

The Effects of Physical Activity on the On-Task Behavior of Young Children with Autism Spectrum Disorders

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Abstract

The purpose of this study was to examine the effects of adult-directed physical activities conducted during circle time on the on-task behavior of students during a journal-writing activity held immediately after circle. The participants of the study were three male students with Autism Spectrum Disorder (ASD) who attended a full day inclusive kindergarten program. During the last five minutes of morning circle the entire class, including the target participants, engaged in one of three activities that required different amounts of physical exertion (yoga, dance party, or book reading) that were selected randomly by the teacher. On-task behavior data was collected for each participant during the first five minutes of the subsequent journal writing activity. Results found that, in general, movement (yoga and dance party) prior to journal led to higher levels of on-task behavior during journal writing, with different activities yielding different outcomes for individual participants. Implications are that students with ASD would benefit from participating in multiple bouts of planned physical activity across the instructional day.

Keywords: Physical activity, On-task behavior, Autism

Introduction

Autism Spectrum Disorder (ASD) is a lifelong neurological disorder characterized by deficits in social-communication and restrictive or repetitive behaviors (American Psychiatric Association, 2013). The Center for Disease Control and Prevention (CDC) estimates the prevalence of autism to be 1 in 68 (CDC, 2016). This means that in the United States over 1.5% of school-aged children are students with ASD, increasing the likelihood that every teacher in the United States will have a student with ASD in his or her classroom. While some of these students are still educated in segregated special education classrooms, many are being educated in the general education classroom, where appropriate behavior, attending skills, and engagement in group and individual tasks are building blocks for school success. Due to the range of social and communication deficits, however, students with ASD are often less engaged during instruction than their typically developing peers (Carnahan, Musti-Rao, & Bailey, 2009) and do not perform as well in

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school as one would expect based on their scores on norm-referenced assessments (Estes, Rivera, Bryan, Cali, & Dawson, 2010; Goodman & Williams, 2007). These challenges and discrepancies in students with ASD have resulted in the need for an expansion of classroom interventions that are both effective and practical for teachers to implement. Evidence-based interventions targeting engagement and on-task behavior – skills fundamental to learning – are especially valuable. Interventions that are easy to implement, involve all students, and may have benefits for everyone in the classroom will be more likely to be adopted and implemented with fidelity by busy classroom teachers.

The National Research Council (NRC) defines engagement as, “sustained attention to an activity or person” (p. 160) and recognizes engagement as a key component for effective programming for students with ASD (National Research Council, 2001). Students who are more engaged with peers, teachers, and educational materials are better positioned to learn academic and social-emotional skills needed to be successful in school and their communities (Marks, 2000; Wang & Holcombe, 2010). There are several ways in which researchers have increased the academic engagement of students with ASD including arranging the instructional/classroom environment (e.g., Carnahan, Hume, Clarke, & Borders, 2009; Koegel, Singh, & Koegel, 2010; Schilling & Schwartz, 2004), visual supports (e.g., Bryan & Gast, 2000; Carnahan, Hume, Clarke, & Borders, 2009; Delano & Snell, 2006; MacDuff, Krantz, & McClannahan, 1993; Spriggs, Gast, & Ayres 2007), self-monitoring (e.g., Holifield, Goodman, Hazelkorn, & Heflin, 2010), and systems of reinforcement (e.g., Koegel et al., 2010). While effective, maintaining a scripted intervention for only one or two students in the classroom may not be feasible for some teachers.

Therefore, one challenge facing researchers and practitioners as they attempt to develop and use strategies to increase the on-task behavior of children with ASD in the classroom, is the feasibility and thus sustainability of the intervention. Sustainability includes features such as how the intervention is viewed by the classroom teachers, how the intervention fits into the social context and actual schedule of the school, and how much effort and/or cost is required for the intervention to be implemented. The sustainability of an intervention, often measured by social validity assessments in behavioral research, is essential to consider. If a classroom teacher is unwilling or unable to implement an intervention, students with ASD may not have access to the same learning opportunities as their peers (Schwartz & Baer, 1991).

A promising intervention for increasing appropriate on-task behaviors in children, including those with ASD, is physical activity or exercise (Wong, et al., 2014). Physical activity interventions may be particularly appealing because many require little to no specialized training (jogging or dancing, for example) and fit well into the ecology of a school day. This feasibility, combined with the added impact of health and well-being (National Center for Chronic Disease Prevention and Health Promotion, [NCCDPHP]), and the overwhelming evidence that young children – especially those with autism, whose overweight and obesity rates were higher than the national averages (Egan, Dreyer, Odar, Beckwith, & Garrison, 2013) – do not engage in enough activity throughout their day (Brown et al., 2009; Brown, Googe, McIver, & Rathel, 2009; Hinkley, et al., 2014; Pate, McIver, Dowda, Brown, & Addy, 2008; Tucker, 2008) are additional, critical reasons to further explore the effectiveness of these interventions, especially when implemented by classroom teachers.

Within the breadth of physical activity literature, studies specifically examining the effects of antecedent movement on on-task behavior in children without ASD have mixed results. Many studies show that activity can prevent off-task behavior (Grieco, Jowers, & Bartholomew, 2009; Ma, Mare, & Gurd, 2014) and increase on-task behavior (Howie, Beets, & Pate, 2014; Jarrett, Maxwell, Dickerson, Hoge, Davies, & Yetley, 1998; Mahar,

Murphy, Rowe, Golden, Shields, & Raedeke, 2006). Of these interventions, however, few take place within in the context of a classroom. In a review of literature examining the relationship between physical activity and academic performance, Rasberry and colleagues (2011) found only 9 studies out of the 42 articles that met inclusion criteria took place in the classroom and only one of these measured on-task behavior (Rasberry, et al., 2011). A second review and meta-analysis of physical activity and features of engagement (i.e., emotions, cognition, and behavior) showed that only 7 of the 38 studies looking at behavioral engagement were embedded into classroom activities, while only an additional 5 took short breaks from academics to engage in an in-class physical activity (Owen, et al., 2016).

For students with ASD and/or developmental delays, much of the physical activity research focuses on using activity to decrease stereotypic and self-stimulatory behavior (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Elliott, et al., 1994; Kern et al., 1982; Kern, et al., 1984; Levinson & Reid, 1993; Powers et al., 1992; Rosenthal-Malek & Mitchell, 1997; Watters & Watters, 1980). Jogging has been the most common intervention (Celiberti, et al., 1997; Kern, et al., 1982; Kern, et al., 1984; Levinson & Reid, 1993; Rosenthal-Malek & Mitchell, 1997), while roller skating (Powers, et al., 1992), stretches including sit-ups, arm circles, and toe touches (Reid et al., 1988), and playing catch with a ball (Kern, et al., 1984) have also been effective interventions for decreasing maladaptive behaviors. Also noteworthy, the effort exerted during activity has resulted in varied decreases of behavior. For example, vigorous exercise, such as jogging or running on a treadmill was found to have a greater effect on reducing self-stimulatory behaviors than mild exercise such as ball playing or slowing riding a stationary bike (Elliott et al., 1994; Kern et al., 1984; Levinson & Reid, 1993).

In addition to decreasing stereotypic and self-stimulatory behaviors, access to more frequent bouts of physical activity, mainly jogging, has shown an increase in expected classroom behaviors such as increased and correct responding (Kern et al., 1982; Rosenthal-Malek & Mitchell, 1997), on-task behavior (Kern et al., 1982; Nicholson, Kehle, Bray, & Van Heest, 2011; Powers et al., 1992; Reid et al., 1988) and work task completion (Rosenthal-Malek & Mitchell, 1997). While effective, none of these interventions took place in the context of a classroom routine. Embedding physical activity into the existing schedule may influence the ecological validity of the intervention, make the intervention accessible to more students, and increase the likelihood that an intervention will be sustained upon the conclusion of a research project.

The purpose of this study then is threefold: 1) to examine the effect that embedded physical activity has on the on-task behavior during subsequent academic tasks for young students with ASD, 2) to compare rates of on-task behavior based on different types of classroom based physical activities, and 3) to find an intervention that is easy to implement and sustainable in the context of a kindergarten classroom.

Method

Participants

Three male kindergarten students with ASD participated in this study. All three students attended an inclusive full day kindergarten program at a comprehensive early intervention center. The kindergarten curriculum included focused instruction in literacy, mathematics, social skills, and school success skills. Paul was a five year, ten month old Caucasian, Nate was a six year, one month old African-American, and Liam was a six year, three month old Caucasian. Nate and Liam were in the same classroom, while Paul was in a second kindergarten classroom at the same school. On the Peabody Picture Vocabulary Test, 4th Edition (PPVT 4), a receptive language assessment, Paul received a standard

score of 69, while Nate's standard score on the same assessment was 94. No additional assessment information was available for Liam. All three participants were verbal, used full sentences to communicate, and had a diagnosis of ASD from an agency not affiliated with the research.

The head teachers and assistant teachers in each classroom also participated in the implementation of the study. The head teachers both had Master's degrees and certification in special education. The assistant teachers were graduate students working towards their special education certification. The classroom staff members were responsible for implementing the intervention at circle and supervising the students during journal time.

Experimental Design

An alternating treatment design (Gast, 2010) was used to compare the effects of three different types of circle time activities on students' on-task behavior during a journal writing activity that immediately followed the treatment. The three activities that were compared as part of the intervention were yoga, dance party and listening to a story (i.e., book reading). During the intervention portion of this study, one of these treatments occurred during the last five minutes of morning circle every day. Immediately after being exposed to the treatment, children made the transition to their tables and the journal writing activity. Data on child behavior were collected during journal writing. All children in the classroom participated in morning circle, the intervention, and journal writing. Following baseline, treatments were randomly assigned each day. At the beginning of the morning circle, the teacher drew a piece of paper out of a cup to determine the treatment. The cup contained three pieces of paper, one with each of the three treatment options on it. Decision rules for the interventions were established a priori and stated that no intervention option could occur more than two days in a row. If any intervention had been drawn for two consecutive days, on the third day, the piece of paper with that intervention option would be removed from the cup to ensure that a different choice would be drawn. Following that draw, all treatment options would be put back into the cup and the randomization process would continue.

Procedure

A baseline condition occurred prior to beginning the intervention. During the baseline phase, the teachers conducted circle and journal writing in the same way they had been doing all year. The circle followed the same schedule everyday consisting of the following activities: a song or book to start, calendar discussion, and introducing the daily journal topic. Immediately following circle, students were directed to find their seat at small group and begin writing on the previously discussed journal topic.

Intervention

The independent variable was the type of activity performed during the last five minutes of circle: book reading, yoga, or a dance party. For book reading, students sat on circle mats while listening to a book being read by the teacher. Yoga involved all students in the classroom taking turns picking different yoga poses from a choice of pictures cards. Once a pose was picked, all students performed the action based on the teacher's model. If any of the target students were not performing the behavior, an adult prompted the child to perform the action using least to most prompting strategies (Cooper, Heron, & Heward, 2007). Between five and seven poses occurred during each intervention session. The dance party consisted of dancing to a collection of songs created for each classroom by the author. Dance party was also teacher directed and consisted of students copying a "leader's" dance moves and doing partner or group dancing within the circle area. If target

students were not engaged in a dance movement or actively moving their arms and legs for more than 30 seconds, an adult prompted the child to start dancing using least to most prompting strategies (Cooper, Heron, & Heward, 2007).

Prior research (Kern et al., 1984; Elliott et al., 1994; Levinson & Reid, 1993) has shown differential effects based on the intensity of physical exertion. Though not objectively measured, yoga and dance party were chosen in attempt to replicate mild (yoga) and moderate (dance party) forms of physical activity that were common and easy to embed into a kindergarten circle routine. The book reading condition was used represent a current treatment control, since it is a sedentary active that is frequently part of a kindergarten circle time.

Measures

The dependent variable was on-task behavior during a journal-writing task immediately following the independent variable (i.e., the book reading, yoga, or dance party). Data for on-task behavior was collected for the first seven minutes of journal writing. On-task behavior was operationally defined as independent continuous appropriate engagement in the assigned activity. The operational definition of on task included looking at an adult giving a direction, looking at the assignment, manipulating task materials in an appropriate manner (including cutting, writing, drawing), and following group or individual directions. If adult support was needed to complete a task, the participant was scored off-task for that interval. Adult support included prompts to engage in the appropriate behaviors, stay on task, and/or complete the task at hand. Off-task behavior was defined as disengagement from the academic activity at hand, including looking away from the action, staring into space, out of seat behavior, engaging in a task that was not assigned (e.g., reading a book during journal writing time), not responding to group or individual directions and engaging in side conversation.

Momentary time sampling was used to collect the on-task behavior data. Ten second intervals were used to record behavior, meaning that observers recorded the student's behavior – if they were on-task or off-task – by looking up once every ten seconds and recording what behavior they saw at that moment. Observers used a vibrating MotivAider to signal the ten-second intervals and indicate when it was time to collect data for each interval.

Reliability

Inter-observer reliability was assessed for on-task behaviors during journal. Two observers independently recorded incidences of on-task and off-task behaviors for 15% of data collection sessions. The observers agreed on the incidence of behavior type (on task or off task) 96% (range 91 – 100%) of the time for behaviors during journal.

Social Validity and Preference Assessment. At the end of the study, student and adult participants took part in a social validity assessment. The purpose of the assessment was to attempt to understand participants' attitudes about the intervention components and to determine if they were components of the intervention that they preferred (Schwartz & Baer, 1991). To assess the students' preference of the activity choices, every student in the class was given a piece of paper and asked to write down which activity (i.e., book reading, yoga, or dance party) was their favorite. Target participants' responses were marked for data analysis.

In an attempt to understand what the teachers thought about this intervention, teachers were asked to complete a brief questionnaire at the end of the study. It included questions about their perceptions about effect of the intervention on the behavior of the target participants, ease of intervention, how the intervention fit into their classroom routine,

and likeliness to use the intervention again. All questions were answered on a 5-point Likert-type scale, with 5 being the highest possible rating. The questionnaire also had a place for teacher comments.

Results

In general, the results of this intervention suggest on task behavior during journal writing increased when students participated in an activity that required some movement immediately before that journal writing activity. There was, however, some variability within these findings. The results for all of the participants can be found in Figures 1-3.

Paul demonstrated the most robust changes during the intervention. During baseline, Paul (Figure 1) was on-task during journal behavior an average of 53% (range 39 – 67%). When the independent variable was implemented he demonstrated immediate and noticeable changes in his behavior. Following the yoga sessions, Paul was on task for an average of 92% (range 90 – 93%) of the intervals during journal writing. During the journal writing observations following dance party sessions he averaged of 83% (range 77 – 89%) if on-task intervals. Following the book reading condition, the condition that was most similar to baseline, Paul was on-task during journal an average of 45% of the observed intervals (range 8 – 66%).

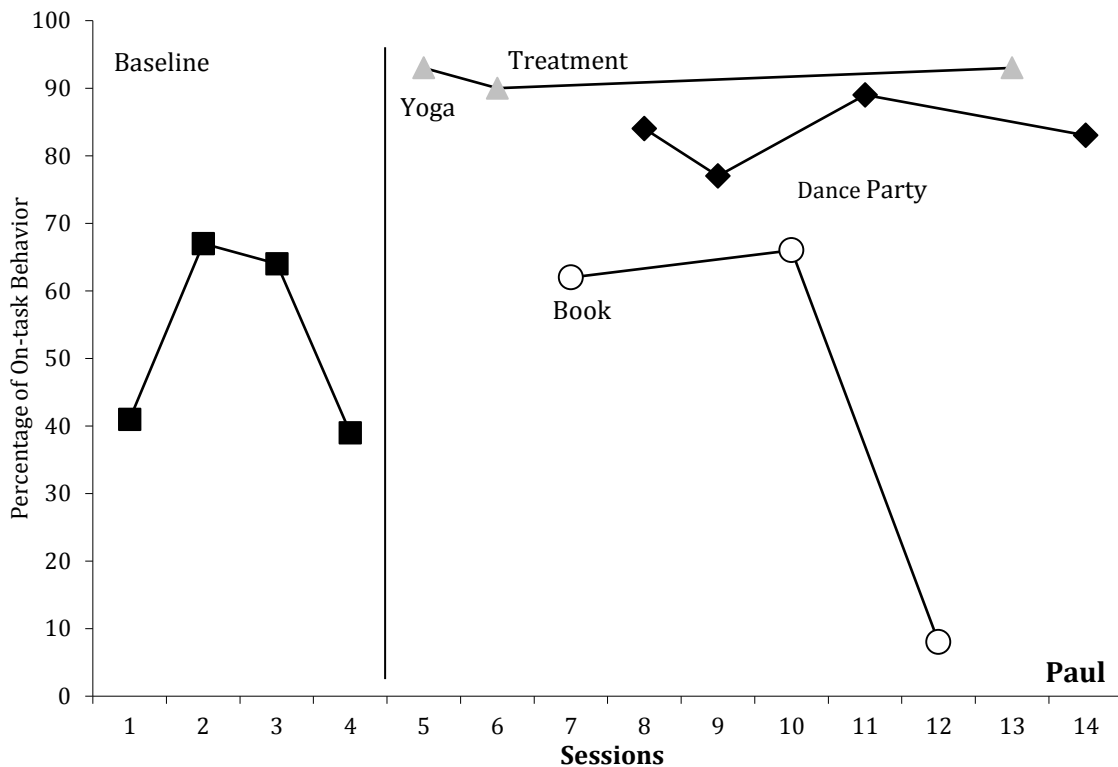


Figure 1. Percentage of on-task behavior during journal writing for baseline and treatment conditions for Paul

Liam (Figure 2) demonstrated similar changes in his behavior. During baseline, Liam was on-task during journal an average of 44% (range 34 – 58%). His average of on-task behavior increased following yoga sessions to 55% (range 30 – 66%) and 66% (range 61 – 71%) during dance party sessions. During the book reading condition, Liam was on-task an average of 42% of the observed intervals (range 37 – 53%).

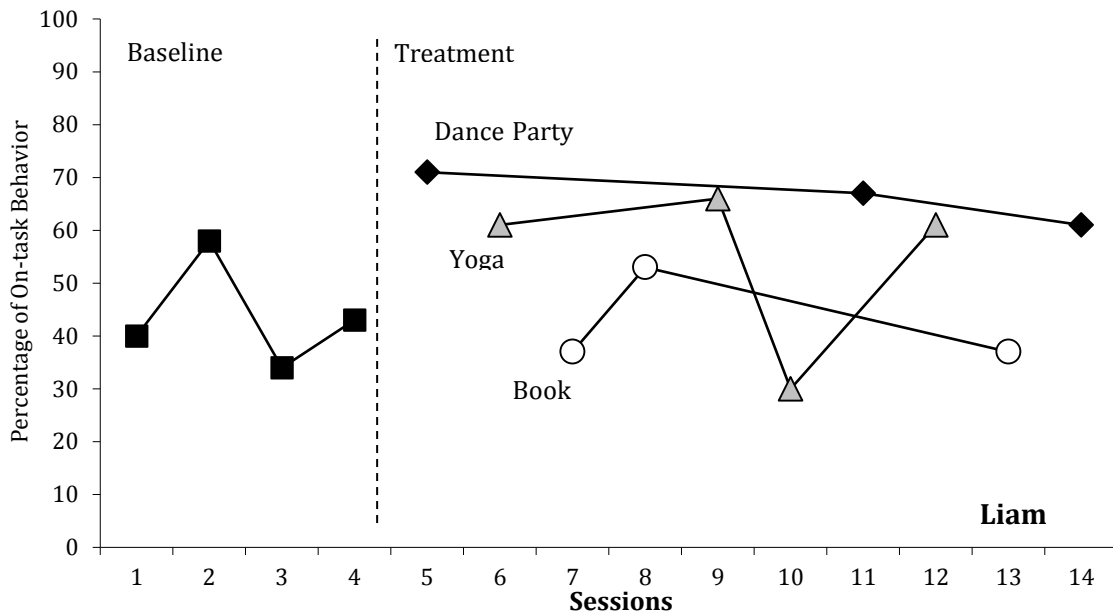


Figure 2. Percentage of on-task behavior during journal writing for baseline and treatment conditions for Liam

Nate (Figure 3), who was absent five times during the month long intervention, was on-task during baseline an average of 48% (range 22 – 66%) of the observed intervals during journal writing. His percentage of on-task behavior increased to 73% during yoga (range 56 – 91%) and approximately 79% (range 64 – 97%) of the time after participating in the dance party. Due to his high number of absences, he only experienced the book reading intervention one time, and his rate of behavior during the journal writing that followed book reading was similar to that during baseline (45%).

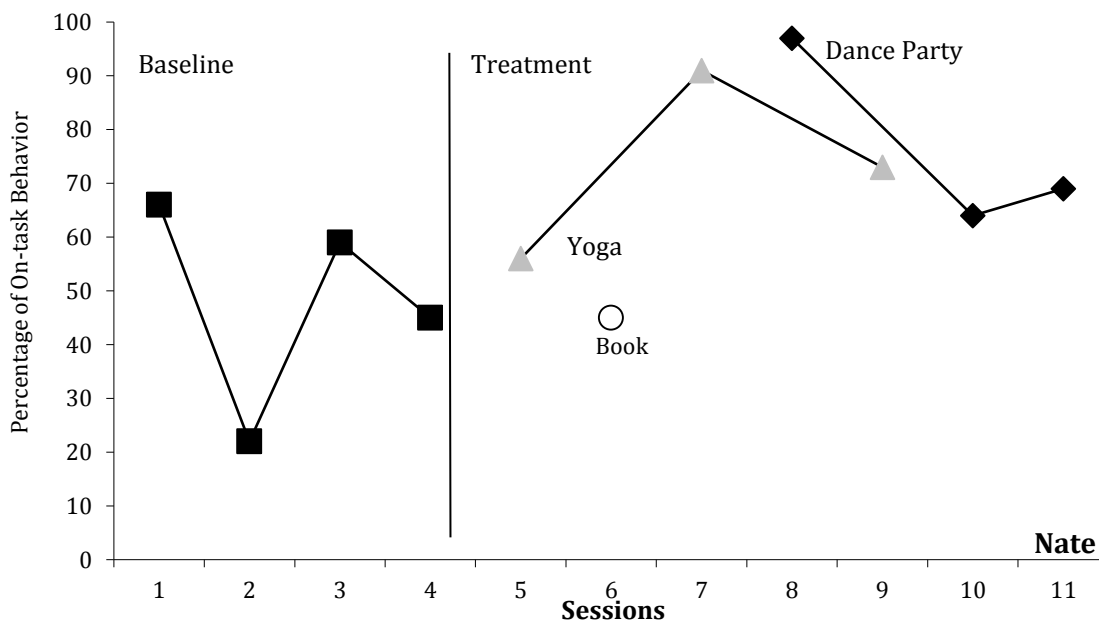


Figure 3. Percentage of on-task behavior during journal writing for baseline and treatment conditions for Nate

Social Validity Data

In attempt to determine what the children, (i.e., one group of primary consumers) thought about this intervention, all 29 children in the kindergarten who had participated in the study were asked to write their favorite intervention on a piece of paper. These pieces of paper were collected before the last intervention session. Of the 29 total kindergarten children, 19 choose the dance party, while 9 students chose yoga, and 1 child chose book reading. Of the three target students, Liam chose yoga while Paul and Nate chose dance party.

The teachers also gave the intervention with very high marks. The 4 participating adults (2 head teachers and 2 assistant teachers) reported that they noticed an increase in appropriate behavior after both activity options (i.e., yoga and dance party). They rated the intervention as very easy to use, giving it a 4 out of 5 on a 5-point scale. All the teachers said that they planned to use this intervention again. One teacher summed up the overall responses of the group by saying, "I thought this intervention as wonderful. A great study that I was happy to be involved with."

Discussion

The purpose of this study was to examine if brief bouts of physical activity that were embedded into a morning circle in an inclusive kindergarten classroom would have an effect on the on-task behavior of children with ASD in a journal writing task that immediately followed. The answer is yes. This study demonstrated that kindergarten students with ASD were more on-task following yoga or dance part (both effortful activities) as compared to book reading (a sedentary activity). The results of the social validity assessment suggest that this intervention was found to be acceptable by two groups of primary consumers – teachers and students. Teachers reported that they would use this intervention again and 28 of the 29 students, including all three of the targeted participants, indicated that they preferred one of the effortful activities to the sedentary activity.

The results of this study, though limited, are promising and support the prior research showing relationships between movement prior to academic tasks and increased on-task behavior. Activity prior to seatwork seemed to benefit Paul the most, with large increases in on-task behavior following both yoga and dance party sessions. Liam, who had the lowest on-task percentage during baseline, had the most variability during intervention. However, it should be noted that only one of Liam's data points during the dance party and yoga interventions (session 10) overlaps with baseline percentages, while all three book reading phases (sessions 7, 8, and 13) are within the same on-task range as baseline. This does show that movement had some effect on Liam as well. Nate's data were more difficult to analyze, given fewer data points due to a high rate of absences. His data, however, are still promising and he, like the other participants preferred movement to the baseline (book reading) condition when asked.

In addition to overall increases following the two movement interventions, two of the three participants also showed greater on-task performance following the most fast-paced activity (dance party), which supports other findings (Kern et al., 1982) that demonstrate less self-stimulatory behavior with more vigorous exercise.

The implications of this study are that students who engage in adult led physical activity can increase their on-task behaviors for academic tasks that follow the physical activity. Though moderate and vigorous physical activity both have an effect on the increase of on-task behaviors, vigorous activity, specifically, may also have a greater effect on on-task behaviors for students with autism. This may be because vigorous physical activity serves

as a more fulfilling sensory experience, allowing students to be available for learning following active vigorous engagement. However, if a classroom teacher does not have the time or resources to engage in vigorous activity (i.e. it is not time for recess and vigorous activity is difficult and dangerous within the confines of a classroom), they can still create moderate activity sessions within the classroom routine that would improve on-task behavior in students with ASD.

Additionally, and perhaps more important, was the high ranking (4 out of a 5-point scale) given by both teachers on ease of implementation and willingness to use this intervention again with a range of students. This intervention has implications for students who may not have a diagnosis, but who demonstrate behaviors that are concerning to teachers such as difficulty transitioning or getting starting on a new task, needing support attending to tasks, and fidgeting or engaging in distracting behaviors. It is also interesting to note that out of the 29 students who recorded their preferred activity on the final day of intervention, only one stated a preference for book reading, with all other students preferred movement. This information could imply that the act of book reading – which is common in many preschool and kindergarten circles – may not be the most preferred or helpful circle time activity.

There are several limitations to this study. The small, homogenous subject size (three high functioning kindergarten boys with ASD) and length of intervention may not produce the same effects when implemented for a longer time (both daily and intervention as a whole) with a greater variety of students. Additionally, it may be difficult to make strong causal claims regarding the effort put forth while engaging in the two kinds of physical activity, as this was not monitored with equipment.

Areas for future research could include adjustments to the current study given the limitations noted above. Monitoring the levels of energy exerted during each intervention phase with equipment can help answer questions related to the timing and dosage of physical activity. How much is necessary to see a change in on-task behavior and how long do the effects last? How long do the bouts of physical activity need to last? Is there benefit of frequent short activities, or does sustained moderate to vigorous physical activity have a longer lasting effect on student behavior. It will also be interesting and important to determine how the amount and type of physical activity that is related to change in classroom behavior relates to the amount and type of physical activity that is recommend for health reason (i.e., obesity prevention).

Additionally, adding a social component to the intervention by using peer models instead of adult support could add to the feasibility of implementation. After all, “development of friendships is a high priority for any child” (Staub, Peck, Gallucci, & Schwartz, 1999; p. 386) and research shows that children gain skills they need to be successful by engaging in positive interactions and developing peer relationships that, in turn, make them feel like a member of the team (Peck, Staub, Gallucci, & Schwartz, 2004). It is critical that children of all ability levels participate in meaningful activities that promote friendship and, as a result, learning. Physical activity is no exception.

Increasing the amount of sustained physical activity that children participate in every day is a topic of great interest across multiple disciplines. It will be important that as work in this area moves forward, researchers and advocates from different disciplines work together to highlight all of the benefits that increased activity may have for young people. It will also be important that as the national dialogue about obesity prevention moves forward, that children with disabilities are included in the discussion. Like many national campaigns for child welfare, the anti-obesity and exercise promotion programs have largely excluded children with disabilities. The results of this study suggest that in

addition to the health benefits, the quality of the classroom experience for children with disabilities may improve with a systematic program to increase their level of physical activity across the day. The participants with ASD not only preferred the vigorous activities to book reading, their behavior improved enabling them to participate more fully and be more successful in the planned activities of the school day.

In conclusion, physical activity should be an important part of the daily schedule for every child, including children with ASD. In addition to the known health benefits, physical activity has behavioral and academic benefits as well. Research has shown that students with ASD show increased on-task behaviors following bouts of physical activity and this study supports the prior research findings. It is imperative that adults play a large role in facilitating and supporting physical activity participation for all children, especially those with ASD. Specifically, planned adult-directed activities have yielded strong increases in physical activity (Wadsworth, 2011; Brown et al., 2009). It is important for adults to guide activity and provide support and encouragement to help students maintain high levels of engagement. This notion is confirmed through studies that show higher levels of physical activity in young children during adult directed activities (Brown, Googe, McIver & Rathel, 2009; Pan, 2008). Equally important is embedding these adult led activities – such as yoga and dance party – into classroom routines as minimal effort can produce impactful health and academic outcomes.



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