Use of a Handheld Prompting System to Transition Independently Through Vocational Tasks for Students with Moderate and Severe Intellectual Disabilities

David F. Cihak
University of Tennessee

Kelby Kessler and Paul A. Alberto
Georgia State University

Abstract: The use of a handheld prompting system by four students with moderate to severe intellectual disabilities to independently transition between an ordered chain of tasks was examined in a community vocational setting. Effectiveness of the handheld prompting system was assessed using a multiple-probe design across participants. Analysis of the data revealed that students successfully used the handheld system to increase independent transitions from task to task. Independent transitioning was maintained at a 100% level for up to nine weeks.

The need to shift stimulus control from a teacher to some other stimulus in the natural environment provides a foundation for the development of self-management procedures (Cooper, Heron, & Heward, 1987; Kazdin, 1994; Repp, 1983). Self-management procedures frequently limit discriminative stimuli allowing the individual to focus attention on a target behavior (Gifford, Rusch, Martin, & White, 1984). One self-management procedure that promotes a shift in stimulus control by limiting discriminative stimuli is the use of handheld prompting systems (Cihak, Kessler, & Alberto, in press; Davies, Stock, & Wehmeyer, 2002a, 2002b, 2004; Ferguson, Myles-Smith, & Hagiwara, 2005; Furniss et al., 2001; Riffel et al., 2005).

Workers with moderate and severe intellectual disabilities often are asked to change from one task to the next without help. Those who are unable to do so may experience decreased success (Lagomarcino, Hughes, & Rusch, 1989; Mank & Horner, 1988), maintain excessive dependence on job coaches and exhibit limited behavioral maintenance (Rusch, 1986), engage in off-task behavior while waiting for external delivered prompts (Browder & Shapiro, 1985; MacDuff, Krantz, McClannahan, 1993), and maintain low productivity rates (Agran, Fodor-Davis, & Moore, 1986). The probability of those undesirable outcomes was decreased by instruction in specific self-management skills (Certo, Mezzullo, & Hunter, 1985; Rusch, Martin, Lagomarcino, & White, 1987). Thus, the use of handheld prompting systems by workers with moderate and severe intellectual disabilities may result in employee autonomy and decrease dependence on coworkers, teachers, job coaches, and peers (Cihak et al., in press; Davies et al., 2002a, b, 2004; Ferguson et al., 2005; Furniss et al., 2001; Riffel et al., 2005).

Handheld computers (e.g., PDA, Pocket PC) are promising technology devices because they are portable, inexpensive, reliable, easy to maintain, program, use, and are socially desirable. One way to distinguish between handheld computer technologies is between commercially available devices and those that are custom made for an individual person (Cook & Hussey, 2002). The term commercially available refers to devices that are mass-produced. These include commercial devices designed for the general population. Increasingly, commercial products are being designed according to the principles of universal design. Universal design is the design of technologies to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. In this ap-
proach, features are built into the product (e.g., various display options-visual, auditory; alternatives to reading text-icons, pictures), which makes a product more accessible to individuals with disabilities. This is much less expensive than adapting a product after production in order to meet the needs of an individual with a disability.

If commercially available devices cannot meet an individual’s needs, it may be modified. However, when modification or commercial devices are not appropriate, it is necessary to design one specifically for the task-at-hand. This approach results in a custom device. Since custom products are not mass-produced, a custom device costs are much higher because it is a special product or a "one of a kind" and the costs of development must be recovered from the smaller production.

Using a custom-made handheld device and software, Davis et al. (2002a, 2002b, 2004) reported that participants with intellectual disabilities were more independent, required fewer external prompts, were more productive, and made fewer errors. Custom-made handheld computers and software have been used successfully across various disability characteristics including, developmental delay, autism, and Prader Willi Syndrome (Riffel et al., 2005). Moreover, custom-made devices have supported individuals with special needs in career and leisure activities (Furniss et al., 2001). Furniss et al. concluded that the use of a custom-handheld prompting system was more effective than static picture prompts in a booklet, it was easily used in real work settings, and that students with severe disabilities preferred the handheld device to the picture booklet.

Using a commercially produced handheld device and software, Ferguson et al. (2005) successfully decreased adult reliance to complete tasks at home and school for one adolescent with Asperger’s Syndrome. Cihak et al. (in press) also used a commercially produced handheld device to successfully teach students with moderate intellectual disabilities to operate the use of the handheld prompting system and to generalize skills across increasing complex vocational tasks in the work setting without additional training. Although the literature has noted that handheld computers efficacy for task acquisition, generalization, and maintenance, Davies et al. (2004) noted that further research was needed to assess the effectiveness of handheld computers as a prompting system across a variety of tasks, domains, and ecologically valid work and employment settings.

The purpose of this study was to determine the effectiveness of a commercially-produced handheld computer, as a prompting system to facilitate the independent transitions from task to task in a community-based vocational instructional site for students with moderate and severe intellectual disabilities.

Method

Participants

Four students, Aaron, Bill, Cate, and Doug were selected to participate based on the following: (a) willingness to participate, (b) level of cognitive functioning within the moderate to severe intellectual disability range, (c) current participation in a high school program with regularly scheduled community-based instruction, (d) no sensory deficits, (e) parental permission, and (f) the student’s verbal agreement to participate. Aaron and Doug were 16 years old with a full-scale IQ of 36 and 40, respectively. Bill and Cate were 17 years old with a full-scale IQ of 48 and 50, respectively. IQ's were assessed using the Wechsler Intelligence for Children (Wechsler, 1991) for Aaron, Bill, and Doug. The Stanford Binet (Thorndike, Hagen, & Sattler, 1986) was used to assess Cate. Students were able to independently complete individual tasks; however, each was dependent on an external source for task transitions. According to teacher reports, after the completion of individual task, if students were not prompted immediately to begin the next task, each student would usually engage in some form of off-task behavior.

Settings

Pretraining instruction using the handheld computer occurred in each student’s school resource classroom. Baseline, handheld prompting, and maintenance phases occurred during community-based instruction (CBI) in three community settings; grocery store, department store and restaurant. Stores and res-
Restaurant were selected because of the convenient location to the students’ neighborhood school. Community instruction for Aaron and Bill was at a grocery store, Doug at a restaurant, and Cate at a department store.

Materials
A Kodak DX3600 Zoom digital camera was used to digitally photograph each task analyzed step. Digital photos were then downloaded into an Axium X30 handheld computer that was used to deliver the picture and auditory prompts. The Axium X30 was selected since it was the least expensive device that allowed capabilities of photo display and to record narration. Picture Perfect software was used to develop the picture and auditory prompts task sequence. The Picture Perfect software was selected due to its relative inexpensive price and capabilities of creating a relatively easy picture and auditory prompting system. Students placed the handheld computer in a pack fastened to their waist with a small headphone that attached around the ear. The headphone wire was worn under the uniform to reduce interference during task engagement. Students advanced the prompting system by pressing an arrow hardware button.

Tasks
Ten vocational tasks were identified for each student at each work site. Table 1 displays the list of tasks each student completed and transitioned to and from. Tasks were randomly ordered so that no two individual tasks would follow one another from session to session.

Data Collection
Event recording was used to record the number of times a student independently transitioned to a separate vocational task within a prescribed chain of tasks. Ten tasks were identified for each student. Since each student began their workday in the employees’ breakroom, a total of 10 transitions were available. An independent transition was defined as the student’s ability to move from task to task without relying on an individual to direct him or her. A student’s independent transition to a task was recorded as correct when the student completed the first task, physically moved to the second task area, and completed the first step of the next task. These transitions occurred after correct completion of each individual ordered task. A transition was considered assisted if the student asked for directions on what was next, waited for someone to provide assistance (a verbal reminder to use a the handheld prompting system was provided after 10s), or received unanticipated instructions from a coworker (such as gestures). If a student, after receiving a handheld prompt, moved to an unprompted task out of sequence, he or she was provided with a verbal reminder of the next task and the response was recorded as assisted. The total number of

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Gathering carts</td>
<td>Aaron 1)</td>
</tr>
<tr>
<td>2) Stocking milk</td>
<td>2)</td>
</tr>
<tr>
<td>3) Vacuuming</td>
<td>3)</td>
</tr>
<tr>
<td>4) Preparing rolls</td>
<td>4)</td>
</tr>
<tr>
<td>5) Putting back returns</td>
<td>5)</td>
</tr>
<tr>
<td>6) Stocking cans</td>
<td>6)</td>
</tr>
<tr>
<td>7) Making cookies</td>
<td>7)</td>
</tr>
<tr>
<td>8) Cleaning registers</td>
<td>8)</td>
</tr>
<tr>
<td>9) Cleaning windows</td>
<td>9)</td>
</tr>
<tr>
<td>10) Sweeping</td>
<td>10)</td>
</tr>
<tr>
<td>1) Straightening mushrooms</td>
<td>Bill 1)</td>
</tr>
<tr>
<td>2) Stocking bananas</td>
<td>2)</td>
</tr>
<tr>
<td>3) Stocking pineapples</td>
<td>3)</td>
</tr>
<tr>
<td>4) Cleaning fitting room</td>
<td>4)</td>
</tr>
<tr>
<td>5) Cleaning registers</td>
<td>5)</td>
</tr>
<tr>
<td>6) Clothes processing</td>
<td>6)</td>
</tr>
<tr>
<td>7) Sweeping</td>
<td>7)</td>
</tr>
<tr>
<td>8) Cleaning windows</td>
<td>8)</td>
</tr>
<tr>
<td>9) Stocking picture frames</td>
<td>9)</td>
</tr>
<tr>
<td>10) Dusting shelves</td>
<td>10)</td>
</tr>
<tr>
<td>1) Preparing coleslaw</td>
<td>Cate 1)</td>
</tr>
<tr>
<td>2) Preparing broccoli</td>
<td>2)</td>
</tr>
<tr>
<td>3) Skewering shrimp</td>
<td>3)</td>
</tr>
<tr>
<td>4) Preparing tea</td>
<td>4)</td>
</tr>
<tr>
<td>5) Rolling silverware</td>
<td>5)</td>
</tr>
<tr>
<td>6) Bussing tables</td>
<td>6)</td>
</tr>
<tr>
<td>7) Setting tables</td>
<td>7)</td>
</tr>
<tr>
<td>8) Sweeping</td>
<td>8)</td>
</tr>
<tr>
<td>9) Cleaning windows</td>
<td>9)</td>
</tr>
<tr>
<td>10) Taking out trash</td>
<td>10)</td>
</tr>
</tbody>
</table>
independent transitions were totaled and divided by 10 to compute a percentage of independent transitions for each student.

Experimental Design

A multiple-probe design across participants (Barlow & Hersen, 1984) was used to determine the efficacy of the handheld prompting system and student’s independent transitions. The multiple-probe design allowed sequential application, comparison effectiveness, and an opportunity to replicate the effects of the handheld prompting system across students. The study included three phases; baseline, acquisition of handheld prompting instruction, and maintenance phases. Prior to baseline a pre-training period occurred during which the students were taught to operate the handheld prompting system, to select the different tasks to perform, to press the hardware button to advance to the next step of the task analysis and to follow the recorded directions.

Tasks were ordered in a semi-random fashion on a session-by-session basis to ensure that no two individual tasks would follow one session to the next ensuring different task-to-task transitions for each session. Before the implementation of the intervention phase, the names all 10 tasks were written on a piece of paper and randomly drawn. If a task was drawn, that followed the same task from the previous session, it was returned to the drawing and another task was selected. The randomization of task ordering allowed different transitions to occur on a session-by-session basis, which reduced the likelihood of practice effects and students remembering what transition was next.

Experimental Procedures

Pretraining. Similar to Cihak et al. (in press), prior to baseline, students’ participated in a pretraining period. For the first phase of pretraining, students were instructed how to operate the handheld computer. They were instructed to physically turn on the device, to wear the headphones, to select color-cued icons representing the different tasks or jobs to perform, and to select a color-cued hardware button to advance to the next step of the task analysis.

In the second phase, students were required to turn-on the device and select a prerecorded icon, which caused a popped-up window to occur with a familiar picture plus auditory prompt, and to follow each instruction. Students also were required to press the hardware button to display the next direction. The prerecorded device instructed students to complete a two-step task familiar to students and normally associated with their morning classroom routine. Students were instructed to “close the door and hang up your coat,” or “sit down at the table and pick-up your pencil.” Each student was required to reach a criterion of 100% accuracy for two consecutive sessions.

Baseline. During baseline, the number of independent transition students made between assigned tasks within a vocational site was recorded. If a student was unable to independently move to the next ordered task and simply waited for assistance, relied on a cowoker or peers to direct him or her to the next task, or asked a teacher or supervisor for directional assistance, assistance was provided and the transition was recorded as “assisted.” Assistance for all transitions was provided by an external source only after 10-s interval of no response. Data were collected until a stable baseline was achieved for a minimum of five sessions.

Handheld prompting procedures. All students started their workday in the employees’ breakroom. Students were provided with the handheld prompting system and headphones and instructed to turn on the device. After the device was activated, a pop-up window with an icon of the targeted task was displayed. After the student pressed the icon, a picture and auditory prompt of the first step of the task was displayed. After the student progressed through the entire chained task, a picture and auditory prompt cued the student to transition to the next task. This process continued until all 10 tasks were complete. If a student did not transition, requested assistance, and/or 10-s interval elapsed with no response, the student was prompted to watch the handheld device screen. Criterion for completion of this phase was 100% independent transitions for three consecutive sessions.
Maintenance procedures. Follow-up probes were collected nine weeks after the student meet acquisition criterion. Follow-up probes occurred in the community setting where the student was initially trained. Follow-up probes were collected to determine if the initial instructional affected the student’s performance over time.

Reliability

Interobserver reliability data and procedural reliability data were collected simultaneously by the primary investigator and the classroom teacher. Interobserver and procedural reliability data were collected during 33% of baseline and each concurrent phase. Observers independently and simultaneously recorded the number of steps the student performed independently or the required prompt and response time. Interobserver agreement was calculated by dividing the number of agreements of student responses by the number of agreements plus disagreements and multiplying by 100. Interobserver reliability ranged from 96 to 100%, with a mean of 99% agreement. The mean interobserver reliability agreement for each student across conditions was Aaron, 97%; Bill, 100%; Cate, 100%, and Doug, 97%.

Procedural integrity measures check the investigator’s performance by using the correct prompting hierarchy and response time. The classroom teacher was trained using an itemized checklist that listed the task-analyzed steps of each task and the level of prompt. The teacher was considered successfully trained after completing 100% of the checklist for three consecutive trials. The procedural agreement level was calculated by dividing the number of observed teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980). Procedural reliability ranged from 97-100%, with a mean of 99%. The mean procedural reliability agreement for each student across conditions was: Aaron, 99%; Bill, 100%; Cate, 96% and Doug 100%.

Results

Number of independent transitions made by students during baseline, handheld prompting intervention, and maintenance phases in the vocational setting is presented in Figure 1. During baseline, students demonstrated limited ability to independently transition between specific work tasks. Number of independent task transitions made by students during this phase was zero. When students used the handheld prompting system during intervention, increases in the number of independent transitions were apparent. Number of independent transitions ranged from 40% to 100% with a mean of 86%. Aaron demonstrated no independent transitions during baseline and increased independent transitioning to a mean of 82% (range = 40-100%) during intervention. Bill demonstrated no independent transitions during baseline and increased independent transitioning to a mean of 84% (range = 50-100%) during intervention. Cate demonstrated no independent transitions during baseline and increased independent transitioning to a mean of 80% (range = 50-100%) during intervention. Doug demonstrated no independent transitions during baseline and increased independent transitioning to a mean of 94% (range = 80-100%) during intervention. Number of instructional sessions to reach criteria ranged from nine to five with a mean of six. Moreover, all students maintained transitioning nine weeks later with 100% independence.

Discussion

The purpose of this study was to determine the effectiveness of a commercially-produced handheld computer, as a prompting system to facilitate independent transitions from task to task in a community-based vocational instructional site for students with moderate and severe intellectual disabilities. Analysis of the data indicated a functional relationship in task transitions performance between baseline and intervention replicated across participants. The current investigation contributes to a growing body of research examining strategies to increase vocational skills of students with intellectual disabilities. This study replicates findings from previous studies which found that students with moderate to severe intellectual disabilities can learn to effectively use handheld prompting systems, increase student autonomy at the workplace, and de-
crease dependency on coworkers, teachers, job coaches, and peers (Cihak et al., in press; Davies et al., 2002a, 2002b, 2004; Ferguson et al., 2005; Furniss et al., 2001; Riffel et al., 2005).

Prior to the handheld prompting interven-
tion, all students relied on specialized services and personnel to assist in meeting the students’ vocational needs. Unfortunately, natural support options in the workplace are reduced greatly for individuals who require extensive and pervasive services or who are unable to work independently. Nisbet (1992) referred to natural supports as reliance on persons within typical environments. Before placement of a worker with disabilities, the workplace should be examined carefully to determine the availability of natural supports and social interactions so that supported employment services can build upon what is already in place. That is, supervisors and coworkers, rather than job coach or vocational counselors, would be responsible for providing some services to assist in successful job placement and job retention. However, the concept of natural supports also includes assuring employers of their minimal involvement (Nisbet & Hagner, 1988). Although businesses have begun to recognize the need to support all workers, how much support is minimal?

Natural supports are successful for individuals with disabilities who require minimal assistance. However, natural supports become problematic if the expectation is that the employer and/or coworker must consistently direct and supervise the worker. Issues including (a) training in strategies and techniques, and (b) employers and coworkers’ skill level to reliably implement intervention plans become heightened when workers require extensive and pervasive assistances. Additionally, if the student requires extensive supports and services, do employers or coworkers find the individual with disability an interference with their performance?

This study extends the research literature of handheld prompting systems by enabling students to use the handheld prompting system to independently transition from task to task in a vocational setting. Workers with moderate and severe intellectual disabilities often are asked to change from one task to the next without help. Those who are unable to do so may experience decreased success resulting in low productivity rates and dependency on job coaches. These prompts were effective for teaching students to manage their own task change behaviors. The use of the handheld prompting system served as the stimulus control for the desired behavior of independent transitioning. With this methodology, teachers and professionals can increase the level of independence, self-sufficiency and the quality of life of students with disabilities.

A second purpose of this study was to increase the probability of long-term maintenance of skills addressed by the use of the handheld prompting system. Since the professional literature recognizes that maintenance is a difficult skill for students with moderate and severe intellectual disabilities to learn, it is incumbent upon teachers and professionals to address these concerns in instructional program planning and teaching strategies. The use of a handheld computer prompting system is one way of enhancing this instructional component.

A third purpose was to use a commercially available handheld computer to enhance skill acquisition and maintenance. The advantages of using commercially available products include lower costs and the availability supports and technical assistances. Moreover, when the universal design approach is applied, accessibility and usability of handheld computers increases. More individuals with disabilities can then utilize this promising technology, which promotes greater independence.

Several limitations of this study may have affected the results and interpretations. First, students were familiar with the vocational site; they could easily navigate to other areas of the store or restaurant. Novel vocational sites may require additional prompts and directional cues, which may produce differentiated outcomes. Second, the study was conducted with students who had extensive CBI experiences. Students with less extensive community experiences may require more intensive instruction to acquire, generalize, and maintain targeted skills. Third, all students demonstrated no resistant behaviors toward wearing the device and were extremely motivated using the handheld computer. Students who are less motivated or resistant to using the handheld computer may perform differently.

Future research is needed to verify the results of this study and to investigate generalization across novel work settings. Additionally, different type of transitions (e.g., place to place, preferred to nonpreferred tasks) and a
type of skills (e.g., domestic, leisure, and community) needs to be investigated. Future research also should attempt to replicate these results across natural support instructors (e.g., job coach, coworker, and parent), student characteristics, and the inclusion of self-evaluation steps.

**References**


Received: 3 May 2006
Initial Acceptance: 1 July 2006
Final Acceptance: 10 October 2006