Article

Journal of Special Education Technology
1-13

DOI: 10.1177/0162643420906075
journals.sagepub.com/home/jst
SAGE

A Comparison of App-Based Video-Modeling Interventions to Teach Physical Activity Skills to People With Autism in a Community Setting

Laura Bassette[1], **Andrew Weissmann**[2], **Emily Pecsi**[3], and **Jenna Seaman**[3]

Abstract

App-based technologies that utilize video-modeling components are an area that can increase the independence of people with autism spectrum disorder (ASD) in community settings; however, less is known about their impact in facilitating acquisition of physical activity (PA) skills in inclusive community fitness sites. It is important to consider how to increase PA skills in community settings for people with ASD given the known benefits of community inclusion and exercise. This study used an adaptive alternating treatment design to explore differences in three participants' ability to perform exercises independently in a community site when using commercial video-models (i.e., video-models available in the app) compared to custom-made video-models (i.e., developed by the researchers). Two participants performed the PA skills more independently when watching the custom-made videos while the third performed the PA skill more independently when watching the commercial video-models. All participants indicated they enjoyed using the app and videos to learn new PA skills. Limitations of the study as well as implications for future research are discussed.

Keywords

autism, exceptionality, APPS, technology perspectives, secondary, age/grade level, physical activity

The use of the application (app)-based technologies to facilitate physical activity (PA) skills in people with autism spectrum disorder (ASD) is an area that holds promise and could significantly assist people with ASD, families of people with ASD, and service providers in combating health concerns. Previous research identified the use of app-based technologies to support the needs (e.g., educational, communication) of people with ASDs in home and school settings (Dixon et al., 2015; Hill & Flores, 2014); however, less is known about the role they may have on health outcomes in community settings (Bassette et al., 2018). It is critical to consider how technological interventions could facilitate PA opportunities for people with ASD, given approximately half of people with ASD are likely to be overweight (McCoy et al., 2016), many do not meet the daily recommended guidelines for PA, and many do not voluntarily engage in PA (Lang et al., 2010; Srinivasan et al., 2014). Furthermore, facilitating opportunities for PA for individuals with ASD may be of particular benefit. Previous research found individuals with ASD who engage in routine participation in PA had less off-task behavior, elopement, aggression, and stereotypy, while improvements in motor skills, engagement in academics, independence, and prosocial behaviors were observed (LaLonde et al., 2014; Sarol & Cimen, 2015; Sorrensen & Zarrett, 2014).

Use of Technology to Facilitate PA in Community Settings

App-based technologies uniquely offer the ability to facilitate PA skill acquisition using ubiquitous technologies (e.g., iPads) and increase access to and inclusion in community settings (Ayres et al., 2015). These technologies enable people with ASD to receive the individualized instruction needed to acquire the PA skills while being transportable, convenient, and socially acceptable to use within community settings. These factors are notable given that promoting individuals' with

[1] Department of Special Education, Ball State University, Muncie, IN, USA
[2] Department of Counseling, Ball State University, Muncie, IN, USA
[3] Department of Speech Language Pathology, Ball State University, Muncie, IN, USA

Corresponding Author:
Laura Bassette, Department of Special Education, Teachers College, Ball State University, Room 705, Muncie, IN 47306, USA.
Email: labassette@bsu.edu

disabilities PA ability to exercise in community settings can improve the individuals' overall confidence, while also transforming or reducing others' limited or negative beliefs of the skills and capabilities of people with disabilities (Richardson et al., 2017). Additionally, individuals with disabilities who exercise in community settings may feel more connected to their communities, have increased opportunities to engage in social interaction with others, feel more comfortable participating in community activities, and have a greater number of leisure activities from which to choose to engage in (Block et al., 2013).

Use of Technology to Teach PA Skills

A review of PA research for people with developmental disabilities including ASD identified several technological interventions, in conjunction with behavioral principles, as effective in promoting PA in people with ASD. First, when exploring an intervention to increase walking, LaLonde et al. (2014) found participants with ASD who participated in a school-based transition setting who wore a FitBit in conjunction with a goal setting and reinforcement intervention increased number of steps walked. Similarly, Savage et al. (2018) also measured walking (i.e., laps walked) in a school setting when praise was delivered in-person or via technology to participants with intellectual disability (ID) and ASD. This study found PA increased for one participant when the praise was delivered in-person, while the other two participants increased laps when it was delivered using the technology. When praise statements in both conditions were thinned, results were maintained for two participants.

Technology's ability to assist with acquisition of PA skills, also in school settings, was further explored through custom-made video-modeling interventions that were used to teach PA skills to people with an ID (Cannella-Malone et al., 2013; Lo et al., 2014). First, Cannella-Malone et al. used custom-made video-models (in conjunction with error correction) to increase participants' with ID, ages 11–14, ability to complete PA skills (e.g., ladder drill) after watching the videos via an iPod touch. Lo et al. similarly increase participants' with ID, ages 19–20, ability to shoot a basket after viewing a progressive video-modeling intervention including chunking on a 13-in. Apple MacBook laptop computer. This body of research provides important information about technology's ability to facilitate PA opportunities for adolescents with disabilities in school settings; however, less is known about maintaining PA skills across the life span. As transition-aged adolescents with ASD enter adulthood, they can further benefit from learning to use technology to exercise in inclusive community settings (e.g., local gym) alongside peers without disabilities.

App-Based Technologies to Facilitate PA in Community Settings

Exercise Buddy is a free app-based technology that was developed to teach PA skills to individuals with ASD (Exercise Connection Corporation, 2015). Previous research found the app was effective in assisting teaching PA skills to people with ASD in contrived and community sites (Bassette et al., 2018) and people with severe ID in school and community sites (Bassette et al., [under review]). First, Bassette et al. (2018) utilized the app features, commercially available video-models (i.e., videos included with the app made by the developer), visual schedule, and audio feedback, along with additional intervention components (i.e., prompts, incremental increase of criteria, and reinforcement) to teach PA skills to participants ages 16–22 with ASD. The results found the intervention was effective in teaching the initial acquisition of PA skills in nonschool contrived settings (e.g., living room at home) and facilitated generalization to community settings.

The second study utilized the custom-made video feature of the app (i.e., video-models developed by the research team delivered as video prompts) along with the other app features (i.e., visual schedule and audio feedback), prompting, and incentives to teach high school students with moderate and severe ID to complete a walking circuit. The results indicate three of the four participants learned to complete the circuit at both the school and community settings; however, maintenance in the community setting varied (Bassette et al., under review). The combined results of these studies are similar to previous research exploring video-modeling technology to teach skills to people with developmental disabilities (e.g., Mechling et al., 2013). The benefits of developing custom-made video-models included the ability to customize the task and videos beyond what was provided with the app; however, the effort required to produce custom-made videos is an identifiable concern (Rosenberg et al., 2010).

The previous research demonstrated both commercial and custom-made videos were successful in facilitating PA skill acquisition but a direct comparison was not explored. The purpose of this study was to expand on the previous research and explore the video-model feature of the Exercise Buddy app. Specifically, the first research question was: (1) Does independence in performing PA skills (i.e., correct form and level of intensity) differ when participants with ASD viewed the commercially available video-models in the Exercise Buddy app as compared to when they viewed custom-made (i.e., developed by the researcher) video-models? Additionally, the previous study taught participants to create their workouts using researcher prompts; however, participants did not create their workouts independently (Bassette et al., 2018). Therefore, the second research question asked: (2) To what extent is the separate custom-made video intervention (i.e., video-prompting intervention delivered through the camera feature of the iPad, *not* the Exercise Buddy app) effective in teaching participants with ASD to create workouts independently in the Exercise Buddy app?

Method

Participants

Three participants were recruited using convenience sampling following Institutional Review Board approval, and

Table 1. Participants' Demographic Information.

Student	Special Education Services Eligibility	Age/Grade	Ethnicity	Cognitive Skills	Academic Skills	Years Powerlifting
Ann	ASD and secondary language impairment	19/12th grade	Caucasian	84[a] (low average range) 78[b] (upper limits of borderline range)	Reading recognition SS < 55[c] Reading comprehension SS < 55[c] Math SS < 55[c] Spelling SS 69[c]	2 years
Nick	ASD and secondary language impairment	21/12th grade	Caucasian	88[a] (low average range) 90[b] (low average/average range)	Reading recognition SS 63[c] Reading comprehension SS < 55[c] Math SS < 55[c] Spelling SS 69[c]	2 years
Paul	ASD and emotional disability	17/12th grade	Biracial	No information found in IEP	222 out of 244 (English did not pass)[d] 199 out of 271 (Math did not pass)[d]	3 years

Note. ASD = autism spectrum disorder; SS = standard score.
[a]Test of Nonverbal Intelligence Fourth edition (Standard Score). [b]Reynolds Intellectual Assessment Scale (Standard Score). [c]Peabody Individual Achievement Test-Revised/Norm Update. [d]State Standardized Assessment.

pseudonyms were used to protect confidentiality. Prior to the study, participants trained and competed in Special Olympics powerlifting competitions (i.e., squat, deadlift, and bench). None of the participants had any health or medical issues; the study took place after the powerlifting competition year ended. Inclusion criteria were (a) be between the ages of 14 and 22 and assent to participate, (b) parental/guardian written consent, (c) diagnosis of ASD verified through medical or educational records, (d) anecdotal report from parents they would benefit from PA instruction beyond current powerlifting activities, and (e) parent perception of ability to engage in intervention activities (e.g., attend to videos). See Table 1 for demographic information.

Ann. Ann was a 19-year-old female Caucasian 12th-grade student who received special education services through her primary ASD diagnosis and secondary language impairment. Ann displayed limited independence in communicating and typically would not initiate interactions with others. When asked questions, she would use her device/card to respond; her Individualized Education Program (IEP) indicated she required prompting to respond approximately half of the time. Ann was working on a certificate of completion and did not complete state standardized assessments. Ann participated in powerlifting for 2 years prior to the study and competed in Special Olympics (i.e., deadlift, squat, and bench) and USA Powerlifting. Ann also participated in Unified Track at her high school. During the study, Ann was typically compliant with researcher prompts; however, she consistently displayed challenges in independently performing the cardiovascular exercises (e.g., running) during the study. Her mom reported that when she previously participated in running activities, she had been pulled or pushed by an assistant, in lieu of performing these types of activities independently; typically she would only walk independently.

Nick. Nick was Ann's brother—a 21-year-old male Caucasian 12th-grade student. He received special education services through his ASD diagnosis and also had a secondary language impairment. Nick used his device as well as cards to communicate. He tended to respond to questions from others but typically would not initiate interactions. Nick did not participate in state standardized assessments and was on track to earn a certificate of completion. A review of Nick's IEP indicated he hoped to earn his General Education Diploma (GED) and live in a group home after completing high school. Nick began powerlifting the same year as Ann (i.e., 2 years prior to the study) and also competed in both Special Olympics and USA Powerlifting competitions as well as Unified Track at his high school. At the start of the study, Nick's mom reported he was willing to attempt new exercises and throughout, he was compliant with researcher instructions.

Paul. Paul was a 17-year-old male 12th-grade student. He received special education services through his ASD diagnosis and also was diagnosed with an emotional disability. Paul was verbal and his IEP describes him as "very social in class and talks with all students" but the IEP also reported at times he would get frustrated with his peers resulting in minor conflicts. A review of Paul's IEP indicated he had not passed the state standardized assessment but would "receive his [Career Technical Education] (CTE) as part of the graduation pathway" and he planned to pursue psychology in college after high school. Paul powerlifted for 3 years at the time of the study and participated in Special Olympics and USA Powerlifting competitions. Paul was well liked by the trainers at the gym and was compliant with researcher requests.

Setting

Prior to the study, all participants had personal training memberships at a private personal training studio which focused on training athletes with and without disabilities in powerlifting. Sessions took place during scheduled powerlifting training times and the order participants were selected to participate in the study varied to reduce potential fatigue. Within the gym, there were two small offices in front. The gym area included exercise machines (e.g., leg press), free weight stands, barbell platforms, and an open area in the back where the sessions took place. During the sessions, there were typically five to eight other people present including three to five other powerlifting competitors (i.e., athletes with and without disabilities) and two or three personal trainers. All equipment needed for the targeted exercises (e.g., ladder) was laid out and accessible for participants at the beginning of the sessions.

Materials

Materials included screenshot pictures of video-models performing selected exercises (used in baseline), task analysis data collection sheets with codes for the system of least prompts for participants to create their workout in the Exercise Buddy Professional (Pro) app, task analyses specifying the requirements (e.g., correct form, level of intensity) for each of the 15 exercises, data sheets to record intervals performed independently during the workouts, equipment needed for the exercises (e.g., ladder, mat), timer to indicate observation/recording periods during each interval, and an iPad with the Exercise Buddy Pro app on it.

Participants accessed the Exercise Buddy Pro app via an Apple iPad Mini (i.e., 7.87 in. tall × 5.3 in. wide × 0.28 in. thick). Exercise Buddy was developed to help increase PA in people with ASD and included Start/Finish, First/Then, or Circuit workout and an inventory of various exercises (e.g., yoga, abdominal strength) under the different categories. For this study, participants used the Start/Finish workout (maximum of 12 clips each up to 30 s in length) feature of the app to select exercises and associated commercial or custom-made video-models demonstrating how to complete each exercise.

Fifteen total exercises were selected to be used in the study from the app (i.e., three functionally equivalent exercises from five categories—cardiovascular, abdominal strength, motor coordination, posture, and yoga; see Table 2). These categories were selected because they were functionally different from the powerlifting exercises participants trained and competed in (e.g., squat); yet the three exercises selected within each category were functionally equivalent to each other (e.g., ladder march forward is functionally equivalent to ladder march side to side).

The commercially available video-models used in the study were those included in the Exercise Buddy app and included models of adolescents with autism completing the exercises. The custom-made videos included college-age adult models who physically demonstrated how to perform the exercise. Both the commercial and custom-made video-models also included a narrator who provided auditory instructions on how to complete the exercise, verbal praise at the end of the video, and a similar backdrop.

Development of custom-made video-models. Additional components were included in the custom-made videos to increase clarity, promote independence, and maintain safety. The specifications for correct form and intensity for the exercise (i.e., task analyses) and associated scripts for the custom-made videos were developed by the research team. First, researchers (e.g., graduate students) who previously used the commercial video-models in the Exercise Buddy app to teach PA skills to people with ASD reviewed the commercial videos for the exercises. These researchers were selected because they were familiar with the types of errors the participants with ASD from the previous projects tended to make when performing various PA skills. When reviewing the commercial videos, the researchers identified areas for elaboration. They then developed initial scripts and task analyses which specified additional components (e.g., clarification of form) which were then reviewed by two additional research team members. The first was the primary investigator, a doctoral-level Board Certified Behavior Analyst with 5 years' experience conducting PA research with people with ASD. The second was a graduate student with expertise in instructing others in PA as a group fitness instructor at the local YMCA. Scripts, task analyses, and the footage of the custom-made videos were reviewed, discussed, and refined until 100% agreement between the latter researchers was reached.

The custom-made videos included additional verbal and visual information beyond the information in the commercial videos (Table 2). First, in all custom-made videos, the narrator specifically stated the skill associated with the exercise at the beginning of the video and provided specific praise focused on correct form at the end. These differed from the commercial videos, which provided general statements at the beginning and general praise at the end. These additions were included to (a) provide clarity on how to perform the exercise with correct form and/or (b) provide greater detail to further minimize the risk of injury. Custom-made videos were filmed directly on the iPad and uploaded into the Exercise Buddy app and specified custom (e.g., the commercially available exercise "table" in the app was named "Table" in the app while the custom-made was name "Table Custom"). Profiles for each participant were created, and all associated commercial and custom video-models were added to the participants' "Favorites."

Table 2. Exercises Assigned to Participants and Changes in Custom-Made Video-Models.

Category	Exercise	Ann	Nick	Paul	Changes specified in Cust videos
Cardiovascular fitness	Least steps	Com	Com	Com	Start with feet together, move quickly the entire time
Cardiovascular fitness	Tight rope run	Com	Com	Com	Start with feet together, keep feet straight on the line
Cardiovascular fitness	Many steps	Cust	Cust	Cust	Start with feet together, move quickly the entire time
Abdominal strength	Elbows and toes	Com	Com	Cust	Keep core tight with back as flat as possible and body straight
Abdominal strength	Floor crunches	Com	Cust	Com	Keep hands on side of head and eyes facing forward
Abdominal strength	Superman	Cust	Cust	Com	Place palms on floor, keep back flat, keep arm and leg as straight as possible
Motor coordination	Ladder march forward[a]	Cust	Cust	Com	Remember you started with right so need to switch to left
Motor coordination	Ladder march side to side[a]	Com	Com	Cust	Do not step on rungs
Motor coordination	Ladder two foot hops[a]	Com	Com	Cust	Do not step on rungs, look behind before jumping backward
Posture	Side leg raise	Cust	Com	Cust	Start on right side, cradle head in bottom arm, keep top arm on floor, keep leg straight as it is lifted up and down
Posture	Log chops	Cust	Cust	Cust	Start with head on log, do not touch ground with arms in back, move arms all the way down to hips
Posture	Hamstring band stretch	Com	Cust	Com	Keep leg not in band straight, hold band to keep it tight
Yoga	Bird	Cust	Com	Com	Keep palms up, lean slightly forward
Yoga	Table	Com	Cust	Cust	Start sitting with legs out and then put hands down, keep hands and feet straight while holding pose
Yoga	Tree	Cust	Com	Com	Do not interlock fingers, do not place foot on knee, option to move foot closer to ground if trouble balancing, Switch only at halfway point
Cardiovascular fitness	Wide run	Gen	Gen	Gen	Place feet outside mat, keep running quickly
Abdominal strength	Leg kicks straight leg	Gen	Gen	Gen	Keep core tight, keep body still while extending, at the halfway point switch legs
Motor coordination	Crossover march	Gen	Gen	Gen	Keep feet shoulder width apart, touch knee with opposite hand
Posture	Log claps	Gen	Gen	Gen	Get down on the log, make sure head is on the log, move arms slowly, do not let arms touch the ground
Yoga	Waterfall	Gen	Gen	Gen	Place feet shoulder width apart, look straight ahead

Note. Com = commercial; Cust = custom-made; Gen = generalization.
[a]Custom-made videos that included two clips.

Experimental Design and Independent Variables

An adaptive alternating treatment design was used to determine whether a functional relationship existed between the intervention and dependent variables (Sindelar et al., 1985; Wolery et al., 2014). The custom-made video-models and commercially available video-models were the independent variables. During custom-made sessions, participants set up the five exercise workouts by selecting the exercises with the custom-made video-models, watched the custom video-models (i.e., research team members) doing the exercise, and then completed the exercise. During the commercial video-model condition, participants set up their workouts using the commercially available videos and completed the exercises after watching the commercial video-models (i.e., the video-models provided in the app). The study included baseline, intervention, best treatment, and generalization phases with randomization of exercises used to reduce carryover effects.

Dependent Variables and Data Collection

The primary dependent variable for this study was the percent of intervals the exercise was performed independently. Specifically, for the exercise to be considered as completed independently, the participants needed to demonstrate the exercise using the correct form and level of intensity based on the custom-made task analyses for the exercises. During all sessions, participants worked with the researchers individually and were required to complete five exercises for 1 min each. Each minute was divided into six 10-s intervals (i.e., total of 30 intervals for the 5-min session). Each 10-s interval consisted of 8 s during which the researcher observed participants and 2 s where the researcher recorded data. Whole interval recording was used to record whether participants performed the exercise independently (i.e., correct form/intensity) for the entire 8-s observation period. The second dependent measure was independence in creating the workout using the app. This was defined as the percentage of steps in the task analysis participants created their workout in the app without researcher prompting (i.e., creating the workout in the app included 13 task analysis steps). Direct observation event recording was used to assess independence in creating the workout.

The third dependent measure was the efficiency, which was captured through the workout history feature of the Exercise Buddy app; however, these data are limited to sessions researchers were able to access the internet (i.e., the Exercise Buddy app would only save workouts and associated data when the iPad was connected to the WiFi which was not accessible during every session). Efficiency data were calculated by dividing the number of seconds participants engaged in the exercises independently (i.e., 300 s for the 5-min workout) and dividing this by the total amount of seconds of the session (i.e., exercise time and off-task time). Off-task time was tracked by the Exercise Buddy app and included when the timer was paused (e.g., when researchers paused the timer because they needed to prompt the participants to correct an error they made completing the exercise) as well as any time participants were transitioning between screens in the app. This included when the participant/researcher went from the Start/Finish schedule screen to hitting the play button to watch the video-model as well as after the participant finished viewing the video-model and transitioned back to the schedule screen to start the 1-min timer for the exercise restarted the timer. Off-task time did not include the time of the video-models, this was tracked separately in the app.

All data collection was overseen by the primary investigator who has over 10 years' experience in delivering technological interventions to individuals with disabilities. The primary investigator trained the research assistants to implement the intervention and collect data. The training was conducted through in-vivo practice sessions, and research assistants were required to demonstrate mastery of delivering the intervention and collecting the data.

Procedures

Warm-up and cooldown. Before engaging in the workout for each session, participants completed a brief warm-up led by the researcher(s). The warm-up consisted of the researcher saying/modeling the activity (e.g., walking for 2–3 min, reaching arms above their head while standing, arm circles, touching toes). Similarly, a cooldown was included at the end of each session (e.g., walking for 1 min, laying down, and stretching arms overhead).

Baseline. Any equipment needed to complete exercises was laid out for participants prior to the start of each baseline session. At the start of each session, participants were shown pictures of the video-models performing the task analysis steps of each exercise. After reviewing the picture for up to 45 s, participants were given the instructional cue "Show me how you do that exercise for 1 min." No videos or prompts were provided and the percent of intervals the participant performed the exercise independently (i.e., correct form/intensity) was recorded. Five of the 15 available exercises were randomly assigned to each session with one exercise from each of the five categories (cardiovascular, muscular fitness, abdominal strength, yoga, and motor coordination); the order of the exercises was randomly assigned in each session. A minimum of five baseline sessions was required for each participant and continued until participants displayed zero-celeration or decreasing trend.

Training to create workouts in the app. Following baseline and before the intervention, participants were trained to create their workouts using the app. Specifically, a written list of the five exercises for the workout for that session was provided to participants and specified the name of the exercise. For example, if it was a commercial video-modeling session, the exercise would be listed "tree" since that is how it was identified in the app. If it was a custom-made session, the list of exercises would specify custom (e.g., "tree custom"). During training, participants watched the video-model which demonstrated how to navigate the iPad to create the workout in the app on the researcher's laptop. Video prompting was used during training sessions. Specifically, participants watched the first step (i.e., Open Exercise Buddy Pro app), then the video-model would be paused and participants would complete the step. The video would then be un-paused and they would watch Step 2 (i.e., "Select Workouts") and the video would then be paused and they would be expected to do that step. This process continued until participants completed all steps to create the workout. If participants made an error in completing the step, a system of least prompts (i.e., verbal prompt, modeling prompt, partial physical prompt, full physical prompt) was implemented by the researcher to assist them in completing the step independently. Mastery criteria were set at two consecutive sessions where participants completed 80% of the steps or more independently (i.e., without researcher prompts). Once a participant independently created one workout at mastery criteria using the video prompts, they had the choice to watch the video-models during subsequent training sessions.

Intervention. Prior to starting the intervention, participants were reminded they would receive $40 in cash for participating at the end of the study. The two conditions used during intervention included five sessions with the commercial video-models and five with the custom-made video-models. Exercises for each condition were randomly assigned to each participant. Specific conditions (i.e., custom or commercial) and the exercises used in each session alternated to minimize order effects. At the beginning of each session, participants were given the written list of the names of the five exercises for that workout (i.e., custom-made or commercial) and told they needed to create the workout for the session. Independence in creating the workout was recorded and the same system of least prompts used during training was implemented if participants made errors. After creating the workout, participants were given the instructional cue "Now that you've created your video it's time to do your workout. You need to watch the videos of each exercise before you do it." The app would be started either by the participants or the researcher and participants would watch the video-models (i.e., custom-made or commercial) demonstrating how to do the exercises. After watching the video of the exercise, the timer would start and the participant would be expected to perform the exercise.

If the participant engaged in the exercise independently based on the task analysis for the entire 8-s interval, the interval was coded as independent; the timer ran continuously for the full minute. If the participant did not engage in the exercise independently during the entire 8-s interval, the timer was paused at the end of the 8-s interval, and the system of least prompts (i.e., verbal prompt, modeling prompt, partial physical prompt, full physical prompt when feasible) was implemented by the researcher to assist the participant in completing the exercise independently. Once the participant demonstrated the exercise independently (i.e., while the timer was still paused), the researcher would record the most intrusive prompt used and the timer would be un-paused to initiate the next interval. Within a given interval, refusals were coded if a participant failed to maintain the exercise for the entire interval succeeding a partial or full physical prompt. Fatigue was also coded within an interval, if participants performed the exercise independently during preceding intervals but did not maintain performing the exercise independently during the latter intervals.

Best treatment. The participant's individual best intervention conditions (i.e., custom-made or commercial videos) were determined based on procedures outlined by Wolery et al. (2014). Specifically, the differences in the data point values between the two conditions, which were alternated, were examined to determine whether one condition was consistently superior when compared to the corresponding data point of the other conditions explored. The percentage of nonoverlapping data (PND) for intervals performed independently/session was used. The PND was calculated by determining the number of sessions in one intervention condition (e.g., custom-made) were superior to corresponding data points of the other condition (e.g., commercial) and dividing by the number of comparison sessions (five; Wolery et al., 2014). Best treatment sessions were conducted similar to intervention sessions—they created their workout in the Exercise Buddy app; however, all videos in all best treatment sessions only included video-models from their best treatment condition (i.e., custom-made or commercial).

Generalization. Five generalization sessions occurred 1 week after the best treatment sessions were completed. During generalization, participants had the option to watch the video-models of their respective best treatment conditions (i.e., custom-made or commercial), but exercises included five new exercises from the same categories. During generalization, participants created workouts in the app, and the system of least prompts was used to correct any errors made in creating the workout. Participants then watched the videos before doing the exercises and performed the new five exercises for 1 min each. No researcher prompts were provided if participants made errors in performing the exercise based on the task analyses and the percentage of intervals performed independently were recorded. During the last generalization session, participants received $40 for their participation.

Interobserver Agreement (IOA) Data

During a minimum of 40% of sessions in each phase for each participant, a second trained researcher recorded participant independence or researcher prompts delivered when participants created their workout. The second observer also directly observed participants during their workouts and recorded if they performed the exercise independently during the entire interval, any researcher prompts delivered, and/or if the participant refused to engage in the exercise or displayed fatigue. The number of agreements of independence or the type of prompt delivered for each step in creating the workout was summed and divided by agreements plus disagreements. The number of intervals where both observers agreed the participants performed the exercise during the interval independently and/or agreed on the type of prompt delivered by the researcher was divided by the number of intervals they agreed plus the number of intervals they disagreed. IOA for creating the workout across participants ranged between 84% and 100% (average 99%). IOA for the intervals performed independently ranged from 93% to 100% (average 97.8%). IOA for efficiency and video time data were collected by a second observer who reviewed the permanent product data saved by the app. The observer calculated efficiency and video time values for all sessions where efficiency data were available, and IOA was 100% for all participants across all phases.

Treatment Fidelity and Social Validity

Fidelity of procedures for each phase of the study was collected for a minimum of 40% of each phase based on the protocol (e.g., during *baseline*, observer recorded whether the researcher provided the participant with the picture task analyses of the exercises; during *intervention*, observer recorded whether researchers implemented the system of least prompts when the participants made errors in the exercises; during *generalization*, observers recorded whether researchers gave participants the written list of the five generalization exercises to create their workouts). Treatment fidelity was 100% for all participants across all phases. Additionally, social validity interview questions were conducted to assess perceptions of the study and use of the custom and commercial video-models to learn exercises. Specifically, participants were asked 5 questions at the start of the study and 10 questions at the end. Parents/guardians/trainers were asked five questions at the start of the study and nine at the end.

Data Analysis

The data were analyzed using visual analysis to determine whether there was a functional relationship between the video-model intervention and primary-dependent measure (i.e., percent of intervals completed independently); phase change decisions were determined based on this measure. Changes in level and trend, variability between phases and conditions, and fractionation of data between conditions were examined. Tau-*U* was used to calculate effect size for the percentage of intervals completed independently and demonstrated contrasts between each intervention condition with baseline conditions for the same participant (Parker et al., 2011). A web-based calculator was used to determine Tau-*U* effect sizes (see http://www.singlecaseresearch.org/calculators/tau-u; Vannest et al., 2011). Tau-*U* scores less than or

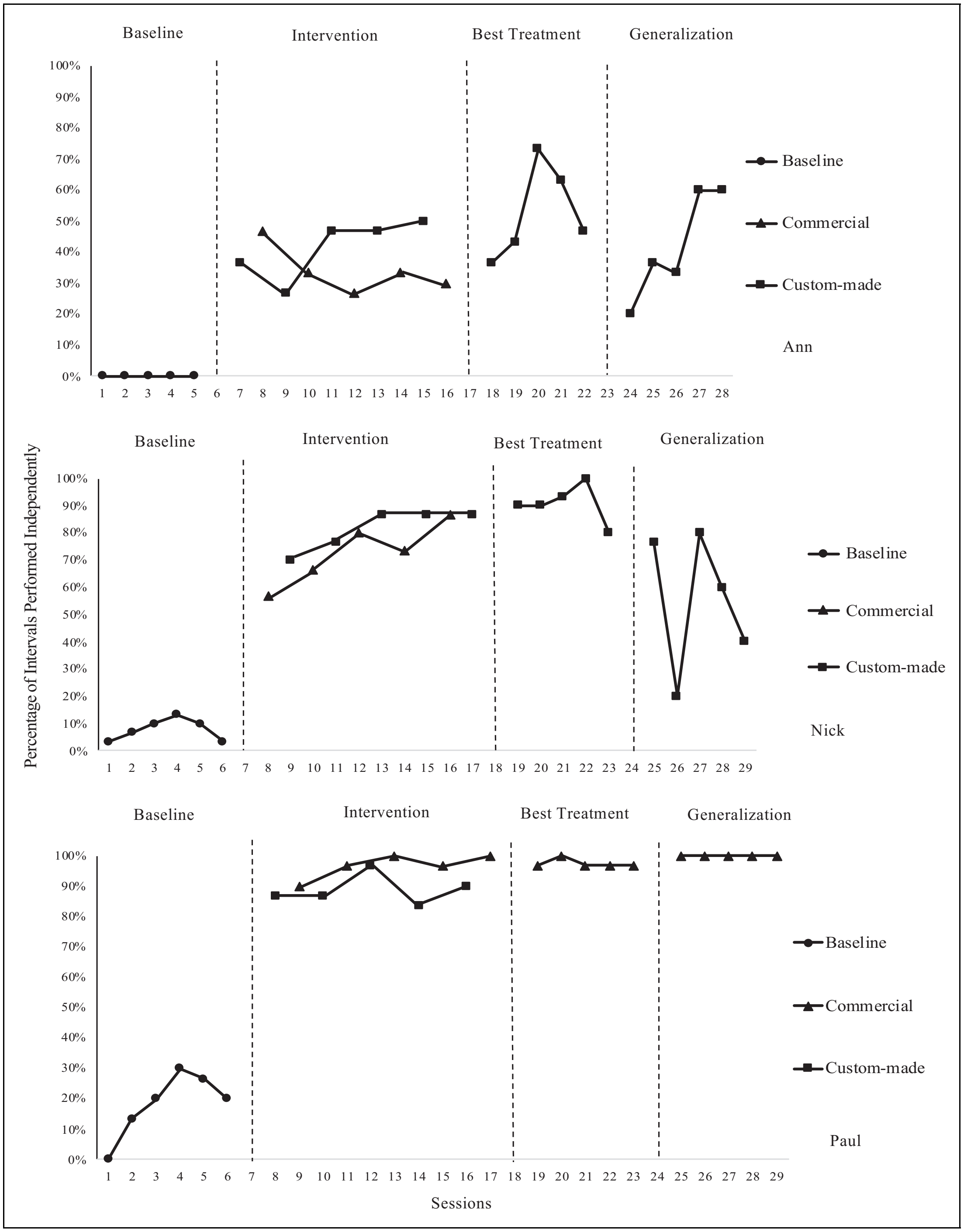

Figure 1. Percentage of intervals performed independently when completing physical activity skills.

equal to 65% indicate a small effect, 66%–92% a medium effect, and 93% and above a large effect (Parker et al., 2009).

Results

Visual analysis of the data indicates an effect of intervention on the intervals participants performed independently (i.e., correct form/intensity) once the video-model interventions (i.e., custom-made and commercial) were introduced (Figure 1) and indicate Ann and Nick performed the exercises more independently when using the custom-made videos compared to Paul who performed more intervals independently when using the commercial videos. Fractionation of the intervals performed independently was observed in the participants. Following training, Ann and Paul maintained their ability to create their workouts in the app, while Nick displayed greater variability.

Ann

During baseline, Ann did not perform any intervals independently and her data were stable, with a zero-celeration trend. During intervention, Ann initially performed more intervals independently during the commercial condition (sessions 7–10); however, during the remaining intervention sessions, fractionation of data for intervals performed independently was demonstrated; she ultimately performed more intervals independently when using the custom-made videos (range 26%–50%, average 41%) than during the commercial video condition (26%–47%, average 34%). Compared with baseline data, Ann's Tau-*U* was 100% for custom and 100% commercial indicating a high effect size. The PND for custom-made to commercial was 60% (commercial to custom-made 40%), and the custom-made video condition was determined to be her best treatment. During the best treatment, Ann performed an average of 53% of the intervals independently (range 37%–73%) and during generalization, she performed an average of 42% of the intervals independently (range 20%–60%). Ann's efficiency and video time data indicate that across the phases, her efficiency in time spent exercising increased (i.e., off-task time decreased) while the time of the video-models decreased. Averages were calculated from available data which included two commercial intervention sessions (efficiency 48.1%, video time 148.5 s), three custom-made intervention sessions (efficiency 38.4%, video time 166.3 s), three best treatment sessions (efficiency 73.3%, video time 145.7 s), and three generalization sessions (efficiency 83.7%, video time 115 s).

Ann learned to create her workout using a custom-made workout since this was the condition randomly selected for her first intervention session. Ann required three training sessions to meet the two sessions at 80% criteria in creating the workout independently. Following training, Ann did not request to watch the video-model demonstrating how to create the workout and she maintained high levels of independence in creating her workout in both conditions (commercial average 94% independent, custom-made average 97% independent). During the best treatment, she continued to demonstrate her ability to create her workouts independently (average 95%) and she independently created her workout for all generalization sessions.

Nick

Nick displayed a decreasing trend in the percent of intervals performed independently during baseline after six sessions and an immediate effect of the intervention was observed when he began intervention. During the intervention, Nick performed more intervals independently during the custom-made condition (range 70%–87%, average 81%) as compared to the commercial condition (range 57%–87%, average 72%). When comparing baseline data to intervention data, Nick's Tau-*U* was 100% for custom and 100% commercial indicating a high effect size. PND for custom to commercial was 80% (commercial to custom was 0%) and the custom-made condition was Nick's best treatment. High levels of intervals performed independently were observed during best treatment (range 80%–100%, average 91%) but were more variable during generalization (range 20%–80%, average 55%). Available efficiency and video time data for Nick were used to calculate averages across three commercial intervention sessions (efficiency 64.6%, video time 141 s), four custom-made intervention sessions (efficiency 72.6%, video time 157 s), three best treatment sessions (efficiency 83.1%, video time 151 s), and three generalization sessions (efficiency 83.6%, video time 115 s).

Nick's first intervention session was randomly selected to include a commercial video workout; therefore, he was trained to create his workout using the commercial exercises and he required three training sessions to meet criteria. During the intervention, average independence in creating custom-made workouts was 80% and was 75% when creating commercial workouts. During the second intervention session (custom-made video session), Nick requested to watch the video-model demonstrating how to create the workout. During all subsequent sessions, Nick did not watch the video-model demonstrating how to create the workout. Independence in creating the workouts was less variable and higher during best treatment (average 91%) and generalization (average 92%).

Paul

Paul initially displayed variability in intervals performed independently during baseline with a decreasing trend following six sessions (range 0%–30%, average 18.3%). An immediate effect of the intervention was observed. During the intervention, Paul performed more intervals independently during the commercial condition (range 90%–100%, average 97%) than in the custom-made condition (range 83%–97%, average 89%). Compared with baseline data, Paul's Tau-*U* was 100% for custom and 100% commercial indicating a high effect size. PND for commercial to custom was 100% (custom to commercial was 0%), and the commercial condition was Paul's best treatment. During best treatment (range 97%–100%, average 97%) and generalization (average 100%), Paul maintained high levels of intervals performed independently. Average efficiency and video time for Paul were available during four commercial intervention sessions (efficiency 94.0%, video time 164 s), four custom-made intervention sessions (efficiency 97%, video time 143 s), five best treatment sessions (efficiency 83.1%, video time 151 s), and three generalization sessions (efficiency 100%, video time 40.25 s).

Paul learned to create his workouts using a custom-made workout and met criteria after two sessions. He only watched the video-model demonstrating how to create the workout during the first training session and did not review it prior to the second training session. Following training, he maintained high levels in his independence in creating the workout (custom: range 77%–100%, average 94% and commercial: range 92%–100%, average 99%). During best treatment and generalization, he was able to create all workouts independently.

Social Validity

Participants, parents, and trainers at the gym were asked pre- and post-social validity questions regarding their perceptions of the intervention. It took participants/parents/trainers approximately 5 min to answer the pre-study questions and approximately 10 min to respond to the post-study questions. Prior to the intervention, Ann and Nick's mom indicated she felt both the custom-made and commercial video-models could assist her children since she identified them as visual learners. She believed the videos would provide information on how to do the exercises in ways that were specific to their needs. She also indicated that having them participate in exercises beyond the powerlifting moves would be beneficial and assist in their understanding of different movements and improve overall awareness of their bodies. All the participants indicated they enjoyed exercising and were eager to learn new PA skills. Nick indicated he enjoyed watching videos and Ann thought the app would help her learn. Paul reported he was not sure about using the app but was willing to try. Ann indicated she currently struggled with her posture when exercising, Nick struggled with dropping weights, and Paul struggled with doing high repetitions due to fatigue.

During the post-survey, Paul's mom indicated she thought the intervention was beneficial due to incorporating the technology and thought others with and without disabilities would enjoy using the app. Ann and Nick's mom appreciated the study's focus on exercises beyond the powerlifting moves while noting the exercises in the app could also be integrated with powerlifting in the future. She mentioned the social importance of having Ann and Nick interact with the researchers and felt the app assisted in facilitating their independence in exercising. One of the trainers at the gym similarly acknowledged the opportunities for independence but noted manual involvement can help improve efficiency in performing the exercises. He further noted he could see his clients using the app in the future during times they were not able to make it to sessions and noted the utility of having a trainer design the workouts. All of the participants indicated they enjoyed watching both types of videos—Paul noted the use of the videos as visuals was particularly helpful, Ann mentioned she liked being able to see what she needed to do, and Nick noted the videos were easy to follow.

Discussion

The primary purpose of this study was to explore the effect of using custom-made and commercial video-models to teach independence (i.e., correct form/intensity) of PA skills in young adults with ASD. Differential impact of treatment was observed with two participants performing more intervals independently when using custom-made video-models and one participant performing more intervals independently when using the commercial video-models. Intervention effects were observed during both intervention conditions as compared to baseline; however, generalization to new exercises was variable across participants. The second research question explored whether the effect of the video-prompting intervention on teaching the participants to create their workouts independently using the app. The results indicate initial variability in the participants' ability to create the workouts independently; however, all participants displayed greater stability in independence in creating their workouts during the best treatment and generalization.

The results of this study extend the literature regarding the use of video-modeling to teach PA skills to people with ASD by implementing the intervention completely within an inclusive community setting on a transportable device (i.e., iPad). The differential impact of the commercial and custom-made videos observed in this study align with previous research which similarly found variation in the effectiveness of using commercial videos compared to custom-made video-models when teaching skills to people with ASD (Mechling et al., 2013; Rosenberg et al., 2010). As suggested by Mechling et al., the custom-made videos used in this study included additional audio and visual components that were not included in the commercial videos; however, unlike Rosenberg et al., they did not include individualized custom-made video-models uniquely created for each participant. This study further extends the previous literature by including a greater variety of tasks (i.e., 15 exercises) compared to the sole handwashing task explored by Rosenberg et al., and the three cooking tasks explored by Mechling et al. Additionally, this study also expanded the opportunities for independence by teaching the participants to create their workouts in the app which expands previous research (Uphold et al., 2016).

Implications for Practice

There are a number of relevant implications for teachers, practitioners, and other service providers considering using app-based video-modeling interventions to teach PA skills to people with ASD. First, it is important to consider the transportability of the technology and opportunities to facilitate independence in inclusive community settings. Practitioners should also be sure to consider the specific PA skills they plan to focus on and the availability of commercial video-models to demonstrate the salient features of the skills to ensure correct form and minimize injury. Similarly, practitioners developing custom-made videos should have their videos reviewed by experts (e.g., fitness instructors) who are knowledgeable of how the exercises need to be executed to ensure safety. Another important factor is the ease of using the technology to both films and deliver the video-models (either commercially available or custom-made). For example, the Exercise Buddy app was selected because it provided the option to create and upload custom-made video-models and also included commercial video-models. The app provided a high degree of flexibility in transitioning back and forth between the video-models and visual schedule. Furthermore, the custom-made video-models were filmed on the iPad using the camera feature and easily uploaded into the app

When teaching PA skills, it is also important for practitioners to consider how additional stimuli beyond the antecedent visual instruction of the video-model may impact acquisition. For example, Ann consistently struggled in independently completing the three cardiovascular exercises across all sessions and reportedly had a history of not performing these types of exercises independently. This suggests that the exclusive antecedent video-modeling intervention was not effective in eliciting the targeted behavior change. It is important for practitioners, as well as future researchers, to consider how additional behavioral components (e.g., incrementally increase of target behavior, contingent reinforcement) may need to be implemented as part of a treatment package in addition to the video-models provided by the technology (Bassette et al., 2018). Finally, beyond teaching initial acquisition, it is also important for practitioners to consider how they will fade video-models (Weng et al., 2014). For example, in this study, the condition (i.e., commercial video-models or custom-made) used during generalization was the same as the best treatment; however, participants were given the option to watch the video-models. During generalization, Ann chose to watch all the videos during all sessions, and she displayed an increasing trend across the phase. Nick also watched all the videos, and he displayed an initial immediacy of effect followed by variability. Paul watched all the video-models during his first generalization session and then only watched one video-model during the fourth generalization session and performed all intervals independently. Practitioners should consider using similar procedures to provide participants with the choice to indicate their respective preferences to determine when and how video interventions are faded (Van Laarhoven & Van Laarhoven-Myers, 2006).

Limitations and Future Research

While this study extends previous literature exploring the use of technology to facilitate PA skills, there were several limitations. A primary limitation associated with the development of the custom-made video-models was the app would only permit videos less than 30 s in length to be uploaded. As a result, the majority of the scripts planned to be used for custom-made videos were shortened which may have limited specificity of the custom-made videos. Additionally, the scripts required for the custom-made videos for the three motor coordination exercises (ladder march forward, ladder march side to side, and ladder two foot hops) were longer than 30 s; all three of these exercises required two separate clips for the custom-made videos (e.g., #1 Ladder March Forward Custom, #2 Ladder March Forward Custom). This resulted in participants having to transition between a sixth custom-made video-model during the intervention.

The Exercise Buddy app typically saved a permanent product record of efficiency and video-time data. Due to technical issues, however, there were several sessions (45% for Ann, 25% for Nick, and 20% for Paul) where the researchers were not able to access the WiFi internet at the gym and not all of the efficiency and video time data were saved; the ability to interpret the available data is limited. It would be of interest for future research to ensure these data are saved (e.g., ensure consistent connection through use of internet hotspot, use a separate timer) as they could provide pertinent information about the instructional time of sessions (e.g., how much time is spent watching the different types of videos, how much time is spent prompting participants).

While all three participants displayed increased performance compared to baseline, another limitation was a lack of mastery criteria for intervals performed independently due to time constraints of the study. This resulted in participants proceeding from intervention to best treatment after completing 10 intervention sessions but not necessarily fully mastering the exercises. Notably, this was only a concern for Ann who did not have any sessions where she performed more than 50% of the intervals independently during the intervention in either condition; however, during generalization she had two consecutive sessions where she performed 60% of the intervals independently. Paul performed 90% or more of the intervals independently during all of the commercial video-modeling intervention sessions and Nick performed 86.7% of the intervals independently during the last three custom-made video-modeling sessions (sessions 6, 8, and 10) indicating both achieved a high level of mastery. Future research should consider including mastery criteria for participants during intervention to ensure the appropriate acquisition of skill as well as maintenance of skills once video-models are faded. Additionally, the focus of this research was to compare the antecedent interventions (i.e., commercial vs. custom-made video-models), and participants received $40 for participation; however, receipt of the $40 was not contingent upon performance. Future research that seeks participants to obtain a mastery criterion of PA skills should seek to address potential motivational deficits (e.g., contingent reinforcement for meeting criterion).

Finally, an exploration of video self-modeling (VSM) may also address motivational deficits of participants performing certain exercises (e.g., cardiovascular) and provide additional insights into the benefits of custom-made videos. Specifically, VSM enables participants to view themselves completing a behavior successfully (e.g., positive self-review) which may help increase mastery of PA skills that fall below desired levels (Dowrick, 1999). Future research using VSM may be of interest when working with participants who fail to acquire PA skill with commercial video-models and may help enhance an understanding of the clinical significance of custom-made videos.

Conclusions

In conclusion, this study supports previous research demonstrating how both commercially available and custom-made video-models can promote independence in people with ASD. This study demonstrated that two participants were more independent when using the custom-made video-models, which supports previous work suggesting that custom-made video-models may be needed to emphasize specific salient components (Rosenberg et al., 2010). The study further contributes to the literature exploring how app-based video-modeling technology can be used in inclusive community settings to promote PA opportunities. Future research is needed to more thoroughly understand the role technology may have on health outcomes for people with ASD.

Acknowledgments

The authors would like to thank Emma Donges and Aly Wittmer for their contributions to this project.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This project was funded through an internal grant and Ball State University's Center for Autism Spectrum Disorders.

ORCID iD

Laura Bassette https://orcid.org/0000-0003-3741-5931

References

Bassette, L. A., Kulwicki, J., Dieringer, S., Zoder-Martell, K., & Heneisen, R. (2018). The use of a multi-component behavioral intervention to promote physical activity in adolescents with autism across inclusive community settings. *Behavior Analysis in Practice*, *11*, 358–369. doi:10.1007/s40617-018-00285-7

Bassette, L. A., Dieringer, S., Zoder-Martell, K., & Cremeans, M. (under review). Behavioral-based technology interventions to facilitate physical activity in individuals with intellectual disability and autism in community settings.

Ayres, K. A., Shepley, S. B., Douglas, K., Lane, J. D., & Shepley, C. (2015). Mobile technology as a prosthesis: Using mobile technology to support community engagement and independence. In T. Cardon (Ed.), *Technology and treatment of children with autism spectrum disorders: Autism and child psychopathology series* (pp. 131–145). Springer International Publishing. http://doi.org/10.1007/978-3-319-20872

Block, M. E., Taliaferro, A., & Moran, T. (2013). Physical activity and youth with disabilities: Barriers and supports. *The Prevention Researcher*, *20*, 18–20.

Cannella-Malone, H. I., Mizrachi, S. B., Sabielny, L. M., & Jimenez, E. D. (2013). Teaching physical activities to students with significant disabilities using video-modeling. *Developmental Neurorehabilitation*, *16*, 145–154. http://doi.org/10.3109/17518423.2012.763192

Dixon, R. M., Verenikina, I., Costley, D., & Pryor, S. (2015). The use of iPads in the home setting for students with autism spectrum disorders. *Journal of Special Education Technology*, *30*, 193–206.

Dowrick, P. W. (1999). A review of self modeling and related interventions. *Applied and Preventive Psychology*, *8*, 23–39.

Exercise Connection Corporation. (2015). *Exercise Buddy Professional*. https://apps.apple.com/us/app/exercisebuddy-professional/id1091153205

Hill, D. A., & Flores, M. M. (2014). Comparing the picture exchange communication system and the iPad for communication of students with autism spectrum disorder and developmental delay. *TechTrends*, *58*, 45–53.

LaLonde, K. B., MacNeill, B. R., Eversole, L. W., Ragotzy, S. P., & Poling, A. (2014). Increasing physical activity in young adults with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *8*, 1679–1684. https://doi.org/10.1016/j.rasd.2014.09.001

Lang, R., Koegel, L. K., Ashbaugh, K., Regester, A., Ence, W., & Smith, W. (2010). Physical exercise and individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, *4*, 565–576. https://doi.org/10.1016/j.rasd.2010.01.006

Lo, Y., Burk, B., & Anderson, A. L. (2014). Using progressive video prompting to teach students with moderate intellectual disability to shoot a basketball. *Education and Training in Autism and Developmental Disabilities*, *49*, 354–367.

McCoy, S. M., Jakicic, J. M., & Gibbs, B. B. (2016). Comparison of obesity, physical activity, and sedentary behaviors between adolescents with autism spectrum disorders and without. *Journal of Autism and Developmental Disorders*, *46*, 2317–2326. https://doi.org/10.1007/s10803-016-2762-0

Mechling, L. C., Ayres, K. M., Foster, A. L., & Bryant, K. J. (2013). Comparing the effects of commercially available and custom-made video prompting for teaching cooking skills to high school students with autism. *Remedial and Special Education*, *34*, 371–383.

Parker, R. I., Vannest, K. J., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children*, *75*, 135–150. DOI: 10.1177/001440290907500201

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining non-overlap and trend for single case research: Tau-U. *Behavior Therapy*, *42*, 284–299. DOI:10.1016/j.beth.2010.08.006

Richardson, E. V., Smith, B., & Papathomas, A. (2017). Collective stories of exercise: Making sense of gym experiences with disabled peers. *Adapted Physical Activity Quarterly*, *34*, 276–294.

Rosenberg, N. E., Schwartz, I. S., & Davis, C. A. (2010). Evaluating the utility of commercial videotapes for teaching hand washing to children with autism. *Education and Treatment of Children*, *33*, 443–455.

Sarol, H., & Çimen, Z. (2015). The effects of adapted recreational physical activity on the life quality of individuals with autism. *Anthropologist*, *21*, 522–527.

Savage, M. N., Taber-Doughty, T., Brodhead, M. T., & Bouck, E. C. (2018). Increasing physical activity for adults with autism spectrum disorder: Comparing in-person and technology delivered praise. *Research in Developmental Disabilities*, *73*, 115–125. http://doi.org/10.1016/j.ridd.2017.12.019

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments desig for instructional research. *Education and Treatment of Children*, *8*(*1*), 67–76.

Sorensen, C., & Zarrett, N. (2014). Benefits of physical activity for adolescents with autism spectrum disorders: A comprehensive review. *Review Journal of Autism and Developmental Disorders*, *1*, 344–353. https://doi.org/10.1007/s40489-014-0027-4

Srinivasan, S. M., Pescatello, L. S., & Bhat, A. N. (2014). Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. *Physical Therapy*, *94*, 1–16. https://doi.org/10.2522/ptj.20130157

Uphold, N. M., Douglas, K. H., & Loseke, D. L. (2016). Effects of using an iPod app to manage recreation tasks. *Career Development and Transition for Exceptional Individuals*, *39*, 88–98.

Van Laarhoven, T., & Van LaarhovenMyers, T. (2006). Comparison of three video-based instructional procedures for teaching daily living skills to persons with developmental disabilities. *Education and Training in Developmental Disabilities*, *41*, 365–381.

Vannest, K. J., Parker, R. I., & Gonen, O. (2011). *Single case research: Web-based calculators for scr analysis* (Version 1.0) [Web-based application]. College Station: Texas A&M University. Retrieved from http://www.singlecaseresearch.org/calculators

Weng, P. L., Savage, M. N., & Bouck, E. C. (2014). iDIY: Video-based instruction using iPads. *Teaching Exceptional Children*, *47*, 11–19.

Wolery, M., Gast, D. L., & Ledford, J. R. (2014). Comparison designs. In D. L. Gast & J. R. Ledford (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed., pp. 297–345). Routledge.

Author Biographies

Laura Bassette (PhD, BCBA – D) is an assistant professor in the Applied Behavior Analysis/Autism program at Ball State University. Her research primarily focuses on the use of technology to deliver behavioral-based interventions to teach functional and academic skills to people with developmental disabilities/autism in applied settings.

Andrew Weissmann is a graduate student in the Counseling program at Ball State who worked with Dr. Bassette as a graduate student and assisted with her research with Ball State's Center for Autism Spectrum Disorders.

Emily Pecsi is a senior in the Speech Language pathology program at Ball State who worked with Dr. Bassette as an undergraduate research assistant.

Jenna Seaman is a junior in the Speech Language pathology program at Ball State who worked with Dr. Bassette as an undergraduate research assistant.