

## Use of a Proximity Sensor Switch for “Hands Free” Operation of Computer-Based Video Prompting by Young Adults with Moderate Intellectual Disability

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*Abstract: In this study, the effectiveness of a “hands free” approach for operating video prompts to complete multi-step tasks was measured. Students advanced the video prompts by using a motion (hand wave) over a proximity sensor switch. Three young adult females with a diagnosis of moderate intellectual disability participated in the study. Effectiveness of the intervention was determined using a multiple probe design across three craft activities and replicated with the three young adults. Results indicate all three students demonstrated the ability to: master operation of the proximity sensor switch to operate the video prompts; independently complete the craft activities and; maintain their performance using the “hands free” approach.*

Research supports the use of video prompting as a means for providing information to persons with intellectual disability in order for them to independently complete tasks (Banda, Dogoe, & Matuszzy, 2011). When using video prompting, tasks are broken down into their component steps and each step, or cluster of steps, is presented via a video clip. The user watches a video clip (prompt), completes the corresponding task step, returns to the video player, watches and performs the next step and so forth until all of the steps of the task are completed. Video prompts have been used to teach a variety of daily living skills including: setting a table (Goodson, Sigafoos, O’Reilly, Cannella, & Lancioni, 2007); cooking (Graves, Collins, Schuster, & Kleinert, 2005; Johnson, Blood, Freeman, & Sim-

mons, 2013; Mechling, Gast, & Fields, 2008; Mechling, Ayres, Foster, & Bryant, 2013; Mechling, Gast, & Seid, 2009; Payne, Cannella-Malone, Tullis, & Sabielny, 2012); washing tables (Cannella-Malone, Brooks, & Tullis, 2013; Cannella-Malone, Wheaton, Wu, Tullis, & Park, 2012); sweeping and vacuuming (Cannella-Malone et al., 2012; 2013); cleaning a sink and folding towels (Mechling, Foster, & Ayres, 2013); washing dishes (Sigafoos et al., 2007); and doing laundry (Horn, Miltenberger, Weil, Mowery, Conn, & Sams 2008); vocational skills (Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009), and recreational skills (Chan, Lambdin, Van Laarhoven, & Johnson, 2013; Edrisinha, O’Reilly, Choi, Sigafoos, & Lancioni, 2011).

When using video prompting to complete such tasks, video has been presented on desk top computers (Cannella-Malone et al., 2006; Sigafoos et al., 2005; 2007; Zisimopoulos, Sigafoos, & Koutromanos, 2011); laptop computers (Edrisinha et al., 2011; Goodson et al., 2007; Horn et al., 2008; Mechling, Ayres, et al., 2013; Van Laarhoven, Kraus, Karpman, Nizzi, & Valentino, 2010; Van Laarhoven, & Van Laarhoven-Myers, 2006); tablet PCs and notebooks (Cannella-Malone et al., 2011; Mechling, Foster et al., 2013); portable DVD players (Mechling et al., 2008; Mechling &

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Stephens, 2009); hand held devices such as personal digital assistants (Mechling et al., 2009; 2010), iPhones (Bereznak, Ayres, Mechling, & Alexander, 2012) and iPods (Cannella-Malone et al., 2012; 2013; Chan et al., 2013; Johnson et al., 2013; Payne et al., 2012; Van Laarhoven et al., 2009). Operation of these formats of video presentation require the person with an intellectual disability to manipulate a computer mouse or touch screen (Bereznak et al.; Cannella-Malone et al., 2012; 2013; Kellems & Morningstar, 2012; Mechling et al., 2009; 2010; Van Laarhoven et al., 2009; 2010; Mechling & Seid, 2011) or another adult to advance the video clips (Cannella-Malone et al., 2006; 2011; Edrisinha et al., 2011; Goodson et al., 2007; Mechling, Ayres et al., 2013; Payne et al., 2012; Sigafos et al., 2005; 2007). While these means of manipulating the video are effective, use of an adult to advance the program reduces the level of independence experienced by the user and there are times when the ability of the person with a disability to operate a computer or handheld device may be impeded. When a person's hands are wet (i.e., cleaning tasks), soiled (i.e., cooking), or occupied (i.e., holding a spoon and stirring) they may find it difficult to touch a screen or computer mouse or they may be hesitant to contact a surface which might result in damage to the device. This concern for operation of video players when the user's hands are dirty or occupied has implications for a hands-free means to operate video prompting (Mechling, Ayres, Bryant, & Foster, 2014a, b).

The purpose of this study was to extend the research on video prompting by addressing the need for "hands free" operation of video players (i.e., laptop computers, tablet PCs and portable devices with touch screens) when completing tasks which require the user's hands to be occupied (i.e., holding materials needed for task completion) or when the user's hands may be wet (i.e., washing dishes) or soiled (i.e., gluing a craft). While other forms of video instruction such as video modeling (video is provided in advance of the task), simultaneous video modeling (automatic playing of the video in sync with task completion), and continuous video modeling (automatic and ongoing playing of the video, over and over), these forms may not be appropriate

when the student finds it difficult to: keep up with the pace of the video (simultaneous video modeling); relocate the target step in the video (continuous video modeling); or for lengthy tasks with multiple steps (Mechling et al., 2014a, b). or and when students find it difficult or Timing with continuous video modeling, much like simultaneous video modeling, is provided which may assist with the flow of the task, but may be difficult to use across complex tasks with numerous steps. The specific research questions included can persons with moderate intellectual disabilities: (a) operate a tablet computer "hands-free" (without touching the screen or use of a computer mouse) through use of a proximity sensor switch; and (b) complete multi-step tasks using video prompting operated via the proximity sensor switch.

## Method

### *Participants*

Three female adolescents with moderate intellectual disability were selected to participate in the study due to their need to independently complete multi-step tasks and expressed interests in completing craft activities. Teresa was the only student who had previous experience with video instruction, but all three students used computers for recreation and instruction. Students attended a high school transition program housed on a university campus. The program focused on teaching daily living, community, and vocational skills.

Teresa was 20 years and 9 months old with a diagnosis of moderate intellectual disability and cerebral palsy with left hemiplegia. Her full scale IQ score on the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV: Wechsler, 2003) was 45. Her permanent record contained no measurement of adaptive behavior skills however, she completed all of her personal care needs (including use of makeup and clothing selection), completed her own laundry, cleaned her room and completed basic household and cooking tasks. She was competitively employed part time at a hair salon. She spoke in complete sentences and was socially interactive with male and female peers although she

engaged in disagreements with female peers that had to be settled by the teaching staff and did not always recognize the consequences of her decisions such as trusting others and interacting with males. In the community she was working on using the next dollar strategy to independently make purchases, following a picture/text based shopping list, and identifying public bus routes to and from frequently used sites. She could read basic sight words and community words and was working on increasing her decoding skills. She completed simple demographic information on job applications and copied additional information on such forms (i.e., work references). She enjoyed spending time with friends and family, playing board games, and completing basic arts and crafts activities.

Qianna was 19 years and 11 months old with a diagnosis of moderate intellectual disability. Her full scale IQ score was 52 on the Stanford-Binet Intelligence Scale – Fifth Edition (Thorndike, Hagan, & Sattler, 1986) and her composite score on the Adaptive Behavior Assessment System – Second Edition (Harrison & Oakland, 2000) was 55. She spoke in complete sentences, used age appropriate phrases and jargon, and demonstrated a sense of humor. Although she was eager to please others she also demonstrated confrontational behaviors with peers and adults. She enjoyed staying up with the latest fashions, but required reminders to brush her teeth, tie her shoes, bathe/shower, and to use deodorant. She was working on preparing healthy snacks such as fruit salads, and could prepare simple microwave and stove top dishes. She was not permitted to travel independently in the community, but understood pedestrian skills and was working on identifying bus stops when traveling with a group. She could follow simple written instructions and lists to complete shopping and classroom jobs. She read on a third grade level and her needs included recalling events in a story and the order of their occurrence. She wrote legibly, but required verbal cues for spacing and size of letters. She was writing up to four sentences in paragraph forms and her needs included identifying the topic sentence and composing her ideas using a tree map prior to writing. She told time using digital and analog clocks and was learning to manage her time and to predict what time to start a task or leave for an appointment to finish

or arrive on time. She counted bill combinations and was learning to count bill and coin combinations with more advanced requirements (i.e., quarter plus dime). She enjoyed shopping, being with friends, listening to music, and drawing.

Lacy was 20 years and 11 months old with a diagnosis of moderate intellectual disability and ADHD. Her full scale IQ score was 54 on the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV: Wechsler, 2003) and her composite score on the Adaptive Behavior Assessment System – Second Edition (Harrison & Oakland, 2000) was 72. Lacy was eager to please others and worked independently on familiar tasks. She was impulsive and hasty in her responses, often saying, “I forget” or “I can’t.” She exhibited aggressive and “bullying” behaviors towards peers with disabilities. She took care of her personal care needs with reminders to complete daily grooming tasks. She enjoyed cooking and was learning to prepare simple stove top meals with multiple ingredients while reading and applying recipe abbreviations and cooking terms. She carried her own money and identification card and could count bill and coin combinations when making purchases. Her needs included following a written list in small grocery and convenience stores when shopping. She read and followed a daily agenda and sections of the newspaper using decoding skills and was learning to read words using blends. She navigated the internet to find and read such things as grocery store flyers and advertisements. She used a calculator to solve math problems and was learning to use the calculator to find grocery totals and determining the amount to pay with tax. She enjoyed sports, computers, music, games, and crafts.

### *Setting*

All sessions took place in a separate classroom of a university building where the transition program was located. The room was equipped with large tables and two such tables were moved together to hold all of the task materials, laptop computer, and switches.

### *Tasks, Materials, and Equipment*

Due to the need for studies to focus on teaching leisure skills to adults with disabilities

**TABLE 1**

**Steps of Task Analysis for Video Prompting Programs**

<i>Holiday Wreath</i>	<i>Floral Centerpiece</i>	<i>Candle Centerpiece</i>
1. Grass stem in bottom	1. Green foam in vase	1. Tall stand on middle of tray
2. Vine in bottom	2. Vine in left side of foam	2. Medium stand on left of tray
3. Berries in bottom	3. Vine in right side of foam	3. Small stand on right of tray
4. Pumpkin on right side	4. Berries in left side of foam	4. Three wreaths on stands
5. Pumpkin on left side	5. Berries in rt. side of foam	5. Three candles on stands (left to rt)
6. Grapes top left side	6. Two pods middle of foam	6. Greenery on front half of stand
7. Grapes top right side	7. Grass in front/back of vase	7. Berries on greenery

(Chan et al., 2013) craft activities were selected for the current study. The three tasks were making a: holiday wreath, floral centerpiece, and candle centerpiece. Each required students to hold, manipulate, and assemble multiple pieces. Table 1 provides the seven steps required to assemble each task. Materials for all three crafts were present on the table, along with distracting materials not used in any of the craft activities, regardless of the task being performed.

Video prompts were made for each of the task steps using a Sony HDR-CX160 Handycam. Videos were made from the perspective of the user by videotaping an adult model (third author) performing each step of the task. The camera operator provided voice over directions (i. e., “Put the tall candle in the middle of the tray”) while recording the step. The videos were then converted to files and a single video was inserted onto a PowerPoint slide. Slides were played on a Lenovo laptop computer. The PowerPoint program was set to play each video automatically when the program advanced to a new slide. Two Candy Corn Proximity Sensor Switches by ablenet, Inc. were attached to a Switch Interface Pro 5.0 by Don Johnston which was in turn attached to the USB port of the laptop. The Candy Corn Proximity Sensor Switch was a motion activated switch and the students operated it by waving their hand in proximity (over) the switch. The interface allowed one switch (positioned on the right side of the laptop) to advance the computer program to the next slide by attaching the switch to the “enter” port on the interface. The second switch (positioned on the left side of the computer) was attached to the interface via the

“click” port to allow the video to repeat on the current slide if the student needed to watch the video again in order to complete a step. In addition, the PowerPoint program was put into “slide show” mode and the laptop mouse was positioned over the video icon so that the repeat (click) function would work properly.

*Experimental Design*

The study used a multiple probe across behaviors design (Gast & Ledford, 2010), replicated with three students to demonstrate a functional relationship between the intervention (hands free operation of video prompting) and subsequent changes in students’ behavior (completion of multi-step craft activities). Conditions included a baseline probe without video prompting, hands free operation of video prompting and maintenance probes with hands free operation of video prompting. Introduction of the hands free video prompting intervention was staggered across three craft tasks and a student’s progression across tasks was independent of other students. The order of the tasks was alternated across the students and criteria for starting a new task was set at 100% independent operation of the proximity sensor switch and 100% unprompted correct responses for completing the steps of each tasks for three sessions. Follow-up, maintenance data using the proximity sensor switch were intermittently collected for mastered tasks and the study concluded with a final condition of three sessions to measure maintenance. Subsequent baseline probe sessions were implemented following mastery of tasks to measure performance by students

when the proximity sensor switch was not present.

#### *Dependent Variable and Data Collection*

The primary dependent measure was the percentage of task steps completed independently in response to hands free operation of the video prompts. Each craft consisted of seven measurable steps for task completion. In addition, data were collected on the percentage of independent switch activations/advancement of the video prompting PowerPoint slides to the next video prompt during the intervention condition. Correct response for completion of task steps during baseline was defined as initiation of the step within 3 s of the task direction or completion of the previous step and completion of the step within 30 s. Correct response for completion of task steps during intervention was defined as initiation of the step within 3 s of the completion of the video prompt and completion of the step within 30 s. The student could also repeat watching of a video prompt and the step was recorded as a correct response if the student independently initiated playing the video within 30 s of the end of the previous video and the step was performed correctly. Individual task steps for assembling the crafts were not considered critical towards the completion of subsequent steps. Therefore incorrect task step responses were ignored by the instructor. An incorrect response was recorded if: (a) the time constraints were not met for initiation and completion of steps; or (b) a step was completed out of sequence.

Correct response for activation of the hands free switch was defined as initiation and advancement of the PowerPoint slide within 3 s of completion of the previous task step. If a student failed to activate the switch, a verbal prompt to, "Try again" was provided followed by the instructor activating the switch if the student was unable to activate the switch following the verbal prompt. Only responses which activated the switch the first time were scored as correct.

#### *Procedure*

*General procedure.* Prior to introduction of the first baseline condition, the instructor modeled activation of the proximity sensor switch by waving her hand over the switch to advance a random PowerPoint slide followed by the student activating the switch for one trial. All sessions were conducted individually, with only one student present in the classroom. Sessions were conducted three days per week and only one task was completed each day during intervention. Students advanced through the three crafts and conditions independent of other students' performances.

*Baseline.* Prior to intervention with the proximity sensor switch, baseline data were collected with the three craft tasks with each student. Individual students were brought to the classroom where all of the craft materials were randomly placed on the table. Each session consisted of one trial per task (three total) and the order of the tasks varied across sessions. The student was provided with a verbal task direction to, "Make a wreath," "Make a candle centerpiece", or "Make a flower centerpiece." The instructor then waited 3 s for the student to initiate the first (and subsequent) step of the assembly task and 30 s for the student to complete each step. Students assembled pieces of each craft until they verbally indicated they were finished with the target task. Verbal reinforcement was provided at the end of the task for student efforts and the craft was dis-assembled in order for all materials to be present on the table for assembly of the next craft. Baseline sessions, prior to the start of the first intervention and each subsequent intervention with a new craft, continued for a minimum of three sessions or until data stabilized with no improvement.

*Hands free video prompting.* During intervention sessions, craft materials were randomly spread across the two tables and the laptop computer was positioned in the middle, back of the tables with the two Candy Corn Proximity Sensor switches were positioned in front of the laptop. Students were provided with a verbal task direction to watch the videos to make the target craft (i.e., "Look at the videos and make the flower centerpiece") followed by the instructor waiting 3 s

for initiation of switch activation. The student then waived her hand in the vicinity of the proximity sensor switch positioned to the right of the laptop to start the first video prompt. When the video prompt ended, the student was given 3 s to initiate the step and 30 s to complete the craft step. If needed, the student could waive her hand in the vicinity of the switch positioned to the left of the laptop to repeat the video prompt. No additional prompts by the instructor were provided. At the completion of each session the student was provided verbal praise for efforts and performance. Maintenance sessions were conducted identically to the intervention sessions.

### *Social Validity*

Informal interviews were held individually with the three students regarding their use of the hands-free prompting switch to complete the three craft activities. Questions focused on whether the switch helped them to watch the videos, advance the slides, and to re-watch a video if necessary. In addition they were asked if they would like to use the switch with other tasks.

### *Inter-Observer Agreement and Procedural Reliability*

Reliability data on the correct number of task steps and switch activations (to advance the video prompting slides) were collected by the second or third author across 95.7% of all conditions and students (baseline probe condition: 91.7%, video prompting with the proximity sensor switch: 100%). Inter-observer agreement between the instructor (first author) and the second or third author on the steps performed correctly was calculated on each task session for each student by dividing the number of agreements on each task and switch activation step by the number of agreements plus disagreements and multiplying by 100 (Ayres & Gast, 2010). Resulting mean inter-observer agreement ranged from 71.4–100% with a mean of 99.4% for task and switch activation steps. Mean inter-observer agreement was 99.1% during the baseline condition (Teresa: 99.1%, Qianna: 98.7%, Lacy: 99.6%) and 99.2% during the video prompting intervention condition for task steps (Te-

resa 98.7%, Qianna: 100%, Lacy: 100%), and 99.8% during the video prompting intervention condition for switch activations (Teresa 100%, Qianna: 100%, Lacy: 99.4%).

The second and third authors also collected procedural reliability data simultaneously with inter-observer agreement on the following instructor behaviors: (a) delivery of task direction for the target craft; (b) adhering to 3 s and 30 s initiation and response times for task steps; (c) adhering to 3 s initiation and response times for switch activation; (d) materials, switches, and laptop computer positioned correctly on the table and in operating condition; (e) providing no prompts for task completion or switch activation except verbal prompts to watch the video; (f) delivery of reinforcement at the end of each session. Reliability was calculated by dividing the number of correct behaviors of the instructor (first author) by the number of assessed behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980). Procedural reliability agreement averaged 99.6% across all conditions and participants. The majority of the errors occurred due to equipment malfunction including the videos on the computer “freezing”, sound not playing, and the PowerPoint slides not advancing when the student activated the switch.

## **Results**

The percentages of correct responding for completing the steps of each craft, across each condition and student are presented in Figures 1–3 along with the percentage of switch activations independently performed during the hands free video prompting condition. When video prompting, activated with the hands free switch, was implemented, performance immediately increased across all three crafts and students. Likewise, all three students demonstrated the ability to master operation of the proximity sensor switch to operate the video prompts.

When video prompting was removed Teresa’s performance decreased when making the wreath to 0% correct on the first probe condition, but steadily increased as the video prompts were re-introduced and reached 100% performance by the last probe session.

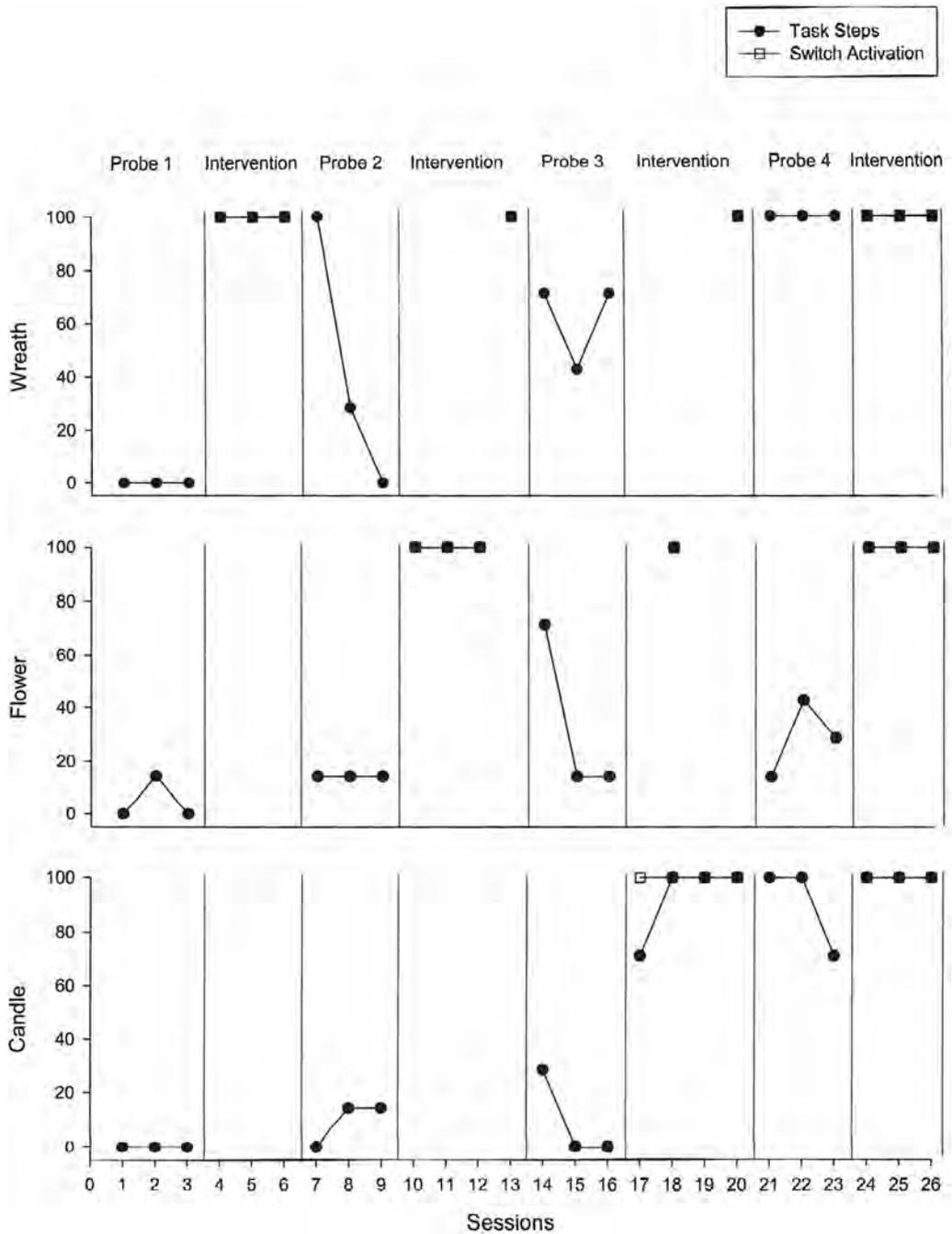


Figure 1. Percentage of task steps (closed circle) and switch activations (open square) independently completed by Teresa.

When completing the second craft, flower arrangement, she was unable to establish criteria performance when the video prompts were

not used and her performance with her last craft was deteriorating on the last session prior to re-introduction of the video prompting. Qi-

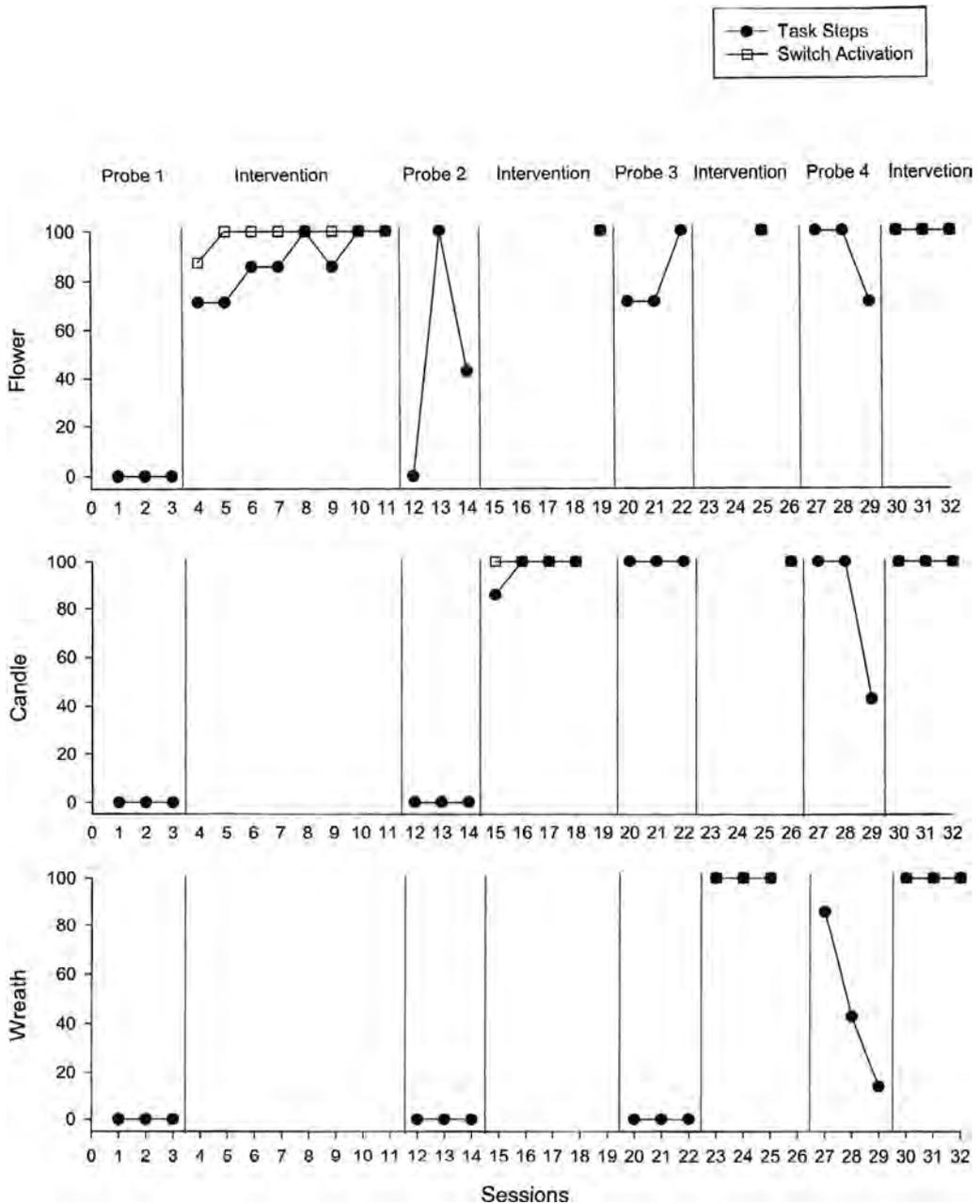


Figure 2. Percentage of task steps (closed circle) and switch activations (open square) independently completed by Qianna.

anna likewise had difficulty with all three crafts when the video prompts were removed. Although she performed the crafts 100% correct during 5 of the 6 subsequent sessions when video prompts were removed, her per-

formance deteriorated during later sessions within 4 of the 6 probe conditions. Of the three students, Lacy was the most successful in performing tasks when video prompts were removed although she was unable to put the

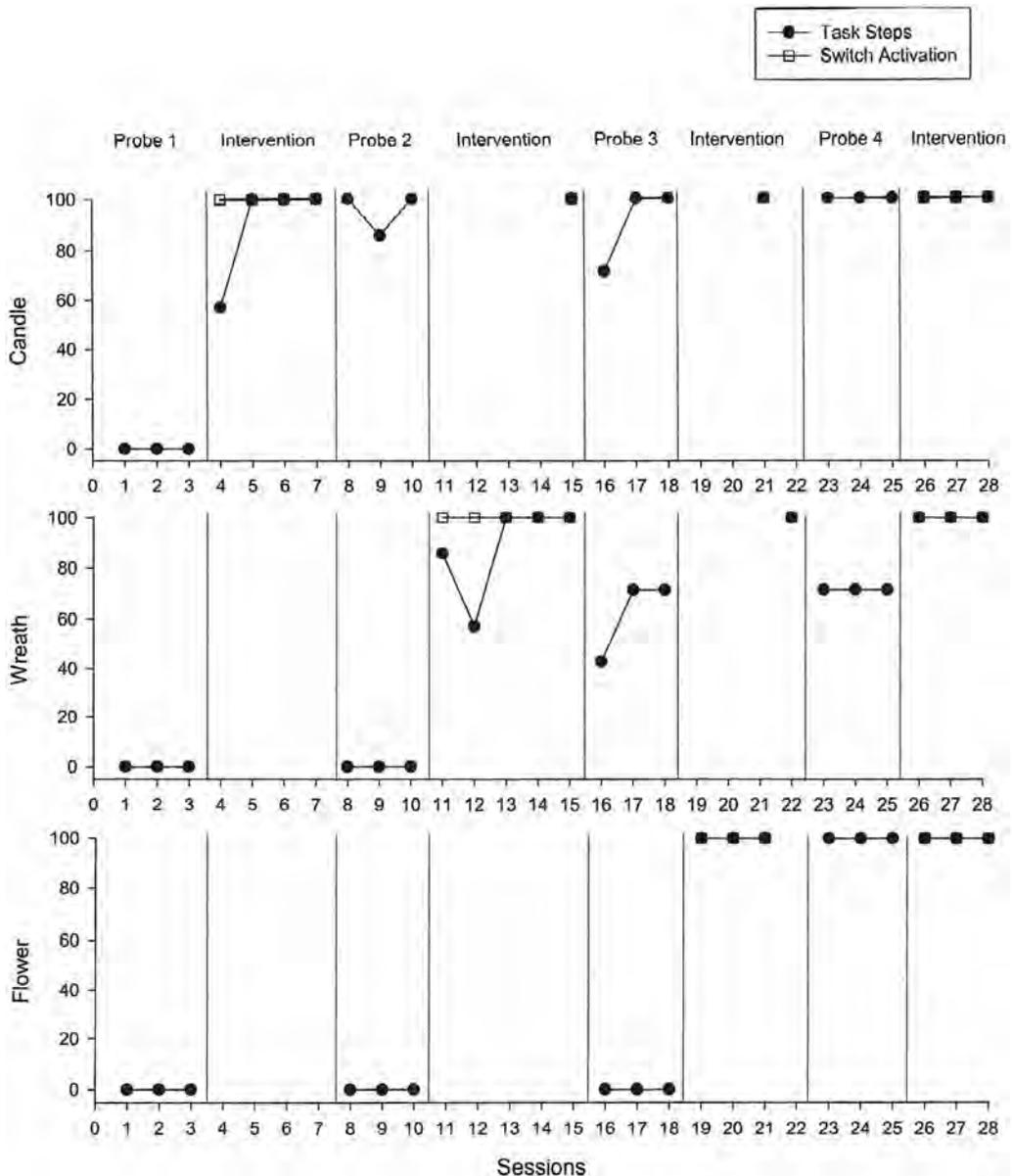


Figure 3. Percentage of task steps (closed circle) and switch activations (open square) independently completed by Lacy.

pumpkin decorations on the wreath in the correct left/right position.

When the video prompts operated by the “hands-free” switches were re-introduced, all three students immediately re-gained criteria level performance across all crafts without committing a single error for operating the switch or completing the tasks.

#### Social Validity

All students reported that they liked using the hands-free switch to operate their laptop and videos and not having to touch the switch. Qianna stated that she sometimes had to remember where to put her hand and Lacy remembered that there were times when the

slides did not advance when, "I moved my hand." Each reported that they would like to use the switch again, but were unable to state for what types of tasks they would like to use the switch. The three students also reported that they liked the crafts that they learned to make and Lacy reported that she helped to make a candle arrangement for Thanksgiving dinner and Teresa said she wanted to make a wreath for her family's front door.

## Discussion

In this study, a hands free approach for operating video prompts to complete multi-step craft activities was evaluated. A Candy Corn Proximity Sensor Switch by ablenet Inc. was independently used by three adolescent females with a moderate intellectual disability to advance PowerPoint slides containing the video prompts. All three students improved their assembly of the three crafts over baseline performance with the introduction of hands free prompting procedure. Students advanced the video prompts by using a motion (hand wave) over the switch rather than actually touching or pressing the switch. Traditionally, video prompting has been advanced through the use of physical touch and manipulation of a computer mouse or touch screen of the device playing the video (i.e., PDA, iPod). Previous studies (Mechling et al., 2014a, b) have found that some of the physical requirements of tasks such as cleaning and cooking impede such manipulations when a user's hands are messy (i.e., wet, sticky). In the current study students were required to hold craft items in one hand (i. e., greenery for the flower arrangement) while the opposite hand was needed to stabilize materials (i.e., green foam in the flower arrangement). When this occurred they could hold items if needed while waving their hand over the top of the switch rather than having to put down the items to advance the video prompt. While the current study was limited to evaluation of the hands free method for making three crafts, future researchers should evaluate its use with other tasks such as those requiring the user's hands to be wet or sticky.

This study evaluated the Candy Corn Proximity Sensor by the company ablenet, Inc. While this was the equipment selected for the

current study, other such devices with more advanced capabilities may be available in the future. The switch in the current study still required the student's hand or body part to be within approximately .5 in. from the top of the switch in order for it to activate. In addition, although referred to as "hands free" the students did use their hands. Although other body parts could be used with the proximity sensor switch it may be more appropriate for future research to evaluate use of sound or voice activated switches when both hands may be completely occupied by the user and it is not appropriate to use another body part.

Although the focus of this study was to evaluate the "hands free" operation of video prompts, results further support the use of video prompting, regardless of the input method used for advancing slides, to prompt independent performance of multi-step tasks. When video prompting was removed in subsequent probe sessions, each student demonstrated differing levels of difficulty completing the three crafts, yet each re-gained criteria level performance and committed no errors when the video prompts were re-instated in subsequent sessions. These results add to the current literature in support of video prompting and apply its use to multi-step leisure skills that can be performed in the user's home.

Teaching persons with moderate intellectual disability to operate video devices on their own has implications for increasing independent functioning and decreasing the need for external adult prompting (Banda et al., 2011). Continuation of this new line of research, presented in the current study, is recommended across tasks using video prompting in light of the fact that video prompting does require a stop and start process for each video clip which may interrupt the flow of tasks. Further research will help to determine whether the use of a "hands free" device will allow operation of videos without hindering performance and will do so as technology advancements provide further devices that can be used in this manner.

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