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Article *in* Journal of Autism and Developmental Disorders · September 2016

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DOI 10.1007/s10803-016-2900-8

BRIEF REPORT

Brief Report: Using Behavioral Skills Training to Teach Skateboarding Skills to a Child with Autism Spectrum Disorder

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Published online: 8 September 2016

Abstract The aim of this study was to evaluate the effects of behavioral skills training (BST) on the skateboarding skills of an 11-year-old male with autism spectrum disorder (ASD). BST was used in a multiple-probe across skills design to teach five target skateboarding skills. Imitation of an additional skill was also assessed outside of BST sessions. The overall percentage of correct skateboarding skills improved following BST. Performance gains were stable in probes across settings, and additional imitations increased across the study.

Keywords Autism spectrum disorder · Behavioral skills training · Fitness · Physical exercise · Sport skills

Introduction

Sport skills can provide a common ground for children with autism spectrum disorder (ASD) to engage in physical activities with typically developing peers and siblings (Weiss and Harris 2001). Compared to their typically developing peers, however, children with ASD often suffer delays in developing the motor skills needed to successfully participate in sports and recreation (Liu and Breslin 2013). A lack of such skills may limit opportunities for social interaction and also reduce exercise, which may lead to adverse effects on physical health (Potvin et al. 2013). For example, recent findings indicate children and adolescents with ASD have an elevated risk for obesity in the general population (Phillips et al. 2014). Over thirty percent of children with ASD are reported as obese, compared to twenty-three percent of children without ASD (Curtin et al. 2010), or only thirteen percent of teens without ASD (Hill et al. 2015; Phillips et al. 2014). Thus, sport skill interventions may be a way to target obesity in children with ASD.

Recent literature also indicates a relationship between motor and social-communication deficits in individuals with ASD (MacDonald et al. 2013). Engaging in physical activities may therefore contribute to improvements in social behavior as well as some of the motor skills necessary for physical fitness participation (e.g., Garcia-Villamisar and Dattilo 2011; Sowa and Meulenbroek 2011). Given the difficulties children with ASD have engaging in physical activity (Potvin et al. 2013; Sowa and Meulenbroek 2011), specialized teaching procedures might be required to increase their competency in sports and recreational activities.

Previous research towards identifying effective intervention practices for improving these skills in children with ASD is limited, yet suggests that behavioral interventions offer promise. For example, a constant time delay procedure was effective in teaching three children with ASD foundational swimming skills (Rogers et al. 2010), and providing task analysis derived instructions, modeling, and feedback, successfully taught three children with ASD to play ball games (i.e., handball and four-square; Miltenberger and Charlop 2014). Behavioral skills training (BST), is a set of

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teaching procedures that includes instructions, modeling, rehearsal, and feedback (Miltenberger 2011). BST has been effective in teaching individuals with ASD conversation skills (Nuernberger et al. 2013) and how to use discrete-trial training procedures with other individuals with ASD (Lerman et al. 2013). The repeated practice in conjunction with performance feedback of BST, therefore, might also be effective in improving competency in recreational sport skills such as skateboarding. The purpose of this study was to evaluate the effects of using BST in teaching a child with ASD how to correctly engage in a series of skateboarding skills.

Methods

Participant and Settings

The participant in this study, Ray, was an 11-year old Egyptian-American male diagnosed with ASD. Ray communicated vocally; however, had several social and motor skill deficits. He scored in the *low overall* to *moderately low* range on the Vineland Adaptive Behavior Scales-2 (VABS-2; Sparrow et al. 2005), with an age-equivalent of 3:9 in gross motor skills, 3:5 in receptive language, 3:6 in expressive communication, 7:5 in written communication (i.e., reading and writing), and a range of 1:9–3:1 in socialization. All experimental skateboarding sessions took place at various sections and surrounding sidewalks of local parks in an urban neighborhood in a large metropolitan city. Prior to the study, informed parental consent and assent was obtained for Ray.

Materials and Safety

During all sessions, Ray was provided with a skateboard, helmet, protective body padding, and a water bottle. Two adults were present on either side of Ray during baseline and training sessions to catch him, as necessary, to prevent contact of his upper body with the ground. In the event that he dismounted from his skateboard (e.g., a foot came off the board and stepped toward the ground), the trial was immediately ended, and another trial was started according to phase (e.g., feedback and rehearse another trial during BST). Instruction occurred on flat surfaces only, and rolling speed did not exceed approximately 5 mph.

Measurement and Integrity

Dependent Variables

The experimenters measured Ray's correct demonstration of six component skills of riding a skateboard using event recording. A task analysis of each skill is provided in Table 1. Correct execution of each step in the task analysis was scored. Dividing the number of correctly performed steps by the total number of steps for that skill and multiplying the quotient by 100 % calculated the percentage of correct execution of each skill.

Interobserver Agreement and Procedural Fidelity

One primary observer scored the dependent variables in-vivo, and two secondary observers scored in-vivo and from video. The secondary observers scored 70 % of randomly selected sessions across all phases. Interobserver agreement (IOA) was calculated using exact an agreement method. Mean agreement for Ray's skateboarding skills was 93.2 % (range = 86.7–100 %). A primary and secondary observer also scored the experimenter's correct implementation of BST during 50 % of training sessions to provide a measure of procedural fidelity. During training, the experimenter followed a written script/checklist containing the BST procedures and descriptions of respective skateboarding steps. Procedural fidelity was 100 % for all observed sessions.

Table 1 Steps for skateboard skills

360° Right Turn (stationary)
Stand on the skateboard with both feet
Push tail down with right foot
Push nose of board to *right* with left foot until completing 360° rotation to right
360° Left Turn (stationary)
Stand on the skateboard with both feet
Push tail down with right foot
Pull nose of board to *left* with left foot until completing 360° rotation to left
Riding Skateboard (i.e., rolling)
Put left foot on top of the front screws
Push right foot on the ground three times
Stand on the skateboard with both feet (while rolling) for ≥5 s
Right Turn (while rolling)
Ride the skateboard with both feet
Bend knees (thighs approximately 45 degree angle from ground)
Push toes down on board to change rolling direction to the right
Left Turn (while rolling)
Ride the skateboard with both feet
Bend knees (thighs approximately 45 degree angle from ground)
Push heels down on board to change rolling direction to the left
"Ollie" (i.e., jumping board into air)
Pushes tail to ground with right foot and makes "snap" sound
Jumps up with both legs (thighs parallel to ground)
Slides left foot on surface towards nose of board (while jumping) to lift board off of the ground

Research Design and Procedures

Experimenters used a multiple-probe design (e.g., Horner and Baer 1978), across responses to assess the effects of BST on five skateboarding skills. When Ray exhibited stability in his baseline performance, BST sessions were initiated in staggered fashion consistent with the multiple baseline design. Performance at 100 % across at least two sessions was defined as mastery of the skill and resulted in the initiation of post-training sessions. Three to five sessions per skill occurred per day. Ray did not access his skateboard outside of the study sessions.

Preference Assessments

According to experimenters' observations and parent report, Ray did not engage in outdoor recreational activities. A multiple-stimulus without replacement preference assessment (MSWO; e.g., DeLeon and Iwata 1996) was used to determine the sport skill to be taught via BST, and included several outdoor sport activities observed in other similar-age children in Ray's neighborhood. Initially, Ray was exposed to the equipment for six different sports (e.g., basketball, frisbee, football, skateboarding). He observed models demonstrating how to use the equipment, and then manipulated the equipment on his own. Next, equipment for the six sports were arranged in close proximity on the ground, and Ray was asked to select an item to play with. After 30 s of play, the selected item was removed from the array and placed out of his reach. The locations of the remaining items were rearranged and Ray was asked to choose another sport from the remaining options until three selections were recorded, per preference assessment. Ray chose the skateboard as his first selection over other sporting equipment during three separate pre-baseline assessments; however, did not ride it correctly. Therefore, skateboarding was selected for the intervention.

Pre-Training

Prior to skateboard training, Ray was taught to correctly locate (i.e., "touch") and say the names of the skateboard parts (e.g., deck, screws, tail, nose), as this was necessary for following directions during training. After he correctly located and labeled each part during three consecutive probes, he entered baseline. Ray learned to correctly locate and label skateboard parts in 20 min and probes prior to each baseline session confirmed this ability was maintained.

Baseline

During all baseline sessions, the experimenter gave Ray a typed list that described the proper steps for the respective skateboarding skill in simple terms that he would understand (as indicated by his VABS-2 written communication scores and routine assessment). The experimenter read the list aloud and then Ray read it aloud. Ray was then given the opportunity to ask questions regarding the skills and the experimenter answered as necessary. Next, the experimenter gave the relevant verbal directive (e.g., "Show me a left turn"), collected data on skill execution, and provided praise for correct steps. Each session consisted of three trials (i.e., opportunities to show skill) and lasted between 3 and 5 min.

Behavioral Skills Training

During BST sessions, the experimenter gave Ray a typed copy of the skateboarding steps and then described each step as in baseline. Next, we reviewed his performance during the previous session by showing him and describing his respective data sheet (e.g., positive comments for correct steps and informative corrective feedback for any steps performed incorrectly). The experimenter then modeled the skill three times. Ray then practiced the skill three times while the experimenter gave immediate descriptive performance feedback. Modeling and rehearsal plus feedback continued for 10 min. Three data collection trials immediately followed training, lasting between 3 and 5 min total. Each session began with a skill specific directive (e.g., "Show me a left turn"), and included praise for correct skill execution.

Post-Training

During the post-training phase the experimenter did not provide BST. Each session began with a skill specific directive, consisted of three trials, and lasted between 3 and 5 min.

Alternate Setting Probes

During BST and post-training, flexibility in Ray's skills were assessed in unfamiliar parks, parking lots, and on sidewalks located in different neighborhoods than baseline and training sessions. Each session began with a skill specific directive, consisted of three trials, and lasted between 3 and 5 min.

Additional Skill Probes

Across all phases, the experimenters periodically demonstrated a skill not directly trained with BST, called an "Ollie," in front of Ray while he was idly standing on his skateboard in locations different from the training contexts. An "Ollie" involves the rider using his/her feet to pop the board and rider into the air while riding on flat ground (see Table 1 for steps). It is a fundamental prerequisite skill for

mastering most popular advanced maneuvers, and is also used as a safety maneuver to avoid obstacles. The experimenters did not establish attending behavior during the probes, nor were instructions or praise provided when the skills were demonstrated. Thus, the probes were attempts to simulate imitation opportunities in a naturalistic setting, such as might be expected if Ray were in a park and peers display interesting skills he might want to acquire that are beyond his trained repertoire. Each session consisted of three trials and lasted between 3 and 5 min.

Results and Discussion

Figure 1 presents data for Ray's percentage of correct skateboarding steps for the five skills during baseline (verbal and written instructions), BST, post-training, alternate setting probes, as well as the probes for an additional skill (the Ollie). Session probes are plotted on the abscissa with the percentage of correct responses on the ordinate. During baseline, Ray had very low levels of correct performance with few or zero correct steps across all skills. Ray then acquired most skateboarding skills quickly during BST intervention, requiring two to nine sessions to master the steps within each skill (range = 20–90 min of training). Ray did not reach criterion for 360° left turns, however, and therefore continued training for this skill with only one session observed above 67.7% correct. Despite this, experimenters moved ahead with training for the mobile skills (e.g., ride, rolling turns) as Ray periodically demonstrated some of the left rolling turn skills during baseline (i.e., pushing heels down to rock the board), and stationary skills were not entirely requisite for mobile skills.

In post training and across alternate setting probes, Ray maintained most of steps for the acquired skills. Variability in scores observed after training were primarily the result of two errors that did not drastically affect his performance. First, Ray periodically failed to bend his knees during turns; however, he still turned the skateboard by adjusting his feet accordingly. While riding, Ray only erred by pushing his foot more than three-times on the ground to propel the skateboard, often while stating, "Go faster!" Finally, imitation of the "Ollie" skill did not occur during baseline sessions. The skill began to emerge after eleven comprehensive BST sessions had commenced for the target skills, and then averaged around 50% during the post training sessions for the targeted skills (maximum of 67.7%).

Results suggest Ray successfully acquired the majority of skateboarding skills through the use of BST, and maintained these skills following training and in alternate settings. Additionally, Ray began to imitate a skill that was not specifically targeted with BST, following the initiation of BST for three of the targeted skills. The present study extends the use of BST in teaching individuals with ASD by showing its effectiveness in teaching sport skills. Thus, the future involvement of BST in building competency in other recreational or sport skills might also have promise. Using these techniques may help build age-appropriate sport skill sets similar to those that peers might have (e.g., Liu and Breslin 2013), which could potentially lead to an increase of opportunities for positive social interaction and fitness activities to combat obesity (e.g., Potvin et al. 2013). Additionally, conducting a preference assessment in this study was imperative for choosing a socially relevant target sport that was of interest to the child. That is, if a child demonstrates interest in the activity, there could be an increased possibility that the activity will be chosen again following training. For Ray, parent and therapist reports indicate that he continues to choose riding his skateboard two to three times a week, which demonstrates his sustained interest in the activity following the intervention. Finally, the use of in-situ training may have helped promote maintenance and generalization effects that are generally noted when teaching in naturalistic settings (e.g., Bellini et al. 2007).

As these results are preliminary findings only, there are some limitations and avenues for future research worth noting. For example, Ray routinely turned his skateboard left and right without bending his knees and also attempted to increase his rolling speed by modifying a step in the riding skill. In practice then, the necessity of all steps involved in a skill set should be carefully considered (e.g., Miltenberger and Charlop 2014), while also considering the child's preferences (safety permitting, of course). With respect to the participant's continued interest in skateboarding following training, future research could explore the feasibility of parental maintenance of the skills, such as providing regular opportunities for practice and recreation, as well as using BST with their children to improve the acquired skills or teach new sport and recreation activities. While research in this area is scant, it's plausible that parents could learn to use BST procedures effectively and the collateral effects of total family participation in recreational activities could be quite beneficial.

Next, measures of social participation were not included in this study, despite the social nature of the activity. Anecdotally, Ray was approached on several occasions during training by random peers who initiated "races", asked to try his skateboard, and also requested that *he* teach them skateboarding. While sport training may not be a replacement for social communication instruction (i.e., semantics and pragmatics), it appears to support entrance and participation in shared activities (e.g., Weiss and Harris 2001). Future research in sports and recreation for children with ASD, therefore, should include observational measures of social behavior with peers and/or family. Finally, objective measures of physical health before, during, and after training are

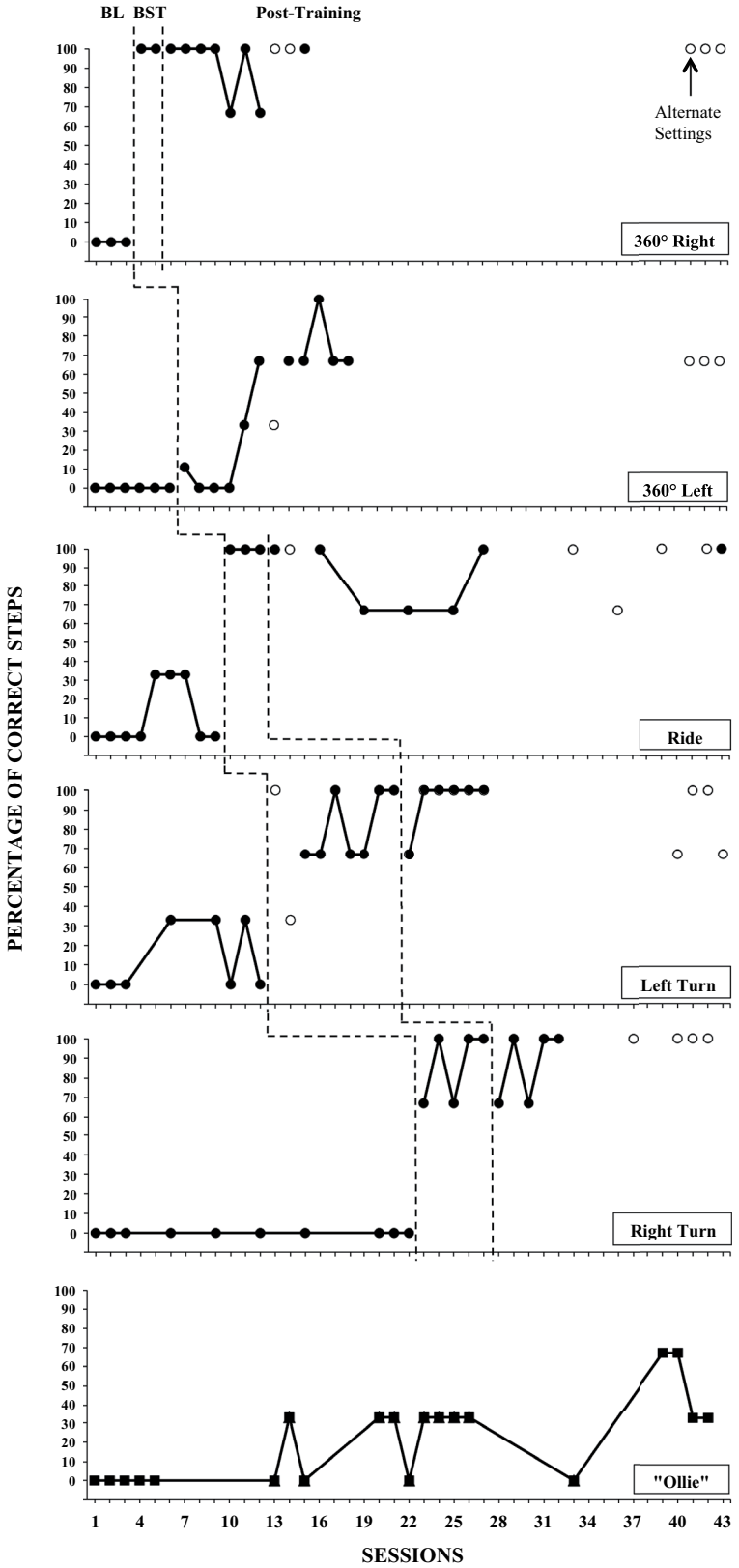

Fig. 1 Percentage of correct steps for skateboarding skills during baseline, behavioral skills training, post-training, and alternate setting probes (*top five panels*), and one additional skill probe across all phases ("Ollie"; *bottom panel*)

needed to evaluate the effects of interactive and vigorous sports to other forms of physical exercise such as walking or treadmills (e.g., Larson et al. 2014).

Acknowledgments The authors thank Jesse E. Jordan for donating skateboards and protective equipment.

Funding The authors did not receive funding for this study.

Compliance with Ethical Standards

Conflict of Interest Benjamin Thomas declares that he has no conflicts of interest. Michael Lafasakis declares that he has no conflict of interest. Vicki Spector declares that she has no conflict of interest.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Prior to the study, informed parental consent and assent was obtained for the participant.

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