Comparing Self-Management Strategies Delivered via an iPhone to Promote Grocery Shopping and Literacy

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Abstract: Four students with moderate intellectual disabilities used electronic lists delivered on an iPhone to assist them in skills related to community-based grocery shopping. An alternating treatments design was used to assist in comparing the effectiveness and efficiency of three different types of lists (Text Only, Audio + Text, and Picture + Text). Data gathered during Experiment 1 indicated that the use of pictorial lists delivered via the iPhone interface appeared to be the most effective and efficient prompting system for all participants. The iPhone based pictorial list prompting system was further evaluated to determine whether or not it would assist students to incidentally learn to read the words after multiple presentations of the picture and text. Data gathered during Experiment 2 indicated that one student learned all of the target words incidentally while another student learned most of the words as a result of using the iPhone based system alone. Two other students required use of a computer-based instructional program with simultaneous prompting to assist them in learning the target words.

The versatility of portable electronic devices (e.g., tablet computers, smart phones, and iPods) for supporting daily living (Cannella-Malone, Wheaton, Wu, Tullis, & Park, 2012; Kelley, Test, & Cooke, 2013; Lancioni, O’Reilly, Seedhouse, Furniss, & Cunha, 2000; Lancioni et al., 1999a; Lancioni, Van den Hof, Boelens, Rocha, & Seedhouse, 1998; Lancioni, Van den Hof, Furniss, O’Reilly, & Cunha, 1999b; Mechling & Seid, 2011; Payne, Cannella-Malone, Tullis, & Sabelny, 2012), leisure (Kagohara, 2011; Kagohara et al., 2011; Lo, Burk, & Anderson, 2014; Uphold, Douglas, & Loseke, 2014), and vocational skills (Cihak, Kessler, & Alberto, 2007, 2008; Collins, Ryan, Katsiyannis, Yell, & Barrett, 2014; Davies, Stock, & Wehmeyer, 2002a, 2002b, 2003; Furniss et al., 1999; Riffel et al., 2005; Tabor-Doughty, 2005; Taber-Doughty, Patton, & Brennan, 2008; Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009; Van Laarhoven, Van Laarhoven-Myers, & Zurita, 2007) adds to their functionality for individuals with intellectual disability (ID). Electronic devices are commonplace and known to provide quick and efficient means to access information for people with and without disabilities. The portability, affordability, flexibility, and ease of use of these technologies provide infinite possibilities for improving the quality of life for all people including those with ID (Carey, Friedman, & Bryen, 2005; Hart, O’Neil-Pirozzi, & Morita, 2003). Additionally, these devices can be unobtrusive, thus less stigmatizing for those individuals with disabilities who use them in community settings (Southall & Gast, 2011). When one device provides support in multiple domains (i.e., academic, domestic, vocational, community, and recreation) and with different types or modalities of support (i.e., textual, pictorial, auditory, and video), their practical value and potential for continued use increases. To date, there has been limited research specifically designed to evaluate the effectiveness of handheld electronic systems with a single type of support such as pictorial only or audio only for students with ID (Bouck, Satsangi, Muhl, & Bartlett, 2013; Douglas & Uphold, 2014; Kelley et al., 2013; Taber-Doughty, 2005; Uphold et al., 2014). A great deal of research exists on pictorial and audio supports; however there are few published studies...
that incorporate handheld technology as the delivery system. The use of one individual support with an electronic device as the delivery system appears to require more extensive investigation. Because only three studies support the use of Palmtop personal computers with picture prompts as being more effective than the manual use of picture cards when completing daily living tasks (Lancioni et al., 2000; 1998; 1999a), it would appear that additional research is needed to better evaluate both the effectiveness and efficiency of electronic delivery systems.

**Self-Created Supports**

One related area of investigation that may assist in extending the literature base is to examine whether students with disabilities can use their electronic devices for creating their own supports (e.g., recording voice memos, taking pictures for a to-do list, or shooting videos to act as a model). Mechling (2007) reviewed 40 studies that targeted students with an ID using assistive technology prompting systems (i.e., pictorial, auditory, tactile, and computer-aided systems) as a self-management tool to complete multi-step tasks or follow a daily schedule. All of the prompting systems studied were created by another individual. Such instructional strategies may serve to increase reliance on other people and decrease the independence of the individual with ID. Consequently, Douglas and Uphold (2014) successfully taught five high school students with ID to create a pictorial to-do list using the First Then Visual Schedule application (app) on an iPod touch and iPad. Bouck et al. (2013) taught three high school students with ID to self-record a grocery list. The use of electronic devices has the potential to promote self-determination of individuals with ID with some initial guidance and instruction.

**Supported Text**

A number of studies highlighted electronic devices that not only can be used as a prompting device, but can serve as a way for people to interact with text electronically. Any text appearing on a computer screen or electronic device is considered eText (Anderson-Inman & Horney, 2007). The benefit of eText over print-based text is that eText can be more easily paired with additional supports (e.g., sound, videos, and hyperlinks), so people of all cognitive and physical abilities can access the text and increase the likelihood that they will gain meaning from what they read (Brochner, Outhred, & Pieterse, 2001; Koppenhaver, Coleman, Kalman, & Yoder, 1991). The use of supported eText can potentially provide opportunities for people with ID to explore text in an alternative format that was previously not available to them and by improving reading skills in natural contexts.

Students who have the ability to independently grocery shop with target adaptations (e.g., photo shopping lists, dollar plus strategies), may still lack important literacy skills that extend the complexity of their shopping experience. For example, grocery apps could assist them in linking recipes to shopping lists and saving lists with common items or multiple lists in pictorial, auditory, or textual formats. The use of electronic devices is commonplace for the general population and may serve as a way for people with ID to blend in with the rest of society while receiving necessary supports. Finally, it is possible for students with ID to start transferring stimulus control from the support (i.e., audio or picture) to the text. After multiple presentations of the supported text, students may learn to read the words incidentally and extend their literacy skills.

**Purpose of Studies**

The purpose of the present studies was to first determine which support modality programmed by students with moderate ID was most effective and second to measure the efficiency of the supports in assisting with item location in a grocery store. Finally, a second study was designed to measure whether or not the target students learned to read the grocery items incidentally as a result of interacting with the electronic supports. Specifically, Experiment 1 addressed the following questions: a) will students with moderate ID independently locate items when presented with lists they helped to create on an iPhone in grocery store settings? and b) will students locate grocery items more efficiently with one type of list over another? Experiment 2 was a continua-
tion of Experiment 1 and was based on the following research questions: a) will students incidentally learn to read the text when the text is paired with the “best” support (over multiple sessions that incrementally increase in number)? and b) will using a computer-based program with simultaneous prompting and the most effective support as identified per student transfer stimulus control to the text?

Method - Experiment 1

Participants

Four high school students with a primary special education eligibility of moderate ID participated in both Experiment 1 and Experiment 2 (see Table 1 for psychometric characteristics). To participate, students had to be at least 14 years old, have an IDEA eligibility of ID with corresponding IEP goals related to the target behaviors, an inability to read the target words, parental consent, an average daily attendance of at least 90%, and the ability to attend to a task for at least 40 min (estimated community session duration). Further, participants had to have already mastered strategies for locating items in a store (i.e., walking up and down the aisles, and searching for items from top to bottom and left to right on the shelves). None of the final participants had ever used an electronic device such as an iPhone to provide their shopping list as supported by a teacher and parent survey. Prior to this study, students required a pictorial list or verbal directions from an adult in order to successfully locate items in a grocery store.

### TABLE 1

Psychometric Characteristics of Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>IQ Scores</th>
<th>Adaptive Behavior Measures</th>
<th>Reading Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aiden</td>
<td>19.2</td>
<td>Stanford-Binet V</td>
<td>ABAS-II</td>
<td>Woodcock Reading</td>
</tr>
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<td></td>
<td></td>
<td>Verbal: 43</td>
<td>Composite: 66</td>
<td>Mastery Tests - R</td>
</tr>
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<td></td>
<td></td>
<td>Nonverbal: 43</td>
<td>Conceptual: 51</td>
<td>Letter identification: 48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Working memory: 48</td>
<td>Social: 81</td>
<td>Word identification: 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual-Spatial Processing: 50</td>
<td>Practical: 69</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-scale: 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miles</td>
<td>17.2</td>
<td>Stanford-Binet V</td>
<td>ABAS-II</td>
<td>WRAT-IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verbal: 43</td>
<td>Composite: 67</td>
<td>Word reading: 55</td>
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<td></td>
<td></td>
<td>Nonverbal: 46</td>
<td>Conceptual: 63</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Working memory: 57</td>
<td>Social: 86</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual-Spatial Processing: 48</td>
<td>Practical: 78</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-scale: 42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cara</td>
<td>17.2</td>
<td>WISC-III</td>
<td>Vineland</td>
<td>Woodcock Reading</td>
</tr>
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<td></td>
<td></td>
<td>Verbal: 52</td>
<td>Communication: 56</td>
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<td>Non-verbal: 50</td>
<td>Daily living skills: 54</td>
<td>Letter identification: 48</td>
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<td>Overall: 48</td>
<td>Socialization: 69</td>
<td>Word identification: 50</td>
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<td>Rita</td>
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<td>Woodcock-Johnson III</td>
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<td>Nonverbal: 52</td>
<td>Daily living skills: 59</td>
<td>Passage comprehension: &lt;20</td>
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<td></td>
<td>Spatial: 50</td>
<td>Socialization: 71</td>
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<td></td>
<td>Speech nonverbal: 48</td>
<td>Composite: 58</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>General conceptual ability: 46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Age: Chronological age at start of the study.
DAS: Differential Ability Scales.
**Aiden.** Aiden was a 19-year 2-month old male student. He was learning to self-evaluate his work as he cleaned tables and floors in the cafeteria. He told time to the minute and was learning to identify when to begin and end his work breaks. Aiden could read 285 Dolch sight words. He used dollar plus strategies to purchase items.

**Miles.** Miles was a male 17-year 2-month old. He cleaned the cafeteria after breakfast and lunch, but he had no vocational training in the community. He used pictorial task analyses to do chained tasks. Miles’ instruction focused on counting mixed coin and dollar combinations, telling time in 5-minute intervals, and increasing his reading from 50 Dolch words.

**Cara.** Cara was a 17-year 2-month old young woman. She trained for employment at a retail sports store where she stocked shelves and cleaned. Cara wanted to eventually work in a restaurant waitressing, busing tables, cleaning, and washing dishes. She counted mixed coins, used a calculator for basic math computations, and told time on an analog watch. Cara read the higher version of News-2-You (Clark, 1997) articles and she read approximately 250 Dolch words. Socially, she worked on appropriate conversations with peers, adults, and coworkers.

**Rita.** Rita was a 20-year 10-month old female who hoped to work at a hair salon when she graduated. Currently, she worked at school and community-based vocational sites busing tables and refilling condiment supplies. She had strong domestic skills in the areas of self-care, cleaning, preparing meals, and doing laundry. In addition, she could tell time and knew when her 10-minute break at work was over. She was learning to take the city bus. Rita had a functional sight word vocabulary of about 25 community words.

**History training and screening.** To ensure that students could physically operate an iPhone, history training occurred prior to the study. Students were taught to navigate through electronic lists on the iPhone touch screen using constant time delay with a point gesture as the controlling prompt. No item during history training was used during the actual study. Practice lists were composed of five items per support modality (i.e., five Text Only, five Audio + Text, and five Picture + Text). To ensure that students were attending to the textual, auditory, or pictorial supports on the iPhone, students had to match the support to the actual physical item within 5 s. Students participated in history training until they achieved the criteria of at least three sessions at 100% correct across all conditions. Students were also taught during this time to independently navigate to and through the different types of lists on the iPhone by selecting the appropriate app (i.e., Notes, iPod, and Photos) as well as to adjust the volume.

In addition to receiving history training, students were screened for their ability to read the list of grocery items. A screening list of 131 grocery related items found on different aisles of the grocery store was first sent home to parents/caregivers so they could mark off any item they never purchase. The remaining items common on each student’s list were presented to the students on a laptop through PowerPoint to determine if they could read any of the words across two prescreening sessions. The students had 5 s to read each word. This process narrowed down the final list to 90 items (i.e., 18 items from each of the five selected aisles) that each student could not read but were still items their family purchased. The large number of items was needed so each condition and each session had different items. No items were ever repeated. Each list included one item from each of the five selected aisles so the distance between items would be similar for each list. Items were sequenced on the list according to the order of the store aisles.

**Settings and arrangements.** All sessions took place in a 1:1 arrangement in a local grocery store with 15 aisles. Sessions occurred during the students’ regular time allotted for community-based instruction. The researcher (first author) stood approximately 1 m behind the student and, when present, the reliability data collector stood behind the researcher to see the student and iPhone. The classroom teacher and paraprofessional instructed the rest of class on other skills not related to the study in other parts of the store or in a neighboring store.

**Equipment.** The handheld electronic device used in this study was a first generation iPhone with earbuds. The iPhone was attached to a lanyard so the student could have
easy access to the device and let go of it as they moved around. Additional materials included one data collection sheet per participant, two stopwatches, and a shopping cart.

Response definitions and data collection. Each session began with the attentional cue “Are you ready to go shopping?” provided by the researcher at the front of the store. The attentional response was the student saying “Yes” or nodding their head up and down. If the student did not respond to the attentional cue, the researcher repeated the cue every 30 s until the student was ready to work.

The researcher handed students the iPhone, asked them to turn it on, and then directed them to find the appropriate app (Notes, Photos, or iPod) and list (e.g., Cara 1). Once students did this, the researcher provided the task direction, “Find all of the items on your list and put them in your cart.” The target behavior for the student was to locate the item that matched the target stimulus and put it in the shopping cart. Students had 10 min to locate all five items within a given condition (i.e., Text Only, Audio / Text, or Picture / Text) for a maximum session duration of 40 min across all three conditions with time for inter-trial intervals and between conditions. Student responses were scored as correct, incorrect, no response, or duration error. A correct response was defined as independently locating the target stimulus (correct brand though size could vary) and putting it in the cart during the 10 min condition duration. An incorrect response was selecting an incorrect item while a no response was recorded if no selection was made because the student quit looking and moved on to the next item. A duration error was recorded if time expired before the student located the item.

Intervention efficiency was evaluated by observing and recording two additional measures: the total percentage of errors per condition and the number of times the student looked at the iPhone for additional prompting while trying to locate each item. After the initial presentation of the discriminative stimulus, the researcher recorded the number of additional self-promptings needed to locate each item. The behavioral definition of “self-prompt” was defined as holding up the iPhone and touching the screen or eyes viewing the screen. For example, if the student holding the iPhone looked at the screen, looked away, and then looked back at the screen, this was recorded as two self-promptings. Reliability data collectors practiced determining what was considered self-prompting during training sessions prior to the study with a student not participating in the study until they reached 100% inter-observer agreement (IOA). These measures helped determine the relative efficiency of the textual, auditory, and pictorial supports used in conjunction with a handheld electronic device. Inter-observer reliability and procedural fidelity was collected during at least 33% of the sessions for each student. IOA was calculated on each dependent measure (accuracy, errors, and self-prompts). A point-by-point method was used for accuracy and errors whereby the number of agreements was divided by the number of agreement and disagreements and multiplied by 100. Self-prompts were calculated using a gross method: dividing the smaller quantity observed by the larger and multiplying by 100. Procedural fidelity was calculated by dividing the number of researcher behaviors by the number of planned researcher behaviors and multiplying by 100.

Experimental design and procedures. An alternating treatments design (ATD) was used to evaluate the relative effectiveness and efficiency of the treatments across four students (Wolery, Gast, & Ledford, 2014). This design was deemed appropriate given the research questions, reversible behaviors, and that the behaviors were not expected to be acquired but to be differentially performed based on the type of support. A general trend of acquisition was not anticipated because the supports were compensatory strategies rather than remedial strategies.

This comparison study evaluated a functional relation between the dependent and independent variables using three separate but equal lists of items across conditions. The three lists were deemed separate but equally difficult because items on the lists had the same number of syllables. Each list randomly selected one item from each of the five aisle categories to create five item lists. In addition, conditions required counterbalancing since each condition was conducted daily.
Student-created lists. Students assisted in creating their own grocery lists prior to the study. First, each student typed their lists into the Notes app on the iPhone. Only one word appeared on the iPhone screen at a time. The researcher provided each randomized list of items typed on a sheet of paper so the students could use it as a model to help with spelling. Second, each student recorded the names of 30 randomly selected items using Sound Recorder on the researcher’s laptop. Each item was saved as a separate file to allow the order of the items to be randomized throughout the study. Students independently typed the name of the item as shown by the researcher to label each file. Third, each student created their own pictorial lists by selecting the picture on the computer that corresponded to the item called out by the researcher. Students dragged each picture into the appropriate folder (e.g., Miles 1, Miles 2) resulting in each folder containing five pictures from the different categories. Any errors were corrected with verbal or gesture prompts. After the students created their audio and pictorial lists, the researcher uploaded the lists on the iPhone through iTunes 9.

Vocabulary reading pretest. Students were assessed on their ability to read the 90 items at the beginning of the study. This pretest ensured that students had not learned the words while creating their shopping lists. Procedures were identical to the initial grocery list screening. If a student read a word correctly, then that word was replaced with an unfamiliar word.

Comparison. In the grocery store, students were evaluated on their ability to locate the items on each type of list (Text Only, Audio + Text, and Picture + Text). The order of the three conditions was counterbalanced across students and across sessions with no more than two consecutive sessions with the same order. The baseline condition of text only was included in the order alternation to evaluate multiple treatment interference. All three conditions made up one session and one session was conducted each day with two or three sessions occurring per week.

After the attentional cue and directions to turn on the iPhone and locate the appropriate app and list (e.g., Notes Rita 3, iPod Aiden 1, and Photos Miles 6), the researcher said “Find all of the items on your list and put them in your cart.” The student had 10 min to locate the items and put them in the cart. Item selections were scored as correct, incorrect, no response, or duration error with verbal praise given to correct selections. Incorrect selections were placed back on the shelf by the researcher and followed by the researcher saying “What’s next?” No responses were ignored while the researcher said “Times up” when the student ran out of time for a duration error. Students received praise after every fifth item for on-task behavior and appropriate performance on other related skills (e.g., pushing the cart and location strategies). The researcher concurrently collected duration data and the number of self-prompts after the initial prompt. Students had a 2 min break between conditions. This process was carried out across the three conditions and all participants. The study continued for at least six sessions or until data stabilized demonstrating an experimental effect in favor of one condition.

Results

Reliability

Interobserver agreement (IOA) data were collected by a trained graduate student during 33% of the sessions for Aiden and Rita and 37.5% of the sessions for Miles and Cara. IOA equaled 100% on accuracy and errors for each student. IOA on the number of additional self-prompts resulted in 96.9% (96.8-96.9%) for Aiden, 92.6% (92.2–93.3%) for Miles, 84.3% (66.6–93.3%) for Cara, and 92.9% (85.7-100%) for Rita. Cara’s low agreement of 66.6% during session 6 resulted from of an unusual number of extra shoppers which occasionally blocked the view of one observer. Procedural fidelity equaled 100% across all four students. Prior to the start of the study, the observer checked the iPhone to ensure that the lists appeared and operated correctly.

Accuracy

Figure 1 displays the percent of correct item selections across all three conditions in each daily session for the four students. Data were
Figure 1. Percent of Correct Item Selections Across Conditions for Each Student.
collected over six sessions for Aiden and Rita and across eight sessions for Miles and Cara. Miles and Cara required two additional sessions due to the upward trends and percent of overlap in the auditory condition for each student respectively. The results showed Picture + Text led to greater accuracy and faster acquisition than Audio + Text or Text Only across all four students.

Aiden responded at 100% correct for all but one session in the pictorial condition, his mean in the audio condition was 33.33% while it was 26.67% in the text only condition. Within the pictorial condition, Miles responded at 100% correct across all eight sessions. During the audio condition, Miles’ mean correct responding was 67.5%. In the text only condition, data ranged between 20% and 60% correct with a mean percentage at 30%. Cara responded 100% correct during all but one Picture + Text session for a mean of 97.5%. Her correct responding in the Audio + Text condition had a mean of 67.5% correct. In the Text Only condition her performance was more variable ranging between 0% and 60% with a mean of 30% correct. Rita responded at 100% correct across all sessions with the Picture + Text support. Her percent correct in the Audio + Text condition had a mean of 67.5% correct. In the Text Only condition her performance was more variable ranging between 0% and 60% with a mean of 30% correct.

### Errors and Extra Prompting

Table 2 displays the total number of errors and extra self-prompting across each condition in addition to the number of correct responses. Each student made the most errors during the Text Only condition while the Picture + Text condition had the fewest errors. Two students (Miles and Rita) did not make any errors during the Picture + Text condition while the other two students (Aiden and Cara) only made one error each. The majority of Aiden’s and Miles’ errors across all conditions were categorized as duration errors at 63% and 44% respectively. On the other hand, Cara and Rita made more no response errors (64% and 56% respectively) than any other type of error.

The number of additional self-promptings by looking at the iPhone was collected to determine if one type of support required more or less prompting than another type. Aiden and Cara self-prompted more during the Text Only condition than any other condition. They also had the most errors and fewest correct responses in this condition. Because students could not read the word, they tried to match the text on the iPhone to the text on an item. They appeared to be intent on finding the item based on the frequency with which they looked at the iPhone. It appeared that

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>Aiden</th>
<th>Miles</th>
<th>Cara</th>
<th>Rita</th>
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<tbody>
<tr>
<td></td>
<td>Corrects</td>
<td>Errors</td>
<td>Self-Prompts</td>
<td>Corrects</td>
</tr>
<tr>
<td>Text Only</td>
<td>8 (44)</td>
<td>10 (56)</td>
<td>142</td>
<td>12 (43)</td>
</tr>
<tr>
<td>Audio + Text</td>
<td>10 (56)</td>
<td>8 (44)</td>
<td>93</td>
<td>27 (71)</td>
</tr>
<tr>
<td>Picture + Text</td>
<td>29 (97)</td>
<td>1 (3)</td>
<td>125</td>
<td>40 (100)</td>
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both Aiden and Cara required fewer additional prompts as their accuracy increased and their errors decreased. Miles averaged seven additional self-prompts per item in the text only and Audio + Text conditions. He had the fewest self-prompts, fewest errors, and most correct selections when supported with pictures. He averaged five self-prompts per item with picture supports. On the other hand, he had the fewest number of self-prompts overall during the text only condition (averaged three self-prompts per item). Her average number of self-prompts per item during the picture condition was also three even though more self-prompts were recorded (98) and correctly located. She self-prompted 88 times (averaged four self-prompts per item) after the presentation of the discriminative stimulus during the Audio + Text condition.

**Method - Experiment 2**

Experiment 2 built on the results from Experiment 1 to evaluate whether students would learn to read the text that was presented with pictures in Experiment 1 without direct instruction. Students read the words with the pictures at the beginning of each session before locating the items in Experiment 2. After being presented with the text and pictures for multiple sessions, if students did not read the words correctly during probe trials, students received computer-based instruction (CBI) using simultaneous prompting (SP) to learn the words. Experiment 2 began one month after the completion of Experiment 1 and used the same participants and setting in addition to the student’s classroom. Prior to starting, all students were screened on reading words and verbally labeling items. The reading list included some grocery items from Experiment 1 and some new items. Lists were individually developed based on familiar items collected from parents in Experiment 1, student’s reading ability, and researcher’s ability to equally counterbalance the items across word sets. Word sets were counterbalanced on number of syllables and first letter of the word. If students could not verbally label the item, they were taught its’ name through SP until the student could independently label the item for two consecutive sessions on different days.

**Materials.** Students continued to use the iPhone in the grocery store. The only apps needed for this study were Notes for reading the Text Only words and Photos because the most effective and efficient support for all four students as identified from Experiment 1 was the Picture + Text support. The pictures and text were created and uploaded to the iPhone in the same manner as stated in Experiment 1 but this time the researcher completed the task to decrease the students’ exposure to the pictures and text. When students required SP to learn the words, a computer-based instructional program was developed using Microsoft PowerPoint.

**Response definitions and data collection.** Grocery store and classroom sessions differed in the assessed dependent variables because they required different data collection methods. Both types of sessions evaluated the students’ ability to read the words while only the grocery store sessions assessed the students’ ability to locate the items.

**Grocery store sessions.** For reading the word, a correct response was the student verbally saying the word within 3 s of the task direction. An incorrect response occurred when the student said the wrong word. When the student did not say anything within 3 s, a no response was recorded. For locating the item, the student was to locate the item that matched the target stimulus on the iPhone within 2 min and put it in the shopping cart for a correct response. An incorrect response was selecting an incorrect item while a no response was recorded if no selection was made.

**Classroom sessions.** For reading the word, a response was scored correct if the student verbally said the word within 3 s of the computer asking “What word?” An incorrect response was recorded if the student stated the wrong word. A no response was scored if the student did not say anything at all. This process was repeated for all five words within a word set.

**Experimental design and procedures.** A multiple probe design (Gast, Lloyd, & Ledford, 2014) across three word sets and replicated across four students evaluated the transfer of stimulus control from the picture to the text incidentally or through SP. This design allowed for intrasubject and intersubject direct replication. Experimental control was evalu-
ated by staggering the introduction of the independent variable across three word sets and by consistently observing changes in grocery store probes only after intervention or CBI for each student.

**Grocery store probes.** Grocery store probe sessions took place immediately before and after the grocery store intervention phase and the CBI phase when necessary. Probe sessions lasted for three sessions or until the data stabilized (i.e., 80% of the data falling within a 20% range). If students returned to baseline levels immediately after the Picture + Text phase, then only one probe session occurred before the CBI sessions.

Researchers randomly presented all 15 target words in the Text-Only condition during probe sessions to assess the students reading of the words. Each student needed at least 12 randomized Text Only lists (some needed 15 lists if they required CBI to learn the words). The Notes app on the iPhone displayed one target word at a time.

After a student responded to the attentional cue “Are you ready to go shopping?” in an affirmative manner and found the designated list on the iPhone, the researcher asked “What word?” The student had 3 s to respond. If the student said the word correctly, then the researcher provided general praise and said “Find the item.” If the student said the word incorrectly or did not respond, then the researcher ignored the response and said “Find the item.” Students had 2 min to locate and select the item that matched the stimuli. Correct responses were praised while incorrect responses were placed back on the shelf by the researcher. When the 2 min elapsed and an item had not been selected, the researcher said “Times up. Go on to the next item.” The student then manipulated the iPhone to the next item and the process was repeated. The researcher provided general praise for on-task behavior after every five items. Students participated in no more than two sessions a day with at least 1 hr between sessions.

**Grocery Store Intervention.** After three stable probe sessions, students received the Picture + Text for items in Word Set 1. One session contained five target words with a picture of each item presented one at a time. For Word Set 1, the criterion was 100% correct for three consecutive sessions with the first two sessions on a continuous reinforcement schedule (CRF) and the third session thinned to a fixed ratio (FR) schedule after five correct responses. If students correctly read the words after intervention which meant they did not need CBI, then the criteria for remaining word sets were the same as Word Set 1 (i.e., 100% correct for three consecutive sessions).

However, if the student did not read the words correctly and needed CBI, then for Word Set 2, the criterion was incrementally increased to 100% correct for five consecutive sessions (CRF for three sessions and FR5 for two sessions). If the student needed CBI for Word Set 2, then for Word Set 3, the criteria increased to 100% correct for seven consecutive sessions (CRF for four sessions and FR5 for three sessions). The criteria for each word set increased in order to determine if the number of stimulus presentations with a picture made a difference in the student transferring stimulus control from the picture to the text. The order of words were randomly presented in each session to keep students from memorizing the lists.

Intervention sessions began with the same attentional cue and response as probe sessions. Once the students located the Photos app and selected their appropriate list for the session, the researcher said “What word?” while the student viewed the word and picture. Students had 3 s to respond. The researcher followed the same procedures and reinforcement schedule as for the grocery store probe sessions for all five target words with pictures. Students received general praise related to their shopping skills at the end of a session.

**Computer-based instruction.** If students did not achieve the criteria of at least 80% correct words read from Word Set 1 during the probe session following intervention, then students received CBI using SP to learn the words from that set. Computer-based lessons included a daily test and training session using Microsoft PowerPoint.

A daily test session was conducted prior to each training session to assess acquisition of the target words without the presentation of the controlling prompt. Each target word was presented one time. After the attentional cue and response, the text-only presentation of the first target word appeared on the screen.
Students had 3 s to say the word before the slideshow automatically presented the next word. Correct responses were praised on a CRF while incorrect and no responses were ignored by the researcher. Criterion was set at 100% correct responding for three consecutive test sessions.

A training session took place immediately after a test session. Training sessions used SP to teach the words with a picture as the controlling prompt. A picture was selected as the controlling prompt because all four students were more effective and efficient grocery shopping with pictorial prompts in Experiment 1. Each of the five target words were randomly presented three times for a total of 15 trials during a training session. Each word was presented once during the first five trials, a second time during trials 6–10, and a third time during trials 11–15. No words were presented back to back.

The training session began with a slide reading the text “Practice.” The second slide presented the first word and immediately a picture of the word was displayed. The student had 3 s to respond to the word. The researcher praised correct responses and ignored incorrect or no responses. After the 3 s, the next word and picture were displayed. This process continued until all 15 trials occurred. Students’ cooperative behavior and attention to the task were praised at the end of each training session. CBI lessons were conducted one-on-one with the researcher. No more than two CBI lessons occurred in one day with at least 1 hr between sessions.

Results

Reliability

To control against instrumentation threats, IOA was collected during at least 27% of the sessions across all phases for each student. The observers agreed on all trials across each session on both accuracy measures (reading and locating items) for 100% IOA.

To monitor adherence to procedural protocols, procedural reliability data were collected and evaluated during at least one session of each phase for at least 26% of the sessions. The mean procedural reliability for each student across all phases was 100%. The iPhone apps and computer-based program were also tested for instrumentation fidelity.

Accuracy

Figures 2–5 display the percent of correct items read and located within each word set across all phases of the study for each participant. Results varied by student. Aiden learned the words after three sessions of the Picture + Text intervention. Cara read two words sets after intervention, but she needed CBI with SP for Word Set 2. Miles and Rita could read the words only after CBI with SP. All students maintained locating the items at 100% correct and reading the words at least 80% correct two months after completing the study.

Aiden. Across each word set, Aiden’s grocery store probe data for reading words remained at zero until the intervention was introduced (see Figure 2). With the picture support, Aiden immediately read the words correctly at 100% for three consecutive sessions. This behavior continued when the pictures were removed and Aiden only saw the text indicating that he had acquired the responses incidentally (i.e., without direct instruction). Two months after the study, Aiden could still read all but one of the words.

Miles. Miles did not read or locate any items prior to intervention (see Figure 3). When pictures and text were presented for Word Set 1, Miles read the words and located the items at 100% correct for three consecutive sessions (two sessions with CRF and one session with FR5). However, after removing the picture and only presenting the text, Miles’ accuracy for both measures returned to zero. He was unable to transfer control from the picture to the text incidentally so he needed additional instruction to read the words. He participated in six CBI sessions for Word Set 1 to reach the criteria of 100% for three consecutive sessions. After achieving this criterion, he returned to the grocery store to check for generalization. He was able to read
Figure 2. Aiden’s Accuracy in Reading and Locating Items.
Figure 3. Miles’ Accuracy in Reading and Locating Items.
the words and locate the items in Word Set 1 at 100% for three consecutive sessions and the behavior maintained throughout the rest of the study.

Even though Miles could read the words in the first set, he continued to perform at 0% correct for Word Sets 2 and 3. Even after five sessions (three with CRF and two with FR5) at 100% correct with the picture and text for Set 2, Miles could not read or locate any of the text only items in Set 2. Again, he received CBI and only needed four sessions to reach criterion. After returning to the grocery store, Miles responded at 100% correct for items read and located for three consecutive sessions with Word Sets 1 and 2 while Word Set 3 remained at 0%. After seven Picture + Text sessions (four at CRF and three at FR5), Miles still could not read or locate any of the text only items in Set 3. He learned to read and locate the items with text only after seven CBI sessions. Miles read and located all 15 items during the last three sessions. During a maintenance check, Miles read 13 out of 15 of the words correctly and located all items.

Cara. For Word Set 1, Cara learned to read the words after three sessions with the picture and text (see Figure 4). For Word Set 2, Cara responded at 100% correct for three consecutive sessions with picture support, but then returned to 0% correct when the pictures were removed. Another Picture + Text session was conducted to see if Cara could read the words after one more session, but she returned to 0% correct with text only. CBI sessions were implemented to teach Cara the words in Set 2. She required five sessions to reach criterion at 100% correct for three consecutive sessions. She was then able to read the words and locate the items in the grocery store for Set 2 at 100% correct for three consecutive sessions and she maintained her ability to read the words and locate items for Set 1. Set 3 remained at 0% correct until intervention. Cara responded at 100% correct for both behaviors for five consecutive sessions (three at CRF and two at FR5). The number of sessions increased to see if more sessions would help Cara learn the words incidentally. When the pictures were removed, Cara continued to respond at 100% correct for three consecutive sessions for words read and located while Word Set 1 and 2 maintained at 100%. Two months later, Cara correctly read and located all items.

Rita. Like Miles, Rita required CBI sessions to learn to read the words in each Word Set (see Figure 5). Her accuracy remained at zero until pictures were presented with the text. Then her accuracy increased to 100% for both words read and items located, but returned to 0% correct immediately afterwards in the grocery store probe session. Rita needed seven CBI sessions using SP to acquire the words and reach criterion for Set 1, nine CBI sessions for Set 2, and five CBI sessions for Set 3. When she returned to the grocery store after CBI for each word set, she responded at 100% correct for both words read and items. Rita maintained locating all items correctly and read 13 out of 15 words correctly 2 months after the study.

Social Validity

Social validity provides documentation that the change in the dependent variable is socially important and the independent variable is practical (Wolf, 1978). After completion of the studies, social validity data were collected via a five-question questionnaire that was sent home to the students’ caregivers and given to the classroom teachers. In addition, participating students were individually interviewed at school on the purpose and outcome of the studies.

All four caregivers completed the survey. Three of the four students (excluding Aiden) help their caregiver shop with a verbal list. All caregivers thought the studies were beneficial and would consider using an electronic device with their student to promote independence.

One teacher and one paraprofessional also completed the survey. On a scale of 1 to 10 with 1 being ineffective and 10 being highly effective, both teachers rated the effectiveness of the iPhone as a community support as an 8. They stated they would definitely use this type of technology if more available to their class. They noticed the pictures seemed to be more effective and preferred by the students. They both thought an iPhone would be useful with task analyses and daily schedules at work and home.

All four students were individually interviewed and said they enjoyed using the
Figure 4. Cara’s Accuracy in Reading and Locating Items.
Figure 5. Rita’s Accuracy in Reading and Locating Items.
iPhone. Cara said she liked using it “a whole lot.” Aiden thought the iPhone was easy to use and fun while the others thought that it was sometimes hard. Rita said it was hard because she could not read the words during the text only condition and Miles said some of the buttons were hard to press. All students recognized that the iPhone helped them locate items in a grocery store. They thought the iPhone would help them in other grocery stores, at home, and at work by showing a picture of the needed items. All students thought the pictures helped them locate items the best. Cara and Aiden said that they liked listening to the items, but the pictures were the most helpful.

Discussion

During the studies, all students assisted with the creation of their grocery lists, stated they preferred shopping with pictures, and appeared to have learned to read the words of the grocery items. Students’ involvement in the development of their own grocery lists is one indicator of increased independence while grocery shopping. Only four other studies to date involved students in creating their paper-based grocery lists (Aeschleman & Schladenhauffen, 1984; Gaule, Nietupski, & Certo, 1985; Giere, Rudrud, & McKay, 1989; Sarber, Halasz, Messner, Bickett, & Lutzker, 1983). Potentially, this number will likely grow with the ease of programming electronic devices such as the iPod iTouch, iPad, and iPhone and the emphasis on teaching self-determination to individuals with disabilities (see Bouck et al., 2013; Douglas & Uphold, 2014).

As supported by the data in Experiment 1 and the social validation interview, all students preferred one format (pictures) to the others (text only and audio) for assisting with locating items. The data gathered in Experiment 2 appears to support the results from Experiment 1 because the picture supports were implemented after students were nonresponsive to text alone. Visual supports continue to be an effective grocery shopping compensatory strategy for non- or low-level readers (e.g., Hutcherson, Langone, Ayres, & Clees, 2004; Morse & Schuster, 2000) and expands the literature base supporting the use of everyday technology to assist individuals with an ID (e.g., Collins et al., 2014; Kagohara et al., 2011; Van Laarhoven et al., 2007; 2009).

Additionally, all students learned to read the words either incidentally or through SP on a CBI program. The results hold promise for increasing the efficiency of incidental learning (Ledford, Gast, Luscre, & Ayres, 2008) as five of the 12 word sets were learned incidentally. While some students required supplemental instruction, SP was an effective instructional strategy (e.g., Birkan, 2005; Waugh, Alberto, & Fredrick, 2011). Students learned to read the words after four to nine CBI sessions in the classroom, generalized the skill to the natural environment (i.e., the grocery store), and maintained the skill for at least two months. CBI was an effective way to deliver the SP instructional strategy because it provides consistent instruction and is available for repetitive use. Additional research should continue to assess the combination of CBI and SP.

There were limitations to the studies as reported here. Experiment 1 may have been strengthened by including a best condition only phase. When using an ATD design, Wolley et al. (2014) recommend that a best only phase be included after the comparison phase to help detect multiple treatment interference. When multiple conditions are quickly alternated in a single session, researchers want to ensure that the best only condition remains at the same level after the other conditions are taken away. Even though this phase was not included, counterbalancing the order of conditions each day should have minimized potential sequence effects. Generalization to other grocery stores should also be assessed in the future.

Practical limitations include the cost of an iPhone and transportation to and from the grocery store. A cheaper alternative to purchasing a new device would be to purchase an earlier version or pre-owned device, which was the case in these studies. While iPhones can be expensive, they, along with iPod touches and iPads, are ubiquitous, which in turn creates a normalcy of electronic devices as providing day to day supports for most people. Of course there are also less expensive alternatives that operate using a different operating system than Apple. These devices could easily be used for instruction of this nature. For
people with disabilities, the use of everyday technologies is more socially acceptable, age appropriate, and versatile. To combat transportation costs, alternatives include walking to nearby stores, taking public transportation, or using community-based instructional time and funds. Pedestrian, bus, and safety skills can be taught during this time in conjunction with learning to grocery shop more independently.

Over the years, technology has become more accessible, user-friendly, and convenient. Teachers and families are using these devices on a regular basis in a variety of ways and these studies demonstrate how the devices can support and teach students with disabilities. The current studies not only illustrate the use of an iPhone as a support system, but they show the importance of considering individual differences when selecting supports and instructional strategies. Students can become more independent with the right supports in place and they potentially can learn additional information presented incidentally or with supplemental instruction.

As students with disabilities increase participation in general education classes with same-age peers and in the community, they need devices and supports that will allow them to fit in socially while also meeting their needs academically and functionally. Because the possibilities within the world of technology are endless, there is great hope for providing individuals with disabilities tools that will increase their independence and inclusion in all environments.

Future research should evaluate the effectiveness of specific apps to assist students with grocery shopping and other self-management tasks. Students should be systematically taught how to use the apps in addition to being taught to independently program, organize, and utilize their devices. As electronic devices are becoming more prevalent in classrooms, research needs to show their efficacy and value for individuals with disabilities.

References


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