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BRIEF REPORT

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Caregiver-implemented toilet training procedures for children with autism spectrum disorder

Hope A. Dabney[1] | Jordan DeVries[1] | Corina Jimenez-Gomez[2]

[1]Department of Psychological Sciences, Auburn University, Auburn, Alabama, USA

[2]Department of Psychology, University of Florida, Gainesville, Florida, USA

Correspondence
Corina Jimenez-Gomez, Department of Psychology, University of Florida, 945 Center Dr., Gainesville, FL 32611, USA.
Email: cjimenezgomez@ufl.edu

Abstract

Children with Autism Spectrum Disorder often exhibit deficits in daily living skills, including toileting skills. Previous studies have evaluated components of common toilet training practices, including differential reinforcement, sit schedules, fluid loading, underwear, and wet alarms. The purpose of this study was to replicate and extend previous work by delivering all coaching remotely. Three caregiver-child dyads participated in this study. A researcher coached caregivers on the implementation of the protocol using a modified behavioral skills training approach via telehealth. Caregivers submitted daily toileting data and weekly audio recordings for treatment integrity checks. The sit schedule fading was individualized to meet the needs and preferences of each family. All caregivers implemented the protocol with high integrity. Two participants met the mastery criteria at the 90-min sit schedule and maintained performance at the 1- and 6-week maintenance follow up probes. The third participant, despite an interruption of treatment, also reached mastery.

KEYWORDS
autism spectrum disorder, caregiver training, continence, telehealth, toilet training

1 | INTRODUCTION

Many children with Autism Spectrum Disorder (ASD) display delays in developing independent daily living skills, such as dressing, feeding, personal hygiene (brushing teeth, showering, laundry, etc.), and toileting (Matson et al., 2009). The delay in mastering toilet training can result in various challenges for families. Caregivers of children without inde-

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pendent toileting skills report higher personal distress than parents of toilet trained children (Macias et al., 2006). This added stress can significantly impact the functioning of the family unit. Additionally, many schools require that children be toilet trained by a certain age to advance grade levels, which could limit the ability of some children to be in less restrictive learning environments. Caregivers of individuals with ASD often require added support in toilet training their child; an effective approach in developing those skills is using principles of applied behavior analysis (ABA).

Within the framework of ABA, Azrin and Foxx (1971) developed the seminal approach of toilet training procedures for individuals with intellectual disabilities in a residential facility. Toilet training procedures have continued to evolve over the years, including a broad range of components to consider when developing a protocol (e.g., LeBlanc et al., 2005; Mevers et al., 2018; Perez et al., 2020). Greer et al. (2016) evaluated three of those recommended treatment components with children of typical development in an early childhood education center, with treatment implemented by classroom teachers. The components used were replacing diapers with underwear, a dense sit schedule, and differential reinforcement of successful urinations. Some participants were assigned to one treatment component, then exposed to the others sequentially until progress was made or all components had been introduced. Other children were assigned to the toilet training "package," which included all three components simultaneously. The results of this study indicated the toilet training package was the most effective in reducing accidents and increasing appropriate urinations. Self-initiations, however, did not increase significantly for participants in any of the components. Greer et al. suggested this may be due to a lack of opportunities for children to mand for the restroom due to the dense sit schedule.

A highlight of the study by Greer et al. (2016) was the implementation of procedures by teachers in the classroom setting. School settings present a more naturalistic setting for toilet training compared to a clinic setting, where children may experience one-on-one interaction with a clinician and a denser schedule of reinforcement. Teachers who participated in this study reported a high response effort was required to implement the dense sit schedule and the underwear components. This high workload may be comparable to that of caregivers who have other competing tasks, such as jobs, errands, and the care of other children. Greer et al., however, did not include caregivers in this study. Although this study did not focus their evaluation of the effectiveness of the toilet training package on children with ASD or developmental disabilities (only one of the 19 participants had an ASD diagnosis), other researchers have explored toilet training interventions with children in these populations more thoroughly (e.g., LeBlanc et al., 2005; Mevers et al., 2018; Perez et al., 2020).

Perez et al. (2020) extended the toilet training package outlined by Greer et al. (2016) to include children with ASD between the ages of two and 13. Researchers conducted sessions in a clinical center rather than in a classroom. The training package, identical to that described by Greer et al., included replacing diapers with underwear, a dense sit schedule (every 30 min, sit for 3 min), and differential reinforcement. To reach mastery, participants had to demonstrate 100% appropriate urinations across three consecutive sessions. For those who were unable to master toileting skills via the treatment package, the protocol was modified to include a denser sit schedule for parts of the day with a higher frequency of urinations or for the entire day. Alternatively, participants who mastered toileting were introduced into the extension phase which involved thinning both the sit and reinforcement schedule. Two participants required further individualized toilet training programs, but only one (Audrey) met the mastery criteria. Overall, 12 of the 13 participants demonstrated continence by the conclusion of the study and it required 60–296 sessions to reach mastery.

The results of the Perez et al. (2020) study suggest that the protocol described by Greer et al. (2016) can be effective for children diagnosed with ASD in a clinical setting. While there was a large discrepancy in the number of sessions to mastery across participants, the method of training was widely effective for daytime urinary continence. This study was, however, limited by a few factors. At the conclusion of training, researchers apprized caregivers of the components that were effective for their child, but throughout the study they instructed caregivers not to alter their pre-existing procedure at home. It is possible that the variability in toileting procedure from clinic to home may have impacted development and maintenance of the skill. Involving caregivers in the implementation of training may decrease the number of sessions to mastery.

Caregiver involvement in ABA services has been deemed incredibly important for individuals with ASD. Much research has been dedicated to caregiver training and caregiver-implemented treatment (e.g., Chaabane et al., 2009; Miles & Wilder, 2009; Suberman & Cividini-Motta, 2020). Behavioral Skills Training (BST) is a widely used and effective approach for coaching caregivers to implement a range of behavioral interventions, such as increasing mand variability (Chaabane et al.), implementing mand training with speech-generating devices (Suberman & Cividini-Motta), and developing social skills (Dogan et al., 2017). Previous research suggests it is possible for caregivers' procedural integrity to be high and that programs implemented by caregivers can effectively impact target behaviors.

Recently, Lapin (2021) replicated and extended LeBlanc et al. (2005) by utilizing BST to train caregivers of children with ASD to implement a toilet training protocol via telehealth. The intervention consisted of a 12-level sit schedule, reinforcement for successful urinations, communication training, fluid loading, and redirection for accidents. Three children and their caregivers participated in this study. The results of this study showed that for two of three participants, the intervention was effective in increasing continence and decreasing accidents to zero. Additionally, according to high treatment integrity data and positive social validity results, findings of this study suggest that training caregivers using BST via telehealth is feasible.

Considering benefits such as decreased cost and increase in access to families in remote locations, training caregivers via telehealth is a useful option for practitioners. Although telehealth has been successfully used to deliver behavioral interventions (e.g., Schieltz & Wacker, 2020; Sivaraman et al., 2021) and train caregivers in a variety of behavioral procedures (e.g., Tsami et al., 2019; Unholz-Bowden et al., 2020), toilet training remains an area that requires further evaluation. For instance, Lapin (2021) evaluated a toilet training package consisting of five components (i.e., differential reinforcement for successful urinations, scheduled sits, communication training, fluid loading, and redirection for accidents) with positive results. Considering the findings reported by Greer et al. (2016) and Perez et al. (2020), it is possible that not all the treatment components included in Lapin's study are necessary for successful outcomes. This is noteworthy because if a less complex treatment package could be similarly effective, it is possible caregivers may be more likely to implement it with high integrity and prefer it over more complex interventions. Thus, the purpose of the present study was to replicate Perez et al., which consists of three treatment components (i.e., underwear, dense sit schedule, and differential reinforcement), coaching caregivers of children with ASD via telehealth to effectively implement the toilet training protocol in their own home.

2 | METHOD

Caregivers implemented the intervention with their children in the home after receiving coaching from researchers via telehealth. Thus, prior to the beginning of the study researchers instructed and trained caregivers using BST on implementation of baseline procedures and the treatment package. These acquisition data are not depicted here, but more information about training is provided in a subsequent section. The focus of the study was the caregiver-implemented toileting intervention.

2.1 | Participants and setting

To qualify for the study, children had to be over the age of two, be diagnosed with ASD, and either unsuccessful previous or no attempted toilet training as reported by the caregiver. Each caregiver completed a survey regarding interest in the study, identifying both child and caregiver availability, history with toilet training, history of ABA, among other demographic information for both the child and the caregiver. In addition, the caregiver completed a questionnaire assessing behaviors that present potential challenges for the child and the respective severities of those challenges via the Home Situations Questionnaire (HSQ-ASD; Chowdhury et al., 2015). This allowed researchers to gain additional knowledge about the child's challenging behaviors and living skills. To participate in the study,

TABLE 1 Demographics of participants.

	Participant		
	Ray	**Gavin**	**Cole**
Caregiver			
Age	50	36	38
Sex	Woman	Woman	Woman
Race	White	White	White
Highest degree	Bachelor's	Bachelor's	Bachelor's
Primary language	English	English	English
Employment	No work outside home	No work outside home	Full-time work
Relationship to child	Biological grandmother	Biological mother	Biological mother
Child			
Age	3	3	4
Sex	Male	Male	Male
Race	White	White	White
Diagnosis	ASD	ASD	ASD
HSQ-ASD score	Moderate severity	High severity	Low severity
Educational placement	None	Special ed classroom	Special ed classroom
Other services	ABA, speech	ABA, speech, OT	Speech, OT
Toileting in educational/therapeutic context	Same protocol during ABA sessions	None	Scheduled sits every hour
Communication modality	Multi-word utterances	Gestural, single words utterances	Gestural, single words utterances

Abbreviations: ABA, applied behavior analysis; ASD, Autism Spectrum Disorder; HSQ, Home Situations Questionnaire.

researchers asked that both the caregiver and the child be in the home together for at least three awake hours across at least 5 days to allow for consistent toileting opportunities. All sessions were at least 3 h in duration. If caregivers were unable to collect data for 3 h (e.g., visiting family, school activity), toileting data for that day were not included.

Three child and caregiver dyads participated in this study. All enrolled participants indicated they would be able to dedicate at least 5 h per day, 5–7 days per week to toilet training. Their demographic information is presented on Table 1. The first dyad was Ray and his maternal grandmother. Their household consisted of his grandmother, grandfather, an older brother, and adolescent aunt and uncle. Ray did not attend school but received ABA services at a university-based clinic three afternoons per week and speech services at a community provider once per week. The caregiver had attempted to toilet train Ray 1 year prior to participating in the study but was unsuccessful. He was able to stay dry for approximately 2 h at the start of the study.

The second dyad consisted of Gavin and his mother. They lived with Gavin's younger brother and biological father, who was often not present in the home due to work obligations. Gavin attended preschool in a special education classroom 5 days per week and concurrently received ABA services at a university-based clinic three afternoons per week, as well as weekly speech and occupational therapy services. Gavin's caregiver had not attempted toilet training prior to participating in this study. Gavin did not demonstrate an ability to discriminate when he voided in his diaper or to refrain from voiding for at least 2 h.

The third dyad consisted of Cole and his biological mother. Cole lived with both his biological parents and younger brother. He attended preschool in a special education classroom 5 days per week and concurrently received speech and occupational therapy services. A previous, brief attempt by the caregiver to toilet train Cole was unsuccessful, and at the beginning of the study, Cole did not have the ability to refrain from voiding for at least 2 h.

Researchers met with caregivers via the secure video conferencing application Zoom, a HIPAA-compliant platform when used with the appropriate encryptions (i.e., password protections, unique links). Meetings were between 30 min to 1 h in duration at least once per week, and consisted of either BST, procedure maintenance checks, or general updates and always included time for the caregiver to ask questions, provide anecdotal information, and discuss concerns with researchers.

2.2 | Materials

Upon enrollment in the study researchers provided caregivers with a training manual composed of a written explanation of the parameters of the study, instructions for installing the Zoom application on their preferred devices, troubleshooting recommendations, an explanation of the Google Form data collection system, and a list of general scenarios and the appropriate caregiver response regarding accidents, appropriate urinations, self-initiations, and problem behavior during the toileting routine. Given the study was conducted via telehealth, researchers ensured the caregiver had access to an Internet connection in their homes as well as access to a computer, tablet, or phone with a web camera for video conferencing. Consistent access to identified reinforcers and an accessible bathroom also was necessary during baseline and treatment.

2.3 | Response measurement and data collection

As defined in Perez et al. (2020) and Greer et al. (2016), caregivers recorded data on *self-initiations*, *appropriate urinations*, and *accidents*. An *accident* was defined as any time urine was detected in the participant's undergarments. An *appropriate urination* was defined as urinating in the toilet. *Self-initiations* consisted of the participant independently requesting access to the toilet using their modality of communication (identified by the caregiver) or by independently walking to the restroom outside of a scheduled sit time. Although this study focused on establishing daytime urinary continence, caregivers also collected data on bowel movements (data not included).

For every elimination, caregivers submitted data via Google Forms, indicating whether the child self-initiated, had an accident or a successful elimination, specifying a bowel movement, urine, or both (see Appendix A). If the child self-initiated but did not successfully urinate, this information was submitted as well, and caregivers selected "N/A" under the accident and success sections. If the child had an accident, caregivers were instructed to select the appropriate type of elimination under both the accident and success sections. The form also included a section for caregivers to self-report treatment integrity (see Appendix B) based on a brief checklist of procedures, which was submitted once per week for every occurrence on a designated day. If needed, an email containing the link to the Google Form was sent to the caregiver each morning or until they demonstrated reliability and consistency submitting data after each occurrence.

Meetings with caregivers were recorded for data collection purposes and stored on Box, a HIPAA-compliant cloud storage platform. Additionally, the caregiver was asked to submit audio recordings of two scheduled sit times or undergarment checks per week via Box file upload. These recordings allowed researchers to use measurement by permanent product to ensure the caregiver was implementing toilet training procedures with integrity.

2.4 | Procedural integrity and interobserver agreement

Caregivers completed a procedural integrity checklist, in which target caregiver behaviors (e.g., appropriate prompting, implementation of the sit schedule, use of differential reinforcement) were listed for them to mark as completed when submitting data for each toileting event. Procedural integrity was self-reported for every data submission

throughout 1 day per week. Procedural integrity was calculated by dividing the number of procedure steps the caregiver reported completing by the number of applicable steps for the occurrence and multiplied by 100. To calculate a daily treatment integrity average, each occurrence's treatment integrity was added and divided by the total number of occurrences in the day. Procedural integrity throughout the study averaged 88% across participants (range 75%–100%).

Throughout the study, researchers met with caregivers weekly via Zoom to review progress and data collection as well as to conduct maintenance checks by presenting toileting scenarios and potential caregiver responses if procedural integrity scores fell below 90%. This allowed researchers to ensure caregivers were still able to describe procedures accurately as the study progressed and provide clarification. Researchers delivered feedback on these responses and corrected any errors.

Due to the nature of toilet training via remote coaching, there were obstacles to collecting interobserver agreement (IOA) data. Researchers were not present in the home to observe trials and asking caregivers to record a video of the child or conduct scheduled sits during a video call would be inappropriate as it would hinder participant dignity and privacy. Thus, researchers relied on self-report information from caregivers and maintenance checks throughout the study. To compensate for this barrier to ensuring treatment integrity, researchers utilized the audio recordings sent by caregivers, in which caregivers recorded an audio message via a mobile device (e.g., the Voice Memos app on iPhone®) and narrated their behavior as well as the child's behavior. This allowed researchers to address any novel issues that arose in a timely manner. Ray's caregiver did not submit audio recordings, therefore it was not possible to calculate IOA for this participant.

IOA was scored using the exact agreement method (Cooper et al., 2020). This method involves scoring each occurrence as an agreement or a disagreement, depicted by a 1 for agreement and a 0 for disagreement. The total number of agreements is divided by the total number of possible steps and multiplied by 100. Researchers listened to the audio recordings and scored data accordingly. The researchers' data was compared to the caregivers' data for the occurrence and scored for IOA. IOA was 100% across 13 toileting instances for Cole's caregiver and 83% across 18 instances for Gavin's caregiver.

2.5 | Experimental design

A nonconcurrent multiple baseline across participants design was used for this study. The interval between sitting on the toilet increased after the child reached mastery criteria in the current interval. Mastery was defined as 100% successful urinations across three consecutive sessions. Intervals during treatment started at 30 min, then increased until the participant reached 90 min intervals between toilet sits. Researchers consulted with caregivers regarding how quickly to increase the intervals, based on the child's behavior and caregiver preference. Whenever possible, researchers accommodated caregiver preferences. Throughout the study, researchers collaborated with caregivers to make recommendations that would be well-accepted by them and produce the desired behavioral outcomes.

The independent variable was the implementation of the treatment package, including underwear, differential reinforcement, and a dense sit schedule. The dependent variables were the frequency of accidents, percentage of appropriate urinations, and the frequency of self-initiations per session.

2.6 | Procedure

2.6.1 | Behavioral skills training with caregivers

Prior to starting data collection, researchers met virtually with the caregiver in an initial appointment to verify that the packet of materials had been received via mail, review the manual covering the nature of the study, ensure that a

stable Internet connection would be possible, familiarize the caregiver with Zoom, and begin establishing rapport with the caregiver. During this initial meeting, researchers also trained the caregiver to implement baseline procedures. This meeting lasted between one and 2 h. In the next meeting, researchers coached the caregiver on implementation of toilet training procedures using BST via Zoom. This session took place in one meeting for each caregiver, approximately 1 h in duration. The BST meeting involved reviewing the instructions, the researcher verbally modeling correct responding to toileting scenarios (e.g., researcher would pose a situation that could occur during toilet training and model how to address it), the caregiver verbally rehearsing correct responding during role play (e.g., researcher would pose a situation that could occur during toilet training and the caregiver had to address it), and feedback on caregiver performance. To begin treatment implementation, the caregiver had to demonstrate 100% correct implementation across eight different toileting scenarios, each session consisted of four scenarios and both could be conducted in the same meeting. Further training sessions were conducted as necessary to reach mastery criteria. All participants reached mastery within a week.

2.6.2 | Preference assessment

Before starting toilet training, researchers used a virtual brief multiple-stimulus without replacement (MSWO) preference assessment to identify potential reinforcers to use during the study (Carr et al., 2000). For Cole and Gavin, the MSWO was conducted during one of the BST sessions with the caregiver. The caregiver selected eight stimuli, edibles or tangibles, to use in the assessment and setup the camera of the device connected to Zoom in a location that allowed researchers to view the child and collect data. The caregiver placed all eight items in an array in front of the child and instructed the child to "pick one." Once a stimulus was selected, the child was allowed 10 s to engage with the tangible or consume the edible item. During this time, the caregiver rearranged the remaining stimuli to represent for subsequent trials. Researchers determined a hierarchy of preferred items by dividing the number of times each item was chosen by the number of trials in which the item was presented. Caregivers and researchers used this information to develop an individualized plan for differential reinforcement procedures. For Cole, the brief MSWO identified chocolate and M&Ms® as his most preferred items. For Gavin, the most preferred item was Starbursts®. For Ray, researchers used the results of a preference assessment conducted through the ABA clinic, which also identified M&Ms® as his most preferred item. For all participants, the highest preferred items were restricted outside of toilet training for the duration of the study. If the child demonstrated loss of interest in the highly preferred edibles (e.g., did not eat it or declined it), another MSWO would have been conducted; however, this was not necessary for any of the participants. It should be noted caregivers preferred the use of edible reinforcers because it was easy to deliver a discrete amount (e.g., one M&Ms®) and restricting access to them did not interfere with daily activities.

2.6.3 | Baseline procedure

Baseline began following completion of the preference assessment and meeting with the researcher. During baseline, the caregiver recorded each occurrence of accidents, appropriate urinations, and self-initiations throughout 1 week. Each session was at least 3 h. Children remained in pull-ups or diapers during awake hours. Caregivers conducted undergarment checks every 30 min, brought the child to the restroom every 90 min, and required them to sit on the toilet for up to 3 min or until urination occurred. If the child was dry at undergarment checks, the caregiver delivered praise. When accidents occurred, the caregiver changed the child providing minimal attention. The timer was not reset, and the next sit occurred as scheduled. If the child appropriately eliminated in the toilet, praise, a highly preferred edible, and leisure item were delivered for 30 s. If self-initiations occurred, the caregiver delivered praise and took the child to the restroom immediately. Table 2 presents the number of sessions each participant was exposed to during each phase of the study.

TABLE 2 Total sessions of data collection at each sit schedule.

	Participant		
Phase	Ray	Gavin	Cole
Baseline	4	6	7
30-min sit schedule	11	39	26
45-min sit schedule	-	3	6
60-min sit schedule	-	16	5
75-min sit schedule	-	7	-
90-min sit schedule	18	6	8
Total sessions to mastery	33	77	52

Note: "-" indicates that sit schedule was not conducted. Sessions were not conducted every day. Therefore, the total number of sessions to mastery does not reflect the total time in days to reach mastery, including the interruption in treatment for Ray.

2.6.4 | Treatment package

The treatment package was identical to that described by Perez et al. (2020) and Greer et al. (2016). When the child woke up in the morning, the caregiver changed them into underwear and began taking them to the bathroom and conducting undergarment checks on a dense, fixed schedule of 30 min, where children sat for 3 min, or until eliminating. This continued throughout the day when the child and the caregiver were both in the home (procedures were not continued outside of the home). If the child was wet at the time of a schedule sit, the caregiver changed the child with minimal attention. If they were dry, the caregiver provided praise (e.g., "nice being dry!") as well as access to a preferred item for 30 s or an edible while transitioning to the bathroom for the scheduled sit. Following appropriate urinations, the caregiver provided praise and access to a preferred item for 30 s or an edible. If the child self-initiated a request to go to the bathroom, the caregiver provided praise, followed through with the mand by bringing the child to the bathroom to sit, and provided an edible or 30 s access to a preferred item while transitioning to the bathroom. The caregiver identified the child's communication modality prior to the study to target an individualized self-initiation response (e.g., "potty," sign language, gesturing toward the bathroom). Prior to scheduled sits, the caregiver prompted the child to request the bathroom using the identified modality if they did not self-initiate. If the caregiver caught the child having an accident, they were instructed to transition the child to the bathroom quickly and calmly to allow them to finish voiding in the toilet. If the child continued to void in the toilet following an accident, the caregiver provided reinforcement as described for successful urinations and the sit schedule timer was reset and both an accident and a successful urination was scored. If the child did not continue to eliminate, the sit schedule timer was not reset and only an accident was scored. Caregivers were instructed to change underwear anytime they were wet or soiled.

Toileting mastery criteria included: (a) 100% successful urinations, meaning that zero accidents occurred, and (b) maintaining this skill across at least three consecutive days of training. Once the child reached mastery criteria at 30 min sit schedule, schedule thinning began. The planned schedule thinning was to increase the interval between sits to 45 min, then 60 min, and finally 90 min. However, researchers worked collaboratively with caregivers to adapt the schedule thinning as needed for each family. Such an approach allowed the intervention to be responsive to the needs and resources available to each family and for caregivers to be actively involved in setting goals for their child. For Cole, the schedule thinning was conducted as originally planned. For Gavin, his caregiver requested to move directly to the 60-min schedule after he reached mastery at 30 min. However, due to behavior rapidly degrading, researchers recommended returning to 30-min sit schedule and following the planned thinning schedule. Gavin's caregiver requested a slower schedule thinning procedure, such that his sit schedule progression was: 30, 45, 60, 75, and 90 min. Ray's caregiver expressed difficulty maintaining the frequent bathroom visits during the 30-min sit

schedule and requested fading directly to the terminal sit schedule of 90 min. When his behavior did not continue to improve, the caregiver asked for a break from the procedures. After approximately 4 weeks, period during which Ray had been in diapers, she submitted data for a baseline probe and requested to reinitiate implementing the intervention. After approximately two more weeks, researchers met with Ray's caregiver to reassess toilet training goals and during the meeting they ascertained the main hesitation for continuing was the demanding data collection involved. Therefore, only probe data were submitted for the remainder of Ray's intervention.

2.6.5 | Maintenance

One week following mastery at the 90-min sit schedule, researchers conducted a follow-up telehealth appointment to discuss toileting maintenance with the caregiver. The caregiver collected toileting data in the Google Form on the day preceding the follow-up meeting, prompted by an email from the researcher (see Appendix D). In the meeting, the caregiver provided anecdotal reports of the status of maintaining successful urinations, absence of accidents, and self-initiations as well as any generalization to other environments. Lastly, a 6-week follow-up was conducted, following the same procedures. The caregiver was prompted to collect data one or 2 days prior to the telehealth meeting, where the researcher inquired about any concerns as well as any evidence of generalization to novel settings. The researcher also provided recommendations on how to proceed, such as further decreasing the sit schedule to regular times of day (e.g., after waking up, before lunch, before leaving the home, right before bed).

2.7 | Social validity

At the conclusion of the study, participants received an email with a link to the social validity survey (see Appendix C). This survey included questions regarding acceptability of procedures and satisfaction with outcomes.

3 | RESULTS

Figure 1 displays the percentage of appropriate urinations on the primary *y*-axis, and frequency of self-initiations and accidents on the secondary *y*-axis across sessions for each participant across panels.

Ray's toileting data are displayed in the top panel of Figure 1. In baseline, Ray had a total of three successful urinations across 7 days and a range of 2–5 urinations reported per day. He self-initiated twice in baseline. In the treatment phase, Ray's accidents quickly decreased to a range to near-zero levels and the percentage of successes increased to 90% or greater starting on the fourth day of the 30-min sit schedule. The caregiver noted concerns with problem behavior (e.g., elopement, tantrums, flopping, crying) surrounding sit times where he did not urinate during the 30-min schedule, and hypothesized that he was engaging in these behaviors because he did not have the urge to urinate (see Perez et al., 2020 for a related discussion). Following 2 days of 100% successful urinations, the caregiver expressed concerns that the 30-min schedule was counterproductive for Ray and was too cumbersome for her to sustain. To prioritize the clinical need and support the caregiver continuing to implement toilet training, researchers suggested attempting a 90-min schedule. Although accidents remained low, self-initiations did not increase and successful urinations were not progressing toward mastery. After a break from the study requested by the caregiver, noted with the break on the *x*-axis, researchers conducted a replication of baseline, with levels of successful urinations and accidents similar to those in the original baseline. Next, Ray's caregiver implemented the 90-min sit schedule and submitted probe data once per week, while continuing to implement the protocol on other days. Ray reached mastery after 5 probe observations. Self-initiations increased to 4–9 per session during the 90-min schedule. In the maintenance probes, the percentage of successful urinations was at 100% at both time points and only one accident was reported; however, no self-initiations were reported.

Gavin's toileting data are displayed in the middle panel of Figure 1. During baseline, Gavin had an average of 54% of successful urinations and six accidents per session. He did not consistently engage in self-initiations, only

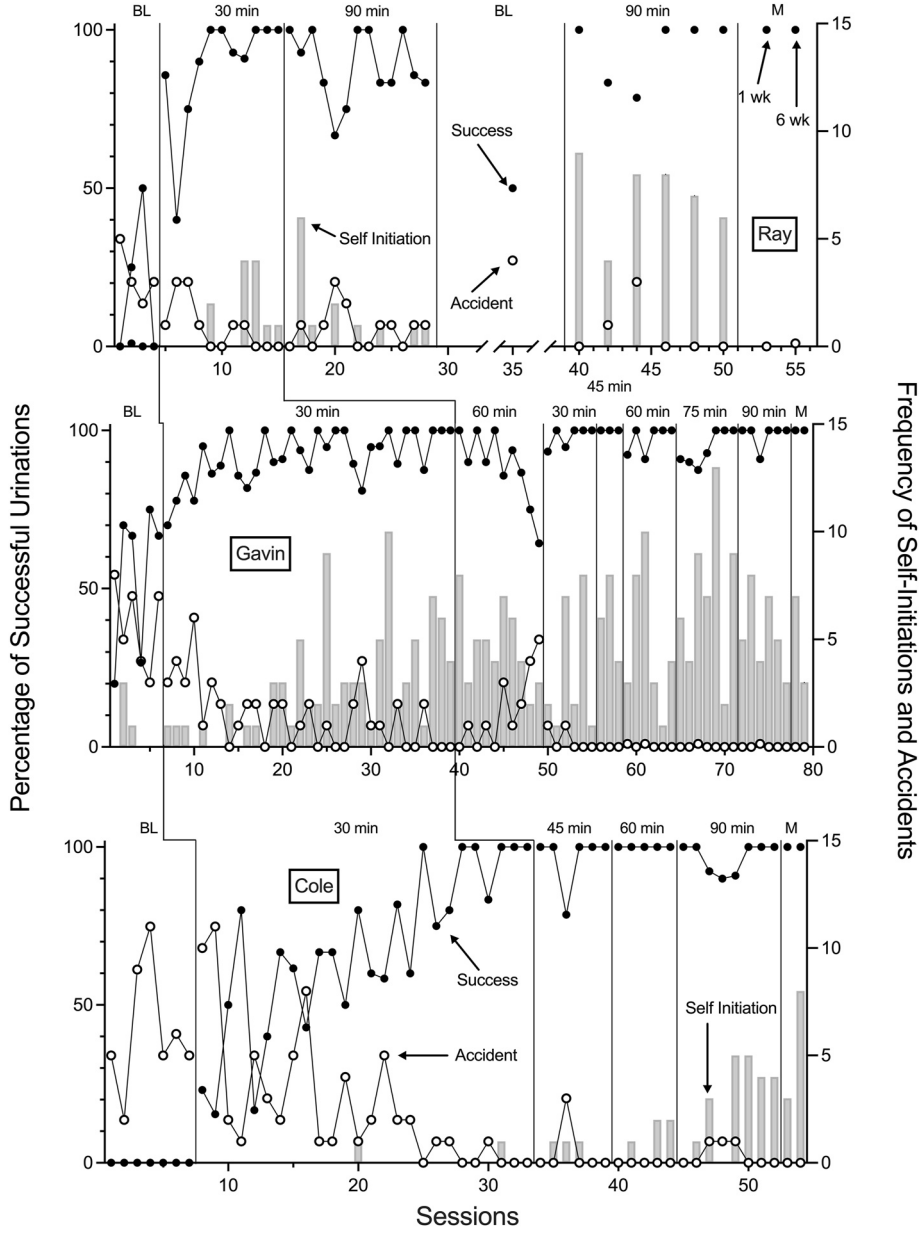

FIGURE 1 Percentage of successful urinations, number of accidents, and self-initiations across toilet training sessions. Shows percentage of successful eliminations (black data points) on the primary *Y*-axis and frequency of both self-initiations (gray bars) and accidents (white data points) on the secondary *Y*-axis for Ray (top panel), Gavin (middle panel) and Cole (bottom panel).

demonstrating this skill during two sessions. The percentage of successful urinations increased to near mastery level, while the number of accidents rapidly declined to near-zero levels within 5 days of introducing the 30-min sit schedule. Self-initiations increased throughout this phase to a maximum of 10 self-initiations per session. Upon reaching mastery the 30-min sit schedule on session 39, the caregiver requested moving to a 60-min sit schedule. However, within six sessions successful urinations began to increase and accidents started to decrease. Therefore, researchers returned to the 30-min schedule until Gavin reached three consecutive days of 100% successful urinations.

Subsequently, the sit schedule was increased to 45 min, during which Gavin met mastery in three sessions and accidents remained at zero level. Gavin met mastery at the next three phases of 60-, 75-, and 90-min within 6–7 sessions. He continued to demonstrate 100% successful urinations and zero accidents at the 1- and 6-week maintenance checks. Self-initiations continued to occur at variable levels, with a minimum of one and a maximum of 13 occurrences per session.

For Cole (bottom panel of Figure 1), the percentage of successful urinations remained at 0% throughout 1 week of baseline. Upon introducing the treatment package, the percentage of successful urinations increased to 100% following 26 days in the treatment phase. After maintaining zero accidents for three consecutive sessions, schedule thinning began. After six sessions on a 45-min sit schedule, Cole maintained 100% successful urinations. During the 60-min schedule, the caregiver reported she was unable to collect regular data on day 42 as the child was spending the day with his grandmother. The researcher elected to extend this phase for an additional 2 days to ensure that the limited data would not indicate a false positive for successful urinations. This phase was only 5 days long in total. In the 90-min phase, Cole reached mastery criteria in 8 days.

Cole did not engage in self-initiations during baseline, but the frequency gradually increased as the duration between sit times increased. In the 90 min phase, self-initiations occurred in six out of 8 days. For this child, self-initiations included either vocalizing the word "potty" or approaching his mother, taking her hand, and walking with her to the bathroom. At the 1-week follow-up, the participant maintained this pattern of 100% successful urinations during awake hours, with three self-initiations. At the 6-week follow-up, Cole maintained 100% successful urinations once again, and the caregiver recorded eight self-initiations.

On day six of the treatment phase, the caregiver informed the researcher that per Cole's Individual Education Plan at school, the teachers took him to the bathroom every hour. On this day, the teacher reported that Cole remained dry for the full school day and successfully eliminated in the toilet twice. Anecdotal information about his toileting at school was given irregularly, but the caregiver reported again on day 38 that he was still having successes at school.

Regarding social validity, Cole's caregiver answered "strongly agree" to all 16 items on the social validity survey, indicating that these procedures were acceptable and effective from the caregiver's perspective. Gavin's and Ray's caregivers answered "agree" or "strongly agree" to all statements on the social validity survey.

4 | DISCUSSION

This study replicated toilet training procedures as previously evaluated by Greer et al. (2016) and Perez et al. (2020) with three children with ASD and extended the previous literature by training caregivers via telehealth to implement the procedures in their home. The results support those of Perez et al. suggesting these toilet training procedures also can be effective in decreasing accidents increasing appropriate urinations for children with ASD when delivered by a caregiver who received training via telehealth. The treatment package was successful for all participants, who mastered the 90 min schedule in fewer sessions than participants in the Perez et al. study.

There are many benefits to conducting toilet training via telehealth. A notable benefit is the ability to reach families who are unable to attend in-person center-based services. Due to the COVID-19 pandemic, families would not have been able to participate in a clinic-based toilet training program because of widespread, delaying access to this service. In addition to the pandemic, many families live far away from behavioral providers, making it impossible to access support. Secondly, telehealth modality required that caregivers act as the primary behavior change agent, that is, caregivers had to be actively and consistently involved in the implementation of the procedures. By being the primary behavior change agent, caregivers learned and implemented important principles of behavior analysis, including providing positive reinforcement, utilizing prompting procedures, and collecting consistent data over time. Another noteworthy benefit of caregivers as the primary implementors of the toileting protocol is that since caregivers are already with the child regularly and across many different settings, it is possible to facilitate generalization to locations outside the training condition. Although not targeted in this study, it would be interesting for future

research to evaluate whether these skills generalize to untrained contexts (e.g., using bathroom in family member's home, in novel locations). For the participants in this study, caregivers regularly reported generalization to untrained settings. For instance, Cole's caregiver reported successful voids in the bathroom at school as well as at his grandmother's house. Ray's caregiver reported successful voids while the child was attending a birthday party at a novel house, while at the zoo, and he reliably urinated in the toilet at the ABA clinic where he was receiving services at the time. It is possible that conducting the training in the home, in the presence of a caregiver, facilitates generalization, which can have positive long-term effects for the individual.

It should be noted that telehealth service delivery inherently has exclusionary criteria for participation. Reliable access to a stable Internet connection, access to computer or smart phone, and availability during at least 15 h per week to implement the protocol were requirements for participation in this study, which inevitably means members of certain groups (e.g., those living in rural communities, working caregivers) would be unable to benefit from the services as provided in this study. Because the present study was conducted with a limited number of participants who were located near the university, future studies could ways to provide access to rural and underserved communities and to families from more diverse demographics.

Conducting this study entirely via telehealth posed some methodological dilemmas as data were collected by the caregiver. Although researchers thoroughly trained caregivers on implementation of the protocol and data collection, it was not possible to validate the reported data via independent data collection. To prioritize the privacy of the participant, the researchers did not ask the caregiver to install cameras in the house or collect videos of toileting procedures, limiting IOA to audio recordings. In future studies, researchers could explore alternative methods of collecting treatment integrity and IOA data within the bounds of telehealth and privacy. Fortunately, the IOA and integrity data reported by caregivers suggest the intervention was implemented with high fidelity. Due to the extensive time requirement of following toilet training procedures, the researchers preferred the caregiver allocate their time toward implementation as opposed to additional data collection. Future research should continue to consider barriers caregivers already face to implement interventions (e.g., other children, employment obligations, stress, mental health) while simultaneously ensuring accuracy. It also was not possible to record the duration of each session, precluding researchers from calculating rate measures for self-initiation as in Perez et al. (2020) or to analyze data to determine the percentage of appropriate urinations were self-initiated.

The findings of the present study complement those reported by Lapin (2021) by presenting an alternative treatment package delivered in the same modality (i.e., telehealth). In both studies, researchers trained caregivers using BST to implement the procedures in the home, but Lapin included additional components in their procedures (e.g., a level system for sit schedule fading, communication training, fluid loading) that were not implemented in the current study. Toilet training was effectively implemented for participants within a range of 12–30 days, a shorter duration than in the present study. This could be due to the additional treatment components included in the Lapin study. Given these two treatment packages have not been directly compared, it is difficult to conclude anything regarding treatment efficiency. One important consideration for future research, however, is the impact of additional treatment components on effort and acceptability of the treatment package by caregivers. It is possible that a treatment package with more components yields faster results but is not preferred by caregivers because it is onerous or difficult to implement. For instance, a caregiver who has multiple children at home, a job, and other responsibilities may be unable to implement a protocol with more than a few components or may attempt to implement the protocol and quit before results are observed. In the present study, we adapted our procedures to ensure caregivers would be able to implement them while balancing other responsibilities and in a manner that was consistent with their family values (e.g., sitting vs. standing for using the toilet). For example, Ray's caregiver expressed having difficulty implementing the 30-min sit schedule while balancing other household responsibilities, so researchers adjusted the schedule accordingly. Further, personal circumstances, including illness and the addition of another child under her care, required Ray's caregiver to pause data collection. These adjustments and delays in implementing the treatment package led to longer times to reach mastery of toilet training but were socially acceptable for the family. These procedural modifications are in alignment with suggestions by Jimenez-Gomez and Beaulieu (2022) regarding

collaborating with consumers for the delivery of culturally responsive behavioral services (see Schwartz & Baer, 1991 and Wolf, 1978 for related discussions on social validity). Future research could evaluate the balance of efficiency and social acceptability of toilet training procedures.

A noteworthy strength of this study was that all caregivers rated the procedures positively in the social validity survey. In addition, caregivers reported maintenance of successful urinary voids at the 1- and 6-week post intervention probes. Although caregivers reported their children were not having urination accidents at the maintenance check, they indicated their children did not initiate to use the toilet for most urinations. Future research could develop and evaluate more specific procedures for increasing self-initiations, as this skill is socially relevant and may lead to increased independence and access to reinforcement for the child across environments. Current research shows mixed results in increasing self-initiations during toilet training. LeBlanc et al. (2005) incorporated a level system for sit schedule fading. Following mastery of the 12th and final level, the sit schedule was removed, and going to the bathroom was reliant on self-initiations. A similar process is described in Mevers et al. (2018), who removed the sit schedule entirely following mastery of the final phase of training. The removal of the sit schedule results in less frequent bathroom visits, which may serve as an establishing operation for eliminating, therefore increasing the likelihood of self-initiations. When a dense sit schedule is in place, the establishing operation is weakened because the child is accessing the toilet noncontingently. Once the child has established a stable level of bladder control, removing the sit schedule entirely may increase the likelihood or frequency of self-initiations. This procedure should be further evaluated in toilet training research with individuals with varying verbal repertoires.

Overall, the findings of the present study are encouraging because all participants were effectively toilet trained by their caregivers in their own home in approximately 3 months or less. This new skill can lead to decreased stress of caregivers, decreased time and cost of diapers and cleaning up accidents, as well as decreased response effort for caregivers. This is also a behavioral cusp for the individual (Rosales-Ruiz & Baer, 1997), providing further opportunities for reinforcement in social and educational environments. The results of this study indicate that the general treatment package implemented by the caregiver was effective in establishing urinary continence for the children. BST delivered via telehealth was effective in establishing the caregiver's behavioral repertoire necessary for implementing the procedures with high fidelity. These findings contribute to existing research on toilet training for individuals with ASD, the utility of telehealth, and the importance of including caregivers in the delivery of behavioral services.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This study was approved by the University's Institutional Review Board, protocol # 20–212. All participants' caregivers gave their informed consent prior to inclusion in the study.

ORCID

Corina Jimenez-Gomez https://orcid.org/0000-0002-4828-9267

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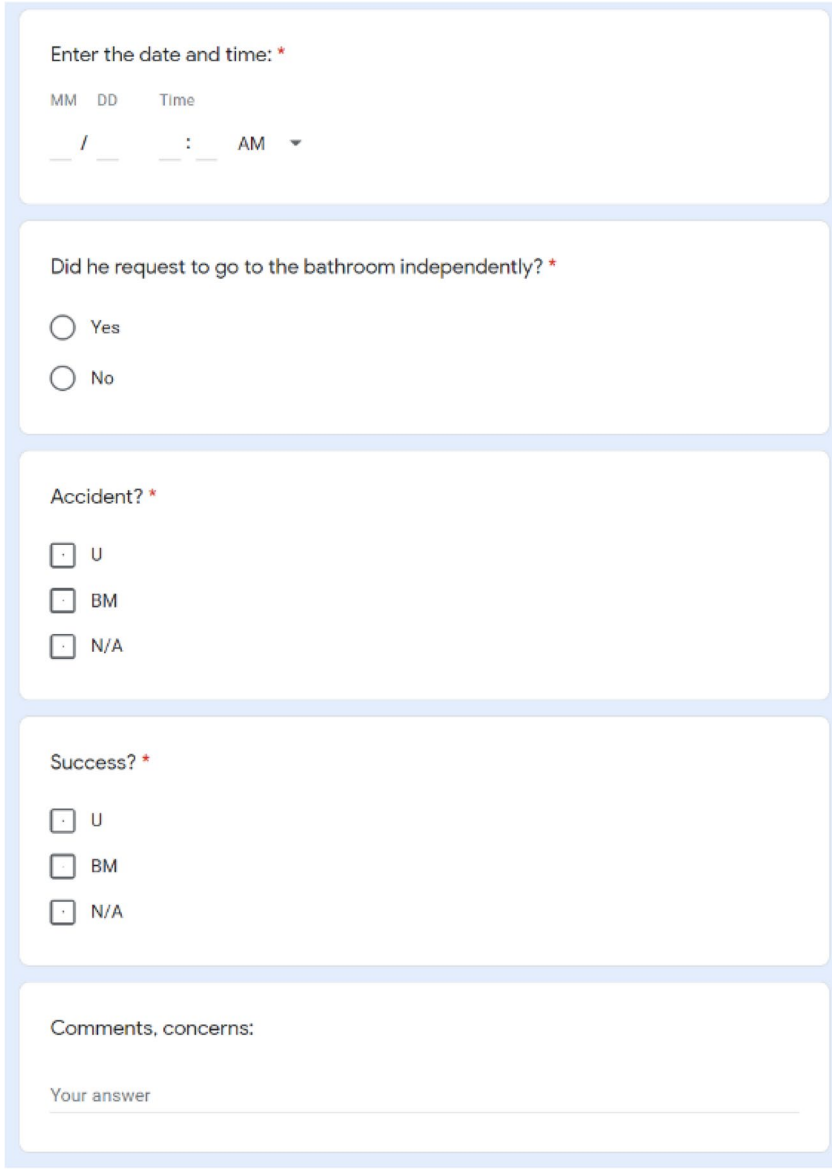
APPENDIX A: TOILET TRAINING DIGITAL DATA SHEET


Enter the date and time: *

MM DD Time

__ / __ __ : __ AM

Did he request to go to the bathroom independently? *

Yes

No

Accident? *

U

BM

N/A

Success? *

U

BM

N/A

Comments, concerns:

Your answer

APPENDIX B: CAREGIVER SELF-REPORT TREATMENT INTEGRITY CHECKLIST

Check the boxes of the steps you completed for this occurrence:

- [ ] Took him to the bathroom at the scheduled time
- [ ] Conducted an undergarment check in the bathroom
- [ ] Cleaned up accidents without providing any extraneous attention
- [ ] Praised him for being dry
- [ ] Prompted him to say "potty"
- [ ] Prompted him to sit on the toilet for 3 minutes
- [ ] Prompted him to sit until he eliminated in the toilet
- [ ] Praised him for successful eliminations in the toilet
- [ ] Delivered a piece of a favorite snack or gave him time with a toy after successfully eliminating
- [ ] Did not praise for scheduled sits when he did not eliminate
- [ ] Praised him for self-initiating
- [ ] Restarted the timer if he successfully eliminated between scheduled sits

APPENDIX C: SOCIAL VALIDITY QUESTIONNAIRE

Please answer each statement regarding the toilet training procedures utilized for this study.

	Strongly Disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I liked the procedures used in this treatment	○	○	○	○	○	○
This intervention was effective in meeting the purposes of the study	○	○	○	○	○	○
This intervention was effective in toilet training my child	○	○	○	○	○	○
I would suggest the use of this intervention to other parents	○	○	○	○	○	○
I felt the training was adequate in giving me the skills needed to conduct the intervention	○	○	○	○	○	○
The technology used in the study was easy to use	○	○	○	○	○	○
This intervention did NOT result in negative side-effects for my child	○	○	○	○	○	○
I believe this treatment is likely to be effective	○	○	○	○	○	○
I believe this treatment is likely to result in permanent improvement	○	○	○	○	○	○
I believe it would be acceptable to use this treatment with individuals who cannot choose treatments for themselves	○	○	○	○	○	○
I was comfortable with video conferencing	○	○	○	○	○	○
I was comfortable taking audio recordings of my child's toileting	○	○	○	○	○	○
I was comfortable collecting data via Google Forms	○	○	○	○	○	○
I felt the researcher took into considerations my child's privacy	○	○	○	○	○	○
I felt supported by the researcher	○	○	○	○	○	○
Overall, I had a positive reaction to this treatment	○	○	○	○	○	○

APPENDIX D: MAINTENANCE SURVEY

Please answer the following questions regarding your child's current toileting skills.

Is your child now toilet trained?

- ○ Yes
- ○ No

Does your child initiate to use the toilet for the majority of the eliminations?

- ○ Yes
- ○ No

Is your child still having bowel movement accidents?

- ○ Yes
- ○ No

Is your child still having urination accidents?

- ○ Yes
- ○ No

Roughly how many accidents is your child having per week?

Do you have any questions for the researcher?