EDUCATION AND TREATMENT OF CHILDREN Vol. 33, No. 3, 2010

Teaching Children with Autism to Play a Video Game Using Activity Schedules and Game-Embedded Simultaneous Video Modeling

Alyssa Blum-Dimaya, Sharon A. Reeve, Kenneth F. Reeve
Caldwell College
Hannah Hoch
Rethink Autism

Abstract

Children with autism have severe and pervasive impairments in social interactions and communication that impact most areas of daily living and often limit independent engagement in leisure activities. We taught four children with autism to engage in an age-appropriate leisure skill, playing the video game Guitar Hero II™, through the use of (a) an activity schedule to set up, turn on, and turn off the game and system, (b) simultaneous video modeling embedded in the game to teach manipulation of the Guitar Hero II™ controller to play the game, and (c) the training of multiple exemplars of songs to develop a generalized repertoire of playing Guitar Hero II™. A multiple-probe design across participants was used to evaluate the effectiveness of the training package. All of the participants successfully learned to play Guitar Hero II™ and playing skills generalized to a song and a setting not used during training.

KEYWORDS: activity schedules, autism, leisure skills, prompt fading, video modeling

Teaching age-appropriate leisure skills to individuals with developmental disabilities is important as these skills have been recognized as filling habilitative needs (Jerome, Frantino, & Sturmey, 2007; Schleien, Wehman, & Kiernan, 1981) that may increase quality of life. Children with autism or other disabilities who can play games with their peers have increased opportunities to learn social skills from their peer interactions and may also improve their motor skills (Luyben, Funk, Morgan, Clark, & Delulio, 1986). Unfortunately, little research has been conducted to identify effective methods to teach leisure skills to children and adults with autism and related disabilities. The few that have been conducted have focused on using task analyses in various formats. For example, Schleien and colleagues

Correspondence to Sharon A. Reeve, Department of Applied Behavior Analysis, Caldwell College, 120 Bloomfield Avenue, Caldwell, NJ 07006; e-mail: sreeve@caldwell.edu.

(1981) taught individuals diagnosed with mental retardation to play darts. The teaching procedure consisted of verbal cues and assistance with a step-by-step training model. The dart skills were mastered and maintained during free time, but the time required to teach the skills was lengthy. More recently, Jerome et al. (2007) taught the age-appropriate leisure skill of navigating the internet to adults with autism and mental retardation using a 13-step task analysis in conjunction with backward chaining and errorless teaching procedures.

Activity schedules involve presentation of a series of written or photographic prompts for each specific task of the desired chain of activities (Massey & Wheeler, 2000; McClannahan & Krantz, 1999). Activity schedules reduce the need of the instructor to directly prompt completion of the activity, thus decreasing the possibility that the learner may become dependent on instructor-delivered prompts. Once the skill is acquired, the instructor's presence can be faded as quickly as possible to promote independent behavior. Activity schedules have repeatedly been shown to be effective in promoting leisure and interactive play-skill acquisition for children with autism (Betz, Higbee, & Reagon, 2008; Machalicek et al., 2009; McClannahan & Krantz, 1999; Spriggs, Gast, & Ayres, 2007). For example, MacDuff, Krantz, and McClannahan (1993) taught children with autism to engage independently in previously mastered leisure skills using an activity schedule. In addition, MacDuff et al. used multiple-exemplar training (Stokes & Baer, 1977) to promote generalization across leisure activities and demonstrated schedule following behavior in the presence of novel leisure activities. Bryan and Gast (2000) also implemented activity schedules and multiple-exemplar training to promote generalization of leisure skills to novel activities. The activity schedules in their study were comprised of pictures that depicted locations participants needed to visit to engage in the activities. Participants learned to follow the schedule quickly and skills generalized to novel leisure activities. Betz et al. (2008) used joint activity schedules to increase peer engagement in interactive games among dyads of preschoolers with autism and also observed generalized schedule following when the order of activities was resequenced and when new games were introduced.

Another procedure that may be effective in teaching leisure skills is video modeling. Video modeling involves the viewing of a video clip which provides a model for an individual to imitate (Ayres & Langone, 2005; LeBlanc, Coates, Daneshvar, Charlop-Christy, & Morris, 2003). Shipley-Benamou, Lutzker, and Taubman (2002) noted that video modeling can increase independence by reducing the need for an instructor to promote learning. In one study, Paterson and Arco

(2008) used video modeling to increase appropriate toy play while simultaneously decreasing repetitive behavior with students with autism. Dauphin, Kinney, and Stromer (2004) incorporated video models directly into computer-based activity schedules to teach sociodramatic play to a child with autism and also observed generalized responding after multiple exemplar training in the form of matrix training.

Although both video modeling and activity schedules have been used to teach play skills and increase independence, neither strategy has been used to teach video game play, a common leisure skill for school-aged children. Therefore, the purpose of the present study was to teach young children with autism to play the video game Guitar Hero II™ independently. The skill was taught through the use of a multiple-component intervention package. One component consisted of a version of simultaneous video models (i.e., learner engages in the response while the video is shown) (Kinney, Vedora, & Stromer, 2003; Sancho, Sidener, Reeve, & Sidener, 2010; Taber-Doughty, Patton, & Brennan, 2008) that are directly embedded in the Guitar Hero II™ video game to teach correct note selection on the guitar-shaped game controller. That is, as a note to be played is modeled by the video game on the television screen, the participant should press the corresponding button on the controller at that time. The camera perspective of the video models displayed in the game is from that of the learner. A second intervention component was an activity schedule that was used to teach participants to set up, turn on, and turn off the game and system. Finally, multiple exemplars of songs were taught to facilitate a generalized repertoire of playing Guitar Hero II™.

Method

Participants

The participants were three boys and one girl, all diagnosed with autism by independent outside agencies. All could match colors, had fine motor skills adequate to manipulate the Guitar Hero II™ game controller, tolerated manual prompting, had a limited leisure skill repertoire, and had previously used activity schedules for other tasks besides playing video games. They exhibited minimal behavior problems and all were able to read the written texts that were embedded into the participants' full day activity schedules to indicate when it was time to play Guitar Hero II™. The participants were also able to follow a photographic activity schedule which they used to set up and shut off the game. James was 11 years old and had experience playing video games (e.g., Mario Kart™, Wii Bowling™, and Sonic the Hedgehog™). James previously used activity schedules for making coffee and baking cookies. Jackie was also 11 years old and

had experience playing video games (e.g., Wii Sports™ and Monkey Ball™). Jackie followed a full-day activity schedule and had used an activity schedule to make trail mix. In addition, both James and Jackie had previously been exposed to video modeling to teach simple toy play and shoe tying. Martin was 12 years old and had experience playing video games (e.g., Frogger™ and Mario Kart™). Martin followed a full-day activity schedule. Jared was 9 years old and had previously played video games (e.g., Mario Kart™ and Monkey Ball™). Jared also followed a full-day activity schedule. Both Jared and Martin had previously been exposed to video modeling to teach a single skill, shoe-tying.

Setting and Materials

The study took place in a self-contained classroom in a private school for children with autism. Four to five classmates of the participants and four to five teachers were also present in the classroom during experimental sessions. The primary experimenter, a graduate student and a classroom instructor for children with autism, conducted all sessions. Several other instructors from the students' classrooms were trained by the primary experimenter and aided in data collection. The room contained five desks with two chairs at each. A table off to the side of the room held a Sony Play Station 2™ video game system used to access and play the Guitar Hero II™ game, the Guitar Hero II™ game controller, and a television used to display the video from the game. The photographic activity schedule followed for playing the video game itself contained 27 pages with laminated color photographs located in the center of the pages. The task analysis of the photographic activity schedule is depicted in Table 1.

The Guitar Hero II™ game. To play the game, the player holds a guitar-shaped game controller which has five buttons along its neck colored green, red, yellow, blue, and orange (see Figure 1, top image). The player selects the song to be played by pressing a round start button on the main body of the controller and takes the role of the guitar player in the animated band. In the game, an animated rock band is displayed on stage (Figure 1, bottom image). While the animated band "plays" the selected song (minus the guitar part), the game's embedded simultaneous video models depict each guitar note as a highlighted colored circle scrolling along a stylized guitar fret board. These highlighted circles correspond to the colored buttons on the neck of the controller (see Figure 1, bottom image for a screen image of the game). As each note to be played is presented on the screen, the player must press the colored button on the controller that matches it in color, timing, and duration while strumming a bar on the main body of the controller. The greater the number of matches made, the

Table 1
Task Analysis for Playing Guitar Hero II™

Task	
1.	Obtain materials
2.	Put game cartridge in game system
3.	Insert yellow plug in hole
4.	Insert white plug in hole
5.	Insert red plug in hole
6.	Press switch in back of game system
7.	Turn on TV
8.	Make sure video is on
9.	Press reset button
10.	Put on guitar (handle to left over right shoulder)
11.	At START screen press green button
12.	On Training press green button
13.	Strum down once to the word PRACTICE
14.	Press green button
15.	Strum down ___ times (to correct song)
16.	Press green button
17.	Press green button Strum up to EASY
18.	Press green button
19.	On FULL song press green button
20.	Strum down 3 times to SLOWEST
21.	Press green button
22.	Play song
23.	Scroll down 5 times to Exit button
24.	Press green button
25.	Turn off system in the back
26.	Turn off TV

higher the player's score on the game. When a match occurs, that specific guitar note sounds and an animated flame shoots from the circle representing the note on the screen, both on a fixed ratio 1 schedule of reinforcement. If the player emits an error (i.e., plays an incorrect note on the controller), the music stops and a high pitched sound occurs until the next correct note is played. To reduce the difficulty of the game in the present study, the songs were set to "practice" mode (the easiest and slowest setting). During practice mode, only three of the five buttons (green, red, and yellow) on the controller were used to play all songs. In addition, the songs used were only instrumental and were not accompanied by lyrics. At the conclusion of a song, the game

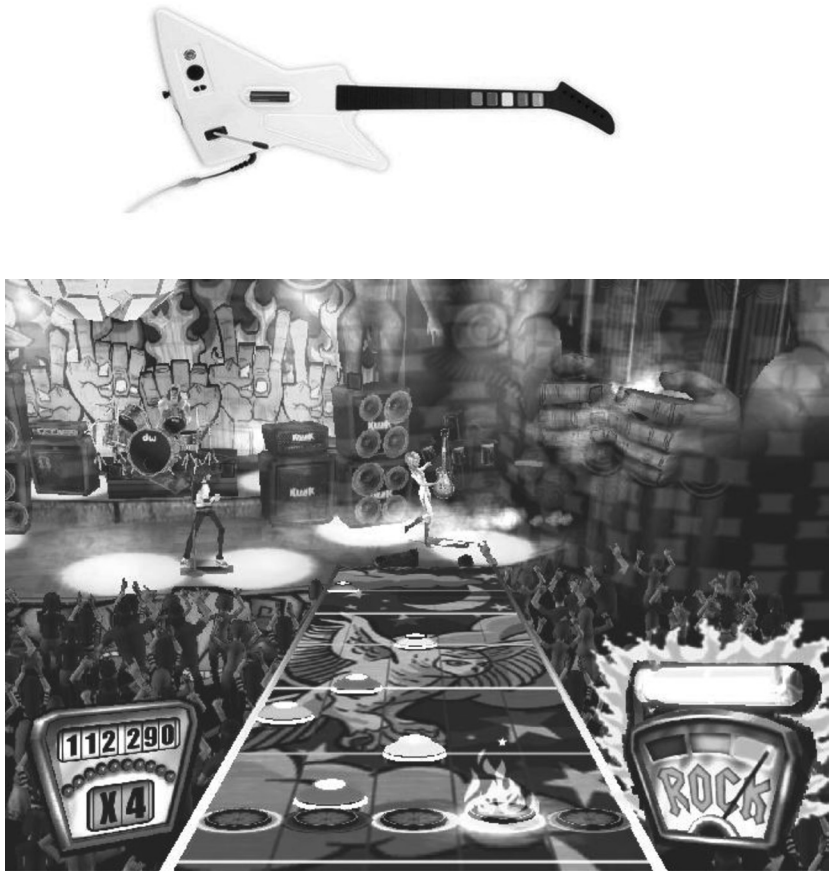

Figure 1. Guitar Hero II™ game controller (top image). Screen shot of Guitar Hero II™ with green, red, yellow, blue, and orange buttons displayed left to right (bottom image). Participants used a beginner setting with only green, red, and yellow buttons to play notes during all songs.

displayed the percentage of correctly played notes on the screen.

Dependent Variables and Data Collection

Data were collected for schedule completion and on-task behavior using paper-and-pencil methods while data on guitar playing were obtained from electronic data collection embedded within the Guitar Hero II™ game. During each session, a trained observer scored whether the child accurately completed each component of the photographic activity schedule immediately after the component. See Table 1 for a complete task analysis of all steps which generally fell into the following categories: (a) setting up game system and guitar controller, (b) selecting the settings (e.g., song, speed), (c) playing the song, and (d) exiting and turning off the game. Three responses were required to score a step of the task-sequence as correct: (a) pointing/looking at the page, (b) completing the target behavior, and (c) turning the page of the schedule. Data were summarized as the percentage of correctly completed schedule components per session.

The trained observers also scored on-task behavior which was defined as (a) visually attending to the materials by orienting the head within approximately a 45-degree field of view of the materials, (b) looking at the schedule, (c) manipulating the materials as they were designed to be used, or (d) transitioning from one scheduled activity to another in the absence of stereotypy (adapted from MacDuff et al., 1993). On-task behavior was recorded using a 60-s momentary time sampling procedure with intervals signaled by a Polder Motivator™ vibrating timer. Data were summarized as percentage of intervals in which the participant was on-task during a session. Guitar playing was defined as pressing the colored buttons on the game controller with enough force to register in the game and produce a musical note. Although accuracy of note playing (correspondence between the note modeled on the screen and the game controller button pressed) was not a requirement of the study, the percentage of correctly played notes was calculated by the game and this score appeared on the screen at the conclusion of each song.

Experimental Design

A multiple-probe across participants design was used to assess the effectiveness of using an activity schedule on correctly completed schedule components, on-task behavior, and guitar playing during baseline, intervention, generalization probes, and maintenance phases. Baseline measures were taken prior to training. Once baseline was stable for the first participant, training was introduced, while the other three participants remained in the baseline phase. Baseline

probes were conducted with the remaining participants at least once per week. The introduction of the training procedure was staggered across the four participants.

The four songs chosen for the study were "You Really Got Me" by Van Halen, "Mother" by Danzig, "Girlfriend" by Matthew Sweet, and "Strutter" by Kiss. The songs ranged in duration from 5 min 7 s to 7 min 12 s and contained 248-301 musical notes. For each participant, three songs were taught and a fourth song, which never appeared during teaching sessions, was used as a probe to assess generalization of playing the video game. Assignment of songs to teaching or probe was counterbalanced across participants such that a different song was used for each participant's generalization probe.

Procedure

Pre-training color assessment. To assess whether the participants had adequate color-matching skills to operate the Guitar Hero II™ game controller, red, yellow, and green bins were placed in front of the participant. Next, 10 small red, yellow, or green items were presented one at a time to each participant and he or she was asked to place the item in the bin that corresponded to its color. All participants were able to correctly match each item presented to its corresponding colored bin. In addition, participants were shown 10 flashcards depicting red, yellow, or green musical notes that corresponded to the button on the game controller. All participants pressed the colored buttons on the controller that matched the color on the cards for all 10 trials.

Preference assessment. Snacks were used as putative reinforcers throughout the study. These were chosen by a brief multiple-stimulus without replacement preference assessment based on procedures described by Carr, Nicolson, and Higbee (2000). Specifically, an array of 10 snacks was placed in front of the participant and the verbal instruction "pick a snack" was presented. After a snack was selected, the participant was given 10 s to consume the snack before it was removed from the array and the verbal instruction was repeated. Attempts to select more than one item at a time were blocked and trials continued until all items were selected or until the participant stopped making selections. The entire procedure was repeated for three sessions and the average percentage of presentations with selection was converted to a rank for each item. The top five snacks were presented in a cup at the end of each experimental session.

Baseline. Before each session, the participant selected which of the top five ranked snacks he or she would earn. A written instruction that stated "Play Guitar Hero" was placed in the participant's daily activity schedule to signal the participant to take a small, plastic bin labeled "Guitar Hero" from his or her shelf in the classroom. This bin

was empty during baseline sessions. The participants had access to the television, the Play Station 2™ video game system, and the Guitar Hero II™ game and controller. No prompting or manual guidance was used. No participant ever played the video game during baseline, thus, within 5 min of retrieving his or her bin from the classroom shelf, the session was ended. The cup of the preferred snack item was provided to the student at the end of the session independent of performance.

Intervention. Before each intervention session, the participant selected which of the top five ranked snacks he or she would earn. During training, snacks were delivered in a clear plastic cup for attending, staying on-task, and correctly completing schedule components. Participants were given access to the snacks at the conclusion of the session. Snacks were restricted for use during the study to prevent satiation.

The written script that read "Play Guitar Hero"remained in place in each participant's daily activity schedule and access to the television, the Play Station 2™ video game system, and the Guitar Hero II™ controller was provided. The small plastic bin on each participant's shelf contained the photographic activity schedule used for playing the game. Each session was approximately 15 min in duration and included all three songs assigned for training with the order of presentation of songs randomized by draw without replacement. Two consecutive sessions occurred each day. After every 7th or 8th training session, the assigned generalization probe song was presented. Generalization probes occurred under the same conditions as in baseline.

During training songs, manual prompting was used to guide the participants' fingers to press the buttons to play the notes on the controller to match those depicted in the video model embedded in the game. Prompts were faded from hand-over-hand prompting to wrist prompts, then forearm prompts, and finally to shadowing. Prompts were faded as soon as the participant completed 70% of the components or greater for two consecutive sessions. When a participant emitted an error, the prompt level was returned to hand-over-hand prompting for one trial and then returned to the previous prompting level before the error was made. If the participant completed 50% of the components or lower on guitar playing for one session, the instructor reintroduced full manual prompts for one session and then used the previous prompt level prior to the low score on the following session.

The participants were taught to follow the activity schedule using manual prompts with graduated time delay (i.e., progressively longer intervals between presentation of the natural stimulus and presentation of the response prompt). The time-delay procedure started

at a 0-s time delay for full manual guidance for two sessions and increased 2 s when the student completed 100% of the components for two consecutive sessions until the terminal delay of 4 s was reached. If the participant made an error, the instructor returned to a 0-s time-delay for that step for one trial and then returned to the previous time-delay level.

Photographic activity schedule pages were completely removed when the participant met mastery criterion (100% correct components, 80% on task for 2 sessions) during training songs, and also completed all the schedule components during their generalization probes. The schedule was removed because it was assumed that the activity schedules were no longer needed to complete the components. The picture that depicted the song to be played during that session, however, always remained present. After the removal of the activity schedule, if the participant did not complete a step or made an error during a step for training songs, the instructor reinserted the page depicting that step and prompted the completion of that step, if necessary. The page was then presented again in the next training session. When the participant correctly completed the missed step in the presence of the picture, the picture was removed for the next session. This process continued until the student correctly completed 100% of the schedule components in the absence of the pictures.

A modification of the activity schedule removal was used for Jared because his percentage of correctly completed components during the generalization probe songs remained low after he had met criterion on training songs. Rather than completely removing his schedule all at once, as had been done for the other three participants, five pages depicting steps for which Jared had at one point made an error during training songs were left in his schedule. When Jared met criterion on one of these steps, the page for that step was removed. Because Jared correctly completed the components during a probe song soon after schedule fading was begun, his entire schedule was removed after four pages remained.

Programmed reinforcement was systematically thinned (FR-1, FR-10, end of session, none) and then removed in conjunction with removal of the activity schedule after the participant correctly completed 100% of the schedule components at a 4-s time-delay and was on-task for 80% of the intervals scored for two consecutive sessions. The game-embedded consequences (i.e., an audible musical note sounding, point accumulation) remained in place.

Two probe sessions were conducted in each child's home both prior to baseline and after intervention to assess the extent to which playing Guitar Hero II™ generalized to the child's own home. The

same song used during each participant's generalization probes throughout the study was used for this home probe. A page from the activity schedule with the assigned generalization song for each participant was presented to the participant with the instruction "Play Guitar Hero II™." No teaching or activity schedules were used. The participant received a cup of snack items at the end of the session independent of performance. Finally, a single maintenance session was conducted for all participants 30 days after the last participant reached mastery criterion. This session was identical to baseline except that the participant chose which of the four songs to play. A cup of snack items was provided to the participant at the end of the session independent of performance.

Social Validity

To evaluate the degree to which participant performance was perceived as age-appropriate typical gaming, eight video segments were made depicting the participants' behavior during baseline and after reaching the mastery criterion in intervention. These video segments were then shown in a randomized order to 15 undergraduate Psychology students who were asked to provide a 5-point Likert-type rating for three questions about the activity and the child's performance (see Table 2).

Inter-Observer Agreement (IOA) and Procedural Integrity

The primary experimenter and a second independent observer simultaneously scored participant behavior on a point-by-point basis for correctly completed schedule components of the task-analysis. They also scored the percentage of intervals during which the participant was on-task during a session. Inter-observer agreement data were calculated by dividing the total number of agreements (either on components or intervals) by the total number of agreements plus disagreements and multiplying by 100. Inter-observer agreement data were collected in vivo during at least 33% of the sessions for each condition and participant. Agreement for correctly completed schedule components was 100% for all participants during baseline and 100% for all participants except Jared (99%) during intervention. Mean agreement for on-task behavior during baseline was 100% for all participants except Jared (98% during baseline) and 98% for each participant during intervention.

To assess procedural integrity, before each session of data collection an observer was provided with written operational definitions of all implementation components along with a summary of the manual prompt levels, time-delay intervals, and reinforcement

schedule used for that session. The observer scored in vivo whether these components were implemented correctly on a trial-by-trial basis and also whether the materials were properly set up for the session. Procedural integrity data were collected during 48%, 45%, 40%, and 39% of sessions for Martin, James, Jackie, and Jared, respectively. A second in vivo observer collected independent data on the procedural integrity measures, which was calculated as previously described. Procedural integrity was 100% for all sessions for each participant and IOA for procedural integrity was 100%.

Results

Figure 2 shows the percentage of correctly completed activity schedule components for each participant. During baseline, the percentage of correctly completed schedule components was low for all participants; however, intervention resulted in systematic increases in the percentage of correctly completed schedule components with continued high levels of performance throughout removal of the schedule, prompts, and programmed reinforcement. Martin's (top panel) correct component implementation increased from 16% in baseline to 97% during intervention with mastery of all schedule components in 27 sessions. Programmed reinforcement was fully removed after 31 sessions. James (second panel) completed only 4% of components correctly throughout baseline, increasing to 97% for training songs and 90% for the probe song during intervention. James required 17 sessions to master the schedule components and 18 sessions before programmed reinforcement was fully removed. Jackie (third panel) did not correctly complete any schedule components during baseline, increasing to a mean of 99% of components for training songs and 86% of components for probe songs. Jackie met the criterion for schedule mastery in 13 sessions and reinforcement was fully removed after 14 sessions.

Jared (bottom panel) completed less than 1% of schedule components correctly during baseline, increasing to a mean of 98% correctly completed components during intervention for training songs. However, he only completed a mean of 27% of components correctly during all probe song sessions. Jared required 23 sessions to acquire the schedule components. Because Jared did not receive a score of 100% on probe songs as the other participants had, the systematic thinning of the schedule was used. The full schedule was removed after 25 sessions. After the first session, once Jared learned the schedule components only five pages remained in the schedule. Following the second session, four pages remained in the schedule. The next day was a generalization probe and he scored 100% on the second ses-

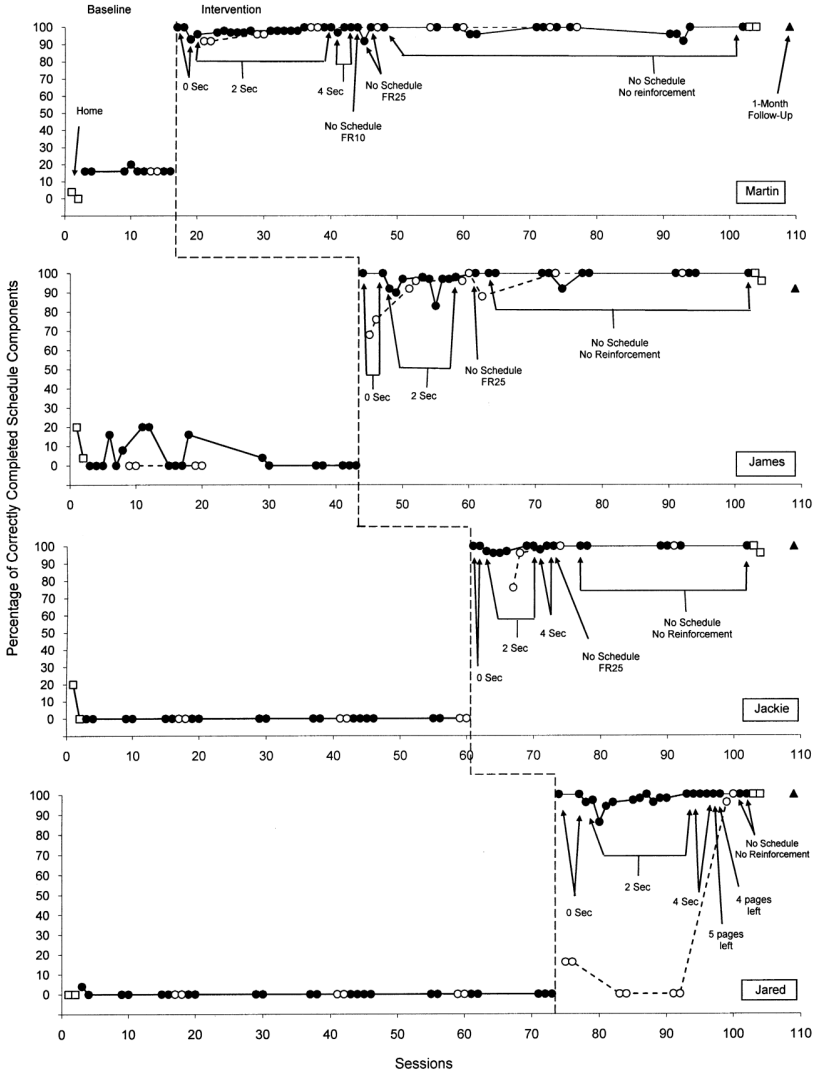

Figure 2. Percentage of correctly completed schedule components with open squares indicating home probes, closed circles indicating training songs, open circles indicating probe songs, and closed triangles indicating maintenance probes 30 days after completion. Sec = seconds for time-delay procedure. FR = fixed ratio for reinforcement schedule.

sion. Because the generalization probe called for no schedule, the entire schedule was removed the next day because he had scored 100% during generalization. Programmed reinforcement was fully thinned after 25 sessions. The home probes conducted prior to baseline resulted in similarly low schedule completion for all participants (range, 0 – 12% across participants) increasing to 100% for all participants except James (98%) after intervention. The maintenance probes resulted in correct completion of 100% of the schedule components for three participants and 96% for the fourth (James).

Figure 3 depicts the percentage of intervals in which each participant was scored as on-task during the 60-s momentary time sampling procedure. Martin's on task behavior (top panel) increased from a baseline mean of 25% of intervals during baseline to a mean of 98% during intervention. James (second panel) increased on-task behavior from a baseline mean of 11% to an intervention mean of 93% of intervals during training songs and during the probe song. Jackie's mean percentage of intervals on-task (third panel) during baseline was 0% for both training and probe songs increasing to an intervention mean of 96% of intervals during training songs and 81% during the probe songs. Finally, Jared's mean percentage of intervals on-task (bottom panel) during baseline was variable with a mean of 42% of intervals on task. During intervention, the mean percentage of intervals on-task for training songs increased to 97% but remained at 43% for the probe song. The home probes conducted prior to baseline and after intervention produced similar results with a low mean percentage of intervals on-task during the pre-test (range 0 - 20%) increasing to 100% for all participants during the post-test. All four participants were on-task during 100% of the intervals during the maintenance probes.

Guitar playing was summarized as the percentage of correctly played notes for each song. No scores were reported for any of the participants during baseline because none of them turned on the system to play the game. During intervention, however, Martin correctly played a mean of 85% of notes during training songs and 77% of notes during the probe song. Similarly, James correctly played 76% of notes during training songs and 72% of notes during the probe song. Jackie correctly played 84% of notes during training songs and 90% of notes during the probe song. Jared correctly played 79% of notes during training songs and 57% of notes during generalization songs. Because Jared did not turn on the video game system during half of the generalization probes, however, only four generalization sessions were used to calculate his percentage of correctly played notes. During maintenance probes, the percentage of correctly played notes was 94% for Martin, 80% for Jackie, and 93% for Jared. Due to a technical

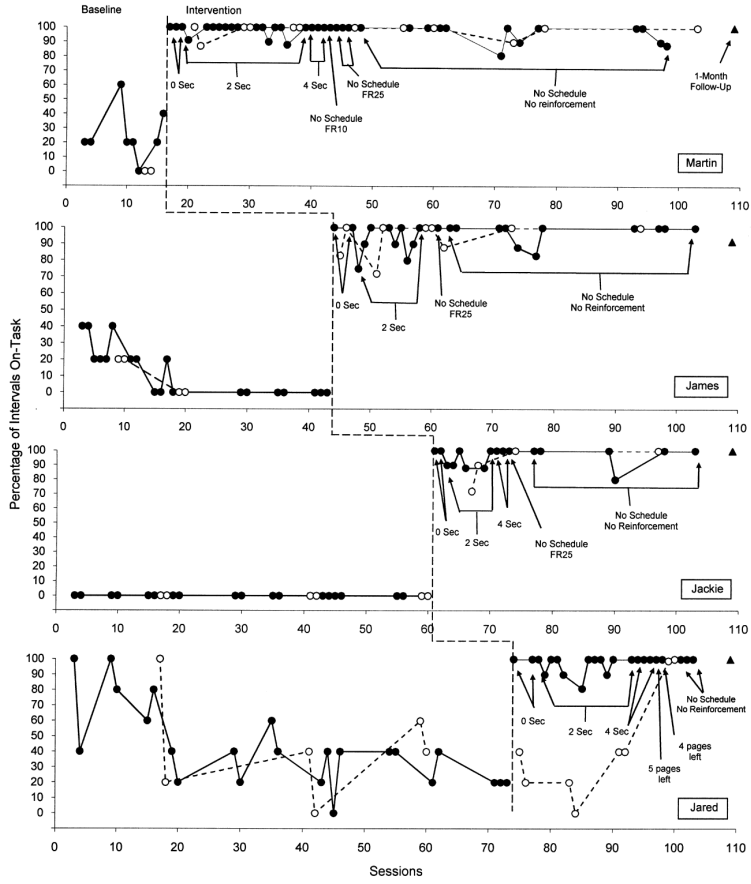

Figure 3. Percentage of intervals on-task with closed circles indicating training songs, open circles indicating probe songs, and closed triangles indicating maintenance probes 30 days after completion. Sec = seconds for time-delay procedure. FR = fixed ratio for reinforcement schedule.

error, no percentage of correctly completed notes could be obtained for James during maintenance.

The results of the social validity ratings (Table 2) indicate that the undergraduate students rated playing this video game as a very age-appropriate leisure skill across both baseline and training conditions for all participants (range 4.3-5.0, agree to strongly agree). They did not agree that the participants were attending to the materials during the baseline video segments (range 1.6-2.0, strongly disagree to disagree) but did agree that participants were appropriately attending to materials during the training video segments (range 4.5-5, agree

Table 2
Social Validity Questionnaire and Results

Question #1: The student is engaged in an age-appropriate leisure skill.

	Baseline		Intervention	
Participant	Mean	Range	Mean	Range
Martin	4.7	(4-5)	5.0	---
James	4.5	(4-5)	4.6	(4-5)
Jackie	4.5	(4-5)	4.5	(3-5)
Jared	4.4	(4-5)	4.3	(4-5)

Question #2: The student is attending to the materials appropriately.

	Baseline		Intervention	
Participant	Mean	Range	Mean	Range
Martin	1.9	(1-3)	4.7	(4-5)
James	1.8	(1-3)	4.5	(4-5)
Jackie	1.6	(1-3)	5.0	---
Jared	2.0	2	5.0	---

Question #3: The student appears engaged in the skill as peers his or her age would.

	Baseline		Intervention	
Participant	Mean	Range	Mean	Range
Martin	2.0	---	4.1	(3-5)
James	2.0	---	5.0	---
Jackie	1.0	---	4.6	(4-5)
Jared	1.5	(1-3)	4.8	(4-5)

Note. 1= Strongly Disagree, 2= Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree

to strongly agree). Lastly, the undergraduate students did not agree that these participants engaged in the skill as peers their age would during the baseline video segments (range 1-2, strongly disagree to disagree) but did agree that these participants were engaged as peers their age would be during the training video segments (range 4.1-5, agree to strongly agree).

Discussion

The current study demonstrated that a training package consisting of an activity schedule, simultaneous video models embedded in a video game, and multiple-exemplar training was effective in teach-

ing young children with autism a generalized repertoire of an age-appropriate leisure skill, playing the video game Guitar Hero II™. The participants continued to correctly complete all schedule components and remained on-task when the manual prompts, photographic activity schedule, and programmed reinforcement were fully removed. In addition, the Guitar Hero II™ playing skills generalized from a training song and setting to a probe song in a setting in which teaching did not occur (the participants' homes). These skills also maintained 30 days after the conclusion of training.

One surprising result in the present study concerned the participants' rapid acquisition of the note playing accuracy for each song. No mastery criterion had been provided for this skill because the goal of the study was for the students to be engaged in an age-appropriate leisure skill, regardless of accuracy when playing the Guitar Hero II™ video game itself. Also surprising were the high levels of correctly completed components and on-task behavior observed during the post-intervention sessions conducted in the student's home because programming for generalization across settings had not been implemented. Because the same game materials were present in both settings, however, this arrangement may have functioned as programming for common stimuli (Stokes & Baer, 1977), thus increasing the likelihood that generalization of game playing occurred in the home. The generalization of game playing to the home setting in the current study increases the functionality of this leisure skill.

Maintenance was programmed for by eventually removing the entire schedule and programmed reinforcement for all participants. Although high levels of correctly completed components and intervals on-task were not surprising, it was surprising, however, that three of the four participants used the expedited removal of the photographic activity schedule. There is a paucity of research to help guide the decisions of when and how quickly to remove a schedule. The removal of the schedule and reinforcement allows for maximal functionality of leisure skills. For the participants in the present study, it is likely that they now have the skills to play this video game with siblings or friends without a schedule to follow or reinforcers present.

This implementation of video modeling in the present study differs from prior studies in that no previous studies used video models embedded in an electronic game to teach game play. In addition, unlike many video modeling studies in which an actor is shown in the video engaging in the activity to be imitated (e.g., McCoy & Hermansen, 2007), the present study used the point of view from that of the learner. The video model showed the buttons on the guitar controller that needed to be pressed. This is a similar procedure to

that used by Shipley-Benamou et al. (2002) in which the experimenters designed video models from the point of view of the learner to teach five different daily living skills. Finally, the game used a form of simultaneous video modeling in which the participant engaged in each component of the model as it was shown (Kinney et al., 2003; Sancho et al., 2010; Taber-Doughty et al., 2008). One limitation of the game-embedded video models used in the present study, however, is that the game does not allow for the removal of the video model to assess generalization of the skill taught in the model's absence, as would typically be done in a video modeling study.

The present study also expands upon previous research on leisure skills. Jerome et al. (2007), for example, taught age-appropriate leisure skills to adults with autism and mental retardation. In contrast, the participants who learned leisure skills in the present study were children diagnosed with autism. MacDuff et al. (1993) used activity schedules with previously learned leisure skills to teach on-task and on-schedule behavior. In the present study, participants were taught a novel leisure skill using a training package consisting of activity schedules, video modeling, prompts, and reinforcement. In addition, prior to the present study, no research had addressed the removal of the activity schedule. MacDuff et al. (1993) had re-sequenced the photographic activity schedule, but did not remove the schedule.

One limitation of the present study is that the particular leisure skills taught may be of limited utility for younger learners. The fine motor skills needed to play the video game effectively may be difficult due to less physically developed hands and fingers. Another limitation of the study is that this procedure never tested the participants' ability to play the video game outside of practice mode. It is unknown whether the participants would be able to play the game effectively during more typical "competitive" modes of the game, such as one would encounter when playing the game with a peer. However, mastery of the practice mode skills creates the opportunity for practicing more advanced skills that could be useful for other modes of the game.

Future research may investigate the use of this training package to teach similar types of video games, as well as other leisure skills, with older learners with autism. The package could also be adapted to investigate the use of written activity schedules for participants who demonstrate pre-requisite reading skills. Additional investigation methods could also be conducted on optimal ways to fade activity schedules based on specific criterion levels, such as when to fade, the direction to fade (removing pictures from front to back or back to front), and how to fade systematically.

Note

This research is based on a thesis by the first author in partial fulfillment of the requirements for the Master of Arts degree in Applied Behavior Analysis.

References

Ayres, K. M., & Langone, J. (2005). Intervention and instruction with video for students with autism: A review of the literature. *Education and Training in Developmental Disabilities, 40*, 183-196.

Betz, A., Higbee, T. S., & Reagon, K. A. (2008). Using joint activity schedules to promote peer engagement in preschoolers with autism. *Journal of Applied Behavior Analysis, 41*, 237-241.

Bryan, L. C., & Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. *Journal of Autism and Developmental Disorders, 30*, 553-567.

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.

Dauphin, M., Kinney, E. M., & Stromer, R. (2004). Using video-enhanced activity schedules and matrix training to teach sociodramatic play to a child with autism. *Journal of Positive Behavior Interventions, 6*, 238-250.

Jerome, J., Frantino, E. P., & Sturmey, P. (2007). The effects of errorless learning and backward chaining on the acquisition of internet skills in adults with developmental disabilities. *Journal of Applied Behavior Analysis, 40*, 185-189.

Kinney, E. M., Vedora, J., & Stromer, R. (2003). Computer-presented video models to teach generative spelling to a child with an autism spectrum disorder. *Journal of Positive Behavior Interventions*, *5*, 22-29.

LeBlanc, L. A., Coates, A. M., Daneshvar, S., Charlop-Christy, M. H., & Morris, C. (2003). Using video modeling and reinforcement to teach perspective-taking skills to children with autism. *Journal of Applied Behavior Analysis, 36*, 253-257.

Luyben, P. D., Funk, D. M., Morgan, J. K., Clark, K. A., & Delulio, D. W. (1986). Team sports for the severely retarded: Training a side-of-the-foot soccer pass using a maximum-to-minimum prompt reduction strategy. *Journal of Applied Behavior Analysis, 19*, 431-436.

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.

Machalicek, W., Shogren, K., Lang, R., Rispoli, M. J., O'Reilly, M. F., Sigafoos, J., & Hetlinger-Franco, J. (2009). Increasing play and decreasing the challenging behavior of children with autism during recess with activity schedules and task correspondence training. *Research in Autism Spectrum Disorders, 3*, 547-555.

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.* Bethesda, MA: Woodbine House.

McCoy, K., & Hermansen, E. (2007). Video modeling for individuals with autism: A review of model types and effects. *Education and Treatment of Children, 30,* 183-213.

Paterson, C. R., & Arco, L. (2008). Using video modeling for generalizing toy play in children with autism. *Behavior Modification, 31,* 660-681.

Sancho, K., Sidener, T. M., Reeve, S. A., & Sidener, D. W. (2010). A comparison of video priming and simultaneous video modeling to teach play skills to children with autism. *Education and Treatment of Children, 33,* 421-442.

Schleien, S. J., 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.

Shipley-Benamou, R., Lutzker, J. R., & Taubman, M. (2002). Teaching daily living skills to children with autism through video modeling. *Journal of Positive Behavior Interventions, 4,* 165-175.

Spriggs, A. D., Gast, D. L., & Ayres, K. M. (2007). Using picture activity schedule books to increase on-schedule and on-task behaviors. *Education and Training in Developmental Disabilities, 42*, 209-223.

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

Taber-Doughty, T., Patton, S. E., & Brennan, S. (2008). A comparison of simultaneous vs. delayed video modeling when used by students with moderate disabilities in community settings. *Journal of Special Education Technology, 23*, 1-18.