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RESEARCH ARTICLE

The Effects of a Video-Enhanced Schedule on Exercise Behavior

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Abstract

Research focusing on physical exercise and individuals with autism spectrum disorder (ASD) is limited. Activity- and video-enhanced schedules have successfully increased leisure, academic, social, and daily living skills for individuals with ASD and may be effective in increasing exercise. We evaluated the effects of a video-enhanced schedule presented on an iPad® on exercise behavior with adolescents with ASD using a multiple probe across participants design. Specifically, the effects of a video-enhanced exercise schedule with graduated guidance on independent schedule-following behavior and on-task behavior was evaluated. Participants acquired a video-enhanced exercise schedule and remained on task; we also successfully faded proximity from the participant. The skills generalized to a novel exercise and setting and maintained over time. The procedures were reported to be socially acceptable by stakeholders. Individuals with ASD are more likely to live sedentary lifestyles, have poor diets and sleep, and be overweight. We evaluated the effects of a video-enhanced exercise schedule presented on an iPad® with individuals with ASD on independent schedule following behavior and on-task behavior. We also attempted to fade proximity from an instructor and assessed generalization, maintenance, and social validity. Individuals quickly acquired the exercise schedule and remained on task. Distance from an instructor was increased, skills generalized to novel exercises and locations and maintained over time, and the procedures and outcomes were reported favorable by stakeholders. Practitioners should continue to evaluate the effects of video-enhanced schedules on exercise behavior and determine how to fade the videos.

Keywords Activity schedules · Autism spectrum disorder · Fitness · Leisure skills

In the last 30 years, obesity among adolescents has quadrupled (Centers for Disease Control and Prevention (CDC), 2014). The prevalence of obesity of US children and adolescents ranged between 17 and 21% affecting nearly 12.7 million youth and adolescents between 2011 and 2014. Moreover, the obesity rates for children with disabilities were found to be 38% higher than for children without disabilities (CDC, 2014).

Children and adolescents with an autism spectrum disorder (ASD) are reportedly at higher risk for being overweight or obese and may have significant secondary health problems (Eaves & Ho, 2008; Holcomb, Pufpaff, & McIntosh, 2009; Rimmer, Yamaki, Davis-Lowry, Wang, & Vogel, 2010). If not addressed, living a sedentary lifestyle and poor health habits may follow from adolescence into adulthood (Nelson, Gordon-Larsen, Adair, & Popkin, 2005). Further, among individuals with ASD, Down syndrome, intellectual disability, cerebral palsy, and spina bifida, adolescents with ASD were the second highest in percentile with obesity. When compared to typically developing peers, individuals with ASD engage in less physical activity. Families identified that low-activity level was due to a lack of athletic ability, energy, disability, and cost (Eaves & Ho, 2008).

Research targeting exercise behavior with individuals with ASD has increased physical activity for participants. Specifically, previous research focusing on exercise behavior increased the frequency, duration, and percentage of steps completed independently across beginner swimming skills (Fragala-Pinkham, Haley, & O'Neil, 2008; Yilmaz,

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Yanardag, Birkan, & Bumin, 2004) snowshoeing, walking, jogging (Todd & Reid, 2006), treadmill use (Pitetti, Rendoff, Grover, & Beets, 2007), and yoga (Downs, Miltenberger, Biedronski, & Witherspoon, 2015; Gruber & Poulson, 2016).

Research targeting physical exercise has primarily used a variety of prompts including vocal, visual, and manual prompts although details pertaining to the systematic prompt-fading procedures have often been omitted (e.g., Lang et al., 2010; Yilmaz et al., 2010). For example, Yilmaz et al. (2010) used a 4-s constant prompt delay to target Halliwick's method of lateral and vertical swimming rotation skills with children with ASD. The specific prompt used was not specified and differed per participant and skill. In addition, Pitetti et al. (2007) evaluated the effects of walking on a treadmill intervention for adolescents with ASD. Although the frequency, speed, and duration was gradually increased across weeks, the authors omitted sufficient details for replication including how walking was prompted. Gruber and Poulson (2016) successfully used graduated guidance and a video model of yoga exercises to teach yoga to children with ASD. Their combined intervention resulted in an increase in independent responses.

Across leisure (e.g., Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; Bryan & Gast, 2000; Carlile, Reeve, Reeve, & DeBar, 2013; Dauphin, Kinney, & Stromer, 2004; MacDuff, Krantz, & McClannahan, 1993; Morrison, Sainato, Benchaaban, & Endo, 2002), academic (e.g., Bryan & Gast, 2000; MacDuff et al., 1993), and daily living skills (e.g., Johnson, Blood, Freeman, & Simmons, 2013; Macduff et al., 1993), picture and video-enhanced schedules have been shown to increase independent schedule following and on-task behaviors. Schedule following behaviors have generalized across novel settings and activities for individuals with ASD (e.g., Blum-Dimaya et al., 2010; Carlile et al., 2013; MacDuff et al., 1993). Picture and video-enhanced activity schedules have been presented using laptop computers (e.g., Dauphin et al., 2004) and handheld devices such as iPods® with individuals with an ASD (e.g., Blum-Dimaya et al., 2010; Carlile et al., 2013).

Activity schedules typically involve a series of pictures, symbols, or text to occasion a chain of behaviors to be completed sequentially (e.g., McClannahan & Krantz, 1999; Kimball, Kinney, Taylor, & Stromer, 2004). In the seminal study, MacDuff et al. (1993) used a packaged intervention consisting of a picture activity schedule and graduated guidance to increase daily living and recreational skills among children with ASD. Once graduated guidance was faded, the activity schedule alone successfully increased on-task and schedule following.

Video-enhanced schedules combine instructional components of activity schedules and video modeling (e.g., Kimball et al., 2004, Spriggs, Knight, & Sherrow, 2015). During video modeling, a video is presented during which the target behavior may be fully viewed, which is lacking from instructional strategies incorporating static pictures. Schedules that incorporate videos have been effective in successfully increasing on-task behavior, independent schedule following behavior (e.g., Spriggs et al., 2015), play, communication skills (e.g., Dauphin et al., 2004), and motor skills. Activity schedules that incorporate video models have resulted in generalization of skills across settings and stimuli (Carlile et al., 2013), have provided consistent presentation of visual cues for the participant to remain engaged and on task (Morrison et al., 2002), may be relatively simple to implement compared to other instructional strategies (Rayner, Denholm, & Sigafoos, 2009; Weng, Savage, & Bouck, 2014), and were reported to be an acceptable teaching strategy (Blum-Dimaya et al., 2010; Carlile et al., 2013). Despite the success of using picture and video-enhanced schedules to teach different skills, limitations in the research exist. First, it remains unknown whether video-enhanced schedules presented on an iPad® can be used to teach exercise behaviors with individuals with ASD. Research focusing on exercise with individuals with ASD is important because of health risks related to lack of exercise such as obesity, morbidity, and mortality (CDC, 2014; Eaves & Ho, 2008; Holcomb et al., 2009; Pan et al., 2016; Rimmer et al., 2010). Second, previous research on exercise behavior neglected to fade the instructors' proximity from the participant (Fragala-Pinkham et al., 2008; Pitetti et al., 2007; Todd & Reid, 2006; Yilmaz et al., 2010) and have omitted assessments of generalization and maintenance.

The purpose of this study was to evaluate the effects of a video-enhanced activity schedule on exercise behavior in adolescents with ASD using an iPad®. Specifically, the study assessed whether adolescents diagnosed with an ASD would acquire a video-enhanced exercise schedule using an iPad®, an instructor's presence could be systematically faded, results would generalize to a different exercise and setting and maintain over 1 and 2 weeks, and the procedures would be socially acceptable by stakeholders.

Method

Participants

Three adolescents enrolled in a private school for individuals with ASD participated. Participants were selected based on teacher nomination and/or individualized education program goals related to health and exercise. Inclusionary criteria required that participants have (1) no previous experience using an activity schedule for exercise; (2) a generalized imitative repertoire per teacher report; (3) a medical waiver; (4) no physical or health impairments that restrict physical activity as confirmed through a Physical Activity Readiness Questionnaire (Shepard, 1988), a physical activity clearance

screening tool; and (5) parental consent. All participants were diagnosed with ASD between 4 and 6 years of age, participated in adapted physical education three to four times per week, had a history with and frequent access to an iPad® for leisure, and a history of following a class-wide textual schedule across their school day. Although use of an iPad® was observed in the classroom, we did not directly assess specific repertoires pertaining to the independent use of an iPad®. The Gilliam Autism Rating Scale-Third Edition (GARS-3; Gilliam, 2014) was completed with classroom teachers for all participants. The GARS-3 is a norm-referenced screening tool that identifies those who engage in behavior consistent with ASD based upon the criteria of the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association, 2013).

Andres was a 13-year-old male diagnosed with ASD, vocally communicated in four- to six-word phrases, initiated conversations, and requested preferred activities or items. He engaged in vocal stereotypy and ritualistic behaviors. According to the GARS-3, Andres had an Autism index score of 84 and ranked "very likely" to be diagnosed with ASD. Andres' weight was considered appropriate. He had a history of following individual activity schedules across work and leisure activities.

Zoila was a 13-year-old female diagnosed with ASD, vocally communicated in 10- to 15-word phrases, initiated conversations, and requested preferred activities or items. She often engaged in vocal protests during interruptions in schedules and in the presence of challenging tasks. With a body mass index of 33, Ziola was considered obese. According to the GARS-3, Zoila had an Autism index score of 46.

Juan was a 12-year-old male diagnosed with ASD, vocally communicated in 10- to 15-word sentence phrases, initiated conversations, and requested preferred activities or items. He vocally protested in the presence of challenging tasks and engaged in ritualistic behaviors. According to the GARS-3, Juan had an Autism index score of 62 and ranked "probably" to be diagnosed with ASD. With a body mass index of 30, Juan was considered obese. Juan had a history of following individual activity schedules across work and leisure activities.

Setting, Sessions, and Materials

All sessions were conducted in a gym or fitness center of a private school for individuals with developmental disabilities. Mean duration of baseline, intervention, maintenance, and generalization sessions equaled 3 min and 14 s (range, 1–7 min and 9 s) across participants. Sessions were conducted two to four times per day, two to four times per week.

Materials included (1) an iPad® tablet with a screen size of .25 m; (2) preinstalled Photos application on iPad® tablet; (3) a yoga mat; (4) a water bottle; (5) a digital video camera; (6) a MotivAider®, a vibrating timer used for data collection; (7) condition-specific data sheets; (8) 9- to 15-s exercise video clips; and (9) a Flip Video Mino HD FVM3160S Digital Camcorder Silver camera and tripod for video recording sessions.

The selection of exercise behaviors was informed by a Certified Strength and Conditioning Specialist® and included core strengthening and cardiovascular exercises. We targeted five discrete exercise behaviors: squat, seal jump, wall sit, march, stretch, and one water intake/rest behavior. Videos ranged from 9 to 15 s in duration and included a fitness instructor modeling three repetitions of each exercise behavior (see Fig. 1). Resting breaks were 15 s in duration and included a fitness instructor modeling drinking water from a water bottle. Presentation of exercises was randomized across presentations with the exception that a resting break separated each exercise.

Dependent Variables and Data Collection

Data were collected on independent schedule following and on-task behavior from video-recorded sessions. Sessions were recorded from a fixed location which permitted viewing both the participant and primary experimenter when applicable.

Independent Schedule Following

Independent schedule-following behavior was recorded using a 43-step task analysis (see Table 1). Data were collected on correct independent responses, prompted responses provided through graduated guidance, or whether an error (i.e., omission or commission) was emitted. A correct independent response was scored when each step was completed within 3 s of the presentation of the video, within 3 s of the preceding response, and in the absence of prompts. Data were summarized as the percentage of steps completed independently by dividing the total sum of correct steps completed by total steps of the task analysis and multiplying by 100. Mastery criterion for independent schedule following was two consecutive sessions at 90%.

Independent schedule following began with the participant tapping the photo application on the iPad®. The initial screen of the iPad® was the standard photo icon provided by Apple, Inc. with no other icons present. Upon tapping the photo icon, a screen shot of the initial exercise, which was randomized across sessions, was presented. Upon tapping the initial exercise screen shot, the screen populated with nine exercise icons. Each icon represented an exercise or a water/rest break. Upon tapping the first video icon on the left, a screen would advance to a video of the initial exercise. The participant would tap the play icon (i.e., a triangle) and the video model was presented. When the video ended, swiping from right to the left would advance the screen to the next target exercise. This sequence was continued until all the videos were presented and the screen remained on the final exercise screen shot.

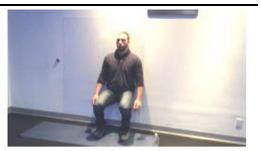
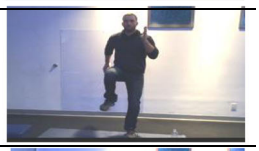
Exercise Behavior	Operational Definition	iPad® Video Screenshot
Squat	Crouch or sit with one's knees bent (within 12.7 cm); sit on one's haunches or heels (no lifting heels above 7.62 cm).	
Seal Jump	Feet together and arms extended to the sides with palms perpendicular to the floor (within 12.7 cm from torso). In one movement, jump and clap hands out in front of the chest. Land with feet apart (minimum 25.4 cm from torso) and palms together (within 12.7 cm from torso).	
Wall Sit	Place back against the wall with feet and shoulders same width apart (within 12.7 cm). Slide down wall into a sitting position until knees are at a 90-degree angle (not exceed a 10-degree difference).	
March	Stand with feet apart and arms at side (within 12.7 cm). March in place, lifting your knees up at stomach level (below or above no more than 25.4 cm) and return to standing position then repeat.	
Toe Stretch	Stand with feet together and legs bent at the knees (within 12.7 cm). Keep your back flat, ned at waist with arms extended toward the floor (within 25.4 cm).	
Water Intake /Rest period	Pick up water bottle and engage in water intake (no less than two engages of water intake)	
Half Burpee (Novel)	Lower body into a squatting position, place hands on the floor extended away from body (within 12.7 cm). Stand up, jump into the air and raise arms overhead (above 7.62 cm).	

Figure 1 Exercise behaviors, operational definitions, and corresponding screen shots of the exercises targeted

On-task Behavior

On-task behavior was defined as the participant (a) orienting his or her body (within 45°) to the appropriate schedule materials for at least 2 s, (b) performing an approximation of the targeted exercise behavior within 3 s of the video presentation, (c) manipulating exercise or related materials as they were designed for at least 3 s, or (d) transitioning between schedule components (MacDuff et al., 1993). Approximations of modeled behaviors were individually defined per exercise behavior (Fig. 2) and were informed by the Certified Strength and Conditioning Specialist®. If the participant performed an exercise behavior topographically similar to the targeted exercise behavior within a designated distance, specific to each exercise, approximations were scored correct. During baseline, a participant would have been scored on-task if he or she emitted any of the target exercise behaviors although this never occurred. On-task behavior was collected using a 10-s momentary time sampling with 2 s for observation and data collection. Data were summarized as the percentage of intervals the participant engaged in on-task behavior and were calculated by dividing by the total number of intervals of on-task behavior by the by the total number of intervals per session.

Pre-experimental Assessments

Pre-assessment of Gross Motor Imitation

Prior to the start of the experiment, participants' gross motor imitation skills were assessed from a video presented on an iPad®. The assessment included five different one-step gross

Table 1 Independent schedule-following behavior task analysis

1. Tap on photo icon
2. Tap on videos icon
3. Tap on first video
4. Tap play
5. Imitate approximation of exercise 1 rep1
6. Imitate approximation of exercise 1 rep2
7. Imitate approximation of exercise 1 rep3
8. Swipe screen right to left
9. Tap play
10. Imitate water intake/rest rep1
11. Imitate water intake/rest rep2
12. Swipe screen right to left
13. Tap play
14. Imitate approximation of exercise 2 rep1
15. Imitate approximation of exercise 2 rep2
16. Imitate approximation of exercise 2 rep3
17. Swipe screen right to left
18. Tap play
19. Imitate water intake/rest
20. Imitate water intake/rest rep2
21. Swipe screen right to left
22. Tap play
23. Imitate approximation of exercise 3 rep1
24. Imitate approximation of exercise 3 rep2
25. Imitate approximation of exercise 3 rep3
26. Swipe screen right to left
27. Tap play
28. Imitate water intake/rest
29. Imitate water intake/rest rep2
30. Swipe screen right to left
31. Tap play
32. Imitate approximation of exercise 4 rep1
33. Imitate approximation of exercise 4 rep2
34. Imitate approximation of exercise 4 rep3
35. Swipe screen right to left
36. Tap play
37. Imitate water intake/rest
38. Imitate water intake/rest rep2
39. Swipe screen right to left
40. Tap play
41. Imitate approximation of exercise 5 rep1
42. Imitate approximation of exercise 5 rep2
43. Imitate approximation of exercise 5 rep3

Rep repetition of exercise

motor behaviors not directly targeted in the videos (e.g., drinking from a cup, clapping hands, rolling arms, turning around, waving). Sessions began with the instructor presenting a video model via an iPad® and the experimenter stating, "Do this." After viewing the video, the participant had the opportunity to imitate the gross motor imitative target. A correct response was defined as imitating the modeled behavior within 3 s after presentation of the video model. No prompts nor reinforcement were provided. Sessions were approximately 1 min and consisted of ten trials during which each target was presented twice in randomized order. A generalized imitative repertoire was considered established when the participant scored 100% across two consecutive sessions. Zoila and Juan scored 100% across the first and second sessions. Because Andres scored less than 100% during the initial assessment, manual prompts were used on subsequent sessions and were faded using graduated guidance. Andres met the mastery criteria within three sessions ($M = 93\%$, range, 80%–100%).

Experimental Design

A concurrent multiple probe across two tiers with a nonconcurrent third tier across participants design was used to assess the effectiveness of a video-enhanced exercise schedule on independent schedule-following behaviors and on-task behavior (Horner & Baer, 1978). A nonconcurrent multiple baseline design was used for the third participant; there was a delay in recruitment because the physical activity readiness questionnaire was inaccurately completed.

Procedure

Baseline

During baseline, a participant was brought to the school gym and presented with an iPad®, yoga mat, and a water bottle. The experimenter stood approximately 1.52 m from the participant and stated "Time to work out." The iPad® was presented; however, graduated guidance was not used. Participants were observed up to a maximum of 3 min during which no prompts or programmed consequences were provided. Sessions were terminated when a participant did not engage in independent schedule following within 1 min, stopped responding for 1 min, or if the participant engaged in disruptive for a duration of 5 s (e.g., throwing materials, yelling). The duration of baseline sessions was brief because the duration of the exercise targets was brief (less than 2 min) and to limit participants engaging in interfering and off-task behavior. Sessions were terminated twice for Andres and once for Juan because they stopped responding for 1 min. At the end of baseline sessions, participants were presented a choice from three highly preferred items identified from a brief multiple stimulus without replacement preference assessment conducted before the start of the study (Carr, Nicolson, & Higbee, 2000; preference assessment results available from the corresponding author). Participants had access to selected item for approximately 3 min for session participation.

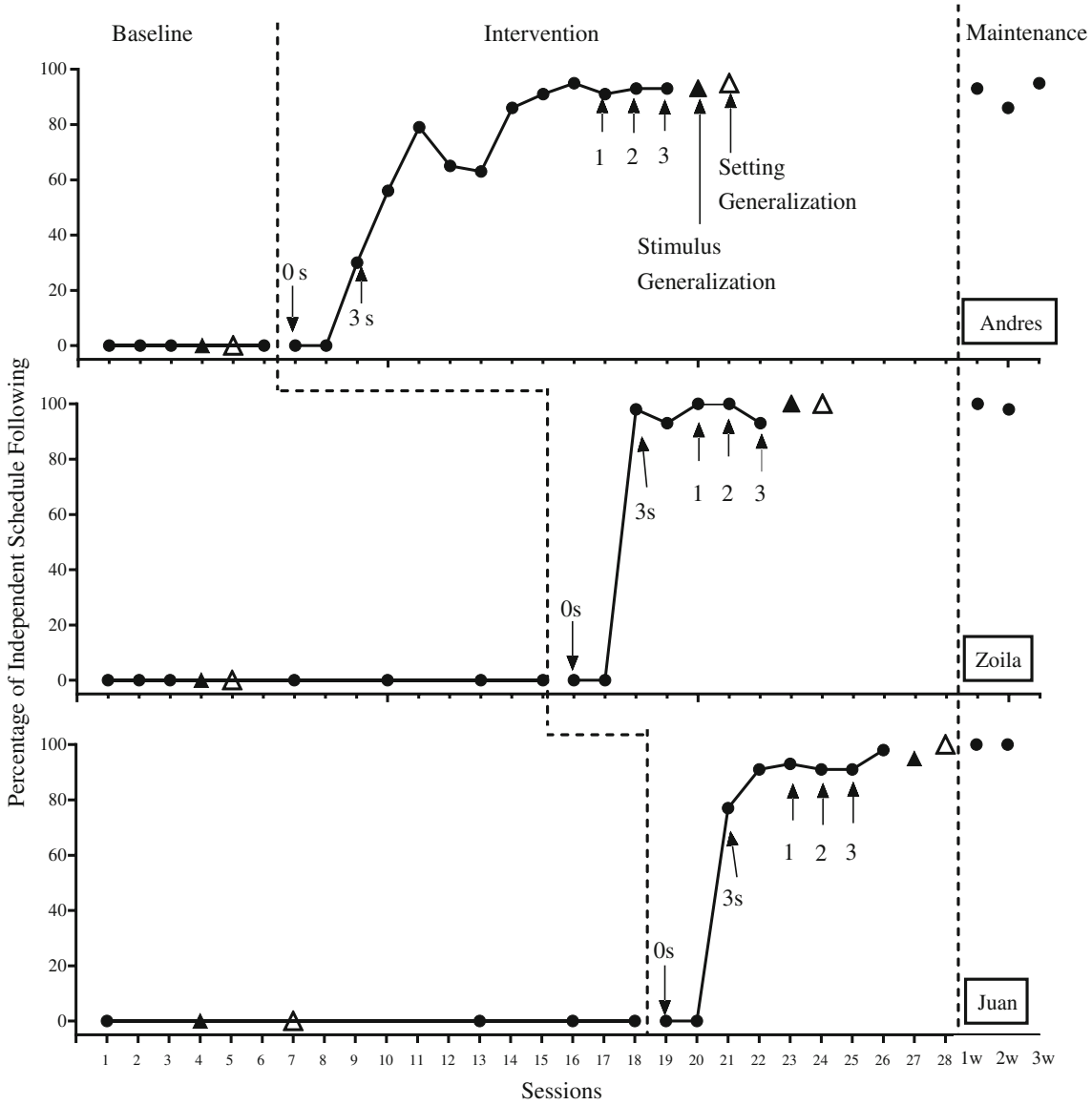


Figure 2 Percentage of independent schedule following for Andres, Zoila, and Juan using a manual prompt at 0 s and faded to 3 s. Proximity from the participant was decreased systematically from 0.92 m (1), to 1.53 m (2), to 2.14 m (3). Solid triangles = novel settings. Open triangles = novel exercises. Maintenance was assessed one (1 W), two (2 W), and three (3 W) weeks following mastery of schedule

Video-Enhanced Exercise Schedule

During the video-enhanced exercise schedule, the experimenter was approximately .30 m from the participant, presented the same vocal instruction, "Time to work out," and the same materials were present as in baseline.

Manual guidance was provided across the 43-step task analysis for the first two sessions. In subsequent sessions and following the vocal instruction, the participant was provided a latency of 3 s to initiate schedule following. If he or she did not initiate schedule following or 3 s elapsed since completing the previous step, the experimenter used graduated guidance to prompt the specific step of the task analysis. Next, the participant was provided the opportunity to independently complete the next step of the task analysis. Manual prompts were faded moment to moment using graduated guidance until the participant was independent in completing the targeted exercise within the video-enhanced exercise schedule (Bryan et al., 2000). Independence was defined as completing the exercise in the absence of prompts with the experimenter approximately .30 m from the participant. After the participant met the mastery criterion for independent schedule following, the experimenter decreased her proximity from the participant systematically to 0.92 m (level 1), 1.53 m (level 2), and 2.14 m (level 3) contingent upon successfully meeting criterion for one session across each distance. If a participant emitted an

error while the distance was being faded, the experimenter approached the participant within .30 m, used graduated guidance for the specific step, and returned to the specified distance. Similar to baseline, at the end of experimental sessions participants were presented a choice from three highly preferred items and had access to the selected item for approximately 3 min.

Generalization

Stimulus generalization was probed intermittently by presenting one video of a novel exercise behavior pre- and post-treatment (the novel exercise replaced one of the five discrete exercises in the video-enhanced exercise schedule). The novel exercise was a half burpee, during which the individual participant was required to touch the floor then jump up while his or her arms were stretched above his or her head. In addition, generalization of the video-enhanced exercise schedule was assessed in a novel setting (the fitness center in the school). The experimenter did not provide prompts or reinforcement during the generalization setting probes, but delivered vocal praise for participation at the end of the session.

Maintenance

Maintenance was assessed 1 and 2 weeks following mastery of independent schedule following across participants. For Andre, maintenance was additionally assessed 3 weeks following mastery because his schedule following decreased during the 2-week maintenance probe. During maintenance, participants were brought to the gym and were instructed, "Time to work out," in the presence of necessary materials. The experimenter did not provide prompts or reinforcement during the maintenance probes, but delivered vocal praise for participation at the end of the session.

Social Validity

Social validity of procedures was assessed across three teachers, two board-certified Behavior Analysts®, and four paraprofessionals to evaluate the appropriateness of the intervention, effectiveness in increasing exercise, the value of participant's independent behavior, and acceptability in other settings using a modified Behavior Intervention Rating Scale (Von Brock & Elliott, 1987). The modified scale had 24 statements rated on a 6-point Likert scale (1 = *strongly disagree, 6 = strongly agree).* Higher scores represent higher social validity. All nine respondents had ongoing contact with one or more of the participants.

Respondents were shown a video recording of the first maintenance session (i.e., after proximity from instructor was fully faded) and were not informed of the specific experimental condition (i.e., baseline, intervention) they were viewing. After viewing the video once, respondents were instructed to complete the questionnaire.

Inter-observer Agreement

Inter-observer agreement (IOA) data were collected by an independent observer via video recordings of the experimental sessions for 50% of experimental sessions on independent schedule following and on-task behaviors across participants. Independent observers were trained to collect IOA by discussing definitions of on-task behavior and following of schedule components. Independent observers scored 100% on videos of an actor completing a video-enhanced exercise schedule on an iPad across the six discrete exercises. The trainee scored two sessions with 100% agreement with the experimenter and was permitted to collect IOA data for the study.

Data were by calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. An agreement was scored when the observers agreed upon the occurrence or nonoccurrence of independent schedule following and on-task behavior. A mean of 98.5% (range, 93–100%), 99.3% (range, 93–100%), and 98.4 (range, 93–100%), agreement was obtained for independent schedule following for Andres, Zoila, and Juan, respectively. A mean of 99% (range, 96–100%), 100%, and 100% agreement was obtained for on-task behavior for Andres, Zoila, and Juan, respectively.

Procedural Integrity

Procedural integrity data were collected for 50% of the experimental sessions by an independent observer via video recording of sessions using condition-specific checklists across baseline, intervention, proximity fading, generalization, and maintenance. For example, during baseline, procedural integrity data were collected as to whether the experimenter presented the iPad®, the yoga mat, and the water bottle, stated "Time to work out," whether she stood approximately 1.52 m from the participant, and whether she did not provide prompts or programmed consequences for responding. Procedural integrity data during intervention assessed whether the same materials as baseline were presented, whether graduated guidance was delivered appropriately and at the appropriate prompt delay response criteria (e.g., 0 or 3 s), and whether the experimenter remained within .3 m from the participant.

Independent observers were trained to collect procedural integrity data by viewing actors completing the video-enhanced exercise schedule components. They were trained on how to use a checklist outlining components of the experimental procedure (i.e., presentation of materials, prompt delivery, and presentation of preferred items). The experimenter described the checklist, modeled scoring a video using the

checklist, and scored the video with each independent observer. When the trainee scored two training videos with 100% agreement for procedural integrity, she was permitted to collect procedural integrity data for the study.

Inter-observer agreement of procedural integrity data were collected for 100% of the sessions in which procedural integrity data were collected. An additional independent observer viewed the same sessions as the initial independent observer and scored each component on the checklist. Inter-observer agreement data were collected on procedural integrity data by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100.

Mean procedural integrity data equaled 99.5% (range, 80–100%), 100%, and 93.3% (80 to 100%) for Andres, Zoila, and Juan, respectively. Mean inter-observer agreement of procedural integrity equaled of 98.8% (range 90–100%), 98.3% (range 90–100%), and 96.6% for Andres, Zoila, and Juan, respectively.

Results

Figure 2 shows the percentage of independent schedule following across participants. None of the participants correctly completed any schedule components during baseline. Once the video-enhanced schedule was implemented for Andres, the percentage of correctly completed components for the schedule increased during the video-enhanced exercise schedule and was mastered within 10 sessions ($M = 64.8\%$, range, 0–95%). Once independent schedule following was mastered, the experimenter's proximity decreased in three sessions. During generalization across materials and setting probes, Andres' mean percentage of correctly completed components equaled 94% (range, 93–95%). During maintenance probes, Andres correctly completed 93, 86, and 95% of schedule components at 1-, 2-, and 3-week probes, respectively.

As shown in the second tier of Fig. 2, Zoila's percentage of correctly completed components for independent schedule following increased during the video-enhanced exercise schedule ($M = 69\%$, range, 0–100%) and was mastered within four sessions. Once independent schedule following was mastered, the experimenter's proximity decreased in three sessions. During generalization probes, Zoila's percentage of correctly completed components equaled 100%. During maintenance probes, Zoila correctly completed 100 and 98% of schedule components at 1- and 2-week probes, respectively.

As shown in the third tier of Fig. 2, Juan's percentage of correctly completed components for independent schedule following increased during the video-enhanced exercise schedule ($M = 68\%$, range, 0–98%) and was mastered within five sessions. Once independent schedule following was mastered, the experimenter's proximity decreased in three sessions. During generalization probes, Juan's percentage of correctly completed components increased ($M = 98\%$, range, 95–100%). During maintenance probes, Juan correctly completed 100% of schedule components at 1- and 2-week probes.

Figure 3 shows the percentage of intervals with on-task behavior across participants. None of the participants were on task during baseline. Once the video-enhanced schedule was implemented, the percentage of intervals with on-task behavior increased for Andres ($M = 87\%$, range, 78–100%). When the instructor's proximity decreased, Andres' on-task behavior remained high ($M = 98\%$; range, 95–100%). During generalization probes, Andres' on-task behavior increased ($M = 95\%$, range, 90–100%). During maintenance sessions, Andres was on task for 100, 78, and 95% of intervals at 1-, 2-, and 3-week probes, respectively.

Once the video-enhanced schedule was implemented, Zoila's on-task behavior equaled 100% of intervals during intervention, decrease of proximity, generalization probes, and 1- and 2-week maintenance probes.

Once the video-enhanced schedule was implemented, the percentage of intervals with on-task behavior increased for Juan ($M = 97.6\%$, range, 93–100%). Juan's on-task behavior equaled 100% of intervals during decrease of proximity, generalization probes, and 1- and 2-week maintenance probes.

Social validity measures assessed the appropriateness of procedures, the effectiveness of the intervention, and the value of participants' independent behavior and acceptability in other settings. As shown in Table 2, respondents rated the intervention as appropriate, reasonable, beneficial, and effective, and would suggest it to others ($M = 4.8$; range, 2–6).

Discussion

The purpose of this study was to extend previous research targeting exercise behavior and evaluate the effects of a video-enhanced exercise schedule presented on an iPad® on schedule-following behavior and on-task behavior. In addition, we evaluated whether proximity from participants to the instructor could be increased to 2.14 m, and results would generalize to a novel exercise and setting maintain over time. Finally, we assessed whether stakeholders would report the procedures as socially valid.

We found that our packaged intervention consisting of graduated guidance and video modeling presented on an iPad® increased independent schedule-following behavior and on-task behavior by adolescents with ASD. Moreover, we successfully faded the instructor's proximity from the participants, generalized skills to a novel exercise and novel setting (a fitness center), and maintained results. We also found that procedures were socially acceptable to behavior analysts, instructors, and paraprofessionals.

The effectiveness of the current study was likely the result of using an effective prompt (i.e., manual guidance) in

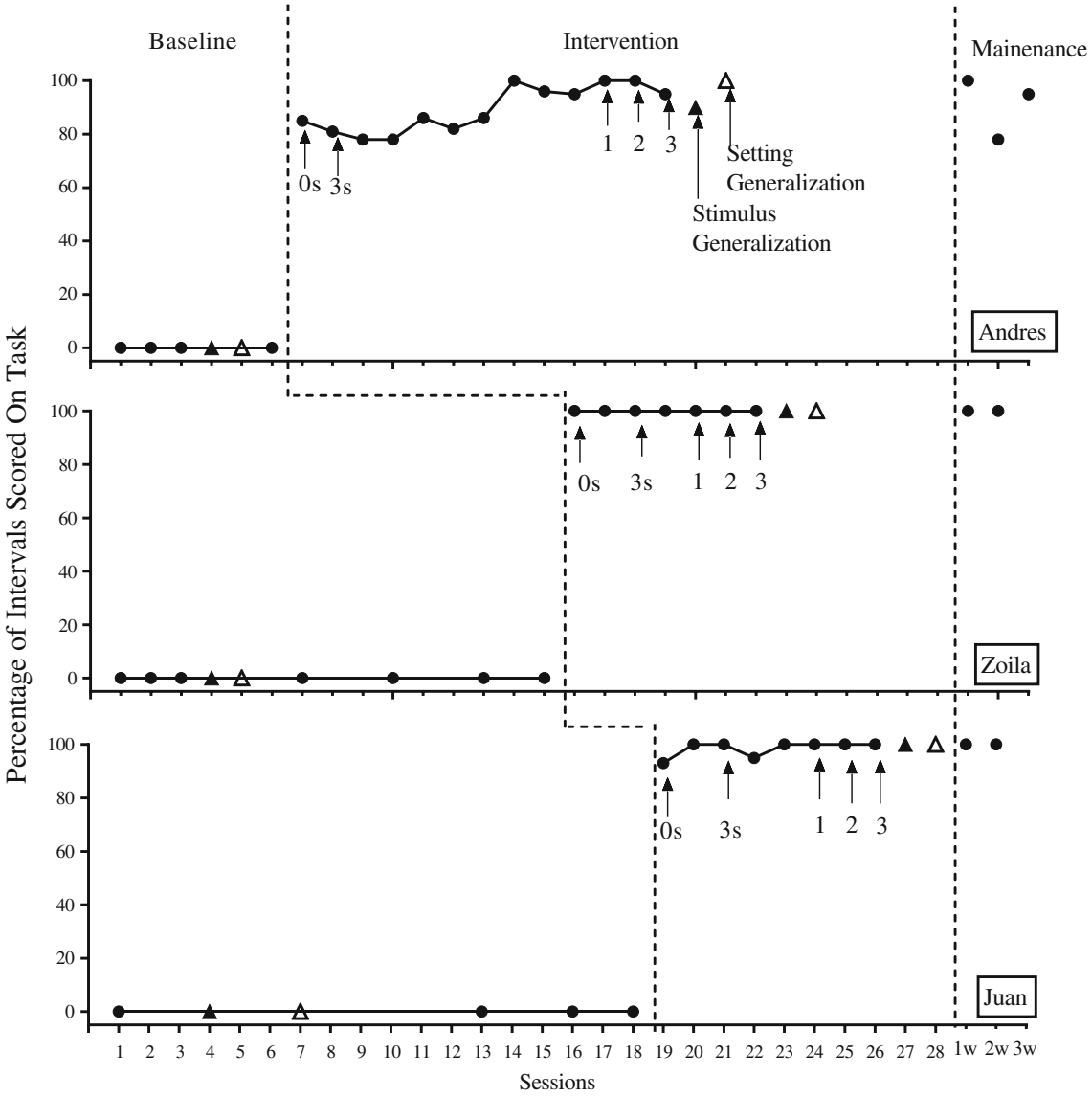


Fig. 3 Depicts the percentage of intervals of on-task behaviors for Andres, Zoila, and Juan using a manual prompt at 0 s and faded to 3 s. Proximity from the participant was decreased systematically from 0.92 m (1), to 1.53 m (2), to 2.14 m (3). Solid triangles = novel settings. Open triangles = novel exercises. Maintenance was assessed one (1 W), two (2 W), and three (3 W) weeks following mastery of the schedule

addition to the use of video-based instruction. One advantage of using video-based instruction with individuals with ASD is that it may build upon the strength of attending to visual stimuli (e.g., Rayner et al., 2009). Prerequisite skills required for video-based instruction to be effective remain unknown. It is likely that the mechanism responsible for the effects are the result of observational and generalized imitation although there is support for delayed imitation and matching (MacDonald, Dickson, Martineau, & Ahearn, 2015). Because we used a packaged intervention, the mechanism responsible for the outcomes is unknown. Future research should conduct a component analysis of the intervention and determine necessary prerequisite skills.

There are several limitations of the current study that future researchers may want to address. The current study targeted a brief duration of exercise. Future research may want to explore additional means to increase the duration of physical activity to at least 60 min per day (CDC, 2014). One possibility would be to assess whether participants would imitate a longer duration of exercises modeled, either in vivo or via a video model. We neglected to assess the intensity of the exercise behavior emitted. An interesting area of investigation would be to assess the effects of heart rate monitors on aerobic exercise behavior. In addition, future research may want to investigate the benefits of using an iPad® for different exercise behaviors such as weight training, dance movement, and sports-related activities. Moreover, we not did assess the effects of choice on type or order of exercise (e.g., Smeltzer, Graff, Ahearn, & Libby, 2009). Researchers may want to explore the impact of choice on exercise schedule-following

Table 2 Social validity results of procedures (modified BIRS, Von Brock & Elliott, 1987)

	Mean	Range
1. The behavior observed was socially acceptable	5.0	2–6
2. Most individuals found this intervention appropriate for someone who does not independently engage in exercise	5.4	4–6
3. This proved effective in increasing exercise	5.0	3–6
4. I would suggest this approach to others	5.1	4–6
5. What I observed warranted the use of an intervention	5.7	3–6
6. Most individuals found this suitable in increasing exercise	4.7	3–5
7. I would use this intervention in a gym setting	4.8	4–6
8. I believe this would not result in negative side effects for the participant	4.7	2–6
9. This was an appropriate intervention for a variety of participants	5.1	4–6
10. This was similar to behaviors observed in other peers with ASD	4.3	3–5
11. This was a fair way to increase exercise	5.3	4–6
12. The behavior was reasonable for the setting	5.3	5–6
13. I liked the procedures used	5.1	4–6
14. This was a good way to handle the participant's exercise behavior	5.0	3–6
15. Overall, this was beneficial for the participant	5.3	4–6
16. The intervention produced a lasting improvement in the participant's exercise behavior	4.7	4–5
17. This improved the participant's exercise behavior	4.3	2–5
18. I believe this would improve the participant's exercise behavior to the point that it would not noticeably deviate from typical peers	4.3	3–6
19. I noticed a positive change in exercise	4.8	3–6
20. The participant's exercise behavior remained at an improved level even after the intervention is discontinued	4.1	3–5
21. This should improve the participant's exercise behavior in the gym, and also in other settings (e.g., community, home)	4.6	3–6
22. When comparing the participant with a typical peer behavior, the participant's and the typical peer's behavior were more alike	4.0	2–5
23. This should produce enough improvement in the participant's exercise behavior to be independent in a fitness setting	4.1	2–5
24. Other exercise behaviors related are also likely to improve by the intervention	4.8	4–5

behavior and on-task behavior. Lastly, we did not directly assess the effects of exercise on stereotypic behavior.

Participants in the current study were reported to have a generalized imitative repertoire and readily imitated modeled behavior presented on an iPad®. The extent to which the current procedures are replicable with additional participants with ASD with and without robust imitative repertoires remains unknown. In addition, all participants had a history of using an iPad®. It is likely that this history and fine-motor capabilities contributed to the acquisition of the schedule. Moreover, to further enhance the external validity of the findings, the procedures should be replicated with other populations (e.g., typical developing children, seniors). In addition, the current study utilized a free preinstalled application on iPads®. Future research could compare the efficacy and efficiency of the current procedures and commercially available exercise applications (e.g., Exercisebuddy). Future research may want to explore ways to fade the video-enhanced schedule to pictures and even to a textual schedule. To enhance the social validity of the pursuit and to increase the benefits of the exercise schedule, researchers may want to replicate the procedures with primary caregivers. Lastly, the current study assessed generalization to a novel exercise and location. Future studies may want to explore whether the current procedures would generalize across commercially available exercise videos or to an in-vivo model.

Exercise promotes a healthy lifestyle and reduces the risk of chronic conditions (CDC, 2014). Children with autism are at risk for being overweight (Eaves & Ho, 2008; Holcomb et al., 2009; Rimmer et al., 2010) and developing poor health habits as adults (Nelson et al., 2005). A video-enhanced exercise schedule may help promote a healthy active lifestyle, promote leisure skills, indirectly decrease reliance on caregivers, and incorporate a socially acceptable technology.

Compliance with Ethical Standards

Human Studies All procedures performed involving human participants were in accordance with ethical standards of the institutional research committee and with 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest All authors declare that they have no competing interests.

Informed Consent Informed consent was obtained from the parents of all individual participants included in the study.

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