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Using Antecedent Physical Activity to Increase On-Task Behavior in Young Children

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ABSTRACT: *A withdrawal design was used to investigate how physical activity affects on-task behavior of young children with significant developmental delays in a special education preschool classroom. Five preschool age children with significant developmental delays engaged in either physical activity or seated center activities for 20 min prior to a 15-min teacher-directed group activity. Momentary time sampling was used to calculate the percentage of intervals the participants were on-task using 15-s intervals. Results indicated all of the participants' on-task behavior was higher during the physical activity condition. These findings suggest physical activity may be used as a proactive behavioral intervention to improve the on-task behavior of young children with significant developmental delays during teacher-directed group activities.*

According to the Federal Interagency Forum on Child and Family Statistics (2007), there are more than 4.5 million preschool age children (3-, 4-, and 5-year-olds) in preschool programs in the United States. Due to the number of children attending these programs, children must share teacher's attention, and the majority of their instruction is done in a group. Because the primary purposes of education programs are promoting academic and developmental growth, helping young children acquire the skills they need to facilitate their learning is important.

The concept of "on-task" is represented in the literature in various ways. For example, some of the terms used include attention to task (Duncan et al., 2007), academic engagement (Nicholson, Kehle, Bray, & Van Heest, 2011), participation in group (Bushell, Wrobel, & Michaelis, 1968), and learning related social skills (McClelland & Morrison, 2003). The similarity of meaning among these terms is apparent regardless of the multiple disciplines from which they originate. For the purposes of this study, we use the term *on-task behavior* to describe behaviors such as looking at teacher, keeping hands to self, singing songs, and reciting poems.

Skills needed during preschool group activities include listening and responding to questions, looking at the teacher, and keeping hands and feet to self. Young children may require behavioral interventions to support learning these skills. They

may engage in off-task or aggressive behaviors that results in escape from the learning demands of group instruction. Some children may also exhibit stereotypic behaviors during group instruction (LeBlanc & Ruggles, 1982). Stereotypic behaviors (e.g., rocking, hand-flapping) may be disruptive to learning new skills as well as teacher–student interactions (Morrissey, Franzini, & Karen, 1992). Whether children are looking at the floor, hitting their peers, or flapping their hands in front of their face, they are likely not engaging in learning. Implementing behavioral strategies that improve their on-task behavior is essential in helping set the stage for learning during teacher-directed group activities. Although demonstration of these on-task behaviors does not guarantee learning is taking place, it does provide a context for learning that is important in preschool.

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There are a number of traditional behavioral interventions used to address problematic behavior in individuals (Carr, Langdon, & Yarbrough, 1999). However, many of these interventions can be classified as *reactive* rather than *proactive*. Reactive interventions would include those that focus on consequent manipulation, generally waiting for the behavior to occur (e.g., response cost) or specifically targeting the shaping or development of new behaviors (frequently through differential reinforcement procedures). Proactive interventions are generally environmental manipulations done to alter the antecedent conditions to prevent a behavior or make that behavior less likely to occur (Horner, Carr, Strain, Todd, & Reed, 2002). Despite the proven effectiveness of reactive interventions, they still essentially allow the behavior to occur for a period of time. Approaching these challenging behaviors proactively (cf., Reeve & Carr, 2000; Sugai et al., 2000) by altering antecedents in children's environments may allow a teacher to avoid aberrant behaviors and the subsequent disruption they can cause. Using antecedent conditions to positively impact children's on-task behavior during group activities is a promising alternative to waiting until the unwanted behavior occurs and responding to it.

One intervention that has been used in antecedent conditions to improve behavior in children and adults both with and without disabilities is physical activity (PA). In the field of special education, PA has been used to reduce maladaptive behaviors (Watters & Watters, 1980), aggressive behavior (Yell, 1988), disruptive behavior (Bachman & Sluyter, 1988), and stereotypic behavior (Bachman & Fuqua, 1983). In the field of early childhood education, some researchers have focused on improving on-task behavior (Mahar et al., 2006), as well as academic achievement (Jarrett, 1998; Tomporowski, Davis, Miller, & Naglieri, 2008). Mahar et al. (2006) investigated the use of a classroom-based PA intervention to increase on-task behavior. The researchers used a multiple baseline design to evaluate the relation between PA and the on-task behavior of third and fourth grade participants during an academic instruction period. The treatment was a classroom-based PA that the teachers led for 10 min (e.g., stretching, hopping, touching toes). The participants' on-task behaviors were observed for 30 min prior to the PA as well as after the PA for 30 min. Results indicated a 20% increase in on-task behavior after the use of the classroom-based PA.

Similarly, Nicholson et al. (2011) used a multiple baseline design to evaluate effects of jogging on academic engagement for four 9-year-old boys diagnosed with autism. The participants jogged for 12 min and then cooled down by walking for 5 min. The results of the study indicated increased percentages of academic engagement for all the participants with varying degrees of effectiveness. Researchers in both special education and early childhood education fields have examined the use of PA and its effects on different aspects of children's development and found it to be beneficial for both children with and without disabilities.

In sum, the use of PA as a behavioral intervention is well documented. Positive behavioral changes have been achieved through physical activities including calisthenics (Morrissey et al., 1992), jogging (Bachman & Fuqua, 1983; Kern,

Koegel, & Dunlap, 1984; Nicholson et al., 2011), roller skating (Powers, Thibadeau, & Rose, 1992), aerobic exercise (Bachman & Sluyter, 1988), and nonstructured exercise (McGimsey & Favell, 1988). Based on Gabler-Halle, Halle, and Chung's (1993) findings that the greatest degree of change in the participants' behavior occurred immediately following the PA, scheduling of PA should occur in very close proximity to instructional time. Furthermore, Holmes (2006) found that preschoolers' attention improved after 10 min and 20 min of recess, whereas 30-min periods of recess resulted in higher rates of inattention. Other studies using PA as a behavior intervention technique limited the PA to 10 to 20 min as well (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Nicholson et al., 2011).

In addition to the behavioral benefits of using PA, research suggests that PA is related to positive outcomes in children's cognition (Sibley & Etnier, 2003; Tomporowski et al., 2008) and health (Binkley & Specker, 2004; Olstad & McCargar, 2009; Reilly et al., 2006). Recently, Howie and Pate (2012) conducted a literature review of articles published in the last 5 years related to PA and academic achievement in children. They argue that although the literature indicates PA is linked to academic achievement, researchers investigating PA often "highlight positive outcomes in overall conclusions" (p. 165) and emphasize positive findings. They go on to report that authors neglect to draw attention to null or negative results and that a positive publishing bias should be considered when reviewing the literature surrounding the benefits of PA.

In addition to the behavioral benefits of using PA, research suggests that PA is related to positive outcomes in children's cognition

The National Association for Sport and Physical Education (2002) published a position paper stating children between the ages of 3 and 5 should participate in 60 min of daily structured PA. The National Association of Educating Young Children acknowledges National Association for Sport and Physical Education's position for PA and recommends preschool programs adhere to the standard of 60 min per day of PA. This would mean that 1 hour per day of gross motor time should already be part of quality preschool programs and strategically scheduling the PA times would allow practitioners to potentially help children's on-task behaviors in subsequent activities. Practitioners using PA as a behavioral intervention might break the recommended hour into two 30-min segments and use them prior to a teacher-directed group time, rather than before lunch or rest time.

The study of preschool age children and the effects of PA on their prosocial learning skills is limited. Some research exists that examines the effects of exercise on externalizing and internalizing behaviors (Tubic & Golubovic, 2010), but further research on the effects of practical PA on young children's on-task behavior is needed. Timmons, Naylor, and Pfeiffer's (2007) review of PA and young children suggested that physical activities be spontaneous and intermittent, locomotor or gross motor play activities that children find fun, facilitated by an adult with modeling and feedback and take place outside whenever possible. This work needs to be expanded to explore the effects of PA as a behavioral intervention for young children with and without disabilities. The purpose of the study was to answer the question: Does PA affect the on-task behavior of young children with developmental delays during a teacher-directed group activity?

METHOD

Participants

Five males between the ages of 3 and 5 who attended a suburban public elementary school in the southeast United States participated in the study. Criteria for participation consisted of (a) 3 to 5 years old, (b) eligibility of significant developmental delay, (c) attend same special education preschool class, and (d) demonstrate off-task or stereotypic behaviors. This study received institutional review board approval, and participants were recruited based on these criteria. The teacher, who was also the primary researcher of the study, contacted their parents by phone to explain the study and answer questions. Then, permission forms that identified the particular procedures of the study were sent home for parent review and signatures.

TABLE 1
Participants' Assessment Scores

	Cognitive		*Language*		*Social*	
	Mullen Scales of Early Learning		*Preschool Language Scale–4*		*Developmental Assessment of Young Children*	
Participant (age)	*SS*	*SD*	*SS*	*SD*	*SS*	*SD*
Bo (3)	62	–2.53	76	–1.60	61	–2.60
Stephan (3)	85	–1.00	69	–2.07	71	–1.93
Craig (5)	55	–3.00	*no scores available*		55	–3.00
Bill (4)	70	–2.00	71	–1.93	69	–2.07
Ron (4)	78	–1.47	76	–1.60	76	–1.60

Note. *SS* = standard score; *SD* = standard deviation

The self-contained special education classroom the participants attended was composed of one certified special education preschool teacher, one paraprofessional, one half time paraprofessional, one student teacher, and 10 students. Participants received services in the classroom for 6 hours per day, 5 days per week, with the exception of one of the participants, who attended 3 days per week. Specific assessment information and test scores of each participant are summarized in Table 1.

Ron was a 4-year-old Asian American male who was determined to be eligible for special education services for children with significant developmental delays. Ron received 4 months of special education services in a preschool classroom in the public school system prior to the start of this study. Ron had significant deficits in the areas of communication and social development, as well as moderate deficits in cognition (see Table 1). He demonstrated high rates of stereotypic behaviors during both structured and unstructured activities including picking skin around his nails, hand flapping, and head shaking. Ron frequently demonstrated behaviors such as spinning in circles, running in circles or running into peers, as well as resistance to touching a variety of sensory materials during classroom activities (e.g., play doh, squishy foam, clay).

Bo was a 3-year-old Caucasian male who was recently diagnosed with Fragile X syndrome and autism according to *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV) criteria (American Psychiatric Association, 2000) by his developmental pediatrician in June 2011. Prior to this diagnosis, Bo had attended a daycare and had not received any type of early intervention or therapy. Once he received the diagnosis of autism from his doctor, his parents had him evaluated by the public school system, and he qualified for special education services under significant developmental delay and speech language impairment. In addition to the school-based speech therapy and special education classroom support, Bo received private speech therapy one time per week. Bo demonstrated significant delays in the area of communication, social, and cognitive development (see Table 1). He demonstrated high rates of stereotypic behaviors such as moaning, rocking, and staring at strings (or his shoes laces), as well as maladaptive behaviors such as tantrums and screaming. Bo's play skills were atypical and he required a teacher to sustain his engagement in play activities.

Craig was a 5-year-old African Russian male diagnosed with Down syndrome who lived in an orphanage in Russia for the first 5 years of his life. He was recently adopted and brought to the United States in July 2011 and referred to the school system for evaluation by his adoptive parents in August 2011. Medical documentation of Craig's Down syndrome was not made available to the researchers of the study. Upon the decision of his parents and public school personnel, Craig was retained in kindergarten, and determined to be eligible for services on the basis of significant developmental delay and speech/language impairment. He was assigned to a special education

preschool classroom. He showed significant delays in all areas of development (see Table 1). Craig demonstrated a range of maladaptive and stereotypic behaviors both at home and at school such as tantrums, noncompliance, elopement, thumb sucking, rocking, and moaning. The stereotypic behaviors were most evident during group activities. His play skills were characterized as constructive and solitary. His play repertoire was limited to using manipulatives to build tall structures repeatedly.

Bill was a 4-year-old African American male who was evaluated by the public school system and qualified for special education services under significant developmental delay and speech/language impairment. Bill received 1 year of special education services prior to the study. He showed significant delays in his language and social development (see Table 1). His family's first language was French; however, both of his parents were fluent in English. His behavior issues were comprised of refusing to speak when he was upset as well as some stereotypic behavior such as rocking during group activities or turning his head away from the teacher and looking back at her from the corner of his eye. His play skills were characterized as constructive and cooperative. He engaged in child-directed play without teacher facilitation, but required teacher supervision to monitor his interactions with his peers and ensure that he was communicating appropriately during play.

Bill was a 4-year-old African American male who was evaluated by the public school system and qualified for special education services under significant developmental delay and speech/language impairment

Stephan was a 3-year-old Caucasian male who was evaluated by the public school system and qualified for services under significant developmental delay and speech/language impairment. Stephan's medical birth history was significant and included a left hemisphere brain lesion, hydrocephaly with shunt placement, and probable sleep apnea. He received early intervention services through a state agency as well as occupational, physical, and speech therapies. He demonstrated significant delays in his social language development (see Table 1). Stephan consistently demonstrated noncompliant behaviors such as refusing to physically or verbally participate during group activities. He also had difficulty sustaining attention and maintaining on-task behavior during group instruction. He did not exhibit any stereotypic behaviors and his play skills were similar to other same-age typical children.

Setting and Materials

There were three separate settings used in this study. One setting was the observation setting where students engaged in a teacher-directed activity across conditions. This was consistent across the study and was the location where the primary data collection took place on the dependent measures. The other settings were essentially the settings associated with the independent variables and included two PA settings and one child-directed center (CDC) setting for sedate student-directed activity.

Observation setting. Observations were collected during the teacher-directed group activity, which took place in a typical elementary school classroom. Ten cube chairs were positioned in a semicircle facing the whiteboard. The cube chairs were 15 inches high with seat heights of 7 inches or 9 inches with rounded corners. The rules of circle (e.g., feet on floor, eyes on teacher, hands to self), a behavior management system (e.g., happy face, sad face, neutral face), a calendar, and the daily schedule were provided as visual supports and posted on the whiteboard. To the left of the chairs was the play area that had three shelves with labeled bins and materials to play with in them. To the right of the chairs were a child-sized computer desk and two teacher desks. A large kidney-shaped table, sink, and classroom bathroom were behind the semicircle of chairs. The materials used during observation sessions were classroom books, an iPod for music, and visual aids to support learning during poem review. A flip camera positioned on a tripod was used to record the teacher-directed group activity.

CDC settings. This was the same setting as that used for the observation period except when the

students were engaged in this pre-observation setting they would have 15 activity centers available to them. These were spread around the room and designated to the students by signs on the outside of the center boxes to aid the students in identifying the center they would like to play with. The materials at these centers were typical preschool center toys. They had access to foam and wooden blocks, cars, trains, figurines, puzzles, puppets, dolls, costumes, kitchenette, magnets with balls, manipulatives (e.g., tube stars, legos, tile blocks, pattern blocks, nuts and bolts), and other similar items that might be found in a preschool classroom.

PA settings. The PA took place either outside on the school playground or inside in a designated classroom designed for gross motor activities. The outside setting was a typical elementary school playground. The metal playground equipment consisted of three slides: a bridge, a pole, and one set of stairs. The playground area was surrounded by wood chips, which were contained by large wooden timbers. The playground was positioned in the middle of a large field and had a dirt track around it. The field was surrounded by a chain link fence for the privacy and protection of the students at the school. Materials such as small balls and jump ropes were available to the participants to play with on the playground.

When weather did not permit the use of the outside playground, a standard size classroom inside the school with various types of equipment for the participants to engage with was used. Equipment in the room included a large ball pit with stairs leading up to a slide that allowed the participants to slide into the pit of small plastic balls. Several hula hoops, two scooters, two metal tricycles, a box of large plastic blocks, four jumping mats, an individual trampoline, and a wooden wagon were available to the participants. There were also various balls to play with and two balance beams to walk on in the room. The floor was carpeted and the ball pit was surrounded by thick blue mats.

Dependent Variable

The dependent variable was on-task behavior, which was defined separately for each component of the teacher-directed activity that took place in the observation setting. Overall, on-task behavior included behaviors such as looking at teacher, keeping hands to self, and singing or imitating movements to songs or poems. For more accurate collection of data, the teacher-directed group activity was divided into components: calendar, song, poem, book reading, and song. Behaviors were specified based on the component of the group activity. During calendar, on-task behavior was defined as looking at the teacher or calendar and keeping hands to self. Off-task behaviors demonstrated by participants during this time were touching peers and looking at the floor, their hands, or the back of the room. During the poem and the songs, on-task behavior was defined as keeping their hands to themselves while imitating the movements of the teacher or keeping their hands to themselves while singing the song or reciting the poem. Off-task behaviors observed were touching peers, not singing the song or reciting the poem, or not imitating the movements of the teacher. During the book reading component, on-task behavior included keeping their bottom in their chair, keeping their hands to themselves, and looking at the teacher or the book. Off-task behaviors observed during this time were standing up, turning around in a chair, touching peers, and looking at the floor.

The participants' on-task behavior was measured by a momentary time sample 15-s interval recording system. There were a total of 60 intervals, so for each day the number of on-task intervals was divided by 60 in order to get the percentage of interval occurrence for time on-task. The classroom teacher and the student teacher took turns leading the teacher-directed group activity. While one of them led the activity, the other one took procedural reliability data.

Experimental Design

A withdrawal design (Gast & Hammond, 2010) was used to evaluate the effects of 20 min of antecedent PA participants' on task behavior during the teacher-directed group activity (that occurred in the observation setting). In an A-B-A-B format, the researchers contrasted an antecedent (A) CDC activity that involved little gross motor effort or PA to (B) PA. The only change between conditions was the antecedent PA and the setting in which it took place.

Procedures

Observation period. This period occurred daily across conditions. The activity lasted for 15-min as the teacher led the group. This period immediately followed the CDC or the PA, depending on the condition. All participants were simultaneously digitally recorded during the observation period, and the video was reviewed later for data collection. The teacher-directed group activity consisted of a review of the calendar and days of the week, reciting a poem about the topic of the week, a movement song where the participants were required to imitate the movements of the teacher, a book reading time, and an additional movement song. An initial verbal direction was given to begin each component of the teacher-directed group activity. For example, to begin the teacher-directed group activity, the teacher would say, "Everyone is looking at my calendar." After the verbal direction was given, the general group verbal prompts and praise statements (e.g., "nice job," "thank you," "you guys are awesome") were documented and counted for each observation period. No individual prompts were given during the observation period with the exception of two instances. Bill received a physical prompt on the 15th day of the study where the teacher had to physically remove him from another student's chair so that the other student could sit down. Craig received a physical prompt to sit in his seat as he was flipping out if it backwards on the 18th day of the study. He also received a proximity prompt (teacher walked towards him) when he tried to leave the teacher-directed group activity on the 19th day of the study. No other individual prompts were given to any of the participants during this observation period. The paraprofessional in the classroom sat at her desk and worked on other things and did not interact with the participants during the teacher-directed group activity.

CDCs. Participants entered the classroom in the morning, put their book bags away, and began a CDC time. The procedures here followed typical daily routines in accordance with the National Association for the Education of Young Children (Copple & Bredekamp, 2009). During the CDC time, the participants chose a center and engaged in a self-directed center for 15 min. The participants did not engage in PA and sat or stood to play with the toys or manipulatives in the classroom during this time. Due to the nature of the CDC time, the participants were not allowed to engage in any kind of physical exertion (e.g., running, jumping, chasing). For example, if a participant began running around the table, the teacher directed him to walk his feet and choose a center. The teacher played a responsive role during this time and did not direct the participants to engage in specific centers, but provided attention to them by answering questions, redirecting them to engage in a center of their choosing, and acknowledging them when they showed her something they created. The participants were required to choose a center and engage with the materials for 15 min, but were free to choose preferred activities and materials. The teacher facilitated the CDC time using a system of prompting. These prompts were not systematically manipulated, but varied based on the discretion of the teacher. *Physical prompts* were defined as providing physical assistance to the participants when they were unable to complete a desired task (e.g., opening a box, stacking a block) or using physical prompts to guide them back to the center area. *Model prompts* were defined as encouraging participation through demonstration (e.g., stacking blocks, driving a train on tracks). *Verbal prompts* were used in response to participants' requests for help or were used as reminders to follow rules of the classroom such as keeping their hands to themselves, using their words, or choosing a center. A digital timer was placed on the whiteboard and beeped at the end of the 15-min center time, and the participants transitioned to the teacher-directed group activity.

PA. During this 20-min PA (e.g., running, jumping, skipping, climbing, playing chase), the child participated in a variety of activities (see Table 2). The PA intervention was constructed around four recommended components of the Timmons et al. (2007) literature review. The teacher, student teacher, and paraprofessional played a responsive role during the treatment and did not direct participants to engage in specific activities, but provided suggestions for participants that were not engaging in PA independently. The PA was not restricted to a specific type of movement; rather, the focus was on the participants choosing a PA and constantly engaging in it for the 20-min period. For example, some of the participants chose to run around the playground

TABLE 2
Physical Activities Used During Treatment

Activity	*Description*
Animal walk	Move your body like a bird, lion, or frog. Make the sound!
Bear walk	Lay on your stomach and push up on your hands and toes so you are looking at the ground. Walk around on your hands and feet and growl like a bear!
Bunny hops	Put your feet together and hop. Hold your hands in front of you like a bunny.
Chase	Line up in a row. When I say go, I'm going to get you. On mark, get set, go! Chase participants and encourage them to chase each other as well.
Race time	Line up on the line. When I say go, run to the fence. On mark, get set, go! Run with participants to the fence and back again.
Climb the mountain	Climb the ladder one ring at a time. You climbed the mountain. Hurry, go down the mountain (slide).
Skip to my Lou	Bring your knee up and jump. Do it again with the other knee. Now let's start moving. Sing the song if you know it.
Up and Down	Reach your hands in air as high as you can. Now jump up and touch the sky. Reach down and touch your toes. Now tap your toes.
Wheelbarrow	Put your hands on the ground and give me your feet. Now walk your hands as far as you can.
Lightning McQueen	Get your engine ready. "Vroom Vroom" (make the sound). Go! Run as fast as you can, you are Lightning McQueen!
Pole circles	Hold the pole with one hand and run as fast as you can without letting go. Don't get dizzy!
Jogging	Let's see how long we can run without stopping. Follow me.
Missing Monkey	Run to the fence and look for a monkey on the loose. Run back and tell a friend if you saw one.
Trampoline	Jump as long as you can. Don't let go!

by themselves, whereas others chose to model an adult or play a game with a teacher or peer. No participant was allowed to sit down or stand still during the 20-min activity. If a participant sat or stopped moving for 5 s, an adult would use a verbal, model, or physical prompt to help the participant engage in a PA of his choosing. The teacher initiated the start of the treatment by saying "Get ready, get set, go" to cue the children to start playing as the paraprofessional started the timer. The verbal, model, and physical prompts were not systematically manipulated, but varied based on the discretion of the adults facilitating the PA similar to the prompts given during the baseline condition. The prompts were given to the participants in specific ways and individually. The paraprofessional collected fidelity data and documented all of the prompts given to every participant. *Physical prompts* were defined as providing physical assistance to the participants when they were unable to complete a desired task (e.g., climbing a ladder, going down the slide) or using physical guidance to encourage participation (e.g., holding hands and running together). *Model prompts* were defined as encouraging participation through demonstration (e.g., sliding, jumping off platform, walking balance beam). *Verbal prompts* were used in response to participants' requests for help (e.g., "one foot at a time," "hold on tight") or to encourage participation through statements (e.g., "good job running," "you need to be moving"). The primary goal of the treatment was that the participants choose a PA and engage continuously for 20 min with help from adults as needed.

Reliability

Dependent variable. The primary researcher (first author) trained a graduate student in special education to collect reliability data across five sessions using digital recordings of the students in the classroom. Data were collected on each participant individually by watching the video recording once for each participant. The observers were unable

to see one another's data collection sheet, and the training sessions took place at the end of the school day in the classroom where the study was being conducted. Interobserver agreement (IOA) reached 80% or above after the second training session, but to ensure consistency, three more sessions were completed resulting in 90% or above IOA. The same procedures were used to collect IOA during all conditions of the study. The researcher and graduate student independently reviewed the video recordings. IOA was calculated using a point-by-point method (Ayres & Gast, 2010) based on the number of agreements divided by agreements plus disagreements and then multiplied by 100%. *Agreements* were defined as instances when both observers agreed that on-task behavior occurred or did not occur during an interval. *Disagreements* were scored if the observers did not agree on the occurrence of an on-task behavior during an interval. IOA data were collected in at least 20% of each condition of the study for every participant. In the initial CDC condition (A1), the IOA ranged from 91% to 96%, with a median of 93%. In the first PA condition (B1), IOA ranged from 86% to 96%, with a median of 93%. Returning to CDC (A2), the IOA ranged from 86% to 96%, with a median of 88%. In the final PA condition (B2), the IOA ranged from 88% to 100%, with a median of 93%.

Procedural reliability data were also collected a minimum of 20% of sessions per condition for every participant to determine to what extent procedures were followed. The observer used a checklist to monitor occurrences of the planned procedural steps. By calculating the percentage of steps correctly followed by the number of possible steps and multiplying by 100 (Ayres & Gast, 2010), researchers concluded that procedural reliability for observation sessions was 90% due to the extra prompts given to Craig noted previously in the Procedures section.

The video recording was reviewed for each observation period and the group verbal prompts and praise statements were documented and counted for every participant. Verbal prompts were totaled and an average per observation period was calculated. The initial CDC had a total of 14 verbal prompts divided by six observation periods, averaging 2.3 verbal prompts per observation. The initial PA condition included 12 verbal prompts over four observation periods at averaging three verbal prompts per observation. During the return to CDC activities, a total of 15 verbal prompts were given over five observation periods for an average of three verbal prompts per observation. In the final PA condition, 17 verbal prompts were given over five observation periods for an average of 3.4 per observation.

The average number of praise statements given during the observation period (teacher-directed activity) was also calculated for across conditions. During the observation period for initial CDC condition, the average of three praise statements per observation period was made. In the first set of observation periods during PA, 11 praise statements over four observation periods were made for an average of 2.75 praise statements per observation. For the observation periods during the second CDC condition, the teacher averaged two praise statements per observation. In the final PA observation periods, the teacher averaged 2.6 per observation.

Independent variable. A checklist was used to ensure the accuracy of the treatment procedures for every treatment session as well as to document every verbal, model, or physical prompt for every participant during the treatment. The paraprofessional monitoring the timer collected treatment fidelity data for each treatment session. Throughout the 20-min PA, the paraprofessional did random interval checks (every 1–5 min) to ensure that the participants were engaging in constant PA. In addition to the paraprofessional monitoring and documenting the participants' PA, the other two adults were monitoring all participants to ensure any participant that was not moving for 5 s was provided the prompt necessary to participate. A paper checklist was used and the paraprofessional placed a checkmark beside each participant's name if he was participating. The type of teacher prompting each participant received was also recorded by the paraprofessional. The same system of prompts used during baseline and withdrawal conditions was used and included physical, model, or verbal prompts. Five checks per treatment session were used each time the treatment was implemented. These times were 1 to 5 min apart and were predetermined on the fidelity data collection forms prior to the start of the study. The adults facilitating the PA were

unaware of when the checks occurred and different times were used for each treatment session so that the adults could not predict when the paraprofessional was checking. For example, on one day of the treatment, the paraprofessional might check at 1, 5, 8, 11, and 17 min. The next day of treatment, she would choose another data fidelity sheet that had a different interval of minutes. There were a total of three forms with varying times and the paraprofessional chose a different form each time the treatment was implemented. Treatment fidelity was calculated by dividing the number of steps completed during the treatment by the total number of intervals available. The treatment was implemented with 100% integrity throughout the study.

In order to facilitate the participants' engagement during the PA conditions, the adults used verbal, model, and physical prompts. The paraprofessional documented the number of prompts given to the participants. These prompts were totaled and an average per activity period was calculated per participant. Bill and Ron participated in the PA independently 100% of the time and received no individual prompts during either treatment condition, with the exception of Ron, who received one physical prompt to engage on day 19 of the study. Bo averaged 2.25 physical prompts per day in the initial PA condition and 1 physical prompt per day in the second PA condition. Stephan averaged 1.75 physical prompts per day in the initial PA condition and 2 physical prompts per day in the final PA condition. In the initial PA condition, Craig averaged 2 verbal prompts per day, but was only verbally prompted once in the second PA condition for an average of 0.2.

Social Validity

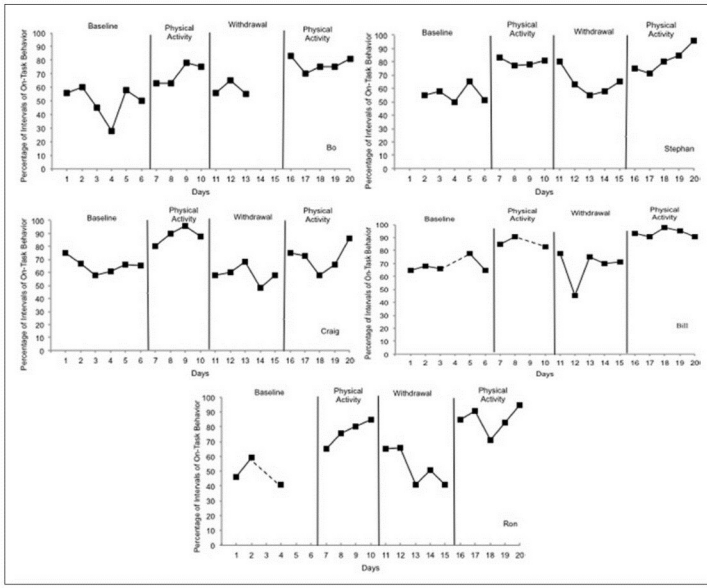
In an effort to address the social validity of PA, several types of information were gathered. The participants, their parents, and other school personnel were informants for the social validity of this study. Due to the participants' age and disabilities, a formal measure was not used to rate the appropriateness of the PA intervention; however, the participants were asked if they wanted to participate in the PA and were given freedom to choose activities that were meaningful and enjoyable to them throughout the study. The parents of the participants contributed to the social validity of the study by voicing a concern about their child's attention difficulties and lack of on-task behavior at home or daycare. All these concerns were documented in each participant's individualized education progam (IEP) and were reconfirmed when interviewed by the classroom teacher prior to the study. Because the classroom teacher and paraprofessional participated in the implementation of the study and intervention, three blind observers working at the school participated in a pre/postobservation regarding the PA intervention. These observers came into the classroom and observed prior to the implementation of the PA intervention and again after the study had been completed. All three observers acknowledged the group appeared more engaged and on-task after the PA rather than prior to the PA. These observers also acknowledged a willingness to try the intervention in their own classrooms or recommend it to other preschool classrooms such as this one. Although the teacher of the classroom was also the primary researcher in the study, she felt the PA was successful and indicated she would use the intervention in the future as a means of proactively supporting on-task behavior in her classroom. Finally, not only was the intervention unanimously agreed upon as successful, but it was also a response to the participants' need for intervention regarding their on-task behavior during teacher-directed group activities. Every participant had an IEP goal related to on-task behavior and required an intervention to address this area of weakness.

RESULTS

Each participant's data are presented in Figure 1. In addition to Figure 1, mean, median, and range percentages of each participant's on-task behavior for each condition are presented in Table 3. In total, data were collected for 20 sessions: 6 days in the first CDC, 4 days in initial PA, 5 days in the second CDC, and 5 days in the final PA. Data were taken once per day on Mondays, Wednesdays, and Fridays because one of the participants only attended school on those days. However, due to school holidays, data were collected intermittently on only those days over the course of a 12-week period.

FIGURE 1

Percentage of intervals of on-task behavior across baseline, withdrawal, and PA conditions



Note: PA = physical activity.

During baseline, both Bo and Ron had variable baseline data with a decelerating trend. Stephan and Bill both had stable baseline data, but Bill's on-task behavior was relatively high, ranging from 65% to 75%. Craig's on-task behavior began relatively high at 75%, but slowly decreased steadily before stabilizing.

Upon introduction of PA, Bo's on-task behavior improved immediately with an increase in level and trend from a mean of49.5% in baseline to 69.7% in intervention. Stephan's on-task behavior also immediately improved in level and went from a mean of 55.8% in baseline to 79.9% in PA. Stephan's on-task behavior stabilized, and he maintained a consistent level of on-task behavior for the duration of the PA. Similar to Bo, Craig's on-task behavior improved from 65% in baseline to 88.5% in PA. Bill was absent on the third day of PA, resulting in only three data points. His on-task behavior immediately improved and ranged from 85% to 91% with a zero celerating trend. Despite the instability in the baseline condition for Ron, his on-task behavior immediately improved upon introduction to the PA with a significant improving level change and trend. His on-task behavior improved from a mean of 48.6% during baseline to 76.5% during treatment. Overall, all of the participants demonstrated increased on-task behaviors during the intervention condition with immediate level changes and increasing trends.

Upon returning to CDC, Bo's on-task behavior deteriorated. He was absent the last 2 days of the withdrawal condition and only 3 days of data were collected. Stephan showed an immediate return to previous levels; however, his on-task behavior began to increase the last 2 days of the withdrawal condition. These increases remained comparable to initial CDC and did not reach previous PA

levels. Craig's on-task behavior also dropped in level and trend and was lower than his initial CDC data. Bill showed an immediate and deteriorating level change paired with a slight increasing trend. A decrease in his on-task behavior was noted on the second day of CDC, but his behavior returned to baseline performance on the third day and remained stable. Bill's on-task behavior decreased from 86.3% during PA to 67.8% during withdrawal. Ron's on-task behavior continued to steadily improve during PA, and then upon withdrawal a deteriorating level change and trend immediately took place. Ron's on-task behavior slowly deteriorated until returning to baseline percentages.

Once PA was reintroduced, Bo showed an immediate improving level change with a zero celerating trend. Bo's on-task behavior increased from a mean of 58.6% during withdrawal to 76.8% during the final PA condition. When the PA was reintroduced, Stephan's on-task behavior immediately improved in level and trend, and his on-task behavior increased from a mean of 64.2% during withdrawal to 81.4% in the final PA. Craig showed an improving and immediate level change, along with a therapeutic trend. When comparing the withdrawal condition to the second PA condition, Craig's on-task behavior improved from a mean of 58.4% to 71.6%. Bill's on-task behavior increased to 93.6% with an improving and immediate level change. He demonstrated a zero celerating trend at a high level with stable data until the conclusion of the condition. Ron's on-task behavior also immediately improved in level and trend with reintroduction of PA with a mean of 85%.

DISCUSSION

The purpose of the study was to answer the question: Does PA affect the on-task behavior of young children with developmental delays during a teacher-directed group activity? Momentary time sampling was used to calculate the percentage of intervals the participants were on-task using 15-s intervals. The PA that the participants engaged in was 20 min in duration and was comprised of age typical physical activities for 3-, 4-, and 5-year-old children that was facilitated by the classroom teacher and student teacher. Results indicate that engaging in PA immediately prior to a teacher-directed group activity was effective in increasing every participant's on-task behavior during the group activity.

The results of this study were consistent with the other antecedent PA studies examining the effectiveness of PA on participants' on-task behavior (Mahar et al., 2006; Nicholson et al., 2011). Although it is doubtful that antecedent PA in isolation can sufficiently eliminate maladaptive behavior, its role as a component of a larger behavior management plan should be considered. The relative efficacy of the PA treatment, as well as the ease of using it with more than one child at a time, makes it a feasible method of behavior intervention by practitioners. Practitioners might easily modify physical activities similar to the ones used in the study without specialized training or materials (see Table 2). Using PA prior to instructional times such as going to the playground before small groups or a teacher-directed group time would be an easy way practitioners could incorporate this behavioral support into the preschool classroom routine. Most preschool programs include a gross motor or recreational playtime outside, so arranging for the PA to occur prior to instructional time might be possible for most preschool classrooms.

Although incorporating PA into the preschool day is relatively simple, practitioners must do more than take the students to playground and monitor them. Researchers agree that many children do not participate in moderate to vigorous activity in preschool settings on their own, and that teacher facilitation of PA is essential in children participating in it (Brown, Googe, McIver, & Rathel, 2009; McKenzie et al., 1997; Pate, McIver, Dowda, Brown, & Addy, 2008). Brown et al. (2009) found that children did not engage in moderate to vigorous PA without teacher facilitation, and that teachers seldom promote children's PA during playtimes. Because the effectiveness of the PA is related to the participants' engagement in it, the teacher facilitation component is critical.

Despite the benefits and positive behavioral effects using antecedent PA may provide, several limitations were identified that might influence conclusions that can be drawn. First is the issue of the intensity or rigor in which the participants engaged in the PA. Previous antecedent PA studies have found that the level (intensity) of the PA affects the level of improvement of behavior

(Kern et al., 1984; Rosenthal-Malek & Mitchell, 1997). Although three adults monitored the participants' PA, no quantifiable measure was used to assess the intensity of their participation (e.g., accelerometer). For example, Pate et al. (2008) used accelerometers in their descriptive study of PA in preschool to quantify the PA of preschool-aged children that attended preschools. In this current study, the adults only visually monitored the PA and limited observational checks took place (ranging 1-5 min and five per PA period). Specific levels (low, moderate, vigorous) and types of PA (e.g., running, walking, jumping) participants engaged in were not documented. The absence of these kinds of data is a limitation for this study, and future studies might strengthen their findings by having participants wear accelerometers and document the activities the participants choose to engage in during PA.

The second limitation for this study is that the dependent variable is difficult to quantify and easily subject to observer drift and bias. Although high percentages of reliability were found, on-task behavior may be defined differently by other researchers and practitioners, and this may affect the external validity of the findings. In addition, the teacher and student teacher in the classroom were also the researchers of the study and had prior knowledge of the participants, their behaviors, and the classroom expectations of behavior during a teacher-directed group activity. They also knew the study design, research question, and implemented the intervention. Their prior knowledge of the study and its procedures is a limitation, but it is common in applied research. No generalizations can be made from the results of the study, but replications of the study might strengthen the evidence base for using PA as a proactive behavioral intervention in preschool classrooms.

A third limitation to the study is the limited observation of the on-task behavior. The observation sessions were 15 min in length and provide only a small sampling of each participant's daily behavior during teacher-directed group activities. They also do not provide information regarding the duration of intervention effects in other teacher-directed group activities. The observational data were collected during the same instructional period for each child and thus may not represent each child's engagement in more or less preferred teacher-directed group activities. Future studies may include an additional observation session per day or evaluate the delayed effects of the PA intervention.

The use of PA as a behavioral intervention for older children and adults with autism spectrum disorder has been well studied; however, research surrounding the use of PA as a behavioral intervention for young children with and without disabilities is limited. The current study adds to this research base by demonstrating that antecedent PA can increase the on-task behavior of young children with developmental delays during a teacher-directed group activity. Although the degree of efficacy of PA on improving on-task behavior is still unclear, the potential for using PA as a behavioral intervention is promising. Researchers and practitioners must share the responsibility for finding and implementing innovative strategies that enhance the educational experience of all young children through the development of their positive learning behaviors.

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