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ORIGINAL ARTICLE

Using Video Modeling Incorporating Animation to Teach Toileting to Two Children with Autism Spectrum Disorder

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Abstract A multiple-baseline across behaviors design was employed to investigate the effects of a video modeling intervention incorporating real and animated models and a chaining procedure, on increasing independent toileting skills in two young boys diagnosed with ASD. Results showed this intervention was effective in reducing the number of prompts required for the boys to walk to the toilet, undress, sit on and urinate in the toilet, redress and flush. Gains were maintained over a 4 week period and generalized to other settings. Both participants could independently complete the toileting sequence post-intervention. The current study contributes to the small body of research literature regarding toilet training and video modeling, providing evidence for a rapid and effective toilet training method, and introduced the use of animation to overcome obvious practical limitations in depicting a sensitive private event such as toileting.

Keywords Toilet training · Autism Spectrum Disorder · Video modeling · Chaining · iPad

Independent toileting is an important developmental skill which many individuals with Autism Spectrum Disorder (ASD) have difficulties mastering (Cicero and Pfadt 2002). Dalrymple and Ruble (1992), for example, in a survey of parents of persons with autism with a mean age of 19.5 years, reported that 39 % had continuing problems with toileting. Szyndler (1996) found that 82 % of parents of children with ASD reported having difficulties over toileting; acquisition of continence and mastery of the chain of behaviors associated with going to the toilet is often delayed, and in some cases never attained.

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Current methods of teaching toileting to individuals with developmental disabilities are generally based either on the Rapid Toilet Training (RTT) program developed by Azrin and Foxx (1971), or the Response Restriction method (RR) (Duker et al. 2001). Each has been trialed in its original and modified forms in numerous studies to toilet train individuals with disabilities (Didden et al. 2001; Radstaake et al. 2014) though relatively little research has been conducted with children with ASD. Both RTT and RR procedures are designed primarily to teach in-toilet voiding. Importantly, Dalrymple and Ruble (1992) highlighted the fact that, after training in in-toilet voiding, over one third of parents reported continuing problems with urinating or defecating in places other than the toilet, refusal to use different toilets, appropriate use of toilet paper, and flushing. Though important, in-toilet voiding is only one element of successful toilet training. It has been suggested that the current approaches to teaching toileting may not be the best options for children with ASD (Keen et al. 2007), hence alternative approaches are required. One such alternative is video modeling (VM).

Video modeling involves the child observing a video of a model engaging in the target behavior and subsequently imitating it. VM has been shown to be effective in teaching a range of skills to individuals with ASD (Bellini and Akullian 2007), including social skills (Litras et al. 2010; Tetreault and Lerman 2010), play (Hine and Wolery 2006), academic skills (Jowett et al. 2012; Moore et al. 2013), and self-help skills (Rayner 2010; Shrestha et al. 2013). In a recent meta-analysis, de Bruin et al. (2013) concluded that sufficient research exists to consider video-based interventions evidence-based practices for adolescents and young adults with ASD.

VM interventions are more likely to be effective if children with ASD possess certain pre-requisite skills including the capacity to attend to the videos, and immediate and delayed imitation of modelled behavior (Weiss and Harris 2001). Recently researchers have included pre-requisite skills assessments to determine the participants' skill levels prior to intervention (Hine and Wolery 2006; Tereshko et al. 2010) with a view to adapting the intervention in light of their performance (Lindsay et al. 2013; Rayner 2014). Lindsay et al. (2013) suggested that children who have problems with imitation of multistep-actions or delayed matching-to-sample will most likely struggle with imitating extended videos. Instead these children may be better suited to a chaining procedure; as skills are acquired additional segments of the behavior chain are added to the video until the full behavior sequence is presented (see e.g. Shrestha et al. 2013; Sigafoos et al. 2005).

Little is known about the effectiveness of VM in teaching toileting to children diagnosed with ASD. To date, only three such studies have been reported. Bainbridge and Myles (1999) successfully used a 25 min long video *It's Potty Time* (Howard 1991), to teach a 3-year-old boy to walk to the toilet when given the verbal prompt "It's time to go potty". Keen et al. (2007) explored the effectiveness of a 6 min video (Intellectual Disability Services Council and Minda Incorporated 2001) in teaching daytime urinary control to five children with ASD. Participants in both these studies were not independent in the performance of behaviors related to toileting (going to the toilet, undressing, sitting on the toilet, in-toilet voiding, redressing and flushing) on completion of the interventions, and Keen et al. (2007) reported that their participants appeared to lose interest in the video after repeated viewings. Both these research teams used commercially-produced videos. Although insufficient work has been done

to date on the relative effects of commercial versus custom-made videos, two studies (Palechka and McDonald 2010; Rosenberg et al. 2010) have reported comparatively slow rates of skill acquisition with commercial videos, suggesting that custom-made videos may be more effective as they can be tailored to known interests and skill levels of the learner.

Recently Lee et al. (2013), used VM to teach a 4-year-old boy with ASD to perform a chain of toileting behaviors when presented with a card depicting a toilet. The participant was taught the skills of dressing, sitting on the toilet and flushing through the use of an instructional package including a custom-made video. However, the participant did not effectively learn the skill of in-toilet voiding. Lee et al. (2013) attribute this to the fact that the participant never viewed the model void in the toilet. To avoid genital exposure, the video used sound effects when the model was sitting on the toilet to represent in-toilet voiding. Darden-Brunson et al. (2008) have argued that VM may be unsuitable for teaching such sensitive private events as even custom-made videos must maintain appropriate video content. Toilet training videos including live models typically do not contain footage of genitalia. *It's Potty Time* (Howard 1991) used by Bainbridge and Myles (1999), for example, depicted the top half of children's bodies during the process of in-toilet voiding, not providing a visual model of voiding behavior. Lee et al. (2013) suggested that this could be addressed by using animation to depict steps that may be considered inappropriate to film with a live model, thereby providing a platform for children to observe behaviors to which they may have limited exposure. This could result in children more rapidly associating the process of elimination with the toilet bowl.

The aim of the present study was to investigate the effectiveness of VM using a custom-made video incorporating animation to teach toileting skills to two children diagnosed with ASD. It was predicted that the use of the VM intervention would lead to the acquisition of toileting skills, and more independent toileting, evidenced by reduced prompt dependency. It was further predicted that these skills would be maintained at follow-up and generalize to other toilet settings.

Method

Participants

Two children, Tim and Scott, both pseudonyms, participated in the study. Both had previously been diagnosed with autism based on the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV; American Psychiatric Association 1994) by psychologists not involved in this project. Tim was 4 years and 1 month old. He was recruited through an autism association research participant register. A previous assessment of Tim's developmental abilities using the Psycho-Educational Profile- Third Edition (PEP-3; Schopler et al. 2004) revealed impairments in areas of socialization, communication and play skills. At 35 months of age at testing, Tim's Communication composite score was at the 22 month old level (Moderate Delay), and his Motor composite score was at the 23 month old level (Moderate Delay). Tim's adaptive behavior skills were assessed using the Vineland Adaptive Behavior Scales – Second

Edition (VABS II; Sparrow et al. 2005) and yielded an adaptive behavior composite score of 71.

At the time of the study, Tim attended child care four times a week. He also attended speech therapy and occupational therapy sessions fortnightly. Tim's language consisted of single or two word phrases, and was often immediate or delayed echolalia rather than spontaneous utterances. Tim was reported by his mother to display the toileting skills of walking to the toilet, undressing and redressing, sitting on the toilet, and flushing, but had never eliminated in the toilet. Tim performed these toileting behaviors infrequently and inconsistently, requiring much assistance and prompting. Tim was wearing nappies 24 h a day when the study commenced.

The pre-requisite skill assessment (see Lindsay et al. 2013) contained matching-to-sample and delayed matching-to-sample tasks, where participants had to match a sample picture on an iPad to the corresponding picture in a field of six images. The assessment also contained an object imitation task, where participants watched seven videos of 1–2 step actions on object imitation objects (e.g. flatten dough with a rolling pin, pour beans through a funnel into a container). Participants viewed all seven items on a laptop computer which was placed on the desk near the test items. The videos were played individually and participants were given the opportunity to copy the video after each viewing. After the participant finished viewing the video he was placed in front of the test item (standing position) and given the instructions "your turn" with no further prompts.

Tim obtained scores of six out of ten in matching-to-sample tests and three out of ten in delayed matching-to-sample tests. Tim obtained a score of seven out of 12 on the imitation object test.

Scott was 5 years old. Scott's diagnosis of autism was accompanied by a severe language delay. When assessed at 38 months of age, Scott scored 36 on the Childhood Autism Rating Scale (CARS; Schopler et al. 1988), placing him in the mild-moderate range. Scott was also administered The Bayley Scales of Infant and Toddler Development (Third Edition; Bayley 2005), and his results for this screening test placed him in the "At Risk" category for development delay. Scott was recruited through a specialized early intervention program at a school he had attended once a week for 3 years. He also attended a kindergarten 2 h per week, participated in speech therapy 1 h per week, and Applied Behavior Analysis (ABA) sessions twice a fortnight. Scott's vocabulary consisted of almost 100 words, which he mainly used as mands in single or two-word phrases. Prior to the intervention Scott had limited toileting skills and frequently had accidents. He sometimes urinated in the bowl, but was largely dependent on his caregivers bringing him to the toilet and undressing him. Scott fed himself most of the time but was unable to dress independently. Scott was reported to be non-compliant, and frequently did not complete tasks at school, except in outdoor play activities.

Scott was non-compliant during pre-requisite skills assessments and therefore did not complete the matching-to-sample and delayed matching-to-sample tests though he scored six out of 12 points on the object imitation test.

As both boys experienced some difficulty with action-on-object imitation, a video chaining procedure was implemented (see Lindsay et al. 2013), with the steps being presented to the participants sequentially rather than all at once.

Settings and Materials

Video production, baseline, intervention and follow-up sessions were conducted at each participant's home. All video viewings occurred in the playroom or living area of the house, with the toilet 3 to 5 m away. Generalization sessions were conducted in the child care center Tim attended and the special school Scott attended.

Materials for the pre-requisite skills assessment included common objects such as a plastic spoon and fork, an iPad™ to display sample stimuli, a booklet with printed stimuli and recording sheets, and a Flip™ video camera. A personal computer installed with Windows Live Movie Maker and Adobe Flash Professional CC programs, and a picture cue card of a toilet bowl, were used in the construction of the video. The picture cue card was 6 by 4 cm and depicted a labelled drawing of a toilet. When this card was not in use it was placed on the wall of the living room. The participants were reinforced with food items during filming. During intervention, an iPad™, the toilet picture cue card, observation recording sheets and treatment fidelity checklists were used. Social validity was assessed using the Treatment Acceptability Rating Form (TARF-R; Reimers et al. 1992). This questionnaire contains 20 items rated on a 7-point Likert scale, 17 of which measure a single dimension of acceptability, with the remaining three addressing problem severity as well as understanding of the proposed intervention. Higher scores indicate higher ratings for each variable.

Video Production and Content Video production occurred immediately prior to the baseline phase to control for potentially confounding effects of participating in the filming. The animated elimination clip was created during baseline as it did not involve filming the participants. Using Adobe Flash Professional CC, the elimination clip was created by superimposing a picture of a urine stream over a picture of a male's genitals and legs placed on the toilet in a sitting position. The urine stream was animated to move from the tip of the genitals into the toilet bowl, which gave the impression of a moving stream.

The videos contained both video self-modeling (Dowrick 1999; Mechling 2005) and point-of-view video modeling (PVM) (Rayner et al. 2009) elements. PVM was used to capture footage of behaviors that required fine motor skills such as flushing the toilet. To produce the self-modeling segments of the video, each participant was prompted to perform the behaviors and rewarded for attempts. Footage of each participant walking to the toilet, pulling his pants up and down, sitting on the toilet bowl for a short period of time and flushing the toilet were captured in this way. Camera positioning and oversized clothing ensured that footage did not depict genitalia during the dressing or sitting stages.

The footage was then edited and compiled in the correct order, showing the participants going to the toilet in a flawless sequence. Based on information obtained from observation and the reinforcer assessments, clips of trains and trams in motion were added to the beginning and end of the videos to maintain interest while watching. These clips were a common interest for both participants and hence used in both video sets.

Three videos were created reflecting the chaining process. The first video displayed the behaviors of (1) walking to the toilet and (2) undressing. The second video added the behaviors of (3) sitting on the toilet bowl and (4) in-toilet voiding. The final video

added the steps of (5) redressing and (6) flushing the toilet thereby displaying all six behaviors. The videos for Tim were 1 min 43 s, 2 min 8 s and 2 min and 46 s in duration respectively. Scott's videos were 1 min 12 s, 1 min 30 s, and 1 min 57 s long.

Voice-overs were inserted before the depiction of each step, telling the learner what the next step was, for example, "First, we walk to the toilet" or "Then, we sit on the toilet". In each video, immediately before the toileting sequence began, a hand was shown holding up the picture cue card, then the card was handed to the participant's mother who said "It's time to go to the toilet." A voice-over saying, "Yay! You did it Tim/Scott- great job!" was inserted following the final behavior depicted in each video. The videos were uploaded onto an iPad™ for ease of viewing.

Data Collection and Dependent Measures

Information regarding the participants' interests was collected using a reinforcer assessment sheet (Central Region Autism Spectrum Disorders 2005). This was used to identify preferred television shows or activities, as clips of these were incorporated into the video in an attempt to increase the likelihood of attending.

Six behaviors in the toileting repertoire were determined following a task analysis from Lee et al. (2013): (1) walking to the toilet, (2) undressing, (3) sitting on the toilet, (4) eliminating in the toilet, (5) redressing and (6) flushing. The number of prompts required to complete the steps was the dependent measure in the study. For each step, a least-to-most prompting procedure was used. A verbal prompt could be given followed by a physical prompt, completing the step for the participant. Thus two prompts could be given for each step, except for eliminating in the toilet, where only a verbal prompt could be given.

All sessions were conducted by the participants' mothers or a researcher. A toilet monitoring chart was used to establish the participants' elimination schedule. For all subsequent sessions, data were recorded on the observation recording form. This form had space to record the date, session number, and time of day, and columns to indicate if the participant required physical, verbal or no prompts to successfully complete each toileting behavior, and whether verbal praise was offered.

Experimental Design

A single-subject, multiple-baseline across behaviors design with follow-up was used to assess the effectiveness of the VM intervention. The sequence of toileting behaviors was divided into three subsets containing two steps each. Subset 1 included (1) walking to the toilet and (2) undressing. Subset 2 consisted of (3) sitting on and (4) eliminating in the toilet. Subset 3 included (5) redressing and (6) flushing the toilet. Mastery of each subset was set at three consecutive sessions in which the participant required zero prompts to complete the behavior. On achieving mastery with one skill set, intervention began on the next pair of toileting behaviors.

Procedure

Before the study, approval was obtained from the State Department of Education and Early Childhood Development and the University Human Ethics Committee. Written

informed consent was obtained from participants' parents, teachers, school and childcare center. For all phases of the study, participants were given free access to liquids to increase the operant rate of urination.

Pre-Baseline Phase Data of each participant's elimination schedule were collected between 7:00 a.m. and 6:00 p.m. over 7 days. Toileting behavior was recorded by checking for the presence of urine and/or faeces in the toilet or the participants' pants at the beginning of every 30 min interval. Using these data, the probability of the participants eliminating in each half hour interval was calculated. Time intervals with a probability of 50 % or greater were chosen as times during which the intervention was implemented. Eight such times were identified for Tim (7:30, 8:30, 10:30, 11:30, 13:00, 14:00, 15:00, 18:00) and seven for Scott (7:30, 10:00, 12:00, 14:00, 15:30, 17:30, 18:00).

Baseline The participants were prompted to use the toilet at any of the times identified in the pre-baseline phase, meaning sessions occurred at least once per day with a maximum of eight (Tim) or seven (Scott) per day. Tim had a minimum of one toileting session per day, and a maximum of eight sessions per day, over the course of the whole study. Scott had a minmum of two sessions per day, and a maximum of four sessions per day. The participants were first shown the picture cue card and told, "It's time to go to the toilet". The participants were given 6 s to initiate the appropriate behaviors in the toileting chain. If no initiation of the behavior occurred within that time, the participant would be verbally prompted. A physical prompt followed if no initiation occurred within 6 s of delivery of the verbal prompt, effectively completing the step. Participants were verbally praised when a step was completed independently i.e. without prompts. No physical prompt was given for elimination, however the participants were given a 2 min window in which to eliminate, whereupon a verbal or physical prompt was given to get off the seat.

Intervention The participants were shown the video immediately prior to the designated toileting times. After one viewing, they were given the picture cue card and told, "It's time to go to the toilet". As in baseline, participants were given 6 s respectively before first a verbal, then a physical prompt was given. The participants were required to sit on the toilet bowl until they had eliminated, or for a maximum of 2 min. The participants were verbally praised after each step completed independently. Because a chaining procedure was employed, participants viewed videos focusing on two new steps at a time. For example, if participants viewed the first video depicting walking to the toilet and undressing, then after attempting to complete these target behaviors, they continued with the non-target behaviors with prompts as usual, and praise if a step was completed independently.

With Tim, diapers were worn during the pre-baseline and baseline phases, however no diapers were worn once the intervention was introduced for the first target behavior. No specific instructions were given to his mother if Tim had an accident; she handled this situation as she would prior to the study.

Generalization Generalization probes were conducted at least once per phase (baseline, intervention, follow-up), for Tim at the childcare center and for Scott at his school.

Procedures for the generalization probes were identical to those during the baseline phase.

Follow-Up Follow-up data were gathered 2 and 4 weeks after the conclusion of the intervention. The participants had not been shown the video since the intervention phase ended. Procedures were as described in baseline, with the picture cue card and standard phrase delivered before the participants attempted the toileting sequence.

Interobserver Agreement

To determine the reliability of observations, 20 % (Tim) and 25 % (Scott) of sessions in the baseline, intervention and follow-up phases were observed independently in vivo by two observers, one being a researcher the other being the participant's mother or other family member. Interobserver agreement was calculated as a percentage of prompts agreed upon by the total number of prompts observed. If one observer recorded a verbal prompt and the other observer recorded a verbal and physical prompt, the later, larger, number was used in calculating the total. This yielded 98 % agreement overall for Tim and 100 % agreement with Scott.

Treatment Fidelity

A 7-item fidelity checklist was used to ensure consistent and accurate delivery of all sessions. Items included whether the child watched the video, was shown the toileting cue card, was appropriately given verbal and physical prompts, whether a 6 s interval elapsed before prompt level was increased, if verbal praise was delivered after a step was completed independently, and whether the child sat on the toilet for at least 2 min (or until elimination occurred). Minor variations occurred in treatment fidelity assessment across the two participating families. In Tim's case the treatment fidelity checklist was completed by his mother after each toilet training session, and by a researcher during each jointly observed session. Treatment fidelity was calculated by dividing the number of correct steps by the total number of steps. Compliance with the procedures for each training session was observed to be in excess of 95 % with interobserver agreement for treatment fidelity at the same level.

In Scott's case, the researcher ran a practice session at the beginning of each phase with Scott's mother to ensure she could run subsequent sessions appropriately for that condition. In order to maintain treatment fidelity, feedback based on the treatment fidelity checklist was given to Scott's mother following all joint sessions.

Social Validity

The TARF-R was used to assess social validity. To obtain a measure of possible changes in the parents' perception of the intervention over time the questionnaire was completed by the parents pre- and post-intervention.

Results

Results were graphed to display the occurrence of prompts during the three phases of the study: baseline, intervention and follow-up, for Tim – Fig. 1 – and Scott – Fig. 2. These figures show the number of prompts each participant required to complete the six toileting behaviors over time.

During baseline, Tim generally required both verbal and physical prompts to walk to the toilet, but did not require any prompts to undress. Initially, when VM for walking and undressing was introduced, Tim only required verbal prompts to perform the behaviors. Within five sessions Tim completed this subset independently and he reached criterion by the seventh session.

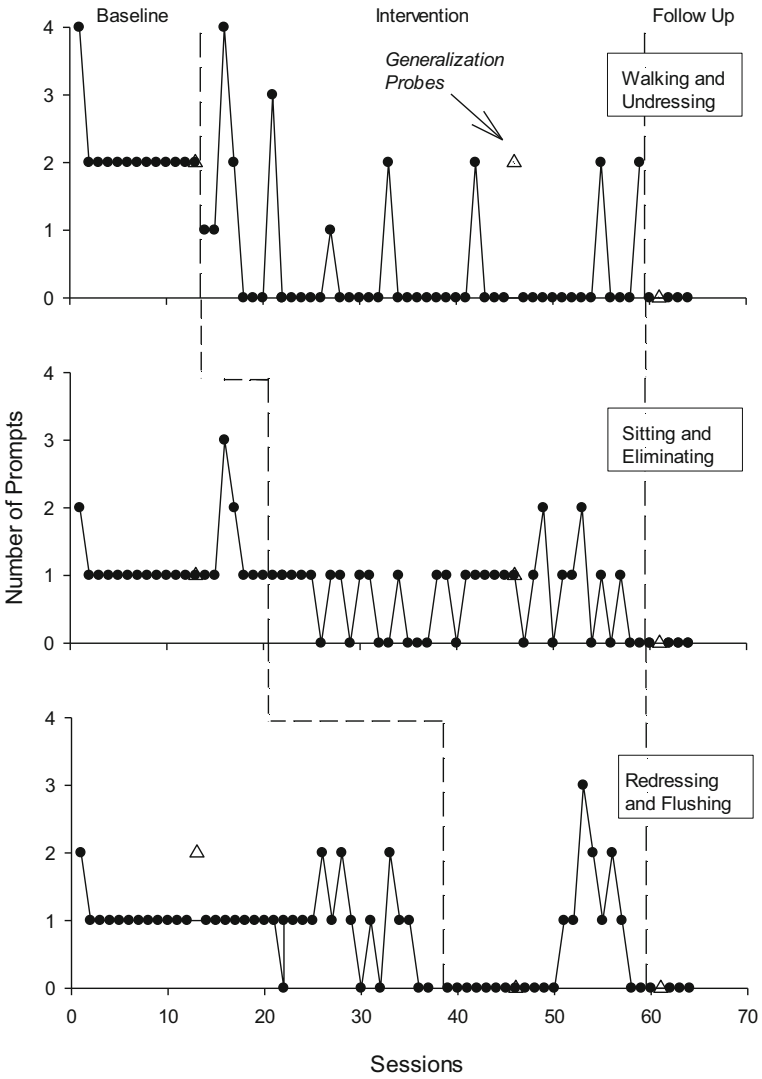

Fig. 1 Number of prompts Tim required to complete toileting behaviors pre, during and post-intervention

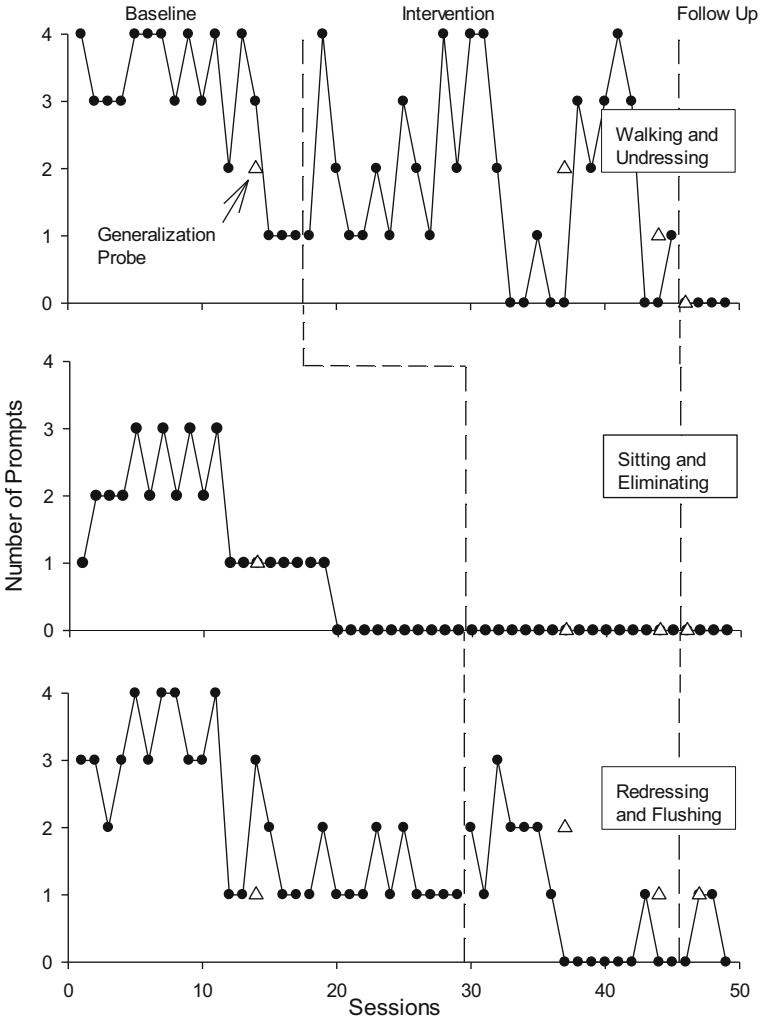

Fig. 2 Number of prompts Scott required to complete toileting behaviors pre, during and post-intervention

The number of prompts required for sitting and eliminating was relatively stable through baseline and was not impacted by introduction of the first video. Tim generally did not require any prompts to sit on the toilet but he consistently required verbal prompts to eliminate in the toilet. Within seven sessions of the introduction of the VM targeting these behaviors Tim independently performed both sitting and eliminating and he achieved criterion 18 sessions after the intervention commenced. As Tim did not eliminate every intervention session, an additional verbal prompt ("Finished") was given when he had not eliminated within 2 min.

In baseline Tim generally required verbal and occasional physical prompts to redress and verbal prompts to flush the toilet. As is evident in Fig. 1, Tim performed both behaviors independently on five occasions during the baseline phase, all of these occurring after the intervention for sitting and eliminating commenced. Once the

intervention for redressing and flushing was introduced, Tim performed both behaviors independently, achieving the criterion within three sessions.

In four follow-up observations 2 and 4 weeks after the conclusion of the intervention Tim completed the six toileting steps without prompts. The generalization probes provide some evidence of setting generalization for redressing and flushing during the intervention phase and for all six behaviors during follow up.

Figure 2 shows the number of prompts Scott required to complete each subset of the toileting sequence over baseline, intervention and follow-up. Initially in baseline Scott required verbal and physical prompts from his mother for all steps in the toileting chain. In Session 11 Scott did not respond to prompts, instead asking his mother for help. In Session 12, having required both verbal and physical prompts to walk to the toilet, Scott undressed, sat on the toilet, and redressed, without prompting. By the end of baseline Scott was consistently completing these three steps independently, but required prompting to walk to, eliminate in, and flush the toilet.

The first VM video, depicting walking to the toilet and undressing, was introduced in Session 18. In Session 20 Scott performed in-toilet voiding without prompts. The video for this step had not yet been shown to Scott. He continued to independently eliminate in each session thereafter, thus completing four steps of the sequence independently (undressing, sitting on the toilet, eliminating, and redressing). The number of prompts Scott required to walk to the toilet and undress varied over the intervention with the mastery criterion of three successive days without prompting never being achieved in this phase. To avoid stimulus satiation on Session 30 the *third* video depicting both sitting and eliminating, and redressing and flushing, was introduced. The videos being cumulative this video also continued to model the first subset of behaviors. The presentation of this complete video was associated with a decrease in the number of prompts required to walk to the toilet and undress and within eight sessions he also reached criterion for redressing and flushing. At the beginning of Session 36, Scott indicated he needed to go to the toilet ("Wee!") for the first time and after Session 41 he spontaneously began to say the accompanying phrase from the video, "Bye, bye wee!" whenever he flushed the toilet. By the end of the intervention, Scott was independently performing all six steps, only occasionally requiring a verbal prompt to walk to or flush the toilet.

At 2 and 4 weeks follow-up Scott had maintained his toileting behaviors. In Sessions 47 and 49, Scott said to his mum, "Wee!" after she gave him the toileting card. In Session 48 Scott said "Wee!" and walked to the toilet without his mother. By the time she arrived he was in the process of undressing. However, on two occasions in follow-up he needed a verbal prompt to flush the toilet.

During baseline and intervention phases Scott's toileting behavior in generalization settings were similar to that seen at home, and he gradually required fewer prompts over time to go to the toilet. By the third generalization probe, Scott only needed verbal prompts to both walk to and flush the toilet. The fourth probe, in follow-up, was conducted in a newly-built bathroom in Scott's home, rather than at his school. Before Scott's mother could show him the toileting card, Scott said, "Wee!" and walked to this toilet on his own though he again required a verbal prompt to flush the toilet.

The results of the TARF-R social validity questionnaire administered to Tim's mother pre- and post-intervention are presented in Table 1. Post-intervention there was an improvement in scores for reasonableness, willingness

Table 1 Comparison scores for pre- and post-intervention social validity scores from TARF-R completed by Tim's mother

Variable scores	Pre-intervention	Post-intervention	Maximum score
Total acceptability	72	92	119
Reasonableness	15	19	21
Willingness	15	21	21
Affordability	14	7	14
Side-effects	6	11	21
Effectiveness	8	19	21
Disruption/time	3	8	21
Severity	*12*	*12*	*14*
Understanding	*7*	*7*	*7*

Italicised categories are not included in the Total Acceptability score

and effectiveness of the procedure. Tim's mother also reported that the video modeling intervention had fewer side effects than anticipated. However the intervention was perceived to be more disruptive and less affordable post-intervention. Upon enquiry Tim's mother explained it was costly as taking Tim out of child-care for a week to focus on toilet training at home resulted in the loss of paid tuition fees. Overall, the VM intervention was seen as being acceptable, reflecting it as being an appropriate, effective, fair and reasonable procedure for toilet training Tim.

The results of the pre- and post-intervention TARF-R questionnaire completed together by Scott's parents are presented in Table 2. Scott's parents' perception of the intervention changed over its course. Post-intervention Scott's parents rated the intervention as more reasonable, affordable and effective, having fewer side-effects and being less disruptive than they did prior to the intervention.

Table 2 Comparison scores for pre- and post-intervention social validity scores from TARF-R completed by Scott's parents

Variable scores	Pre-intervention	Post-intervention	Maximum score
Total acceptability	87	105	119
Reasonableness	17	20	21
Willingness	18	18	21
Affordability	12	14	14
Side-effects	12	8	21
Effectiveness	16	18	21
Disruption/time	12	9	21
Severity	*11*	*11*	*14*
Understanding	*6*	*7*	*7*

Italicised categories are not included in the Total Acceptability score

Discussion

The current study examined the effectiveness of a video modeling intervention incorporating animation to teach toileting to two children with autism. The intervention was effective in teaching independent toileting behaviors that were depicted in the video model through the use of video self-models and animation as reflected in the reduction in prompts required to complete the sequence. All acquired toileting behaviors were maintained over a 4 week period after the intervention ended. With both participants these behaviors generalized to a second toilet setting.

Darden-Brunson et al. (2008) suggested that video modeling may not be suited to some sensitive behaviors (e.g. bathing) due to privacy issues and current social expectations regarding the explicit depiction of genitalia and excretion. In the present study we trialed the use of animation to provide a visual depiction of in-toilet urination. With one participant, Tim, the skill was acquired to criterion after a little less than 40 training sessions. The other participant, Scott, began to demonstrate in-toilet voiding shortly after the video for the initial toileting steps (walking and undressing) was presented – and indeed well before those target behaviors were acquired. Thus the effects of animation are unknown in this case. Despite this, it is evident that the practical limitations of video depiction concerning Darden-Brunson et al. (2008) can sometimes be overcome by the use of animation. Animated videos are a promising learning tool (Gale 2007) and their use needs to be further explored.

Results of the current study are consistent with the view that children with ASD who perform poorly on pre-requisite tasks assessing memory and imitation skills, are likely to benefit from video chaining procedures (Lindsay et al. 2013; Tereshko et al. 2010). The results of the pre-requisite skills assessment provided information that the participants found it challenging to imitate multi-step actions and perform them after a delay. As a result, the procedural modification of presenting the video in segments rather than as a full sequence was made. The measurement of participant pre-requisite skill level prior to undertaking intervention allowed for relevant modifications to be made to the intervention. Consequently, positive behavior change was optimized.

Tim and Scott were able to perform all toileting behaviors independently after 6 and 8 days of intervention respectively. This rate compares favorably to skill acquisition rates reported by other researchers where toilet training continued for between 7 days and 4 months (Cicero and Pfadt 2002; Keen et al. 2007; LeBlanc et al. 2005). This fast rate of skill acquisition could be due to the utilization of video chaining.

Overall, the results extend previous findings of successful outcomes through video modeling interventions with children with ASD through, for the first time, teaching the complete chain of behaviors involved in toileting, including but not limited to, in-toilet voiding. In addition, both participants were reported to display other novel behaviors during and post-intervention including initiating toilet use on several occasions by vocalizing their need to go to the toilet. Though toileting initiations were not the focus of this study, this suggests that this procedure provides a promising avenue for promoting such behavior.

During the intervention, Scott began to say, “Wee!” to mand for toilet use. Despite the limited spoken language in the video, the word “wee” was used, suggesting that verbal cues may have played a role in Scott’s learning, and it is possible that verbal cues may add to the effectiveness of a video modeling intervention. The systematic

collection of data on the participants' toileting initiations would have provided information that would have strengthened the current study and this should be investigated in future research.

The timing of video production in this study is different to that of Lee et al. (2013) who carried out video production during the baseline phase. In the current study, even though the production of the video occurred prior to the collection of baseline data, the baseline data showed that the participant still required intervention to acquire independent toileting skills. It can be inferred that video production did not result in any significant changes to the participants' behavior.

However, particularly with Scott, it is evident that some learning occurred during baseline independent of the video modeling intervention. Scott began to independently perform three steps (undressing, sitting on the toilet, and redressing) before viewing any of the videos. Similarly, in three sessions during baseline, Tim was able to successfully perform two steps (redressing and flushing the toilet) without prompts prior to the introduction of intervention for those behaviors. Arguably the routines established in baseline may have contributed to this. It is possible that for some steps both Scott and Tim did not require prompts as the completion of an early step provided a discriminative stimulus for the next step in the sequence. Thus with Tim the execution of the first four steps of the behavior chain became antecedents for redressing and flushing, and enabled him to perform these two final steps without instruction upon completion of the earlier steps.

An alternative explanation for apparent learning effects in baseline is that these could be due to social praise. In Session 12, Scott independently completed undressing for the first time. Scott's mother reported that the praise and attention she provided on this occasion was different in kind to that offered previously. Thus, despite our efforts to control for reinforcement effects, differential social reinforcement may have confounded the VM intervention.

The declining number of required prompts evident across all subsets during baseline with Scott was a major limitation of this research. Learning effects that occurred during baseline meant that Scott was already performing the toileting sequence more independently, prior to introducing the video modeling intervention thereby weakening the internal validity of this element of the study. Prior to baseline Scott's mother reported that he had already demonstrated he was capable of all the toileting behaviors in the sequence, but he required prompts to do so. Scott also displayed high levels of noncompliance when demands were placed on him, perhaps reflected in the prompting required for walking and undressing, and redressing and flushing even after he had previously performed these to criterion. That Scott was independently performing Subset 2 (sitting on the toilet, & eliminating) before he was exposed to the intervention focusing on teaching these behaviors is a further limitation of our study. As Scott mastered this subset before he was exposed to the video depicting this element of the chain, this video was skipped and Scott was shown the final video modeling the entire toileting sequence.

It is worth noting that gestural prompts were not used in this study. Verbal prompts were the lowest prompt level, however, gestural prompts could have been used at the level below verbal prompts as they are less intrusive. The use of gestural prompts may have contributed to the participants' toileting skills becoming independent at a faster

rate, as Scott or Tim may have become reliant on hearing the verbal cue before executing certain steps.

Tim wore diapers during baseline but not after the first intervention commenced. Though practical and at his mother's request, this procedural change may also have confounded the VM intervention effects although no evidence of such a confound is apparent in the continuing baseline trajectories for Subsets 2 and 3. Future research exploring the effects of removal of diapers may be justified.

In conclusion, the present study was designed to investigate the effectiveness of video modeling in teaching children with autism toileting skills, a skill area which is quite problematic for many families with children with autism, but one which has not received sufficient attention from researchers. The study, with intervention effects replicated across two participating children and their families, showed this procedure to be effective in increasing the independent performance of a number of toileting skills beyond those reported previously (Bainbridge and Myles 1999; Keen et al. 2007; Lee et al. 2013). The intervention was associated with good generalization and maintenance of skills. The data suggest that incorporating a chaining element into the video modelling intervention may be useful when participants obtain low scores on pre-requisite skill measures of memory and imitation. Furthermore, the successful integration of animation in the custom-made video has illustrated that the practical limitations raised by Darden-Brunson et al. (2008) concerning the use of video modeling to teach sensitive behaviors can be overcome by using animation. Further research on video modeling techniques incorporating animation is encouraged.

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