J Autism Dev Disord (2015) 45:1408–1418
DOI 10.1007/s10803-014-2300-x

ORIGINAL PAPER

Using WatchMinder to Increase the On-Task Behavior of Students with Autism Spectrum Disorder

Lisa Finn · Rangasamy Ramasamy · Charles Dukes · John Scott

Published online: 7 November 2014

Abstract This study assessed the use of WatchMinder™, a vibrating prompt watch, and self-graphing on the on-task behavior of students with autism spectrum disorder in an elementary special education setting. Using a multiple baseline across subjects design, results showed an immediate increase in on-task behavior when the intervention was introduced. Participants maintained high levels of on-task behavior during the follow-up phase. Implications for expanded self-monitoring treatment packages are discussed.

Keywords Autism spectrum disorder · Self-monitoring · Tactile prompting · WatchMinder · Self-graphing · Classroom intervention

Introduction

Individuals with autism spectrum disorder (ASD) often struggle with focusing and sustaining attention, rapidly retrieving relevant information, managing time effectively, self-monitoring, self-correcting, and sequencing a plan of action (Bjorklund 2012). These skills, collectively known as executive functions, are coordinated in the brain and work together to help a person achieve goals. Executive functioning skills develop naturally in most individuals without disabilities. However, those with ASD may require systematic interventions to acquire such complex skills. "In the academic setting, the ability to attend to tasks is a requisite skill for success in school," (Holifield et al. 2010, p. 230). Therefore, individuals with attention challenges, such as those with ASD or attention deficit hyperactivity disorder, may benefit from self-monitoring interventions that target these specific executive functioning skills (Milley and Machalicek 2012). Self-monitoring is a covert process involving self-assessment and self-recording enabling an individual to become more aware of whether he/she is performing a specific task (McDougall et al. 2012). These skills are critical for many daily life tasks, including time management, acquiring and comprehending new information, meeting deadlines or due dates, and performing multi-step tasks (Lee et al. 2007).

Self-monitoring training is a proactive intervention that can be individualized and applied in a variety of settings. There have been numerous studies that support self-monitoring as an effective practice in the field of education. For example, in a review of literature, Anderson and Wheldall (2004) analyzed 44 research studies on self-monitoring between 1991 and 2003 and concluded that self-monitoring was effective in helping students increase their attention and on-task behavior. Positive effects of self-monitoring have been reported in the literature on a range of target behaviors for individuals with a variety of disabilities and across several age groups, including high school students with multiple disciplinary referrals (Blick and Test 1987), adults with traumatic brain injury (Van Hulle and Hux 2006), adults with intellectual disabilities (Green et al. 2011), and school age students with developmental disabilities and learning disabilities (Amato-Zech et al. 2006; Miller et al. 2007; Trammel et al. 1994). In addition, many studies have focused on the effectiveness of self-monitoring programs specifically for students with ASD. Such research targeted skills including increasing on-task behavior (Callahan and Rademacher 1999; Holifield et al. 2010; Legge et al. 2010), reducing self-stimulatory behaviors (Koegel and Koegel

L. Finn (✉) · R. Ramasamy · C. Dukes · J. Scott
Department of Exceptional Student Education, College of Education, Florida Atlantic University, 777 Glades Rd., Boca Raton, FL 33431, USA
e-mail: lisa.finn@palmbeachschools.org

1990; Mancina et al. 2000), increasing independence in social settings (Parker and Kamps 2011), and increasing academic productivity (Farrell and McDougall 2008; Soares et al. 2009).

Self-monitoring interventions typically do not stand alone since it is a complex skill to teach and requires many processes to work together simultaneously. Therefore, many interventions intended to promote self-monitoring are delivered as "treatment packages" comprised of several components including self-recording, goal setting, evaluation, graphing/charting, and reinforcement (Briesch and Chafouleas 2009). In addition, these packages typically include prompts such as a bell or recorded tone (Callahan and Rademacher 1999; Holifield et al. 2010; Koegel and Koegel 1990; Mancina et al. 2000; Parker and Kamps 2011). While these prompts are effective in training students to self-monitor, they have limitations because of their obtrusiveness, and possible interference with generalization (Amato-Zech et al. 2006; Anson et al. 2008). A tactile prompting device may hold special advantages over auditory cues in that they can be more discreet and easily set to deliver the prompt in accordance with the unique needs of the individual (Anson et al. 2008; Legge et al. 2010). Such advantages make using tactile prompting devices particularly feasible for inclusive educational settings. Furthermore, tactile prompting devices are portable so they may be more practical for facilitating generalization and spontaneous use of acquired skills (Farrell and McDougall 2008; Lee et al. 2007).

Currently, there are several types of tactile prompting devices available. WatchMinder, a vibrating wristwatch, is one tactile prompting device. Van Hulle and Hux (2006) successfully used WatchMinder to teach adults with traumatic brain injuries to remember to take their medications. Green et al. (2011) used WatchMinder to assist adults with intellectual disabilities with task completion and transition skills within the workplace. Another tactile prompting tool called MotivAider is a pager-like device that clips to the waistband and is used to provide vibrating prompts so students can monitor themselves (Richards et al. 2014). Farrell and McDougall (2008) utilized MotivAider to increase math fact fluency for high school students with disabilities by helping them self-monitor their work pace. Legge et al. (2010) successfully used MotivAider to help three-fifth and sixth grade students to increase their on-task behavior during math and the students were able to maintain their on-task behavior once the MotivAider was removed.

It is essential that individuals become active participants in their self-monitoring programs because the nature of the skill requires self-directed behavior (Briesch and Chafouleas 2009). Involving students as active participants in all steps of the intervention process is important because it can help them learn to set goals, make plans, identify struggles, and ideally evaluate their own progress (Sebag 2010). Additionally, self-graphing has the potential to improve motivation because it provides immediate feedback (Anderson and Wheldall 2004). Few studies have included techniques to increase active participation. Although many researchers have recommended goal setting and self-graphing as potentially effective components of self-monitoring programs (i.e., Anderson and Wheldall 2004; Briesch and Chafouleas 2009; Sebag 2010), in a meta-analysis, Joseph and Eveleigh (2011) reported that only five of the 16 studies reviewed included a self-graphing component. Therefore, there is a need for more research on the newest technologies available for self-monitoring programs including tactile devices and student friendly graphing applications. The purpose of this study was to evaluate the (a) efficacy of WatchMinder as a means to promote self-monitoring to increase on-task behavior, (b) effects of self-graphing using an iPad application, and (c) maintenance of self-monitoring skills when the intervention was removed.

Methods

Participants and Setting

Four students participated in the study. They all received special education services in a community elementary school in South Florida. Pseudonyms are used in place of students' names. See Table 1 for demographic information.

Adam was 8 years 10 months old at the time of the study and was in third grade. Adam was working on grade level curriculum for all academic subjects. However, he required frequent verbal reminders to remain focused and engaged in the task. He had difficulty completing work independently due to prompt dependency and often was not aware of his off-task behavior.

Bill was 8 years 7 months old and was in third grade. During the study, Bill was performing on grade level for all academic subjects. He had difficulty following directions, adhering to the classroom routine, and initiating and completing tasks. His preoccupation with imaginary games, guns, and violence contributed to his off-task behavior during independent seatwork.

Paul was 9 years 10 months old and was in fourth grade. Paul's academic skills were about 2 years below his chronological age. Paul was reliant on prompts to complete work independently. He frequently left his work area, played with his materials, and laid his head on his desk during seatwork. He often demonstrated problem behaviors including screaming, lying on the floor, and talking to himself.

Table 1 Demographic characteristics of participants

Participant	Age	Grade	Ethnicity	Educational eligibility	IQ	Academic services	
						ASD	Gen. Ed.
Adam	8:10	3	Caucasian	ASD, LI	N/A	Reading Writing Math	Science Social studies
Bill	8:7	3	Caucasian	ASD, OHI	97	Reading Writing Math	Science Social studies
Paul	9:10	4	Hispanic	ASD, LI	71	All Academics	
Tom	8:8	3	Hispanic	ASD, LI	101	Reading Writing	Science Social studies Math

IQ's were obtained from different evaluations (Bill-WISC-IV; Paul- DAS-2; Tom-Leiter-R). No IQ score was available in Adam's file

LI Language impairment, *OHI* otherwise health impaired, *IQ* intelligence quotient

Tom was 8 years 8 months old and was in third grade. He was on-grade level for all subject areas. However, he demonstrated compulsive tendencies that caused him difficulty with completing tasks. For example, he spent most of his time making sure his answers were sized to fit exactly on the line given on the worksheet. He was also highly distracted by other's activities in the classroom and often watched the teacher working with other students rather than working on his tasks.

Students were chosen to participate in this study if they were diagnosed with ASD and participated in the autism cluster program for at least a portion of the school day. All of the students were highly distracted while working on academic tasks and required numerous verbal prompts. In addition to these characteristics, each of the participants were suitable for a self-monitoring intervention because they were able to differentiate between working and non-working behavior and were capable of completing some tasks within the classroom independently.

The study was conducted in the first author's classroom. A total of ten students in the class followed individual schedules to complete a rotation of activities including language therapy, small group instruction, and hands on tasks. In addition, each student completed a 30-min independent work period at some point during the day at stand-alone desks located in the middle of the classroom. This period served as the intervention period for the four participants in this study.

Table 2 On- and off-task definitions across participants

Participant	On-task	Off-task
Adam	Reading Writing the answers Raising hand for help Putting work in finished basket	Looking around the room Staring at paper Rolling pencil on desk Calling out
Bill	Reading Writing the answers Raising hand for help Putting work in finished basket	Looking around the room Drawing pictures on work Staring at paper
Paul	Writing Cutting Gluing	Out of seat Making noise Looking around the room Playing with materials Laying head on desk
Tom	Reading Writing the answers Raising hand for help Putting work in finished basket	Looking around the room Looking at the teacher Staring at paper

Experimental Design

A multiple baseline across participants design was used to teach self-monitoring skills. This design is used to analyze the effect of an independent variable across several participants so that the variable's function can be predicted by the level of change in the participant who receives the intervention while little or no change is evident with those who have not yet received the intervention (Richards et al. 2014). In this study, the independent variable self-monitoring intervention package was used to measure the percentage of on-task behavior during daily independent work sessions.

Task and Behavioral Measures

The dependent variable in this study was on-task behavior. On-task behavior was defined for each student based on the actions required during the work period. A participant was considered to be on-task if he was demonstrating any of the behaviors listed on his checklist as "working" when the WatchMinder vibrated. On and off-task were operationally defined for all participants so they could learn to differentiate between the two when they were taught to self-monitor. See Table 2 for on and off-task behavior definitions for each participant.

The independent variable in this study was the self-monitoring intervention package that included the WatchMinder, a checklist, self-graphing using Data Manager Pro, and a reinforcer. Some of the common reinforcers were playing the Angry Birds board game, extra computer time, playing MineCraft on the iPad, and drawing time.

Data Collection

Data collection took place during a 30-min independent work period while the participants were working on previously mastered academic tasks at stand-alone desks located in the central part of the classroom. Data were collected by the first author and the classroom paraprofessional across conditions and by participants during intervention phases using a momentary time sampling system. When the WatchMinder vibrated, it cued the student to assess what he was doing at that moment and then record it on his checklist. During the training, for self-monitoring and self-monitoring plus graphing phases, the watch was set to a 2-min fixed interval and it displayed the message "PAY ATTN" (pay attention) when it vibrated. During the fading and maintenance phases the watch was set to a 5-min fixed interval. In addition, adult observers collected data by wearing WatchMinders using identical settings.

Materials

The materials used in this study included the WatchMinder, adult and student checklists, an iPad with the Data Manager Pro application, and student-selected reinforcers. The WatchMinder is a vibrating prompt watch that resembles a digital sport watch. The device is available in black or white and can display as many as 65 preprogrammed messages including "use the bathroom, pay attention, relax, eat, and take medication." The watch can be set to a fixed interval from one to 60 min that automatically repeats for the selected duration. Each morning before the students arrived in class the first author calibrated all of the WatchMinders to ensure they would vibrate at the exact same time.

In addition to the WatchMinder, each participant was given a checklist on a half sheet of 8½ × 11 in. white paper. The checklist defined specific behaviors that were considered to be "working" (on-task) and "not working" (off-task). Participants used the checklist to self-record when the watch cued them. Adult observers used a data sheet with columns to collect five sessions worth of data for each participant.

Data Manager Pro is a graphing application for iPhone and iPad. It allows for multiple data files to be created on the home screen. Each participant was assigned a file based on a participant number in the first author's iPad to maintain confidentiality. After tapping on their assigned file, an input screen allowed for data to be entered at the completion of each work session. At the bottom of the input screen there was an option to look at a line graph of the data. There was also an option to set a goal line, which will place a red line across the graph.

Procedure

Baseline

During baseline, the participants were observed to measure the percentage of intervals they were on-task during the independent work period without the use of WatchMinder or a checklist. They were expected to sit at their desks and complete the assigned work located in their independent workbaskets. Students received verbal prompts for redirection when needed. The first author and a paraprofessional wore WatchMinders set at 2-min fixed intervals and began data collection once the student retrieved his materials and began working. The first participant entered the training phase after three stable baseline sessions. The remaining participants moved from baseline to intervention once previous participant demonstrated at least three consecutive sessions of 100 % accuracy in self-recording during the training phase, and when the next target participant had at least four stable baseline data points. An exception to the baseline criteria was made for Tom. Although his baseline data was unstable, the decision was made to intervene for clinical benefit rather than scientific research purposes in hopes that the intervention would help him perform well on a more consistent basis.

Training

The WatchMinder, as well as the training procedure, was introduced to each participant. Training included an 11-step procedure that involved systematically fading verbal prompts and increasing proximity from the participant while he monitored himself and completed work tasks (see Table 3). During the work session when the watch vibrated, the participant was taught to ask himself, "What am I doing right now?" and then check "yes" or "no" accordingly on the checklist. For example, on the first day of training, each participant was asked to verbalize what he was doing each time the watch vibrated and mark that behavior on his checklist accordingly while the adult stood

Table 3 Eleven-step training procedure

1. Show student how to get checklist and watch from the closet
2. Ask the student to write the date and what he is working for on the checklist
3. Review the criteria for "on" and "off-task" on the checklist
4. Ask the student to verbalize what he was doing when the watch vibrated and tell him to check yes or no accordingly
5. Instruct the student to shade in the check box when the reminder vibration occurs
6. Watch the student as he records with decreasing proximity
7. Intervene if the student inaccurately records for two consecutive intervals
8. Instruct student to count yes checks at the end of the session
9. Discuss accuracy of recording with the student
10. Show student where to put the watch and checklist at the end of the session
11. Provide reinforcement if earned according to the requirements on the student checklist

next to him. In subsequent days, as the participant was able to accurately identify what he was doing when the watch vibrated, the requirement to verbalize the behavior was faded and the adult observer monitored the student from across the room. As each participant demonstrated proficiency with completing a training step for two consecutive sessions, instruction was no longer given on that step. The criterion for moving to the next phase was five consecutive sessions of 100 % accurate recording, regardless of the percentage of time on-task.

Self-monitoring

The participants wore the WatchMinder and independently completed the same steps that were taught during the training procedure. The watch was set to a 2-min interval. At the end of the 30-min session, the participants independently counted their "yes" checks, placed their checklists and watches in the correct location, and retrieved the reinforcer if it was earned. Participants earned their reinforcer if they were on-task for at least 13 of the 15 intervals. The criterion for moving to the next phase was five consecutive sessions of at least 80 % or more intervals on-task. After becoming proficient with using the WatchMinder to self-monitor, self-graphing was added to the intervention.

Self-monitoring Plus Graphing

The purpose of self-monitoring plus graphing was to assess whether adding a graphing component to the intervention package would contribute to an increase in on-task behavior compared to only using the WatchMinder and a checklist. All procedures during the self-monitoring plus graphing phase were the same as those in the self-monitoring phase. However, at the end of the session, the participants were trained to graph their data point on the Data Manager Pro application. Training involved showing participants how to convert the number of intervals measured on-task into a percentage by looking at a percentage chart posted on the inside of the cabinet where the watches were stored. Then they were taught to tap the application, access their data file, and input the percent of intervals on-task. After inputting the data, the participant was able to view a graph by taping "graph" at the bottom of the iPad screen. Prior to participants entering this phase, participant data was entered into the application so they would be able to compare their current progress with what they had done previously. This application also allows a goal line to be put into the graph. This was set at 80 % for each participant since the criterion for reinforcement during each session was 80 % or more intervals on-task. The participants moved onto the next phase in the study after five consecutive sessions of 80 % or more responding.

Fading

The purpose of the fading phase was to decrease the amount of feedback participants received from the watch with the hypothesis that they would be able to maintain high levels of task engagement without the watch vibrating as often. During this phase, all procedures were the same as the previous phase, including the graphing, except the WatchMinders were set to a 5-min fixed interval rather than 2-min. As with other phases, the participants met criteria for this phase if they demonstrated five consecutive sessions of on-task behavior for 80 % or more intervals.

Follow-Up

Behavior was measured during this phase, as the ultimate goal in teaching students to self-monitor, so that they will be able to engage in certain behaviors without prompting of any kind (Wilkinson 2008). It was important that the WatchMinder was faded as soon as possible to avoid prompt dependency. Therefore, after participants met criteria with the watch being set to a longer interval, the WatchMinder and checklist were removed. Adult observers continued to keep data on each participant's on-task behavior for five consecutive sessions following the removal of the WatchMinder. Two additional probes were collected 1 week apart beginning 1 week after the five consecutive follow-up sessions.

Interobserver Agreement and Intervention Fidelity

The first author and the classroom paraprofessional completed interobserver agreement (IOA) across all conditions.

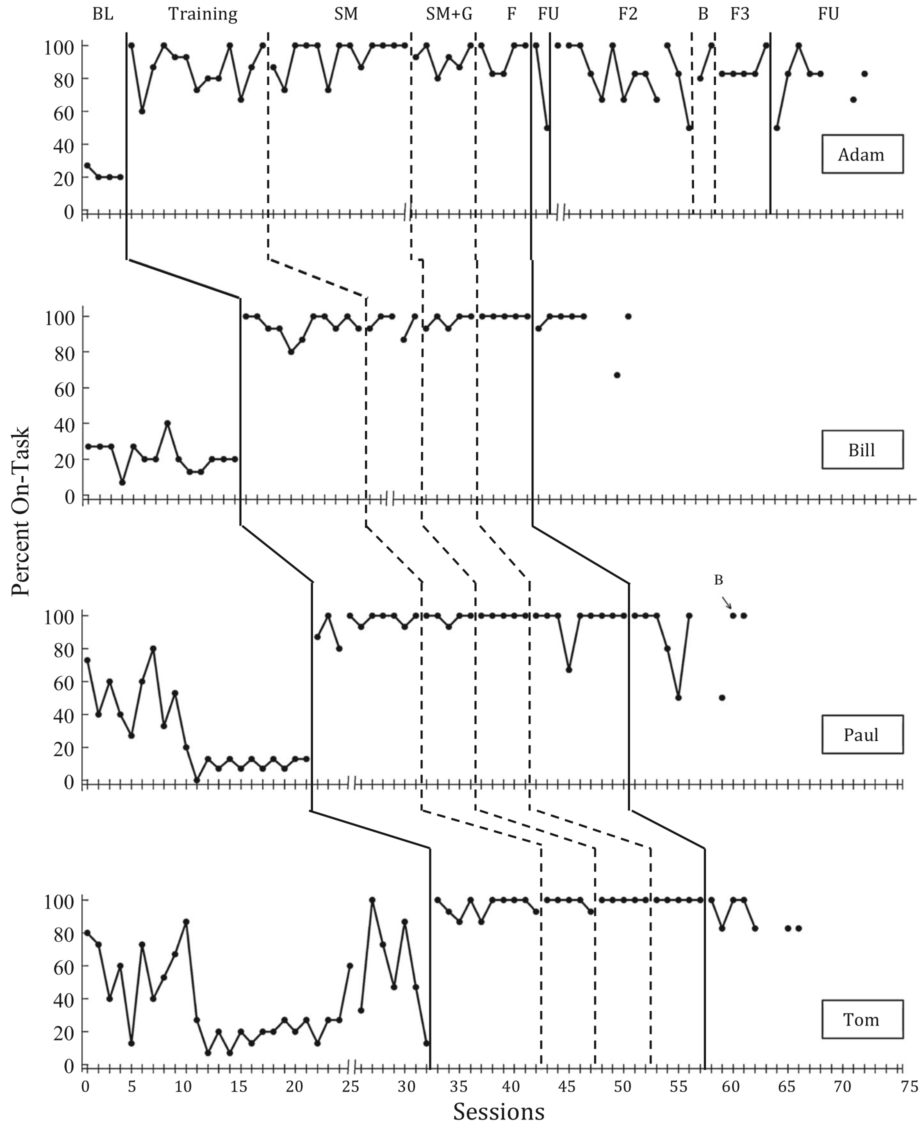

Fig. 1 Self-monitoring intervention across participants. *Note*. BL = baseline, SM = self-monitoring, SM + G = self-monitoring plus graphing, F = fading, F2 = fading 2, F3 = fading 3, B = booster session, FU = follow up. * = Session break due to prolonged illness. Adam was the only participant to receive the F2 and F3 phases

Prior to collecting IOA data, the paraprofessional was trained and practice sessions were conducted until both observers agreed for 100 % of intervals for each participant. Data were collected using the same participant watch settings: 2-min for baseline, training, self-monitoring, and self-monitoring plus graphing, and 5-min for fading, and follow-up. IOA was completed for approximately 40 % of sessions for each participant. It was calculated by dividing the number of agreements by the number of agreements plus disagreements. The mean agreement on the dependent variable across participants and phases was 95.3 % (67–100 %). Three sessions during baseline resulted an IOA of 67 %. Also, during the fading phase there were two sessions in which IOA was at 67 % due to two disagreements between observers. However when that occurred, both data collectors reviewed the definitions of on-task before collecting subsequent data.

To maintain fidelity of the intervention, the paraprofessional collected data on the first author as she implemented the WatchMinder intervention program with two of the four participants due to her availability. A checklist containing the 11-step training procedure was used for the first six sessions of training for both Paul and Tom, which consisted of 60 % of the training sessions. A step was marked as not applicable if the student was able to complete the step independently during the two previous sessions. For example, once the participant was able to retrieve the watch and checklist from the cabinet on his own, the researcher did not continue to show him how during subsequent sessions. Treatment fidelity data was calculated by dividing the number of steps the observer saw the trainer implement by the total number of steps in the training procedure multiplied by 100. Using this formula, 100 % percent of the steps in the training procedure were completed accurately.

Results

Figure 1 displays the effectiveness of WatchMinder on self-monitoring the on-task behavior of all four participants. The results reported in Fig. 1 include the data collected by the first author in the baseline and training phase, and participant data once they were responsible for collecting their own data during intervention phases.

The first panel of the graph in Fig. 1 displays Adam's results. Adam's baseline data revealed a mean percentage on-task of 23.5 % and a decelerating trend. When Adam entered the training phase his level of on-task behavior increased immediately and the mean for his on-task behavior was 86.15 %. His on-task behavior remained at very high levels during the self-monitoring and self-monitoring plus graphing phases (93.9 and 92.2 %, respectively). During the fading phase, Adam's mean percentage on-task was 93.2 %. As he entered the follow-up phase, he became very ill with the flu and was absent on and off for the next 5 weeks, a total of 24 school days. Increased variability during his cycles of illness created a need for additional fading phases and booster sessions as depicted in Fig. 1. Once Adam's health improved and he was in school consistently, his performance stabilized and returned to levels achieved previous to illness. During the Fading phase 3, his mean percentage of on-task behavior was 86.4 %. In the final follow-up phase, his mean percentage on-task decreased slightly to 76.2 %.

The results for Bill are shown in the second panel of the graph in Fig. 1. Baseline data for his on-task behavior revealed a mean of 21.5 %. A trend line using the split-middle method (Gast 2010) revealed a slight acceleration. However, since the level of his performance was very low (a median level of 20), the intervention was implemented. When the training was introduced, the level of Bill's on-task behavior increased immediately and remained above 80 % for the rest of the intervention. Bill's mean percentage of on-task behavior in the training phase was 94.5 %, self-monitoring 96 %, self-monitoring plus graphing 97.2 %, and fading 100 %. In the follow-up phase Bill maintained his on-task behavior at a mean of 91.1 %.

The third panel in the graph in Fig. 1 shows Paul's performance. The mean percentage of on-task behavior for Paul during baseline was 28.2 %. The trend for his baseline data revealed a significant deceleration, which warranted the need for intervention. During training his mean percentage of on-task behavior was 95.3 % with an accelerating trend, self-monitoring 98.6 %, self-monitoring plus graphing 100 %, and fading 96.3 %. During follow-up, Paul's performance was more variable than during any of the intervention phases and some of the problem behaviors he demonstrated during baseline began to reemerge. As a result, he was given a booster session in which he wore the watch set to the 5-min interval and assessed his performance. Immediately after asking Paul to get his watch and checklist, the problem behaviors diminished and he completed all of his work with 100 % of intervals on-task. In the final follow-up probe he was able to maintain his on-task behavior at 100 %. Paul's mean percentage on-task during this phase was 81.7 %. Paul's data in the follow up phase demonstrated a decelerating trend unlike the other intervention phases.

The fourth panel in the graph in Fig. 1 represents Tom's performance. Tom's baseline data were variable ranging from 7 to 100 % throughout the 32 baseline sessions; however, overall the trend within this phase was decelerating. His mean percentage of on-task behavior during baseline was 41.3 %. His mean percentage of on-task behavior in the training phase was 96 %, self-monitoring 98.6 %, self-monitoring plus graphing 100 %, and fading 100 %. Tom's data showed more variability in the follow-up phase than any of his intervention phases with a mean of 88.1 %, a decelerating trend that was not evident since the baseline phase. While this percentage of on-task behavior can be seen as acceptable during follow-up, he had four sessions at 83 %, which had not occurred since the beginning of the training phase.

In addition to measuring on-task behavior, participants' recording accuracy was measured during at least two sessions in each intervention phase for the four participants. The results revealed that all participants remained accurate in their self-recording behavior with a mean of 97.3 % accuracy.

Finally, percentage of non-overlapping data (PND) was calculated for each participant in order to assess the effect of the independent variable on the dependent variable (Gast 2010). For Adam and Bill PND equaled 100 %, and for Paul it was 92 %. In contrast, due to variability, three of Tom's baseline data points overlapped once the intervention was introduced.

Discussion

This study was conducted to answer three research questions. The first question was whether WatchMinder was an effective prompting device for increasing on-task behavior of students with ASD. Based on the functional relationship that was noted through replicated results across all four participants, it was evident that the WatchMinder was an effective prompting tool that contributed to their increased on-task behavior. All participants were able to increase their work productivity and independence while working at their seats.

The second question sought to determine the degree to which self-graphing and immediately analyzing progress had an effect on the participants' ability to increase on-task behavior. Compared to the self-monitoring phase, the addition of the graphing component contributed to a slight increase in on-task behavior for all participants except for Adam whose mean percentage of on-task behavior dropped slightly from 93.8 % to 92.2 %. It should be mentioned that since the amount of on-task behavior was already above 90 % for each participant, there was not much room for improvement when the graphing component was added. In addition, all participants verbally expressed that they liked graphing their results and were enthusiastic about discussing how well they were doing. Based on this information, the addition of the self-graphing component could have contributed to the increase in on-task behavior. However, it also could have been attributed to the participants becoming more comfortable and proficient with self-monitoring. Further research on the addition of this component is needed to determine the full effect of adding the graphing component into the intervention package.

The third research question asked whether participants would be able to maintain self-monitoring skills when WatchMinder was removed. According to the data, all participants were able to maintain their self-monitoring skills and their on-task behavior at a higher level than baseline. However, there was a decrease in the mean percentage of on-task behavior during follow-up when compared to previous intervention phases. Paul and Tom's follow-up data showed more variability during follow-up than any of the intervention phases. In addition, when the intervention was removed, Paul's problem behaviors began to redevelop as they did during baseline. The follow-up sessions revealed the same type of variability and slight decrease in on-task behavior for each participant.

Based on the information yielded from the follow-up data, a few assumptions can be made. First, the self-monitoring program may have been faded too quickly. A more systematic fading procedure may have been effective in helping participants maintain their self-monitoring skills. Rather than abruptly stopping use of the WatchMinder, requiring participants to wear it 3 days per week in the fading phase may have promoted increased maintenance of the skills once the WatchMinder was removed. Second, some individuals may require brief booster retraining sessions to help them maintain their skills. Therefore, a booster session can be used in which the individual would wear the WatchMinder for one session. The effectiveness of a booster session was demonstrated with Paul during the follow-up phase. Two booster sessions were also used with Adam after his cycles with illness when data became variable. After returning to the 2-min interval for two sessions, he was able to move back to using the 5-min interval successfully. While it is the goal for individuals to be able to maintain self-monitoring skills without prompting, this type of device would also be appropriate for long-term use for those with a greater degree of inattention (Milley and Machalicek 2012).

Self-monitoring is a lifelong skill that can be used in many facets of one's daily lives. There were several benefits to using this self-monitoring package in the classroom. First, it reduced the number of verbal prompts the teacher needed to give to her students. This allowed her more time to focus on the students she was teaching in a small group and it reduced problem behaviors that occurred from giving numerous prompts to the same students. McDougall et al. (2012) also indicated freeing up teacher time for more productive tasks as a benefit of teaching self-monitoring skills in the classroom.

In many classrooms teachers take the full responsibility for grading and reporting progress. However, when students become active participants in their educational programs, they can be more accountable for their performance and therefore need to self-manage themselves effectively. This can foster an increase in motivation, responsibility, self-reliance, and independence, which are skills all teachers should help students develop.

Another benefit to this type of self-monitoring program is the ease with which classroom teachers are able to implement it. Since students are responsible for monitoring themselves, it takes the pressure off of the teacher to persistently provide prompts. Amato-Zech et al. (2006) cited minimal teacher demands or curricular modifications to be a benefit of self-monitoring programs. With fewer demands on the teacher and more responsibility on the students, the WatchMinder intervention was ideal for this classroom environment. It may be more manageable for general education environments when there are a large number of students to monitor. However, it is ideal for a special education classroom because of varying student schedules and activities.

Tactile self-monitoring programs such as the one used in this study can be considered socially valid interventions because they are unobtrusive and contribute to a drastic increase in acceptable classroom behavior. Because the WatchMinder vibrates rather than beeps, most other students in the classroom are unaware of the watch going off. It also allows multiple students to wear watches based on their individual needs. One student can wear a watch that vibrates every 2 min, and another can wear one set to vibrate at every 5 or 10 min. Also, since the WatchMinder looks like a regular sports watch, it does not make the person wearing it stand out amongst others. In addition to being an unobtrusive prompting device, the data from this study, as well as others that investigated tactile prompting devices, showed a drastic increase in socially acceptable classroom and community behaviors (Green et al. 2011; Legge et al. 2010; Van Hulle and Hux 2006). In the classroom setting, when on-task behavior of a few students increases, the dynamic of the classroom can change and more learning can occur for everyone. Therefore, lessons and activities may flow better because more content can be covered.

Finally, it is possible that after developing self-monitoring skills, some students may be able to increase the amount of time they spend in general education classes. For example, once Tom learned to be aware of the specific behaviors he demonstrated were off-task, he was able to complete more work independently, and by the end of the school year Tom entered a general education classroom full time. This may not be solely a result of the WatchMinder intervention; however, it played a significant role that helped him gain the few skills he needed to help him keep up in the general education setting. It should also be noted that intervening in spite of Tom's unstable baseline did provide clinical benefit since he was able to increase his time on-task on a more consistent basis than during baseline.

Limitations

There were several limitations to this study. One limitation was the fact that two of the four participants had been previously exposed to the WatchMinder during the previous school year. In the previous school year, Adam used the WatchMinder to target participating in a small group lesson during reading instruction. While the watch cued him to assess his behavior similar to how it was used in this study, it was not used systematically or on a daily basis. Tom used the WatchMinder to target completing tasks within a given time period using the reminder mode. The watch vibrated once at the end of his work session and if he was finished with his task he earned a star on his behavior chart. This procedure is different from the one used in the current study because the watch did not provide prompts cueing him to monitor his behavior during his work session. Since the watch only vibrated once at the end of his work session, Tom's unstable baseline data in this study should not be attributed to previous exposure since the method in which he used the watch was very different and did not target on-task behavior. In addition, aside from Tom's unstable baseline, the results of the participants who had pervious exposure to WatchMinder were no different from the other two participants. While intervening for Tom in spite of his unstable baseline is a limitation of this study because it broke the research protocol for this intervention, it was done for the benefit of the student rather than for scientific purposes.

Other limitations were winter break and student illness. Winter break did not appear to have an effect on the data for Adam, Bill, and Paul who had already been introduced to the intervention program. However, Tom's baseline data was impacted for a few days when he returned from break. During the study period, all participants missed at least 2 days of school due to illness. However, Adam missed a total of 24 days of school due to a virus. After he began the cycle of illness, his data became more variable.

There were also some limitations related to the WatchMinder itself. First, the WatchMinder has precise charging procedures. If it was not charged properly and lost battery power, it took several hours to recharge and reset. The battery indicator did not always show when it needed to be charged. Therefore, it was important to keep track of the last time the watches were charged and to make sure they were in fact charging once plugged in. Second, there is only a fixed interval option on the WatchMinder. However, a variable interval may be more effective so students cannot anticipate when the watch will go off. Legge et al. (2010), Holifield et al. (2010), and Amato-Zech et al. (2006) also called for the need for a variable interval schedule so behaviors would be more resistant to extinction.

An additional limitation of this study was that treatment fidelity data were only taken for two of the four participants. Several other responsibilities for the classroom paraprofessional, including transporting students to other classes and assisting in fine arts classes, contributed to limited availability to collect treatment fidelity data for Adam and Bill. While she was in the room for a portion of their session, she would have been unable to consistently collect data on all steps of the training procedure. The classroom schedule was altered during the training phase so the paraprofessional was available to collect the remaining treatment fidelity data as well as IOA data later in the study.

Implications for Future Research

The use of tactile cued self-monitoring remains the most underutilized form of self-monitoring interventions (McDougall et al. 2012). However, the research on WatchMinder and other tactile prompting devices such as MotivAider are promising. The results demonstrated that these self-monitoring programs are effective and can assist students to become more aware of their behaviors. However, there are many aspects of these programs that will require more research.

Future research should examine the effects of different fading procedures on participants' ability to maintain self-monitoring skills for an extended period of time. Various fading procedures including extending the time interval and extending the number of days the watch is worn per week should be compared. It will be important to discern how long students are able to maintain these skills to predict whether booster sessions are likely to be needed throughout a person's lifetime to help him/her maintain this essential skill, or whether continued use will be necessary.

Since there are many components that can make up a self-monitoring intervention package, the effect of specific components in conjunction with WatchMinder should be examined. For example, the effect of reinforcement being a part of the intervention package should be assessed. It is possible that there were added motivating operations in place when the reinforcer component was added and it may have affected the magnitude of the behavior change. Another component that should be researched is the effect of the self-graphing on the percentage of on-task behavior. In this study, self-graphing contributed to an increase in on-task behavior, but it was not clear whether self-graphing was the only factor that caused the increase since participants were also becoming more comfortable and proficient with the self-monitoring procedures.

The results of this study should also be extended to other behaviors and settings. Future research should examine the effect of students with ASD using WatchMinder in the general education setting. Since many students with ASD struggle to participate in general education classes due to difficulty focusing and keeping pace with the group, this may be an effective intervention for teaching the specific behaviors required for monitoring task engagement in a large group setting. Finally, future research should address generalization of self-monitoring skills to other subject areas, from individual to small group settings, from small group instruction to whole group instruction, and across target behaviors.

Acknowledgments The authors thank Elisa Cruz-Torres for assisting us with graphing.

References

Amato-Zech, N. A., Hoff, K. E., & Doepke, K. J. (2006). Increasing on-task behavior in the classroom: Extension of self-monitoring strategies. *Psychology in the Schools, 43*, 211–221. doi:10.1002/pits.20137.

Anderson, A., & Wheldall, K. (2004). The who, what, where, when, and why of self-monitoring of student behavior. *Australasian Journal of Special Education, 28*(2), 30–64.

Anson, H., Todd, J., & Casseretto, K. (2008). Replacing overt verbal and gestural prompts with unobtrusive covert tactile prompting for students with autism. *Behavior Research Methods, 40*, 1106–1110.

Bjorklund, D. F. (2012). *Children's thinking: Cognitive development and individual differences*. Belmont, CA: Wadsworth/Cengage Learning.

Blick, D. W., & Test, D. W. (1987). Effects of self-recording on high school students' on-task behavior. *Learning Disability Quarterly, 10*, 203–213.

Briesch, A. M., & Chafouleas, S. M. (2009). Review and analysis of literature on self-management interventions to promote appropriate classroom behaviors (1988–2008). *School Psychology Quarterly, 24*, 106–118. doi:10.1037/a0016159.

Callahan, K., & Rademacher, J. A. (1999). Using self-management strategies to increase the on-task behavior of a student with autism. *Journal of Positive Behavior Interventions, 1*, 117–122. doi:10.1177/109830079900100206.

Farrell, C. A., & McDougall, D. (2008). Self-monitoring of pace to improve math fluency of high school students with disabilities. *Behavior Analysis in Practice, 1*(2), 25–26.

Gast, D. L. (2010). *Single subject research methodology in behavioral science*. New York, NY: Routledge.

Green, J. M., Hughes, E. M., & Ryan, J. B. (2011). The use of assistive technology to improve time management skills of a young adult with an intellectual disability. *Journal of Special Education Technology, 26*, 13–20.

Holifield, C., Goodman, J., Hazelkorn, M., & Heflin, L. J. (2010). Using self-monitoring to increase attending to task and academic accuracy in children with autism. *Focus on Autism and Other Developmental Disabilities, 25*, 230–238. doi:10.1177/1088357610380137.

Joseph, L. M., & Eveleigh, E. L. (2011). A review of the effects of self-monitoring on reading performance of students with disabilities. *The Journal of Special Education, 45*, 43–53. doi:10.1177/0022466909349145.

Koegel, R. L., & Koegel, L. K. (1990). Extended reductions in stereotypic behavior of students with autism through a self-management treatment package. *Journal of Applied Behavior Analysis, 23*, 119–127.

Lee, S., Simpson, R. L., & Shrogen, K. A. (2007). Effects and implications of self-management for students with autism: A meta analysis. *Focus on Autism and Other Developmental Disabilities, 22*, 2–13. doi:10.1177/10883576070220010101.

Legge, D. B., DeBar, R. M., & Alber-Morgan, S. R. (2010). The effects of self-monitoring with a MotivAider on the on-task behavior of fifth and sixth graders with autism and other disabilities. *Journal of Behavior Assessment and Intervention in Children, 1*, 43–52.

Mancina, C., Tankersley, M., Kamps, D., Kravits, T., & Parrett, J. (2000). Brief report: Reduction of inappropriate vocalizations for a child with autism using a self-management treatment program. *Journal of Autism and Developmental Disorders, 30*, 599–605.

McDougall, D., Morrison, C., & Awana, B. (2012). Students with disabilities use tactile cued self-monitoring to improve academic productivity during independent tasks. *Journal of Instructional Psychology, 39*(2), 119–130.

Miller, K. J., Fitzgerald, G. E., Koury, K. A., Mitchem, K. J., & Hollingsead, C. (2007). KidTools: Self-management, problem solving, organizational, ad planning software for children and teachers. *Intervention in School and Clinic, 43*, 12–19. doi:10.1177/10534512070430010201.

Milley, A., & Machalicek, W. (2012). Decreasing reliance on adults: A strategic guide for teachers of students with autism spectrum disorders. *Intervention in School and Clinic, 48*(2), 67–75. doi:10.1177/1053451212449739.

Parker, D., & Kamps, D. (2011). Effects of task analysis and self-monitoring for children with autism in multiple social settings. *Focus on Autism and Other Developmental Disabilities, 26*, 131–142. doi:10.1177/1088357610376945.

Richards, S. B., Taylor, R. L., & Ramasamy, R. (2014). *Single subject research: Applications in educational and clinical settings*. Belmont, CA: Wadsworth Cengage Learning.

Sebag, R. (2010). Behavior management through self-advocacy. *Teaching Exceptional Children, 42*(6), 22–29.

Soares, D. A., Vannest, K. J., & Harrison, J. (2009). Computer aided self-monitoring to increase academic production and reduce self-injurious behavior in a child with autism. *Behavioral Interventions, 24*, 171–193. doi:10.1002/bin.283.

Trammel, D. L., Schloss, P. J., & Alper, S. (1994). Using self-recording, evaluation, and graphing to increase completion of homework assignments. *Journal of Learning Disabilities, 27*, 75–81.

Van Hulle, A., & Hux, K. (2006). Improvement patterns among survivors of brain injury: Three case examples documenting the effectiveness of memory compensation strategies. *Brain Injury, 20*, 101–109.

Wilkinson, L. A. (2008). Self-management for children with high-functioning autism spectrum disorders. *Intervention in School and Clinic, 43*, 150–157. doi:10.1177/1053451207311613.