Laarhoven-Myers suggest a “scaffolding approach” whereby students use more intrusive prompts of a system during initial trials and progress to a less intrusive level of prompting as they become familiar with a task.

In the current study students could: look at a still photograph on a hand held device, touch the photograph and hear an auditory prompt, or watch a video segment with auditory prompting, depending on how much information was needed. In addition, as they learned steps of the task analysis, and did not need additional information, students could progress the system to the next photograph without receiving further prompts. The intention of the combination prompting system in this study was to allow for adaptations as students’ needs for prompts changed (Van Laarhoven & Van Laarhoven-Myers, 2006), to provide different prompt levels depending on the complexity of the step (Mechling & Stephens, 2009), and to provide a system that could be adaptable to varying abilities across students (Mechling et al., 2008). The current study sought to answer the following research questions: a) Would a hand-held self-prompting system, using video, picture, and auditory prompt levels, increase the percentage of cooking steps completed independently by students with moderate intellectual disabilities?; and b) Would students with moderate intellectual disabilities self-adjust their use of prompt levels when using the PDA?

Method

Participants

Three young adults (2 females and 1 male) with moderate intellectual disabilities participated in the study. Each had experience in food preparation, computer-based instruction, and use of picture-based prompting although none had used video based prompting or a handheld system. Students were screened for the following prerequisite skills prior to the start of the study: (a) visual ability to see video and pictures on a small 2 inch × 3 inch digital display; (b) ability to hear auditory prompts delivered by the system; (c) fine motor ability to touch the PDA screen or use a small 1/8 inch diameter stylus; (d) cognitive ability to recognize pictures and icons; (e) ability to attend to video stimuli; and (f) imitation skills. Because the purpose of the study was to evaluate the PDA system as a self-prompting tool, students were also evaluated on their ability to perform individual components of each task analysis. These included: (a) operation of a digital kitchen timer; (b) operation of dials on an electric stove and toaster oven; (c) use of a microwave oven; (d) ability to lift off plastic lids; (e) ability to twist lids on and off of jars; (f) use of a bread clip; (g) cutting with scissors; (h) ability to open cheese slices; (i) removing and putting on a cooking spray lid; and (j) operating cooking spray. In addition, the following skills were adapted to ensure students’ abilities to complete the component steps of the task analysis: (a) using a bread clip rather than a twist tie; (b) placing food items into plastic storage containers rather than zip lock bags in which they were purchased; (c) cutting open bags with scissors rather than tearing or pulling
them open; (d) using oven mitts rather than pot holders; and (e) using color coded measuring cups.

Andy was a 15 year, 11 month old male diagnosed with Williams syndrome, mild autism traits, and a moderate intellectual disability (IQ 55, *Kaufman Assessment Battery for Children*: Kaufman & Kaufman, 1983; Adaptive Behavior Composite Score 48, *Vineland Adaptive Behavior Scales*: Sparrow, Balla, & Cicchetti, 1984). He read simple sight words and some letter sounds and was working on identifying main ideas and themes in stories as well as increasing his ability to read and match words to pictures. He was able to write his name, address, phone number and emergency contact information. He could also write the days of the week and the months of the year. He was working on completing forms, writing sentences with assistance and writing a grammatically correct simple sentence. He could count objects, rote count to 100 by 1s, 5s, 10s and complete simple addition problems using tally marks. He was also able to count sets of nickels and dimes, but not in combination. His short term objectives included use of a calculator and telling time on the hour and half hour. He used appropriate language to ask for help and to interact with others with clear articulation and a strength in pragmatic language. His needs included increasing his vocabulary, use of descriptive words in sentences, and answering simple who, what, when, and where questions. He had difficulty processing auditory information and performed tasks better with visual cues. Andy’s needs further included demonstration of effective listening skills in class when directions were being given. He was able to care for all of his self-care needs and perform simple home living tasks such as making a bed and washing dishes. He was able to operate a microwave oven with visual cues and a toaster oven, but required supervision for all cooking related tasks. He was described as being very social, polite, courteous and enjoyed adult attention. He greeted people appropriately and had a good memory for people’s names and facts about them. He continued to have difficulty with peer relationships, impulse control, and concentration and was easily frustrated. He frequently left his chair and stared out the window and asked for drinks of water or to use the restroom. He worked well in a quiet and structured environment with frequent praise and reinforcement. Andy enjoyed choir, community outings, and working on the computer.

Monica was a 17 year, 3 month old female diagnosed with Down syndrome and a moderate intellectual disability [IQ 51, *Wechsler Intelligence Scale for Children–Third Edition* (WISC-III): Wechsler, 1997; Adaptive Behavior Composite Score 70, *Vineland Adaptive Behavior Scales*: Sparrow et al., 1984]. She had a mild hearing loss and wore eye glasses. She read on a late kindergarten/early first grade level and recognized simple sight words. She knew the sounds for all letters and was working on sounding out and blending sounds to read words. She had difficulty with comprehension and often answered, “I don’t know” to questions about what she had read. She was able to write simple sentences in a journal and copied sentences dictated to her teacher. She used modified spelling and often omitted articles when writing sentences. Her needs included increasing her ability to write simple sentences using periods and to write personal information and prepare a written grocery list. Monica used a calculator to solve computation problems with addition and subtraction and was able to tell time to the hour and half hour. She used a digital clock and watch for all other times. One of her short term objectives was to understand which hour is next and what time of day events happened. She was unable to recognize coins or state their value and had difficulty counting by fives and tens. She was able to take care of her personal needs, was working on folding clothes with a model, and was able to hang shirts and pants with some prompts for positioning on the hanger. She needed assistance making a bed and cooked with supervision and assistance. Her needs included working on planning meals making a grocery list, shopping for items, and preparing meals. She could operate a microwave and oven and needed assistance with a stove top. She was described as being very social, polite, courteous and enjoyed free time, working puzzles, coloring, and computer games. She liked *Hanna Montana* and enjoyed searching websites pertaining to the topic.

Wanda was a 17 year, 9 month old female diagnosed with a moderate intellectual dis-
ability (IQ 44, *Stanford-Binet Intelligence Scales—Fourth Edition*: Thorndike, Hagan, & Sattler, 1986; *Vineland Adaptive Behavior Composite Score* 58, *Vineland Adaptive Behavior Scales*: Sparrow et al., 1984). She was able to read 25 sight words on a primer level and knew the sounds for all letters. She was working on blending sounds to read words. Her comprehension skills were stronger when read to than when she read a passage. She copies sentences and was working on writing simple three word sentences. She used a calculator to complete simple addition and subtraction problems with reminders for entering decimal points. She could tell time on the hour and half hour and need to tell time on five minute intervals. She could count by fives and tens, recognized all coins and their values and was working on counting coin and dollar combinations to $5. She was able to care for all of her self-care needs except for difficult fasteners. Wanda could make her bed, wash dishes, take out the trash, and follow simple recipes with pictures using a microwave, stove, and oven with close supervision. Her needs included planning and cooking healthy meals, writing a grocery list, and locating items in the grocery store. She liked to socialize in the hallways of the high school and had many friends from her community. She was working on appropriate verbal behavior and body language in the hallways. In addition to socializing with friends, she enjoyed making puzzles, working on the computer, physical education class, and playing basketball.

**Settings and Arrangements**

Probe, intervention, and history training sessions, took place in the home living room at the students’ high school. The kitchen area of the home living room was arranged with all of the appliances (refrigerator, stove, dishwasher, and sink) positioned in a single row along the wall with counter space separating each appliance. The microwave was positioned on a countertop next to the refrigerator and the toaster oven was positioned on a counter top next to the electric stove. All silverware, utensils, skillets etc. were kept in the cabinets above and below the counters along the wall. The PDA was placed flat on the counter between the sink and the stove. The instructor stood to the right of the student and when present, the reliability data collector stood behind and to the left of the student.

**Materials and Equipment**

A Cannon ZR 830 digital video camcorder was used to make all video recordings and still photographs. The camera record button was stopped between recordings of each video prompting segment (step of the task analysis) for each recipe. Video recordings were made using an adult model unfamiliar to the students. During recording of each step a voice over procedure was used to record directions (verbal prompts) provided by the person operating the camera. Video recordings were downloaded through the fire wire port of the camera to a Dell Latitude × 300 laptop. Video captions were edited using Windows Movie Maker, and saved on the hard drive of the laptop for later importing onto the PDA. Likewise, photographs were downloaded to the laptop computer through the USB port, converted to a JPEG files, saved into picture files, and later imported onto the PDA. The Personal Digital Assistant (PDA) used in the study was the Cyrano Communicator TM (Hewlett Packard iPAQ Pocket PC with pre-installed software by One Write Company). The software pre-installed onto the PDA allowed for importing of pictures and video links directly onto available templates, linking of presentation slides, and recording of auditory prompts. The program also allowed use of larger photographs on the displays which could be more readily seen and touched with a finger rather than a stylus. The template selected for the current study contained three blocks (Figure 1). A presentation slide, using the template, was created for each step of a task analysis. The top or largest block contained a photograph corresponding to the step of the task analysis. Photographs were downloaded from the laptop, stored on the PDA, and attached to each presentation slide. An auditory prompt was recorded directly onto the PDA and played when the picture block was touched by the student (using a finger or the stylus). The bottom left block contained the label “movie” and linked to the video prompt when touched. Movie files were downloaded from the laptop, and stored di-
directly on the PDA. The video caption played immediately, using Windows Media Player, (available on the PDA) which was automatically opened when the block was touched. After the video caption was complete, the movie stopped, the student closed Windows Media Player using the stylus, and the program then returned to the presentation slide. The block in the bottom right corner contained a picture of an arrow pointing to the right and an auditory prompt which said, “Next”. This block was linked to the subsequent presentation slide corresponding to the next step of the task analysis. When the arrow block was touched by the student (using a finger or a stylus) the program automatically advanced to the next slide. A student could repeatedly touch a picture on a page and hear the auditory prompt or touch the video block and replay the video recording as often as needed until the step was completed, however, the program only advanced forward and students could not go back or “rewind” to a step. The last presentation slide for each cooking recipe contained a photograph of the finished food item, an auditory prompt “finished”, and a video recording of the finished food item on a plate with the voice over, “Finished, you may eat the ____.”

Three cooking recipes were selected which sampled three modes of food preparation: stove top (grilled ham and cheese sandwich), microwave (Hamburger Helper Microwave Singles), and toaster oven (individual serving size pizza). Recipes ranged from 19 to 25 steps and required use of a range of stimuli (i.e., boxes, bags, jars, measuring cups, spatula, digital timer) and responses (i.e., stirring, turning, pouring, holding) (Table 1).

Experimental Design and General Procedures

A multiple probe design across three cooking recipes and replicated with three students was used to determine the effectiveness of a handheld self-prompting system, using video, picture, and auditory prompt levels, to teach food preparation (Gast, 2009). The PDA was operated individually by each student and used to deliver all prompts for task completion. One cooking task was performed during each session and only one session was conducted per day, 3–4 days per week. Experimental conditions occurred in the following sequence: history training for PDA operation, cooking task probe without the PDA (three recipes), PDA prompting (first recipe), cooking task probe without the PDA (three recipes), PDA prompting (second recipe), PDA prompting probe (mastered recipe), cooking task probe without the PDA (two recipes) and so on. Subsequent probe sessions with the PDA following mastery of a recipe were conducted to evaluate use of the device over time (maintenance).

Dependent Measure and Data Collection

During each condition, data were recorded for each step of the recipe task analyses shown in Table 1. Data were calculated and reported for the percentage of steps completed independently using the PDA regardless of the prompt level used on the PDA. Although the primary dependent variable was the percentage of steps completed independently correct for each recipe, the type of prompt level the student used on the PDA in order to complete the step (independent, picture only, picture + auditory, or video) was also recorded.

History Training

Prior to the first probe session, students participated in instructional sessions to teach operation of the PDA. A washer and dryer were present in the home living area and a self-prompting program with five presentation slides was developed for operation of the
### Table 1

**Task Analysis for Cooking Recipes**

<table>
<thead>
<tr>
<th>Task Analysis</th>
<th>Number of Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger Helper Microwave Singles</td>
<td>19</td>
</tr>
<tr>
<td>Get box of Hamburger Helper from cabinet and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get 1 cup measuring cup from drawer and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get small spoon from drawer and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get 2 oven mitts from on top of the microwave and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get white mixing bowl from cabinet and put on counter</td>
<td></td>
</tr>
<tr>
<td>Open box and take out one packet</td>
<td></td>
</tr>
<tr>
<td>Get scissors from drawer, cut open packet and pour contents into bowl</td>
<td></td>
</tr>
<tr>
<td>Fill measuring cup with water from sink and pour water into bowl</td>
<td></td>
</tr>
<tr>
<td>Stir mixture 8 times, put spoon on counter</td>
<td></td>
</tr>
<tr>
<td>Put bowl in microwave, close door, Press “5” “0” “0” “Start:</td>
<td></td>
</tr>
<tr>
<td>Wait 5 min for microwave to “ding”</td>
<td></td>
</tr>
<tr>
<td>Take bowl out of microwave using oven mitts, put on counter, close microwave door and stir mixture 8 times</td>
<td></td>
</tr>
<tr>
<td>Close box and put in cabinet</td>
<td></td>
</tr>
<tr>
<td>Put oven mitts on top of microwave</td>
<td></td>
</tr>
<tr>
<td>Put measuring cup in sink</td>
<td></td>
</tr>
<tr>
<td>Put spoon in sink</td>
<td></td>
</tr>
<tr>
<td>Throw empty packet in trash can</td>
<td></td>
</tr>
<tr>
<td>Put scissors in drawer</td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td></td>
</tr>
<tr>
<td>Grilled Ham and Cheese Sandwich</td>
<td>24</td>
</tr>
<tr>
<td>Get skillet from cabinet and put on front right stove burner</td>
<td></td>
</tr>
<tr>
<td>Get plate from cabinet and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get spatula from drawer and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get cooking spray from cabinet and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get bread from refrigerator and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get 2 slices of cheese from refrigerator shelf and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get package of ham from refrigerator shelf and put on counter</td>
<td></td>
</tr>
<tr>
<td>Take off lid of cooking spray and spray bottom of skillet 6 times</td>
<td></td>
</tr>
<tr>
<td>Open bread and place 2 slices of bread in skillet</td>
<td></td>
</tr>
<tr>
<td>Unwrap 2 slices of cheese and place one slice on each slice of bread</td>
<td></td>
</tr>
<tr>
<td>Open package of ham and place one slice of ham on top of one cheese slice</td>
<td></td>
</tr>
<tr>
<td>Turn stove dial to “medium”</td>
<td></td>
</tr>
<tr>
<td>Get kitchen timer from kitchen drawer</td>
<td></td>
</tr>
<tr>
<td>Press minute button two times and press “start”</td>
<td></td>
</tr>
<tr>
<td>Wait 2 minutes for timer to beep</td>
<td></td>
</tr>
<tr>
<td>Turn stove dial to “off”</td>
<td></td>
</tr>
<tr>
<td>Get spatula and place one slice of bread/cheese/ham on top of other, lift sandwich from skillet with spatula and place on plate</td>
<td></td>
</tr>
<tr>
<td>Close bread with bread clip and put in refrigerator</td>
<td></td>
</tr>
<tr>
<td>Put ham in refrigerator</td>
<td></td>
</tr>
<tr>
<td>Place lid on cooking spray and put in cabinet</td>
<td></td>
</tr>
<tr>
<td>Put cheese wrappers in trash can</td>
<td></td>
</tr>
<tr>
<td>Put spatula in sink</td>
<td></td>
</tr>
<tr>
<td>Put timer in drawer</td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td></td>
</tr>
<tr>
<td>Individual Serving Size Pizza</td>
<td>25</td>
</tr>
<tr>
<td>Get plate from cabinet and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get knife from drawer and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get pizza dough packet from refrigerator and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get pizza sauce bottle from refrigerator and put on counter</td>
<td></td>
</tr>
<tr>
<td>Get cheese package from refrigerator and put on counter</td>
<td></td>
</tr>
</tbody>
</table>

*Continued*
The self-prompting program followed the same format as those used for the three cooking tasks. Students were taught individually how to operate the different functions of the PDA using a stylus and their fingers. These functions included: (a) looking at the picture prompt; (b) touching the photograph to hear an auditory prompt; (c) touching the “movie” block to watch the video prompt; (d) closing the movie by touching a small box in the upper right corner of the digital display using the stylist; and (e) touching the arrow block to advance to the next presentation slide. Students were also taught to touch the screen if it went blank during the activity. The PDA was programmed to shut down after a period of approximately 25 seconds of non-use in order to conserve the battery. In addition to operation of the device, students were taught to complete a step and return to the PDA before advancing the program to the next slide. History training, using a system of least prompts procedure, continued until a student was able to independently operate all functions of the device to complete the clothes drying task.

**Probe Procedures: Cooking without the PDA**

The first probe condition served to evaluate each student’s ability to complete the three cooking recipes prior to instruction and without use of the self-prompting system. Initial probe sessions were conducted individually for a minimum of three sessions per recipe or until data stabilized. Subsequent probe conditions without the PDA system were conducted for one session per recipe immediately following mastery of a cooking task (Probe 2–4). Each session consisted of one trial for one of the recipes. Trials began with the instructor showing the student a photograph of the item to be prepared and delivering the task direction, “It’s time to cook _____,” or “Cook the _____. The instructor then waited 3 seconds for the student to respond by initiating the first step for preparing the recipe. Students could perform each step of the task analysis correctly, incorrectly, or not respond. Steps for each task analysis were performed by an adult without disabilities prior to the study to determine criterion levels for duration. A correct response was recorded if the student initiated a step within 3 seconds of the previous step and completed the step within 30 seconds following initiation of the step. Incorrect response was defined as: (a) initiation within 3 seconds, but failure to complete a step within 30 seconds of the previous step (duration); (b) initiation within 3 seconds of the last step, but failure to complete the step correctly (to-
pographic); and (c) no response, characterized by failure to initiate a step within 3 seconds of the end of the previous step. Failure to complete a step or initiate a step was also recorded if a student verbally expressed that he/she did not know how to complete a step. If a student performed a critical step incorrectly or did not respond, the instructor blocked the student's view and performed the critical step. A step was considered critical if subsequent steps could not be completed without the step's completion (e.g. putting the dough on the plate so that the sauce, mushrooms etc. could be placed on the dough). Students received verbal praise for attempting steps and for attending to the materials on an average of every third step (VR-3). Students could also eat the food at the end of the session, offer it to another classmate or staff member, or save it for later consumption if they so desired.

**Self-Prompting PDA Procedure**

During each cooking session, using the self-prompting system, the PDA was placed on the kitchen counter and was used by the student to navigate through each step of the task analysis. Each session began with the instructor turning on the PDA and locating the correct recipe. The first presentation slide contained a photograph of the recipe to be prepared and an arrow block at the bottom right side of the page. The student was given the task direction, “Touch the arrow and start cooking the _____using the iPAQ,” (the PDA was referred to as an iPAQ rather than a Cyrano Communicator because this was the label found on the outside of the PDA). The student then touched the arrow block which linked to the next presentation slide containing prompts for the first step of the task analysis. Following the model of the system of least prompts (SLP) the student could look at the photograph on the slide and complete the step (picture only), touch the photograph and hear an auditory prompt (i.e., “put the dough on the plate”) (picture + auditory), and/or touch the video block and watch a video caption of the step being modeled along with a verbal description of the step (video). The student could also complete steps of the task analysis without advancing the system to the corresponding presentation slide (independent).

For each step of the recipe a student could perform a step correctly or incorrectly, or not respond. An unprompted correct response was defined as initiating a step within 3s and completing a step within 30s following the PDA prompt. Students could also navigate their way through the prompt levels. For example, a student could look at the photograph (picture only) and decide that he/she needed a more intrusive prompt. He/she then touched the photograph and listened to the verbal prompt (picture + auditory). He/she could attempt to complete the step or progress to a more intrusive prompt level – video prompt. In order to be considered an unprompted correct response, the student was required to initiate the next prompt level within 3s of hearing and/or seeing the less intrusive prompt. A student could also return to the system for further prompting on the same level or to receive prompting on a more intrusive level after a step was initiated. In this case, an unprompted correct response was recorded if the student did so within 30s of initiating the step.

An incorrect response was defined as (a) initiation of a step within 3s following the prompts, but incorrect performance of the step (topographic); (b) initiation within 3s but failure to complete the step within 30s of the prompt (duration); or (c) no response, whereby the student failed to initiate a response within 3s of the PDA prompt. If an incorrect response occurred, the instructor prompted the student (i.e., said, “Touch the _____” while pointing to the block) to use the PDA to perform the step correctly (prompted correct). When the instructor prompted the student back to the PDA, she pointed to the next intrusive prompt level. For example, if the student touched the photograph, listened to the verbal prompt (picture + auditory) and responded incorrectly, the instructor prompted the student to touch the video block.

If a student failed to perform a step correctly after being directed through all of the prompt levels on the PDA (incorrect prompted response), the instructor performed any critical steps (while blocking the students view) followed by directing the stu-
dent to touch the arrow block to advance to the next presentation slide. If the step was not defined as critical (subsequent steps did not rely on its completion) the student was immediately prompted to touch the arrow block. No other prompts were provided for task completion by the instructor. Students received descriptive verbal praise on a VR-3 schedule of reinforcement for unprompted and prompted correct responses. At the end of the session the student could also eat the prepared food item, package it to be eaten at a later time, or offer it to another student or staff member. After criteria was reached for one recipe (100% unprompted correct for one session), one probe session was conducted to evaluate the student’s completion of the currently mastered recipe and any remaining recipes without use of the PDA. In addition, mastered recipes were probed using the PDA during subsequent training conditions to measure maintenance.

**Social Validity**

On the day that each student finished the last probe session, each was shown the PDA, a portable DVD player, and a picture-based cookbook. The instructor showed each student a portion of a recipe and operation of the portable DVD player (video and voice over prompts). The instructor also explained one recipe and how to look at and cross off pictures in the cookbook. The instructor then showed the student a box of pudding and asked, “If you were going to make the pudding, which of these would you like to use?”

**Reliability**

Interobserver agreement and procedural reliability data were recorded simultaneously on 33.3% of all sessions across probe and self-prompting PDA conditions. Interobserver agreement was calculated using the point-by-point method in which the number of instructor and observer agreements was divided by the number of agreements plus disagreements and multiplied by 100. Mean interobserver agreement for student independent correct responses was 98.8% across all students and conditions (range = 94.7%–100%) and 98.1% across all students during the self-prompting condition for level of prompt used by the student (range = 94.7%–100%).

Procedural reliability data were recorded for the following instructor behaviors when implementing the study: (a) prompting use of the PDA; (b) delivery of reinforcement; (c) blocking student’s view when completing critical steps; (d) assuring that materials and equipment were in proper locations and working order; and (e) turning on the PDA and delivering task directions. Agreement was calculated by dividing the number of each observed instructor behavior by the number of opportunities, multiplied by 100 (Billingsley, White, & Munson, 1980). Mean procedural accuracy was 97.9% (range = 90.9%–100%). Errors occurred, for example, when a high school staff member removed the bowl from the cabinet, the safety cap was not removed in advance from a new bottle of pizza sauce, Wanda left to go to the bathroom and the skillet was removed from the stove to prevent burning, student held finger on “next” icon too long and the program jumped ahead of the target slide, bread clip was not placed on a new loaf of bread, and the handle broke on the measuring cup.

**Results**

Figures 2, 3, and 4 show the percentage of steps performed independently correct by each student across the three cooking recipes during probe sessions without the self-prompting device and during PDA self-prompting sessions. Visual inspection of the figures reveals an immediate and abrupt increase in steps completed independently after introduction of the PDA system and that performance was maintained over time. Although students could perform some steps prior to use of the PDA, performance remained low during probe sessions with the exception of Wanda for making individual serving size pizza. It is possible that her level of performance increased prior to use of the PDA because she saw the final product (pepperoni, cheese etc. on the pizza) when her classmates brought the pizza into the classroom to share with classmates. In addition, some steps were repeated across recipes and Monica, for example, began to obtain potholders independently before using the PDA on her last recipe.
Figure 2. Percentage of steps performed correctly by Andy across the three cooking recipes.
Figure 3. Percentage of steps performed correctly by Monica across the three cooking recipes.
Figure 4. Percentage of steps performed correctly by Wanda across the three cooking recipes.
As reflected in Figures 2–4 students were able to learn to independently use the PDA self-prompting system to complete recipes without instructor prompts. Andy and Monica required the greatest number of sessions to criteria on their first recipe, however, Wanda increased her number of sessions to criteria on the second recipe. Although the ham and cheese recipe (Wanda’s first recipe) required 24 steps (compared to 19 steps for microwave hamburger helper), it appears that students found this recipe less difficult to perform when using the PDA. Errors across all recipes were most frequently committed when students initiated completion of a step without using the PDA and performed the step incorrectly, thus requiring the instructor to prompt them to use the devise. This behavior occurred with Wanda when completing her second recipe. She proceeded to perform a step incorrectly and was prompted by the instructor to look at the picture (next prompt level). 

Figure 5 presents the percentages for each prompt level used by each student across the three cooking recipes during self-prompting and probe sessions with the PDA. Students showed trends toward requiring less intrusive prompt levels (video and picture + audio) within and across tasks. All three students used video for the greatest amount of time during the first session of their first recipe (Andy 78.9%, Monica 72%, and Wanda 37.5%), but quickly faded it’s use within the second session (Andy 0%, Monica 2%, and Wanda 8.3%) and subsequently relied less on video across the first session of the remaining recipes (i.e., use of video on first session of second recipe: Andy 13.6%, Monica 25%, and Wanda 21.1%). With the exception of Monica on her last recipe, students infrequently used the pic-
ture + audio feature of the PDA, but instead they frequently accessed the picture prompt if they were unable to perform a step independently. This behavior continued for each student into maintenance sessions when students were presented with the PDA for use with previously mastered recipes.

Social Validity

When presented with a choice of the PDA, portable DVD player, or picture cookbook to hypothetically cook pudding, all three students responded that they would like to use the portable DVD player because it had movies. Imitating a cable television cooking program, Monica further said that she wanted to, “Watch the movies and be an iron chef.”

Discussion

As the technology of PDA systems progresses and prices lower (Swan, Swan, Van Hover, & Bell, 2002), handheld computers may be a low-cost, effective means for students to have access to information anywhere at anytime (van ‘t Hooft & Vahey, 2007). The current study supports previous research reporting that students with intellectual disabilities can learn to use an electronic, portable, handheld prompting system to independently complete tasks (Cihak et al., 2008; Davies et al., 2002b, 2003; Riffel et al., 2005; Taber-Doughty et al., 2008; Van Laarhoven et al., 2007). The study extends the research literature evaluating handheld self-prompting systems by using a system that provided picture, auditory, and video prompting within one program.

Students demonstrated the ability to independently use a PDA to self-prompt completion of the three cooking recipes, handheld computers may be a low-cost, effective means for students to have access to information anywhere at anytime (van ‘t Hooft & Vahey, 2007). The current study supports previous research reporting that students with intellectual disabilities can learn to use an electronic, portable, handheld prompting system to independently complete tasks (Cihak et al., 2008; Davies et al., 2002b, 2003; Riffel et al., 2005; Taber-Doughty et al., 2008; Van Laarhoven et al., 2007). The current study used custom-made photographs and video recordings that exemplified each student’s cooking environment. Future research may need to compare the benefits of customized verses commercially available software programs for prompting tasks. Although for more difficult steps (Mechling & Stephens, 2009) or may need to refer back to more intrusive prompt levels when a task is not continuously performed.

The small number of students participating in the study calls for future research to replicate the findings. Furthermore, additional studies are needed to investigate use of self-prompting systems with multiple prompt levels across other disabilities and tasks. Of interest, for example, would be how students with autism use the system and on which prompt levels they would rely (visual, auditory, video). Further evaluation of different tasks may provide information concerning whether some activities or steps are better suited for video modeling or prompting or whether pictures or auditory prompts will suffice. Furniss et al. (1999) stated that the nature of the task rather than students’ abilities likely influenced successful use of a PDA in their study.

A limitation of the current study was that there was no further clustering of task steps as they were learned or a change in the photographs or video segments used. As tasks are learned it may be beneficial to cluster steps into fewer pictures or combine multiple video segments into fewer segments (Furniss et al., 1999). Students may initially require video prompting and then move to lengthier video segments that resemble video modeling (Cannella-Malone et al., 2006). It is important to select methods of instruction that match the needs of the individual students (Simpson, 2005). One critical advantage of a PDA is the ability to individualize the system to meet the needs of each student (Furniss et al., 1999). Future studies may wish to investigate the adaptability of prompts as a student’s performance progresses, presentation of cues at the student’s own individual pace (Davies et al., 2003), and other customization features that can be adapted to the individual. For example, realistic photographs and video segments from the student’s actual environment may assist with acquisition of skills compared to generic stimuli on commercial programs. The current study used custom-made photographs and video recordings that exemplified each student’s cooking environment. Future research may need to compare the benefits of customized verses commercially available software programs for prompting tasks. Although
easier to obtain, commercially available products may be more costly. The question remains, are commercial products as effective as those made specifically for each student? In addition, auditory recordings pertinent to the student such as key words or a student’s name may be used to gain attention before presenting a step.

Researchers have also identified the importance of allowing students to select their own preferred method of prompting (Taber-Doughty, 2005; Taber-Doughty et al., 2008). Taber-Doughty found that students increased their skill acquisition and decreased their time to complete tasks when provided a choice between prompting systems (adult, pictures, auditory). In the current study students could choose within the system what to use (i.e., picture, video), but were limited to using the hand-held system. Further, although students were asked at the completion of the study which system they preferred, students need to have opportunities to use all of the systems before they determine their preferred system (Taber-Doughty et al.).

Another factor to consider when interpreting results and determining what role a PDA can play in supporting programming for persons with disabilities is that the current study used the device to prompt completion of multi-step tasks, for which students could already perform the component steps, rather than instruction or acquisition of a new task. The instructor also turned on the PDA and found the target recipe. Further independence could be increased by setting up a home page with photographs of the recipes or tasks to be completed and to evaluate students’ abilities to navigate through a range of available task analyses. Additional studies are needed to evaluate use of the extensive features available through these developing technologies. Future studies may also address features for prompting and using lists of tasks and daily schedules for organizational skills, self prompting across a range of complex tasks, and students abilities to enter and use information on the systems through text, auditory and video recordings and taking their own photographs. Portable digital assistants and other hand-held electronic devices appear to hold promising potential for persons with disabilities due to their non-stigmatizing use by the general public (Davies et al., 2002b) and their non-obtrusive format that does not make students stand out among peers in school (Myles, Ferguson, & Hagiwara, 2007).

References


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