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Using Activity Schedules on the iPod touch to Teach Leisure Skills to Children with Autism

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Abstract

Although activity schedules are often presented to learners in book form, this format may be cumbersome and socially stigmatizing to a child with autism. Conversely, presenting an activity schedule on an iPod touch may provide a more socially acceptable format, in that it would be more discreet and allow for easy portability, especially if supports, such as prompts and an adult's presence, are eventually removed. The present study investigated whether an iPod touch could be used to effectively teach activity schedule following involving independent leisure activities to four children with autism. Manual prompts, progressive time-delay procedures, and reinforcement were also used. Prompts were faded using a progressive time-delay procedure, and experimenter proximity to the participants was faded until she was no longer present. A multiple-probe-across-participants design was used. Prior to intervention, none of the participants followed the schedule and they rarely engaged in on-task behavior. Following intervention, all participants learned to independently follow leisure activity schedules presented on the iPod touch and increased their on-task behavior. In addition, these skills generalized to novel settings and novel schedules, and maintained over time. Social validity measures suggested that the participants preferred to follow activity schedules using the iPod touch. Community members also rated the use of the device as more typical of age-related peers and more socially acceptable in the community. The implications of incorporating technology to increase independence in children with autism are discussed.

Keywords: Activity Schedules, Autism, Independence, iPod Touch, Leisure Skills, Proximity Fading

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Although independence in completing activities with complex response chains is essential for children with autism, they may be unsuccessful due to stereotypy, repetitive patterns of behavior, and a reliance on adult prompts (MacDuff, Krantz, & McClannahan, 1993). Independently participating in leisure skills is important for individuals with autism because doing so may increase quality of life and social acceptance, especially as adolescence approaches (Caldwell, Finkelstein, & Demers, 2001; Dodd, Zabriskie, Widmer, & Eggett, 2009; Schleien, Wehman, & Kiernan, 1981).

Independence in leisure activities can be achieved through the use of activity schedules, which involves the presentation of a series of photographic or written prompts corresponding to specific tasks in a chain of activities (Massey & Wheeler, 2000; McClannahan & Krantz, 1999). Activity schedules have also been used to teach a variety of other skills, including play, academic, and self-help, while simultaneously decreasing prompt dependency and challenging behavior (MacDuff et al., 1993; McClannahan & Krantz, 1999). Traditionally, activity schedules have been presented to learners in a binder or book format (McClannahan & Krantz, 1999). However, this format may be cumbersome to carry and socially stigmatizing to a child with autism. Conversely, presenting an activity schedule on a discreet and portable device such as an iPod touch may provide a more socially acceptable format, especially if supports, such as prompts, reinforcement, and an adult's presence during teaching, are eventually removed (Blum-Dimaya, Reeve, Reeve, & Hoch, 2010). The use of the iPod touch may allow for a reduction in proximity of adults from children with autism because prompts can be embedded on the device (e.g., calendar reminders, schedules), providing information needed to complete an activity independently. Presenting prompts in the absence of adults may then provide children with autism increased access to less-restricted environments and promote success in those settings.

Studies to date have used iPods to teach individuals to communicate (Kagohara et al., 2010), complete work-related tasks (Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009), transition in the general education setting (Cihak, Fahrenkrog, Ayres, & Smith, 2010), access leisure items (e.g., music, movies, and photos) (Hammond, Whatley, Ayres, & Gast, 2010; Kagohara, 2011), and learn social and self-management skills (Blood, Johnson, Ridenour, Simmons, & Crouch, 2011). In these studies, individuals were taught to access information contained on the iPod touch, to use the iPod touch as a prompt, or to view video models.

Although activity schedules have been presented using different technology formats in recent studies, including video modeling,

video enhanced schedules on the computer, and Microsoft PowerPoint, (Blum-Dimaya, et al.), to date, no study has demonstrated the effectiveness of teaching activity schedule following on the iPod touch. Additionally, only one study to date has attempted to fade adult proximity during activities despite the intent of activity schedules to foster independence (Shabani, Katz, Wilder, Beauchamp, Taylor, & Fisher, 2002). Thus, the purpose of the present study was to teach children with autism to independently structure leisure time through the use of an activity schedule presented on an iPod touch, in the absence of both reinforcement and direct supervision by an adult. This was taught through the use of a time-delay procedure and the systematic fading of manual prompts. To facilitate independence and maintenance during schedule following, instructor proximity was faded and programmed reinforcement was thinned. To facilitate generalization, multiple exemplar training (Stokes & Baer, 1977) was used and activities were presented in a variable order and in varied locations.

Method

Participants

The participants were four 8- to 12-year-old boys with autism who were enrolled in an applied behavior analytic (ABA)-based public school program. Each had received his diagnosis from an outside agency. All participants had prior experience using an iPod touch at school to play games, listen to music, and complete teacher-directed programs. Participants could also engage in various leisure activities, respond to a timer, and independently follow a picture activity schedule presented in book format. Participants had previously been taught a variety of skills using a delayed reinforcement procedure in which preferred snacks and/or pennies were delivered contingent upon on-task behavior and/or correct responses. Participants were selected based on parental requests for their children to independently complete tasks at home and to increase on-task behavior. These children's teachers also noted that the participants did not effectively structure their own leisure time.

Ian, age 9, had an extensive vocabulary and spoke in 5- to 8-word sentences, while Neil (age 12), Brian (age 8), and Ryan (age 9) had limited vocabularies and spoke in 2- to 5-word sentences. Prior to the study, all participants independently initiated conversations with instructors. Ian and Neil also commented on peers' activities and initiated conversations with peers. Ryan communicated with the assistance of an augmentative and alternative communication (AAC) book.

Setting and Materials

Baseline, intervention, and ongoing generalization probes were conducted in the participants' self-contained classroom. Materials were placed on a shelf in a designated area of the classroom. A small digital video camera was used to record sessions. Additionally, a video camera and monitor were used to remotely observe participants during the final steps of instructor proximity fading. During each session, participants were exposed to multiple potential distracters, including staff entering and exiting, public address announcements, ringing bells and telephones, phone conversations, paraprofessionals working in the classroom, administrators observing experimental sessions, and other students engaging in inappropriate behavior.

Pre- and post-intervention generalization sessions were conducted in the participants' general education classroom, which differed from the self-contained classroom in that (a) it did not have an area designated for play, (b) it was set up for a larger number of students (15-20), and (c) the participants were only present in it for a small portion of the day. Maintenance sessions were conducted in the participants' self-contained classroom during transition times (i.e., between class periods) and during times with decreased staff-to-student ratios.

The iPod touch 4G is a handheld personal digital assistant, media player, game console, and Wi-Fi mobile device designed and marketed by Apple, Inc. Individualized picture activity schedules were embedded into the device to teach the participants to structure their leisure time. Pictures of each leisure activity were used for each respective participant (see Figure 1). Each picture also contained an icon of the standard iPod touch clock application on the bottom right corner. Each activity schedule was located under the photos icon on the main screen of the device. Upon selection of the appropriate album, the participant advanced to subsequent pictures by placing his finger on the right side of the screen and sliding it to the left side of the screen, or by using the arrows on the picture to advance to the next activity. Participants exited photos and started the timer, which was pre-set to 2 min, under the clock application. When the timer went off, the participant stopped the timer, returned to the photo album, and advanced to the next activity. After all activities were completed, the arrow to advance was no longer highlighted and the screen remained on the final activity.

Experimenter and Assistants

The experimenter taught children with autism at the school and was a student earning her Masters of Arts in applied behavior

Figure 1. The iPod touch 4G device showing photo icons of five activities in an individualized picture activity schedule used to teach the participants to structure their leisure time.

analysis. Assistants were paraprofessionals who worked in the same classroom as the experimenter. All were familiar with activity schedules, interobserver agreement, data collection, time-delay procedures, delayed reinforcement procedures, proximity fading, and the iPod touch.

Dependent Variables and Measurement

Independent schedule completion. Data were collected on independent schedule component completion. A task analysis was used to identify components required to complete the chain of activities. Data were summarized as the percentage of correctly completed activity schedule components (Blum-Dimaya et al., 2010).

On-task behavior. On-task behavior was defined as the participant (a) visually attending to any appropriate components of his schedules, (b) looking at his photographic schedules, (c) appropriately manipulating materials (i.e., as they were designed to be used) that were part of his schedules, or (d) transitioning from one scheduled activity to another (MacDuff et al., 1993). Off-task behavior was defined as the participant (a) using materials in a manner other than that for which they were designed, (b) manipulating but not visually attending to the materials, (c) engaging in inappropriate behavior (e.g., aggression,

tantrums, stereotypy), or (d) not engaging in activities or using the materials (MacDuff et al., 1993). On-task behavior data were collected using 60-s momentary time sampling with a 1-s observation period for the first 10 min of each session. The intervals and observation period were signaled to the experimenter by a vibrating timer. Data were summarized as the percentage of intervals in which participants were on task.

Interobserver agreement (IOA). Independent observers were trained to collect IOA by discussing definitions of both on-task behavior and completion of schedule components with the experimenter. Next, trainees scored videos of a child actor completing an activity schedule on an iPod touch. Once trainees scored two training videos with 100% agreement with the experimenter, they were permitted to collect IOA data for the study.

Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements, and multiplying by 100. IOA data were collected on all experimental sessions and 100% agreement was obtained for all activity schedule components completed correctly. A mean of 98% (range 80-100%) agreement was obtained for on-task behavior across participants.

Procedural integrity. Independent observers were trained to collect procedural integrity data by watching training videos of actors completing activity schedule components. They were also trained how to use a checklist outlining different aspects of experimental procedures (e.g., presentation of materials, prompt delivery, reinforcer delivery, etc.). The experimenter described the checklist, modeled scoring a video using the checklist, and then scored the video with each independent observer. When a trainee scored two training videos with 100% agreement for procedural integrity, he or she was permitted to collect procedural integrity data for the study.

Procedural integrity data were collected for all experimental sessions by an independent observer via video, or in vivo, and with the use of the checklist. The implementation of the techniques and procedures outlined in the study was completed with 100% accuracy. IOA was also collected on procedural integrity data. An additional independent observer viewed the same sessions as the initial independent observer and scored each component on the checklist. IOA was collected for 100% of all sessions in which procedural integrity data were collected. IOA for procedural integrity was 100%.

Selection of Schedule Activities

We identified leisure activities to incorporate into the schedules based on the responses of 12 general education grade-equivalent

students who were asked whether they would enjoy playing with or using 30 toys and leisure materials. The toys and activities were available to the general education students while they completed the survey. The criterion for activities to be used in the study was selection by at least 50% (6/12) of the general education students as something they would enjoy. Additionally, manufacturer's suggested ages for possible activities were used to guide selection of activities for the study.

Based on this survey, 15 activities were selected for an activity preference assessment (described below) for the participants to select their top 10 preferred activities. The top 10 activities for each respective participant were presented to him prior to the beginning of every second session (see Table 1). Each participant chose the order of the activities to complete. The first five activities were completed that session, and the subsequent five were completed the next session.

To assess generalized schedule completion performance, activities available on the iPod touch, as either a standard application or a free downloaded application, were used, but in the absence of programmed consequences. Generalization activities included listening to music (songs recommended by the parents and located under the music icon), watching videos (age-appropriate and parent-recommended movie clips located under the Videos or YouTube icon), playing games (age-appropriate, free downloaded video games located under each specific game icon), and using the static or video camera (located under the camera icon).

Preference Assessment

A multiple-stimulus-without-replacement preference assessment (MSWO) (DeLeon & Iwata, 1996) was conducted three times (Carr, Nicolson & Higbee, 2000) prior to the study to identify participant preferences for activities. Materials from 15 activities were placed in front of the participant and the instruction "pick one" was given. If the participant made a selection, he received access to the item for 10 s and the other items were temporarily removed to prevent multiple selections. After 10 s, the chosen item was removed and the remaining items were re-presented in varied locations in front of the participant. This procedure continued until all items were selected and manipulated. Data were summarized by calculating the average selection preferences across the three sessions to obtain a rank ordering of the top 10 preferred activities. After every two sessions during the study, preferences were re-assessed by presenting pictures of the top 10 activities. The first 5 selected were then used for that session and the remaining 5 activities were used for the subsequent session.

Table 1
Assignment of Leisure Activities to Participants

Activity	Description	Ian	Neil	Brian	Ryan
NERF Basketball set	Participants obtain the ball and shoot the ball into the hoop attached to the wall.	X	X	X	X
Air Hogs HeliBlaster	Participants load the rocket onto the base and step on the switch to launch it.	X	X	X	X
Table Top Pinball Machine	Participants place the pinball machine on a flat surface and work flippers to keep the ball in play.	X	X	X	X
Perplexus	Participants move the ball to get the marble inside onto the track and navigate it through the maze.	X	X	X	X
Spinning Tops	Participants wind tops and press release button so tops hit the floor and spin.	X	X	X	X
Paper Jamz Drums	Participants play the drums on a flat surface.	X	X		
Crayola Color Explosion Makers	Participants color on the special paper with markers.	X	X	X	
Cuponk	Participants toss a ball into the cup by throwing or bouncing.	X		X	X
Frisbee Golf	Participants throw the discs into the goal.	X		X	X
Slinky	Participants stretch and compress the toy.		X	X	
Pin Toy	Participants place objects in the toy to produce shape forms.		X		X
Hot Wheels Matchbox Cars	Participants move the cars to race them, crash them, etc.	X		X	
Hot Wheels Monster Trucks	Participants set up and play with the hot wheels trucks on the set.				X
Remote Control Car	Participants turn on vehicle and remote, and play with vehicle in designated play area.		X		
Beyblade Metal Fusion	Participants launch the tops into the arena.				X

The Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996) was given to the parents of the participants to identify potential snack or prize reinforcers. An MSWO was conducted for snacks and prizes identified on the RAISD with the same frequency and procedure as the MSWO for activities previously described. The 10 most preferred snacks/prizes were used for the study. Prior to the start of each session, the participant was presented with all 10 snacks/prizes and allowed to select one to earn for that session, when applicable.

Experimental Design and Response Criteria

A multiple-probe-across-participants design was used. Once the first participant completed the activity schedules with prompts fully removed, the next participant entered intervention, while the others remained in baseline. This continued until all participants entered intervention. The criterion for on-task behavior was two sessions at 80% of intervals. The criterion for schedule completion was two sessions at 100% of correctly completed components.

Procedure

General format. The experimenter gave a vocal instruction, such as "Go play," in the presence of leisure activities located on, or directly in front of, a shelf. The corresponding activity schedules were also contained on the iPod touch for that session. Each individual activity's duration was 2 min and was signaled to begin and end using the timer on the iPod touch. Sessions occurred 1-3 times daily and the mean duration of each session was approximately 13 min. Ian's sessions had a mean duration of 13.1 min (range, 12.3 to 15.2 min). Neil's sessions had a mean duration of 13.3 min (range, 12.2 to 16.3 min). Brian's sessions had a mean duration of 12.3 min (range, 12.6 to 14.8 min). Ryan's sessions had a mean duration of 13.8 min (range, 12.6 to 15.6 min).

Baseline. No prompts were used, but preferred snacks or prizes were delivered independent of performance at the end of each session. If off-task or disruptive behavior occurred (e.g., throwing materials, aggression, screaming), the participant was prompted to engage in a previously mastered skill (e.g., clapping hands or standing). Once the participant emitted the previously mastered response independently and correctly, the preferred snack/prize was delivered. Baseline sessions were terminated if the participant did not respond for 5 min, stopped completing components in his activity schedule for 5 min, or began engaging in repeated disruptive behavior. All requests for help were redirected (e.g., If the participant said, "Help me play this game," the experimenter said, "You can do it!"). Although never

needed in the present study, if a request had been made for help related to technological issues with the iPod touch (e.g., the device screen froze), participants would have received help.

Intervention. Manual guidance was defined as providing hand-over-hand prompts to complete activities and activity schedule components. Manual guidance was provided for completing the components in the activity schedule based on the fading level specified for each session. For the first two sessions of intervention, a 0-s time delay was used. In subsequent sessions, manual guidance was only used if the participant did not complete the component within the time specified under the current time-delay fading procedure. Prompts were faded systematically through the use of a progressive time-delay procedure after two days at 100% of correctly completed components for 0 s and one day at 100% of correctly completed components for subsequent fading levels, which were delays of 2 s, 4 s, and then no delay. If an error occurred, a behavior rehearsal trial was conducted in which the experimenter provided manual prompts to correct the error. On the next session during which that schedule appeared, there was a return to a 0-s time delay only on the component in which the error occurred, followed by a return to the previous time delay on the following session (Blum-Dimaya et al., 2010).

In addition, a delayed reinforcement procedure was used in which conditioned reinforcers (i.e., pennies) were delivered into a container within the participant's view for correct responses and for remaining on task. Participants had the opportunity to trade these conditioned reinforcers for back-up reinforcers (preferred snacks or prizes), upon successful completion of the scheduled activities.

Nine different levels were implemented to thin the schedule of reinforcement and fade the proximity of the experimenter. When a participant met the mastery criterion for schedule completion and on-task behavior, the schedule of reinforcement for the subsequent sessions was systematically thinned from FR-2 (Level 0), to FR-3 (Level 1), to FR-4 (Level 2). Next, experimenter proximity fading was implemented (described below). After experimenter proximity was faded to 2.1 m from the participant (i.e., Levels 3-5), schedule thinning continued to FR-5 (Level 6), FR-9 (Level 7), FR-22 (Level 8), and no reinforcement (Level 9) (Blum-Dimaya et al., 2010). If the participant's on-task behavior fell below 80% for two consecutive sessions, the experimenter returned to the previous level for one session and then returned to the level in which the participant was last successful for the following session.

Experimenter proximity was defined as the distance between the participant and the experimenter, measured with 0.3 x 0.3 m tiles

on the classroom floor. When a participant independently completed all activity schedule components and was at FR-4 (Level 2), the experimenter's proximity was faded systematically to 0.3 m (Level 3), to 1.2 m (Level 4), to 2.1 m (Level 5), contingent upon one day at 80% for on-task behavior and 100% completion of schedule components. In the next levels of proximity fading, the experimenter was out of the room and entered to check in on the participant 10 times per session (Level 6), 5 times per session (Level 7), 2 times per session (Level 8), and finally 0 times per session (Level 9). Although never needed in the present study, if a participant had made an error during Levels 3-9, the error would have been corrected and the experimenter would return to a distance of 0.3 m for that component for one session, and then return to the previous level for the following session.

Generalization was programmed by (a) presenting activities in a variable order, (b) varying the location of the activities, (c) presenting multiple exemplars of activities, and (d) using the same timer on the iPod touch throughout all activity schedules. Generalization was assessed with 4 novel iPod touch activity schedules presented after approximately every 3rd baseline and experimental session. These leisure activities were built into the device itself (e.g., music, games, videos, camera). Generalization was not programmed or assessed across instructors, because one goal of the study was for participants to complete the activity schedule in the absence of instructors. Sessions in which generalization was assessed were identical to baseline, with the exception that no snacks or prizes were delivered.

Pre- and Post-Intervention Probes

To determine whether participants could complete their schedules in a different setting, two pre- and two post-intervention sessions were conducted in a general education classroom not associated with teaching the target schedules. Procedures were identical to baseline, with the exception that snacks or prizes were not delivered.

Maintenance

When criterion was met on the final fading and schedule thinning levels, maintenance was assessed 2 weeks, 1 month, and 3 months following intervention. Maintenance sessions were identical to baseline, with the exception that no snacks or prizes were delivered.

Social Validity

To evaluate the value of participant engagement and completion of activities, the appropriateness of the activities, and whether participants were appropriately structuring their leisure time as compared

to typical 8- to 12-year-olds, 13 undergraduate psychology major students were shown two randomly selected video clips of each participant (one pre-intervention and one post-intervention) presented in a counterbalanced order across participants. That is, two videos were shown in the order of pre- then post-intervention and the other two were presented in the opposite order. Raters were then presented with a questionnaire using a 7-point Likert scale (see Table 2).

In a second social validity measure, 12 peers of typical development from an age-equivalent general education classroom were shown a 3-min video of a participant post-treatment. Prior to viewing the video, the peer raters were presented with an overview of autism and the educational supports often needed for children with autism, as outlined in the *Kid's Booklet on Autism* (*www.autismnj.org/Doc/KidsBookFinalWeb.pdf*). The peers were then given a fourth-grade reading level questionnaire asking them to rate the video regarding the acceptability of the intervention and peer on several dimensions (see Table 3). An age-equivalent child not involved with the study read all questions prior to the peers rating the outcomes of the study to ensure that each survey question was presented clearly.

In a third measure, 7 instructors, supervisors, and other staff who taught the participants outside of the study, were given a questionnaire to rate treatment outcomes (see Table 4). Prior to the survey, they received a written description of the treatment procedure, with a video segment of an experimental session available upon request.

To further rate the outcomes of the study, as well as to provide evidence regarding the use of the iPod touch in the present study, two additional social validity assessments were conducted. At the conclusion of the study, participants were presented with a randomly selected leisure activity schedule on the iPod touch and an identical schedule in a three-ring binder. The experimenter showed participants that each contained the same schedule. The participant was then asked to choose which schedule he preferred to complete. Both schedules were presented five times in front of the participants in varied positions to control for location preference.

The final social validity measure evaluated community preference for treatment by surveying 91 individuals consisting of age-equivalent peers, teachers from elementary, middle, and high school, non-teaching school staff, high school students, college professors, undergraduate and graduate students, and members of the community who did not attend or work in a school. Each rater was presented with one video of a participant completing the leisure schedule on the iPod touch and one video of them completing the identical schedule in a three-ring binder. The survey and videos were presented on a

password protected website. Raters were asked which video looked more typical of an age-equivalent peer, and which would be more accepted in the community.

Results

Completed Schedule Components

Figure 2 shows the percentage of correctly completed components for each participant. None of the participants correctly completed any schedule components during baseline. Ian's percentage of correctly completed components increased to a mean of 95.8% (range, 85-100%) during intervention with mastery of all schedule components occurring within 10 sessions. Once the schedule was mastered, schedule thinning and proximity fading were completed in 10 sessions. During generalization probes, Ian's percentage of correctly completed components gradually increased to 100% across intervention. Neil's percentage of correctly completed components increased to a mean of 92% (range, 60-100%) during intervention with mastery of all schedule components occurring within 12 sessions. Once the schedule was mastered, schedule thinning and proximity fading were completed in 10 sessions. During ongoing generalization probes, Neil's percentage of correctly completed components gradually increased to a mean of 57% (range, 50-65%) during intervention, and schedule thinning and proximity fading.

Brian's percentage of correctly completed components increased to a mean of 92.5% (range, 64-100%) during intervention with mastery of all schedule components occurring within 14 sessions. Once the schedule was mastered, schedule thinning and proximity fading were completed in 10 sessions. During generalization probes, Brian's percentage of correctly completed components gradually increased to 50% during intervention, schedule thinning, and proximity fading. Ryan's percentage of correctly completed components increased to a mean of 96% (range, 85-100%) during intervention with mastery of all schedule components occurring within 11 sessions. Once the schedule was mastered, schedule thinning and proximity fading were completed in 10 sessions. During ongoing generalization probes, Ryan's percentage of correctly completed components gradually increased to a mean of 73% during intervention, schedule thinning, and proximity fading.

Intervals On Task

Figure 3 shows the percentage of intervals in which each participant was on task. Ian was on task for a mean of 40% of intervals (range, 0 to 100%) during baseline and increased to 100% during intervention

Table 2

Social Validity Results Comparing Pre- and Post-Intervention Videos of Participants

Survey Question	Child	Pre-Intervention		Post-Intervention	
		Mean	Range	Mean	Range
Is the participant appropriately manipulating the materials?	Ian	3.0	1-6	5.4	3-7
	Neil	2.5	1-7	5.8	2-7
	Brian	2.0	1-5	4.8	1-7
	Ryan	1.6	1-6	5.8	3-7
Are the leisure activities the participant is engaging in age-appropriate for 8- to 12-year-olds?	Ian	5.0	1-7	5.3	4-7
	Neil	3.3	1-6	5.7	3-7
	Brian	2.8	1-6	5.0	1-7
	Ryan	2.6	1-6	5.4	3-7
Is the participant engaged in the activity as a typical 8- to 12-year-old would be?	Ian	3.4	1-7	5.1	3-7
	Neil	2.8	1-6	4.0	1-7
	Brian	2.0	1-5	4.5	1-7
	Ryan	1.6	1-5	5.5	4-7
Overall, was the learner appropriately structuring his leisure time?	Ian	3.3	1-6	6.1	5-7
	Neil	1.8	1-6	4.9	1-7
	Brian	1.8	1-5	4.3	1-7
	Ryan	1.6	1-5	5.7	5-7

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Undecided, 5 = Slightly Agree, 6 = Agree, 7 = Strongly Agree

Table 3
Peer Acceptability Results

Survey Question	Percentage of Students Responding		
	Yes	Maybe	No
Would you use an iPod touch?	100%	0%	0%
Do you own an iPod touch?	75%	0%	25%
Should the student in the video be allowed to use an iPod touch in school?	58%	42%	0%
Would you be upset if the student was allowed to use the iPod touch in school even if you cannot?	33%	8%	58%
If you knew the iPod touch was helping the student learn, would you be upset if you could not use it?	17%	8%	75%
Would you want to play with the participant if they were using an iPod touch?	58%	25%	17%
Is the student playing with the toys the way you would?	100%	0%	0%
Would you want to help the student learn using the iPod touch if you were allowed?	67%	25%	8%
Is it cool that the student is learning new things with the help of an iPod touch?	92%	0%	8%
If you could, would you like to learn using an iPod touch?	92%	8%	0%

Table 4
Treatment Acceptability Results Rated by Instructors

Question	Mean	Range
How clear is your understanding of the suggested procedures?	6.4	6-7
How acceptable do you find the strategies to be regarding your concerns about the identified learner?	6.8	6-7
How willing are you to implement the suggested procedures as you heard them described?	7.0	7
Given the learner's behavior issues, how reasonable do you find the suggested procedures?	6.6	6-7
How costly will it be to implement these strategies?	2.8	1-5
How disruptive will it be to your classroom to implement the suggested procedures?	2.0	1-4
How affordable are these procedures?	5.8	4-7
How much do you like the proposed procedures?	6.8	6-7
How much discomfort is your learner likely to experience as a result of these procedures?	1.4	1-2
How willing would you be to change your classroom routine to implement these procedures?	6.6	6-7
How well will carrying out these procedures fit ito your classroom routine?	6.6	6-7

Note: Raters used a 7-point Likert scale to rate each item.

and 95 (range, 80 to 100%) during schedule thinning, and proximity fading. During ongoing generalization probes, Ian's percentage of intervals on task increased rapidly to 100% and remained at that level throughout schedule thinning and proximity fading. Neil was on task for a mean of 12.5% intervals (range of 0-60%) during baseline, a mean of 99% (range of 90-100%) during intervention, a mean of 99% (range of 90-100%) during schedule thinning and proximity fading. For generalization probes, Neil's percentage of intervals on task decreased to 48% (range, 29-67%) during intervention and 80% (range, 40-100%) during schedule thinning and proximity fading with maintenance at 100% once all thinning and fading steps were completed.

Brian was on task for 0% of intervals during baseline increasing to a mean of 84% (range, 60-100%) during intervention, a mean of 84% (range, 80-100%) during schedule thinning and proximity fading, and 80% after instructor proximity was faded. For generalization probes, Brian's percentage of intervals on task increased rapidly to a mean of 69% (range, 20-100%) during intervention and 100% during and after schedule thinning and proximity fading. Ryan was on task for a mean of 7% of intervals (range of 0-60%) during baseline, increasing to a mean of 85% (range of 70-100%) during intervention, a mean of 89% (range of 80-100%) during schedule thinning and proximity fading and 80% after instructor proximity was faded. During generalization probes, Ryan's percentage of intervals on task increased to a mean of 50% (range, 0-100%) during intervention and 100% during and after schedule thinning and proximity fading.

Maintenance

During maintenance sessions, all participants correctly completed 100% of their schedule components at 2 weeks, 1 month, and 3 months. Ian and Neil were both on task for 100% of intervals at 2 weeks, 1 month, and 3 months. Brian and Ryan were both on task for 80% of intervals at 2 weeks, and 90% at 1 and 3 months.

Pre- and Post-Intervention Across-Settings Generalization

As seen in Figures 2 and 3, pre-intervention probes assessing generalization across settings indicated 0% for correct completion and on task behavior for all participants. Post-intervention probes for components completed were 100% for Ian and Neil, a mean of 98% (range of 96-100%) for Brian, and a mean of 97% (range of 94-100%) for Ryan.

Post-intervention probes for intervals on task were 100% for Ian, a mean of 90% (range of 80-100%) for Neil and Brian, and a mean of 85% (range of 80-90%) for Ryan.

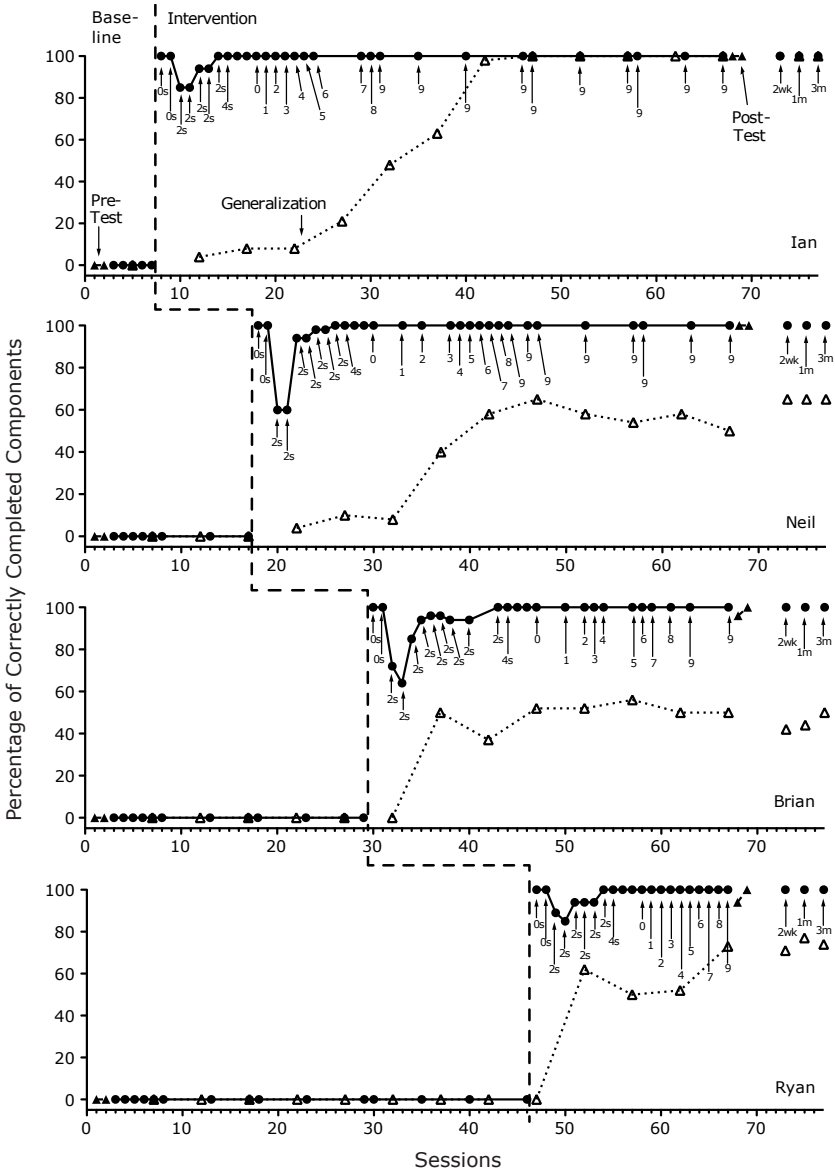

Figure 2. Solid circles represent the percentage of correctly completed components in activity schedule following. Open triangles represent the percentage of correctly completed components in novel activity schedule following. Xs represents the time delay in effect. Solid triangles represent the percentage of correctly completed components during pre- and post-tests. Numbers 0-9 represent the levels of reinforcement schedule in effect and the proximity of the experimenter as described in the Procedure section.

Social Validity

One social validity measure assessed whether participants were appropriately structuring their leisure time pre- versus post-intervention. Undergraduate student ratings that followed viewing pre- and post-intervention videos of participants were a mean of 2.6 and range of 1 to 7 for pre-intervention and a mean of 5.2 and a range of 1 to 7 for post-intervention (see Table 2). Thus, the participants were rated as not appropriately structuring their leisure time prior to intervention but were rated as appropriately structuring their leisure time following intervention.

The results of the survey completed by grade-equivalent peers are shown in Table 3. Overall, peers found the procedures acceptable and reported that he or she would not become upset if the participant was using the iPod touch, even if he or she could not. Additionally, the peers reported that they may want to play with the participant and potentially help the participant learn using the iPod touch. The peers also expressed an interest in wanting to learn using an iPod touch.

The treatment outcomes based on data collected from instructors and other staff personnel teaching the participants outside of the study are depicted in Table 4. The procedures were rated as acceptable, reasonable, affordable, and those that completed the assessment were likely to implement the procedures, liked the procedures, and were willing to incorporate the procedures into his or her classroom routines. In addition, raters indicated that it would not be very costly to implement the strategies, it would not be disruptive to the classroom routine to implement the strategies, and the learners involved in the study were not likely to experience discomfort as a result of the procedures.

To further assess the outcomes of the study, as well as to support the use of technology, the participants were asked to choose which schedule they wanted to complete. Three of the participants chose the iPod touch over the book format to complete their schedule for 100% of the trials. The fourth participant, Ian, chose the iPod touch during 80% of the trials and the binder schedule during 20% of the trials. Based on these results, the participants preferred the use of the iPod touch schedule to an identical schedule presented in a binder.

In addition to the participants preferring the iPod touch, when 91 members of the community rated videos of a participant completing the leisure schedule on either the iPod touch or with a three-ring binder, 78% selected the video with the iPod touch as the format that looked more typical in relation to age-equivalent peers. In addition, 80% selected the iPod touch as the format that would be more accepted in the community.

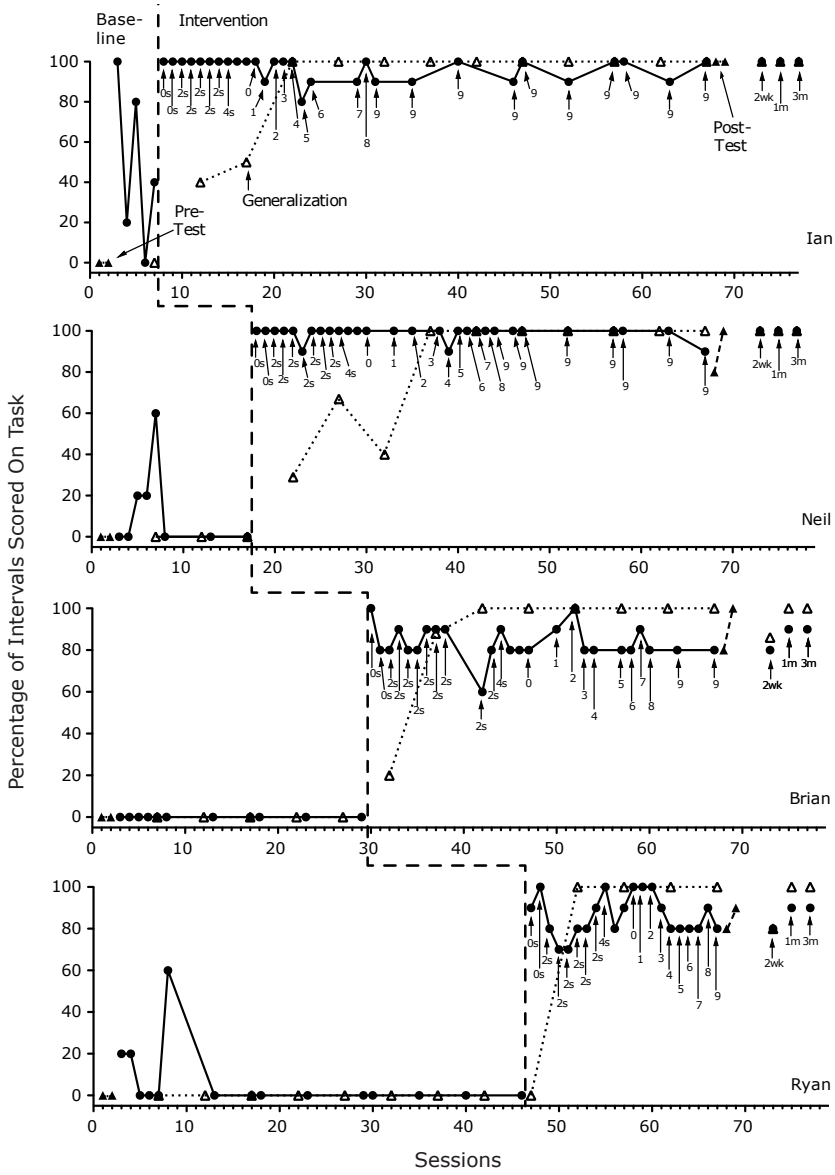

Figure 3. Solid circles represent the percentage of intervals scored on task. Open triangles represent the percentage of intervals scored on task during novel activity schedule following. Xs represents the time delay in effect. Solid triangles represent the percentage of intervals scored on task during pre- and post-tests. Numbers 0-9 represent the levels of reinforcement schedule in effect and the proximity of the experimenter as described in the Procedure section.

Discussion

To our knowledge, this study is the first to use an iPod touch to teach activity schedule following to children with autism. All of the participants correctly completed a high percentage of activity schedule components and increased to a high percentage of intervals with on-task behavior. In addition, this is also the first study to completely remove the instructor from the room to promote independence for schedule completion and on-task behavior. In a previous study by Shabani et al. (2002), tactile prompts were used to fade adult proximity, but this support was only partially faded. Objective observers also reported improvement in the quality of, and engagement in, independent activity schedule following, as well as preference for using technology in teaching. The intervention procedures are robust in that they were effective in a public school classroom that had many distractions and contained varying numbers of students, staff, and visitors.

The use of the activity schedule to complete leisure activities partially generalized to novel schedules and in a room not associated with the intervention. It is possible this occurred because all of the students had some prior experience with the iPod touch, ranging from using it only in the classroom for instruction and for preferred activities, to having full access to an iPod touch at home. When teaching the students to navigate the iPod touch, the timer in the standard clock application was a common stimulus (Stokes & Baer, 1977) programmed to promote generalization to the novel schedules, which consisted of applications that were either standard or downloaded on the device. Performance during ongoing generalization probes may have been lower than those data obtained during training sessions because correct responding involved manipulating applications on the device itself, as opposed to only using the device to present the schedule. Thus, it may be more likely that schedule following will generalize when using novel activities that are more similar to those used during training, as was done by MacDuff et al. (1993).

To extend previous research (e.g., Blum-Dimaya et al., 2010), maintenance was programmed not only by fading manual prompts, and thinning the schedule of reinforcement, but also by fading experimenter proximity to further support transfer to naturally maintaining contingencies. Manual prompts were systematically removed using a progressive time-delay procedure, experimenter proximity was systematically faded by distance and then number of times entering the classroom until the instructor was no longer present in the room for the duration of schedule following, the reinforcement schedule was thinned until completely removed, and during the

fading of instructor proximity, the instructor entered the classroom for a varied specified frequency per session that was not made known to the participant.

To further support the use of this intervention, the experimenter conducted several social validity assessments to ensure that the materials, procedures, and technology were appropriate for the age of the participants, where previous studies had included one measure of social validity (e.g., Blum-Dimaya et al., 2010). Age-equivalent peers were incorporated into the assessments and the feedback received from them was used to select the materials for the study. Additionally, the age-equivalent peers assessed the outcomes of the study and reported that they were accepting of the procedures and the use of the iPod touch even if they were not allowed to use the device themselves. Teaching individuals with autism to use the iPod touch could promote increased social interactions, as the age-equivalent peers said that they may be more likely to play with the participants or help the participants learn using the iPod touch.

Additional assessments showed that the procedures were clear, reasonable, acceptable, and others were likely to implement the procedures. The participants were not deemed to be structuring their leisure time pre-intervention, but then were deemed to be structuring their leisure time post-intervention. These findings are similar to those obtained by Blum-Dimaya et al. (2010).

To our knowledge, this is the first study to assess the preference of community members in relation to the use of technology. Specifically, community members were given an assessment on the acceptability of the iPod touch schedule and its use in the community, and it was preferred over the binder schedule to be used in the community. The participants also preferred the iPod touch schedule over the schedule in a binder. When learning of this preference and viewing the skills acquired by the participants, all parents reported anecdotally that they purchased these devices for their children to use at home. Parents also reported that they are incorporating schedules at home on the iPod touch. Preference for technology can also lead to better attending and more robust instruction and should continue to be evaluated in the participants' daily schedules.

Prior studies involving the iPod touch focused on using the device as a prompt (Van Laarhoven et al., 2009), to access communication (Kagohara et al., 2010), to view video models (Cihak et al., 2010), and to access applications on the device (Hammond et al., 2010; Kagohara, 2011). This study added to the literature by using the iPod touch as a teaching tool to increase independence for the participants, without the assistance of an adult.

Given that the participants all had some prior experience using the iPod touch in the present study, it is unclear whether children without such histories would experience similar results. Because an errorless manual prompting procedure was used in the present study, however, it seems likely that children without experience with the device would also learn to use the device effectively to structure their leisure time. If individuals had difficulty with certain tasks, such as turning on the device, selecting icons, or swiping the screen, these skills could also be taught using the prompting procedure used in the present study. Researchers may wish to address this question, however, in future studies. Regardless of prior experience, the iPod touch should continue to be investigated as a tool to teach additional skills to children with autism such as following scripts, receptively identifying stimuli, transitioning in hallways, and participating in inclusion settings. Researchers might also compare skill acquisition of an activity schedule presented on an iPod touch versus an activity schedule presented in a binder format. Additionally, researchers might compare skill acquisition between participants with prior experience with schedule following and participants without previous exposure to activity schedules. Another area for future research might be teaching adults with autism to follow work schedules on the iPod touch in the community setting.

References

Blood, E., Johnson, J. W., Ridenour, L., Simmons, K., & Crouch, S. (2011). Using an iPod touch to teach social and self-management skills to an elementary student with emotional/behavioral disorders. *Education and Treatment of Children*, *34*, 299-321.

Blum-Dimaya, A., Reeve, S. A., Reeve, K. F., & Hoch, H. (2010). Teaching children with autism to play a video game using activity schedules and game-embedded simultaneous video modeling. *Education and Treatment of Children, 33,* 351-370. doi:10.1353/etc.0.0103

Caldwell, L., Finkelstein, J., & Demers, B. (2001). Exploring the leisure behavior patterns and experiences of youth with endocrinological disorders: Implications for therapeutic recreation. *Therapeutic Recreation Journal*, *35,* 236-249.

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*, 353-357. doi: 10.1901/jaba.2000.33-353

Cihak, D., Fahrenkrog, C., Ayres, K. M., & Smith, C. (2010). The use of video modeling via a video iPod and a system of least prompts to improve transitional behaviors for students with autism spectrum disorders in the general education classroom. *Journal of Positive Behavior Interventions*, *12,* 103-115.

DeLeon, I., & Iwata, B. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29,* 519-533. doi:10.1901/jaba.1996.29-519

Dodd, D., Zabriskie, R., Widmer, M., & Eggett, D. (2009). Contributions of family leisure to family functioning among families that include children with developmental disabilities. *Journal of Leisure Research*, *41,* 261-286.

Fisher, W. W., Piazza, C. C., Bowman, L., & Amari, A. A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal on Mental Retardation*, *101,* 15-25.

Hammond, D. L., Whatley, A. D., Ayres, K. M., & Gast, D. L. (2010). Effectiveness of video modeling to teach iPod use to students with moderate intellectual disabilities. *Education and Training in Autism and Developmental Disabilities*, *45,* 525-538.

Kagohara, D. M. (2011). Three students with developmental disabilities learn to operate an iPod to access age-appropriate entertainment videos. *Journal of Behavioral Education*, *20,* 33-43.

Kagohara, D. M., van der Meer, L., Achmadi, D., Green, V. A., O'Reilly, M. F., Mulloy, A., … Sigafoos, J. (2010). Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism. *Clinical Case Studies*, *9,* 328-338. doi:10.1177/1534650110379633

Kimball, J. W., Kinney, E. M., Taylor, B. A., & Stromer, R. (2004). Video enhanced activity schedules for children with autism: A promising package for teaching social skills. *Education and Treatment of Children*, *27,* 280-298.

MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26,* 89-97. doi:10.1901/jaba.1993.26-89

Massey, N. G., & Wheeler, J. J. (2000). Acquisition and generalization of activity schedules and their effects on task management in a young child with autism in an inclusive pre-school classroom.

Education and Training in Mental Retardation and Developmental Disabilities, 35, 326-35.

McClannahan, L. E., & Krantz, P. J. (1999). *Activity schedules for children with autism: Teaching independent behavior.* Bethesda, MD: Woodbine House.

Rehfeldt, R. A., Kinney, E. M., Root, S., & Stromer, R. (2004). Creating activity schedules using Microsoft PowerPoint. *Journal of Applied Behavior Analysis, 37,* 115-128.

Schleien, S., Wehman, P., & Kiernan, J. (1981). Teaching leisure skills to severely handicapped adults: An age-appropriate darts game. *Journal of Applied Behavior Analysis, 14,* 513-519. doi:10.1901/jaba.1981.14-513

Shabani, D. B., Katz, R. C., Wilder, D. A., Beauchamp, K., Taylor, C. R., & Fischer, K. J. (2002). Increasing social initiations in children with autism: Effects of a tactile prompt. *Journal of Applied Behavior Analysis, 35,* 79-83. doi:10.1901/jaba.2002.35-79

Stokes, T. F., & Baer, D. M. (1977) An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10,* 349-367.

Stromer, R., Kimball, J. W., Kinney, E. M., & Taylor, B. A. (2006). Activity schedules, computer technology, and teaching children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 21,* 14-24. doi:10.1177/10883576060210010301

Van Laarhoven, T., Johnson, J. W., Van Laarhoven-Myers, T., Grider, K. L., & Grider, K. M. (2009). The effectiveness of using a video iPod as a prompting device in employment settings. *Journal of Behavioral Education, 18,* 119-141.