Implementing self-monitoring to reduce inappropriate vocalizations of an adult with autism in the workplace

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ABSTRACT

Individuals with autism spectrum disorder (ASD) are capable of competitive employment and can work successfully in community businesses. However, it is common for individuals with ASD to be unemployed or underemployed at higher rates than other groups with disabilities and the population at large. ASD encompasses a range of behaviors with the potential to interfere with productivity within the workplace. Research has supported management of these behaviors, through methods such as self-monitoring, may improve community access and employment. A singlesubject withdrawal design was utilized to evaluate the functional relationship between implementation of the I-Connect self-monitoring intervention and inappropriate vocalizations, with secondary measurement of work engagement and hair pulling behaviors. An adult female with ASD received training on the use of the I-Connect self-monitoring application in her work place medical records setting. Introduction of the I-Connect self-monitoring application resulted in an immediate decrease in inappropriate vocalizations. Social validity measures suggest the application was easy to utilize and may be beneficial in increasing a person's perceived ability to regulate inappropriate vocalizations in a work environment.

1. Introduction

Despite the fact that many adults with autism spectrum disorder (ASD) are capable of competitive employment and can work successfully in community businesses (Capo, 2001), most are unemployed or underemployed throughout their working careers (Cimera & Cowan, 2009; Cimera, Wehman, West, & Burgess, 2012; Henninger & Taylor, 2013; Schall et al., 2015). Adults with ASD have higher rates of unemployment than other groups with disabilities (Howlin, Moss, Savage, & Rutter, 2013; Roux et al., 2013; Schall, Wehman, & Carr, 2014), and the population at large (Hurlbutt & Chalmers, 2004; Robertson, 2010). Results from a survey of 66 young adults with ASD indicated 25% of respondents had no (or few) formal day activities after completing secondary school (Taylor & Seltzer, 2011). Only 6% of the 66 young adults surveyed indicated they were competitively employed, where competitive employment is defined as: earning at least minimum wage; working with people with and without disabilities; and having the same pay, benefits, and opportunities to succeed and be promoted as their typically developed co-workers without receiving supports or adult day services (Taylor & Seltzer, 2011).

Further, individuals with ASD who are employed often report underemployment and difficulty maintaining employment (Hendricks, 2010). Not only does lack of employment, underemployment, and alternating employment likely limit the future success of individuals diagnosed with ASD, it also contributes to stress, depression, isolation, and financial insecurity (Goode, Rutter, &

Howlin, 1994; Muller, Schuler, Burton, & Yates, 2003). The World Health Organization (2001) has reported the importance of an individual's ability to work and its relationship with one's independence, health, and well-being. However, families, health care professionals, and educators report being unclear about the future of those with ASD due to limited employment options (Holwerda, van der Klink, Groothoff, & Brouwer, 2012; Schall et al., 2014; Shogren & Plotner, 2012; Watson, Hayes, Radford-Paz, & Coons, 2013).

ASD is associated with qualitative impairments in communication, social interactions, and stereotypic/repetitive behaviors, each of which have the potential to interfere with engagement and productivity within the workplace. Stereotypic behavior, also known as stereotypy, encompasses a vast array of motor and vocal behaviors. These complex stereotypic behaviors are thought to serve sensory, stimulatory, and communication functions (Reed, Hirst, & Jenkins, 2014). However, these behaviors often lead to inhibited task completion, disrupted instructional routines, and deficits in social interactions, while propagating the stigma of disabilities and ASD (Kennedy, Meyer, Knowles, & Shukla, 2000; Lanovaz et al., 2014). Research suggests management of these stereotypic behaviors may improve learning opportunities (Cervantes, Matson, Williams, & Jang, 2014), increase social interactions (Lee, Odom, & Loftin, 2007), and improve community access, including employment (Reid, Parsons, & Lattimore, 2010).

Unfortunately, there is a paucity of research identifying effective interventions for addressing behaviors that interfere with successful employment outcomes for adults with ASD (Westbrook et al., 2012). For example, in a literature review, Westbrook et al. (2012) found limited studies related to the effectiveness of adult employment interventions in securing and maintaining employment for adults with ASD. Their literature review initially revealed 8528 studies, from which 77 studies were selected for a full review. However, upon examination only two studies met the inclusion criteria (e.g., Garcia-Villamisar, Ross, & Wehman, 2000; Mawhood & Howlin, 1999), leaving the authors unable to definitively identify an intervention that could predictably result in positive employment outcomes for those with ASD.

A more recent systematic review of interventions to promote employment for adults with autism examined the effect of behavioral-skills training, video-based instruction, or self-management practices on skills likely to increase employment opportunities (Anderson et al., 2017). They identified nine behavior-skills training studies ($N = 37$ participants), five video-based studies ($N = 14$), and four self-management studies ($N = 11$), which met their inclusion criteria. Only behavior-skills training met the replication standards needed to consider the intervention to be effective and evidence-based for individuals with ASD in a work setting. The authors reported studies on video-based instruction and self-management procedures in the workplace are emerging, but few studies have been published. Anderson et al. (2017) proposed these interventions did not reach evidence-based status due to the limited number of research studies available. However, they reported that the studies available are promising approaches, with the potential to capitalize on independent functioning in a work place environment.

2. Self-Monitoring

Self-management interventions often utilize a number of self-management strategies such as self-assessment, self-instruction, self-reinforcement, and self-monitoring (Kamps & Tankersley, 1996). Self-monitoring refers to an individual systematically observing his own behavior and responding to the occurrence or non-occurrence of a specified target response (Cooper, Heron, & Heward, 2007). Self-monitoring has a robust evidence-base for improving outcomes of individuals with ASD in school settings. For individuals with ASD, self-monitoring has been primarily evaluated in school settings, improving such outcomes as on-task behaviors (e.g., listening to the teacher and completing assigned tasks; Stasolla, Perilli, & Damiani, 2014), decreasing disruptive (e.g. physical aggression, talking out) and noncompliant behaviors (e.g. wandering from assigned location, not following adult directives; Koegel, Koegel, Hurley, & Frea, 1992; Shogren, Lang, Machalicek, Rispoli, & O'Reilly, 2011) along with reciprocal conversation (Koegel, Park, & Koegel, 2014) and initiations (Reynolds, Urruela, & Devine, 2013). Research has also indicated self-monitoring was an effective intervention for decreasing stereotypy and promoting independence (Ganz, Heath, Davis, & Vannest, 2013; Shabani, Wilder, & Flood, 2001).

While strong evidence supports self-monitoring for students with ASD in school settings, the impact of self-monitoring on addressing skill deficits and excesses for adults with ASD in the workplace is limited. One study by Ganz and Sigafoos (2005) demonstrated the promise of self-monitoring for addressing the workplace behaviors of adults with ASD. Ganz and Sigafoos (2005) demonstrated the effectiveness of self-monitoring for two individuals (one with autism and one with an intellectual disability) in a school-based vocational training program. Results revealed self-monitoring was effective in increasing work-based independent task completion and verbal requesting, yet evidence supporting self-monitoring in the workplace is limited.

Technological advancements may help advance self-monitoring in the workplace. A recent study examining self-monitoring procedures noted an electronic device produced more effective and efficient outcomes compared to paper and pencil assessment (Bouck, Savage, Meyer, Taber-Doughty, & Hunley, 2014). In addition, social validity measures have demonstrated youth with ASD enjoy working with electronic devices to learn on-task behaviors (Xin, Sheppard, & Brown, 2017). Research has also demonstrated self-monitoring strategies can be adapted for various levels of functioning (Pierce & Schreibman, 1994: individuals with intellectual disabilities; Loftin, Odom, & Lantz, 2008: individuals with fluent language and high cognitive functioning). Given the promise of technology-based self-monitoring, technological advances, and the ability to adapt self-monitoring strategies to individual development, more research is needed to extend this evidence base to adults with ASD.

One promising recent advancement in self-monitoring is the use of technology-based self-monitoring, such as the I-Connect application (Wills & Mason, 2014). I-Connect is a technology-based self-monitoring application, which can be utilized on a variety of electronic devices to provide prompts and structure for self-monitoring. The I-Connect application allows for the customization of prompt questions and statements (e.g., "Are you on task?", "Are you being appropriate?"), frequency of prompts (e.g., 30 s, 60 s), and alert type (e.g., chime, vibration, or flash).

The I-Connect self-monitoring application is cumulating empirical support as an effective self-monitoring intervention (Clemons, Mason, Garrison-Kane, & Wills, 2015; Wills & Mason, 2014) and has demonstrated promising preliminary effects on the reduction of stereotypic and disruptive behaviors in individuals with autism (Crutchfield, Mason, Chambers, Wills, & Mason, 2015; Rosenbloom, Mason, Wills, & Mason, 2015). For example, Crutchfield et al. (2015) utilized an ABAB reversal design with an embedded multiple baseline design across participants to examine the implementation of the I-Connect self-monitoring application with two 14-year-old students with ASD who engaged in stereotypy. Implementation of the I-Connect application resulted in a decrease of stereotypic behaviors from baseline (60%–100% of intervals) to intervention (40% of intervals). Rosenbloom et al. (2015) obtained similar results with a 9-year-old male with autism who demonstrated disruptive behavior in a general education classroom. Utilizing an ABAB design, the functional relationship between the implementation of the I-Connect self-monitoring intervention and an increase in on-task behavior with concurrent decreases in disruptive behavior was established. The study reported an increase in on-task behavior from baseline (22.45% average on task) to intervention (83.1% average on task), along with a decrease in disruptive behavior from baseline (41.2 disruptive behaviors per session) to intervention (no more than 5 disruptive behaviors per session) (Crutchfield et al., 2015; Rosenbloom et al., 2015).

The current study addresses the pressing need for easily implemented interventions which promote autonomy and success for individuals with autism in a workplace setting. Even though many adults with ASD are capable of competitive employment and can work successfully in community businesses, individuals with ASD have higher rates of unemployment than other groups with disabilities and the population at large. ASD is associated with qualitative impairments in communication, social interactions, and repetitive behaviors, which have the potential to interfere with productivity within the workplace. Though it is evident impairments associated with ASD are related to unsuccessful employment, there is a paucity of research identifying effective interventions for addressing behaviors that interfere with successful employment outcomes for adults with ASD. This study addresses this gap in the literature by expanding previous research findings which have supported management of these behaviors through self-monitoring in other important domains to the work place setting, specifically. Furthermore, the current study seeks to contribute to the literature on technology-based self-monitoring through the utilization of the I-Connect application in the workplace environment for an adult with ASD, an area which technology-based self-monitoring has not been investigated.

The primary research question for this study is: To what extent does implementing self-monitoring reduce the inappropriate vocalizations on an adult with ASD in the workplace? A secondary research question for this study is: Does self-monitoring and any decreases in inappropriate vocalizations adversely affect the participant's levels of engagement and hair pulling? Finally, this study addresses the question: What is the social validity of the self-monitoring intervention as reported on a social validity survey?

3. Method

3.1. Participant, setting, and materials

3.1.1. Participant

A thirty-year-old Caucasian female, pseudonym Audrey, working in a medical records position, volunteered and provided informed consent to participate in the research study. The study was approved by an institutional ethics review board. Audrey was diagnosed with autism at the age of 12, although prior to that she had been diagnosed with developmental aphasia and tactile defensiveness. She had also been diagnosed with ADHD and bi-polar disorder. Audrey's supervisor referred her for the study and noted her knowledge and capacity for doing the work. Audrey needed additional workplace support as she had received supervisor warnings indicating her position at the medical records office was at risk. Her supervisor noted this was because of her inappropriate behavior with the primary concern being her inappropriate vocalizations. The supervisor also noted that Audrey occasionally lost focus while she pulled her hair or otherwise became disengaged, both leading to accuracy problems.

Audrey had a medical records certification and had been employed in medical records for 7 years. Her work supervisor noted that Audrey's primary inappropriate behavior was her high level of perseverative talk and inappropriate vocalizations. This presented as near constant mumbling, occasional swearing, and at times psychosis, as she would answer as if someone was talking and saying disparaging remarks towards her. Audrey also had a restrictive interest in writing anime stories (traditionally Japanese animation) that were often violent. In previous years, Audrey had been warned at work that she could not write the stories while doing her job and that she could no longer have her cell-phone while working, as she would use it to type out her stories. Audrey attributed much of her inappropriate vocalizations to developing stories, although direct observation indicated that she would also occasionally mumble statements such as "I know I shouldn't do that." While appearing to be telling her story, some words were inaudible yet occasionally phrases such as "I will murder you" or "Kill" or "You will die" could be heard which were attributed to the violent nature of her stories. Often when Audrey's inappropriate vocalizations escalated, she disengaged, began to make errors while checking documents for accuracy, or inaccurately completed documents. In addition to her inappropriate vocalizations, Audrey struggled with Trichotillomania (she had previously pulled her hair to a bald spot) and had received clinical support practicing strategies to avoid and block it, such as wearing a hat if necessary. No medication changes occurred for Audrey throughout the course of the study, as she was taking numerous medications as prescribed by her Psychiatrist.

3.1.2. Setting

The location of the study was a medical records office at Audrey's place of employment which was located in the United States, in an urban area of a large Midwestern City. Her primary work was conducted at a desk with a desktop computer and a document scanner. Her desk was in an office (approximately 12 × 15 ft) with three other desks and 1–2 co-workers were in the room doing

similar tasks throughout the study. While the tasks of her job varied, her primary responsibility was to check medical records to confirm they were properly filled out and that the appropriate billing codes were associated with the forms. She most commonly entered information into data sheets on her computer and scanned documents. Audrey occasionally delivered and retrieved documents from other offices throughout her building. The first author along with a research assistant signed confidentiality agreements to be in the office and several measures were taken to assure that they did not hear about or see confidential information.

3.1.3. Materials

The primary material used for this study was a Samsung Galaxy Tablet (Galaxy Tab 4 8GB, 7-inch LCD screen and a 1.2 GHz Quad Core Processor) with the I-Connect self-monitoring application (Wills & Mason, 2014). The customized prompt utilized in this study was "Are you being appropriate?" The cue was preset to appear at 1 min intervals with a notification (chime). The application provided response options (large color-coded buttons) of "yes", "sometimes", and "no". By tapping on the button and selecting an answer, the cue went away until the next 1 min interval. Responses were immediately uploaded to a secure database through a wireless internet connection. If the initial cue was not responded to after 15 s, a "no response" was recorded in the database and the cue terminated until the next 1 min interval. In addition to this tablet, an iPad and iPad stand were used to record all sessions. The iPad was set next to Audrey's desk so that she and her work area were visible. Research participants also utilized customized recording sheets, which were appropriate to monitor Audrey's behavior.

3.2. Experimental design and measurement

An ABAB single-subject withdrawal design was utilized to evaluate the functional relationship between implementation of the I-Connect self-monitoring intervention and a decrease in inappropriate vocalizations. All phase change decisions were based on this primary dependent variable of inappropriate vocalizations. In addition, the design and measurement allowed for careful observation of any concomitant changes in engagement and hair-pulling behavior associated with the introduction of self-monitoring. Although withdrawal designs only have one participant, this methodology allows for a high level of experimental control when methodically implemented (Byers, Reichle, & Symons, 2012; Kratochwill et al., 2013). The study maintained a high degree of rigor including demonstration of effect at three separate times, a minimum of five data points per phase, and systematic implementation and withdrawal of the intervention (Kratochwill et al., 2013).

3.2.1. Dependent variables

The primary dependent variable in this study was the percentage of 10 s intervals in which Audrey exhibited inappropriate vocalization behavior. Inappropriate vocalizations were operationally defined as audible mumbling, swearing, aggressive self-talk (e.g., "I will murder you" or "Kill" or "You will die"), story narration, and other non-work-relevant self-talk. Inappropriate vocalizations did not include incidents in which Audrey spoke to her co-worker socially or to ask a work-related question. The target behavior was recorded using 10 s, partial interval recording during 10 min observations. Presence of the behavior was recorded as occurring if inappropriate vocalizations occurred at any time during a given 10 s interval. An interval timing application set to 10 s intervals was utilized on an iPhone.

Engagement was a secondary measure and was defined as Audrey actively working, including typing, entering data, visibly scanning a document or her computer screen, appropriately discussing a work-related topic, faxing, filing, or otherwise actively completing an assigned task. This was collected to assure that any changes in inappropriate vocalizations did not adversely affect engagement, as it would be counterproductive to decrease inappropriate vocal behavior without maintaining engagement in work tasks. Momentary time sampling with 10 s intervals was utilized to measure work engagement.

Hair pulling was also initially recorded as a secondary measure and was recorded using the same methods of partial-interval recording as described above. Hair pulling was defined as pulling on or the process of laying out pulled hair, finding stray hairs in her ponytail holder (or hair tie), or adjusting or pulling at her pony tail. This was collected to assure that monitoring did not increase hair pulling as an adverse outcome of decreasing inappropriate vocalizations.

3.2.2. Interobserver agreement

Two research assistants were trained as independent observers for the purpose of collecting interobserver agreement (IOA) data. The second observer met with the primary observer to: a) review operational definitions and procedures for data collection and b) code video recorded clips of observational sessions until reaching 90% agreement across all variables. Video recorded session files were randomly selected across all conditions of the study for IOA. Thirty-four percent (11 of 32) of sessions were coded for IOA which was calculated using the point-by-point agreement method: the number of agreements divided by the number of agreements + the number of disagreements × 100. The mean inter-observer agreement for the primary dependent variable of inappropriate vocalizations was 83.7% (range 78%–91%). The agreement for the secondary variables of engagement was 95.2% (range 85%–100%) and hair pulling was 98.5% (range 93%–100%).

3.2.3. Self-monitoring accuracy

For this study, the accuracy with which Audrey self-monitored was collected as an indicator of treatment fidelity. To record self-monitoring accuracy, observers recorded a 1 = Agree or 2 = Disagree with each instance that Audrey monitored. If, for example, Audrey recorded a "Yes" response and the observer agreed she was appropriate at that moment, then an agreement was recorded.

3.2.4. Social validity

Social validity was measured through a short self-report survey. The survey contained four items which detailed an individual's self-monitoring experience. Three of the four items were on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*very much so*). The three Likert items included "*monitoring helped me be more appropriate*", "*monitoring helped me be more on task*", and "*monitoring helped me be more accurate.*" The final item was open ended ("*What was it like to use the tablet to monitor?*") which allowed the respondent to comment on her experience.

3.3. Procedures

The first author and the graduate research assistant trained to be reliable in the data collection procedures and collected data for all sessions. All data collection sessions occurred in the morning in Audrey's office at her desk, which was located in the medical service records building, during regularly scheduled work tasks. Data collection occurred over the course of three weeks with an average of nine data points per week, with each data point representing a data session that was 10 min in length.

3.3.1. Baseline

Baseline data sessions were collected during the participant's regularly scheduled work hours during typical work-related activities as assigned by her supervisor. She sat at her desk and, other than being asked to not verbally mention patient names or specific information, she conducted "business-as-usual." Business-as-usual involved Audrey entering and verifying medical data as assigned. During baseline, when Audrey engaged in audible inappropriate vocalizations, research staff did not redirect her behavior. A minimum of five data points was collected.

3.3.2. I-Connect self-monitoring training

Once a stable pattern of responding was established and a minimum of five data points collected, training to instruct Audrey on how to utilize the I-Connect self-monitoring application began. Training was led by the primary author in a small conference room at her place of work. Audrey, her supervisor, and the research assistant were present throughout the 30 min training. Training began with a discussion of Audrey's strengths at work with input from Audrey and her supervisor. Audrey was then asked to identify barriers to her success at work. She identified that her accuracy was very important and that as she had been previously warned, when she was disengaged or talking to herself about things other than work, she did not perform as well with regards to accuracy. An overview of the I-Connect self-monitoring application was then given with an initial rationale for how it may be able to help with the inappropriate vocalizations and improve her success at work. The target behavior for self-monitoring was being appropriate ("Are you being appropriate?") which was defined as the lack of inappropriate vocalizations while engaging in work activities (e.g., entering and verifying medical data as assigned). Audrey then practiced and received feedback identifying examples and non-examples from a baseline video of herself working. This discrimination training lasted approximately 7 min and also served as an opportunity for Audrey to practice using the tablet and self-monitoring application. To conclude training, Audrey was provided a slip of paper and asked to provide 1–3 goals that would remind her why it would be important for her to self-monitor. She wrote out, "1. I need to keep my job 2. I need to be more accurate 3. I need to stop annoying my co-workers." Following training she taped the goals to the bottom of her computer monitor where she would easily see them.

3.3.3. I-Connect self-monitoring practice sessions

Immediately following this 30 min training, two 8 min practice sessions were conducted during which Audrey used the self-monitoring application at her desk while conducting her typical work. Two practice sessions were conducted in order to determine if Audrey was utilizing the application correctly and answering the prompts accurately. During the practice sessions, the primary author recorded Audrey's inappropriate vocalizations using 10 s partial interval recording. The I-Connect self-monitoring application was set to cue Audrey at 1 min intervals with a notification (chime). The primary author's observations of Audrey's inappropriate vocalizations, at the time of the application cue, matched Audrey's response on the application at a rate of 93.7%. This suggested Audrey was accurately utilizing the self-monitoring device and was responding in an accurate manner.

3.3.4. Intervention

Intervention sessions began immediately following the conference room training and two practice sessions with Audrey self-monitoring at her desk. Prior to beginning data collection, the device was placed on Audrey's desk next to her keyboard and she was instructed to start the I-Connect application, programmed to prompt at 1 min intervals. At the end of the 1 min interval, the device would chime and the question, "Are you being appropriate?" with "yes", "no", and "sometimes" response options appeared on the screen. Once Audrey selected an answer, the cue went away until the next 1 min interval. Planned reinforcement, including social praise, was not provided by the research staff for appropriate behavior or responding.

3.3.5. Withdrawal

After a minimum of five data points was collected and a clear pattern of decreased inappropriate vocalizations was established, the I-Connect self-monitoring device was removed. Data collection during this phase occurred in the same manner as baseline.

3.3.6. Reintroduction of intervention

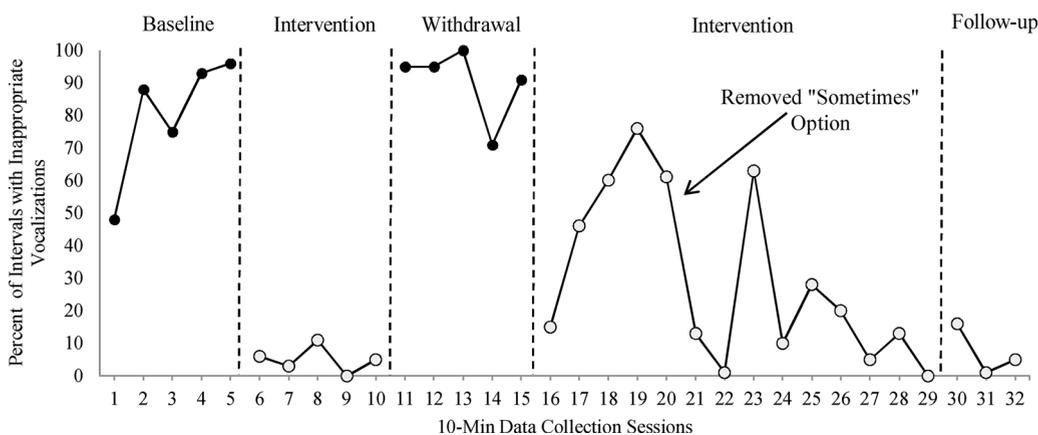Following collection of a minimum of five data points and demonstration of a clear pattern of increased inappropriate

Fig. 1. Percentage of intervals which contained inappropriate vocalizations per 10 min observation.
Note: The arrow represents the change in responses on the I-Connect self-monitoring application from 3 ("yes" "no" "sometimes") to 2 ("yes" "no") optional responses.

vocalizations during the withdrawal phase, the I-Connect self-monitoring application was reintroduced. Additional training did not occur prior to this phase. However, during the reinstatement of the I-Connect self-monitoring application, it was determined by the researchers to remove the "sometimes" response option (the 4th data point in the current phase/19th data point overall). The option to respond with "sometimes" was removed because researchers determined Audrey was utilizing the "sometimes" button in order to maintain occasional inappropriate vocalizations, such as mumbling under her breath or brief interruptions. After the 4th data point in this phase, Audrey was only allowed to respond to the prompt ("Are you being appropriate?") with "yes" or "no."

3.3.7. Follow-up

Three follow-up observations were conducted one month following the last intervention point utilizing the same observation procedures. Audrey utilized the I-Connect self-monitoring application during the follow-up observations at the same interval length she monitored during intervention.

3.4. Data analysis

Visual analysis of the graphical displays of data was utilized to evaluate the functional relationship between implementation of the I-Connect self-monitoring application and decreases in the percentage of intervals with inappropriate vocalizations. Visual analysis was also used to evaluate any changes in engagement and hair pulling behavior. Visual analysis included evaluation of mean, trend, and variability of data within and across phases.

4. Results

Fig. 1 displays the percent of intervals with inappropriate vocalizations across all conditions of the study. The x-axis indicates the session number and the y-axis indicates the percentage of intervals with inappropriate vocalizations. The vertical lines delineate the end of one phase and introduction of the next. Initial visual review of the graph indicates the design established experimental control with a minimum of five data points per phase, a stable pattern of responding prior to phase change, and three demonstrations of behavior change at different points in time (Kratochwill et al., 2013).

In Fig. 1, baseline data indicates an initial steep increase in inappropriate vocalizations after the first data point and then a gradual increasing trend throughout baseline. During baseline, inappropriate vocalizations occurred, on-average, for 80% (range 48%–96%) of intervals. However, during the last four baseline sessions, inappropriate vocalizations averaged 88% of intervals with a narrower range (75%–96%). Introduction of the I-Connect self-monitoring application resulted in an immediate decrease in inappropriate vocalizations as evident by the clear intercept gap and the absence of overlapping data when compared to baseline data. The response pattern during the initial I-Connect intervention phase was stable, with an average of 5% (range 0%–11%) of intervals per session in which inappropriate vocalizations occurred.

Withdrawal of the intervention yielded an immediate increase in the inappropriate vocalizations, returning to baseline levels. Comparison of data in the withdrawal phase to data in the initial intervention phase shows no overlapping data, indicating inappropriate vocalizations across all sessions in the withdrawal phase occurred at a much higher level than during the initial intervention phase. During the withdrawal phase, inappropriate vocalization occurred for an average of 90.4% (range 71%–100%) of intervals per session.

Reintroduction of the I-Connect intervention again yielded an immediate decrease in inappropriate vocalizations, similar to the initial intervention phase. Unlike the initial intervention phase, the data is rather variable with an increasing trend for the first 4 data points. Upon completion of the 4th data point in the reintroduction of the intervention phase, 19th data point overall, Audrey's
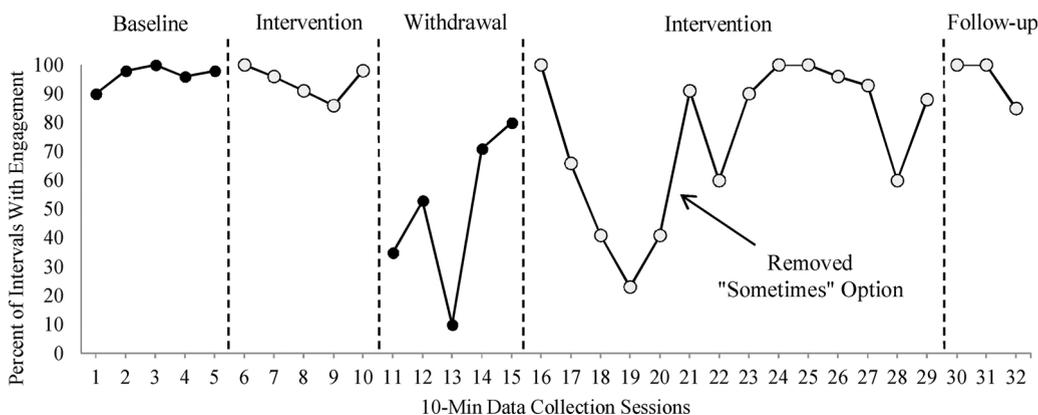
Fig. 2. Percentage of intervals with engagement per 10 min observation.
Note: The arrow represents the change in responses on the I-Connect self-monitoring application from 3 ("yes" "no" "sometimes") to 2 ("yes" "no") optional responses.

responses on the I-Connect self-monitoring application changed from three options ("yes", "sometimes", "no") to two ("yes" and "no") due to her tendency to utilize the "sometimes" button as a way of maintaining inappropriate vocalizations. That is, she noted that if she thought vocalizations were quiet and minor, she then began recording "sometimes". She agreed that the change to a simple "yes" or "no" option would make monitoring more effective and would be easier for her to determine. By the ninth data point in the reintroduction of the intervention phase, data once again stabilized with low levels of inappropriate vocalizations, averaging 12.67% (range 0%–28%) of intervals per session for the last 6 sessions.

Despite the variability in responding during the final phase, data indicated inappropriate vocalizations generally remained below the levels that occurred during the withdrawal phase, with only 1 overlapping data point. During the follow-up phase, Audrey's inappropriate vocalizations generally remained low, averaging 7.33% (range 1%–16%) of intervals per session for the 3 data points contained within the phase.

Fig. 2 shows the secondary variable of engagement, with an average engagement of 96.4% of intervals (ranging from 90%–100%) during baseline. With the use of the self-monitoring application, engagement remained high averaging 94.2% of intervals (range 86%–100%). For the duration of the withdrawal phase when the I-Connect self-monitoring application was removed, engagement dropped to 49% of intervals and was highly variable (range 10%–80%). The average percent of intervals with engagement during the reinstatement was 74.9%, ranging widely from 23% to 100%. During the follow-up phase, Audrey's engagement remained high, averaging 95% (range 85%–100%) of intervals per session for the 3 data points contained within the phase.

The secondary variable of hair pulling (Fig. 3) occurred infrequently and averaged 6.8% of intervals during baseline (range 1%–16%) and remained at a similar level during the first condition of intervention, averaging 4.8% of intervals (range 0%–10%). The withdrawal condition and the reinstatement of the intervention conditions both had low rates of hair pulling, averaging 1.4% (range 0%–3%) and 0.2% (range 0%–1%), respectively. This data was somewhat confounded with the adoption of a blocking or replacement strategy that Audrey utilized for two of the withdrawal condition sessions and one of the return to intervention conditions, as she wore a hat.
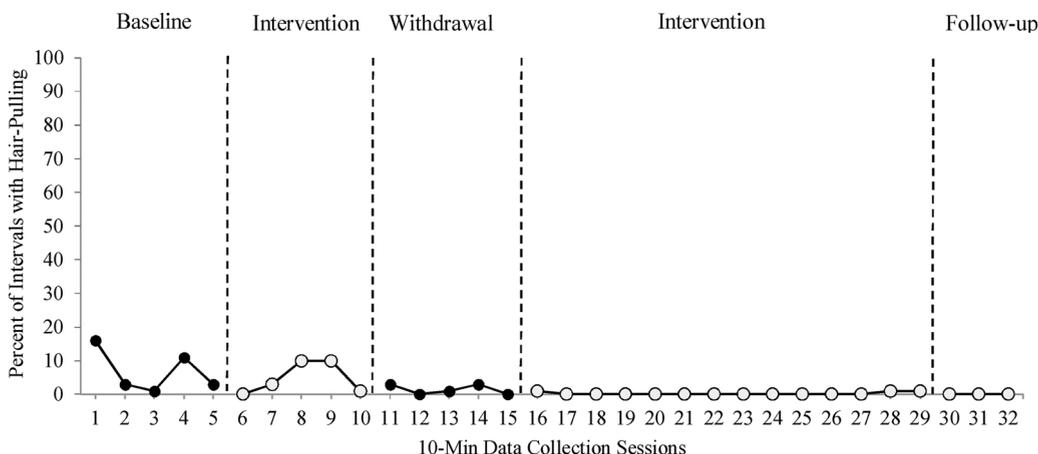

Fig. 3. Percentage of intervals which contained hair-pulling per 10 min observation.

4.1. Self-monitoring accuracy

Audrey accurately responded to the self-monitoring application for 93.7% of the initial intervention phase, and 85.8% and 90% accuracy during the return to intervention and follow-up conditions, respectively. Overall, Audrey inaccurately reported a total of 22 times where she responded with a "Yes" and 19 times where she responded with a "No." She accurately responded with "Sometimes".

4.2. Social validity

Audrey was administered the social validity survey 20 min after the final data point was collected. Audrey selected 3 (*very much so*) for all three Likert scale statements (e.g., *monitoring helped me be more appropriate, monitoring helped me be more on task, monitoring helped me be more accurate*) and wrote a one-word response of "Easy" to the final open-ended question (e.g., "*What was it like to use the tablet to monitor?*").

5. Discussion

The presence of vocal or motor stereotypy is a potential barrier to obtaining or sustaining employment for adults with ASD. Stereotypic behavior, common in individuals with ASD, can be disruptive in the workplace environment and also lead to reduced productivity and decreased precision. As a result, many individuals with ASD report difficulty finding or maintaining employment (Hendricks, 2010; Taylor & Seltzer, 2011). The ramifications of which include dependence on others, development of comorbid anxiety and depression, and loneliness (Muller et al., 2003). Empirically supported interventions aimed at improving the employment trajectories of adults with ASD are desperately needed, particularly interventions that support continued independence and autonomy. I-Connect self-monitoring application, which has been implemented to support students with autism in elementary and secondary school settings, may be one option. The I-Connect self-monitoring application capitalizes on the convenience of technology while also eliminating barriers of typical paper-pencil self-monitoring systems.

The current study, which has strong experimental control and sound internal validity, demonstrates a clear functional relationship between implementation of the I-Connect self-monitoring application and decreases in the participant's inappropriate vocalizations during work activities. The participant demonstrated an immediate decrease in inappropriate vocalizations with both introductions of I-Connect, although the second intervention phase did result in the presence of inappropriate vocalizations at a more variable rate. The participant's conservative evaluation of her behavior during the second introduction of I-Connect is compelling and a plausible explanation for the extinction burst, or increase in behavior targeted for reduction (Cooper et al., 2007). Audrey "redefined" the behavior goal despite the potential consequence of losing her job. Once the interventionist defined the behavior again, including clarification that a non-example included any inappropriate vocalization during the interval, the behavior began to decrease again. Removal of the I-Connect self-monitoring application resulted in an immediate increase in inappropriate vocalizations. Given these results, I-Connect is a promising option for supporting individuals with ASD in the workplace setting.

Another important finding of this study is that use of the I-Connect self-monitoring application did not interfere with the participant's ability to engage in her work tasks. The data indicates Audrey had a high level of engagement during the initial baseline, despite high levels of inappropriate vocalizations, which continued with the initial introduction of I-Connect. Her engagement did decrease with the removal of I-Connect and was higher, yet variable, with the reintroduction. The variability of engagement during the second I-Connect phase was inversely related to the frequency of inappropriate vocalizations, with high levels of engagement occurring when the frequency of inappropriate vocalizations was low.

Findings regarding the secondary variable of hair pulling indicated that the implementation of self-monitoring did not adversely affect an increase in hair pulling. Initial rates of hair pulling were low and rates remained low and even decreased to near zero rates throughout the final phases. Although hair pulling was nearly non-existent in the final phases of the study, this was confounded by her use of the strategy to wear a hat during some of the sessions.

Additionally, results of the social validity assessment indicate the participant perceived I-Connect as easy to utilize and helpful in self-management of behavior without compromising the ability to work. This suggests the I-Connect application is a viable option in a work setting and may be beneficial in increasing one's ability to regulate appropriate behaviors.

6. Limitations

As with all studies, the current one is not without limitations. The primary limitation is that despite strong experimental control, the study is limited to only one participant which precludes the ability to draw conclusions beyond the bounds of the current study. The results are consistent with previous workplace self-monitoring research (Ganz & Sigafoos, 2005). Given evidence that technology-based self-monitoring is more advantageous than traditional paper-pencil systems (Bouck et al., 2014) and the results of this study, more research evaluating I-Connect in the workplace is needed to support findings of the current study.

Future studies should consider alternative research design methods. A potential limitation to the study was the utilization of a withdrawal design because it had the potential, when removed, to hurt Audrey's employment status. Though Audrey's employment status was not affected by the withdrawal of the I-Connect self-monitoring intervention, it is important to consider the effect withdrawal designs may have on research participants. This consideration is even more important in natural and practical settings, such as the workplace. Therefore, other studies should consider utilizing a multiple baseline research design to investigate the effectiveness of the I-Connect application.

The study would be further strengthened if the prompt intervals had been systematically increased, to evaluate the effectiveness of fading the use of I-Connect. Currently, the results indicate that once I-Connect was removed, the behavior returned to baseline levels which is not ideal. Fading may be beneficial in reducing the negative effects of a withdrawal design by allowing the participant to slowly decrease their utilization of the I-Connect self-monitoring application and maintain their behavioral gains. Evaluation of procedures aimed at fading the intervention while maintaining intervention treatment effects is warranted.

7. Implications for future research

As noted, future research should evaluate the use of I-Connect across more participants with ASD in a workplace setting and also evaluate the efficacy of fading procedures. As this is the first evaluation of I-Connect in a workplace, there are multiple avenues left to explore. For instance, evaluation of the efficacy of I-Connect in a variety of workplace settings and across other behaviors is necessary. For example, in the current study, the participant's work task required sitting at a desk, which was conducive to utilizing I-Connect on a device. For other jobs that require moving around, such as working in retail, managing and responding to prompts on a device may prove too cumbersome, albeit still less complicated than paper-pencil systems. Additionally, research that evaluates the functional relationship between I-Connect and improvement in productivity and accuracy could be evaluated as well as improvement in skills across domains of communication, task completion, and organization.

8. Practice implications

Future research is needed and practical implications should be applied with caution. Workplace managers and supervisors may consider working with an employee to set goals and identify areas for self-monitoring. This may provide structure which encourages staff to work together, while reducing problem behaviors and improving employee engagement. Self-monitoring could be utilized earlier in the workplace environment upon employment to assist with the appropriate acquisition of skills, and then faded as appropriate. In addition, self-monitoring maybe utilized in promoting the generalization and maintenance of skills from workshops and trainings into the workplace environment.

Conflicts of Interest

None.

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