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Exploring the Connection Between Physical Activity and On-Task Behavior of Kindergarten Students

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Research Paper

Exploring the connection between physical activity and on-task behavior of Kindergarten students: Does student engagement in physical activity at different intervals throughout the day increase on-task behavior during small group and independent work?

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Abstract

Increased academic demands on elementary school students require them to be on-task for longer periods of time (Mahar, 2011). The purpose of this study was to examine the effect of increased physical activity breaks on kindergarten students' on-task behavior during small group and independent center work. This mixed methods study employed an experimental design with an initial baseline phase followed by a physical activity treatment phase. Data was collected using a planned activity check observation method and observational field notes to compare on-task behavior during the two phases of the study. Data analysis indicated that physical activity breaks was associated with improved on-task behavior directly after the physical activity. When longer periods of time elapsed between the physical activity and data collection observation, on-task behavior showed no-change when compared to the baseline phase data. Results point to the benefits of physical activity breaks for promoting on-task behavior immediately after the break is given.

Keywords: physical activity, on-task behavior, kindergarten

Introduction

Higher academic demands on elementary school students has decreased the amount of time in the school day for physical activity (National Center for Educational Statistics, 2005, Table 15). These higher academic demands at a young age generate the expectation that students will exhibit on task behavior for long periods of time to achieve greater cognitive goals. Yet some research shows a beneficial correlation between physical activity, academic achievement, and on-task behavior (Center for Disease Control Prevention, 2010; Center for Disease Control Prevention, 2016; Mahar, 2011). These two paradigms in early elementary education, an increased demand for on-task behavior and a decrease in physical activity throughout the school day, need to be studied in an effort to see if they are counterproductive elements of school culture.

The dilemma of educators, to inform and instruct children without regard for the role the physical environment plays in the students' educational experience is important to consider. Philosopher John Dewey (1910), in his conversation about dualism helps us see the importance of both the physical and intellectual realm of human existence. Children are not simply brains that must be taught, they are physical beings who must interact with the world on a physical level. Yet the educational philosophy of this day urges educators to teach children what they need to know (mental, intellectual aspect of education) without addressing the other domains of learning, which includes the physical. Dewey (1910) believed that the interaction between the physical and mental is the element that sets the stage for deep thinking. Children must be given opportunity to engage with the content of their learning by being given relevant problems to be solved through physical, experiential and intellectual means. When considering Dewey's philosophy and how it might relate to physical activity in the literal sense, teachers must consider the impact

that physical activity may have on mental, intellectual rigor. If the possibility exists that an increase in physical activity improves students' ability to stay on-task, one indicator of engagement and a skill necessary for deep thinking, would educators not want to include this practice in the daily routine of students? For philosophical and practical reasons, the positive effect physical activity may have on student engagement and learning is an important consideration for research.

Physical activity during the school day may have a positive impact on students' health. In a promising report, the CDC (2016) statistics for 2011-2014 show a decline in the number of obese preschoolers. However, obesity still affects 12.7 million American children aged two through nineteen years of age (CDC, 2016). Most school-age children spend a large portion of their day in school. Therefore, some educators and administrators are concerned about this statistic and are looking for ways to reverse the trend toward obesity. Increasing physical activity throughout the school day may provide a positive impact on student health and help reduce childhood obesity (Donnelly et al., 2009; Perera, Frei, Frei, & Bobe, 2015).

Some studies have shown a positive correlation between physical activity and improved academic performance (Resaland et al., 2016; Van Dusen, Kelder, Ranjit, & Perry, 2011). The United States Department of Health and Human Services, Centers for Disease Control and Prevention (2010) published a comprehensive review of current literature entitled "The Association Between School-Based Physical Activity, Including Physical Education, and Academic Performance" (CDC, 2010). The 50 studies reviewed yielded 251 associations between physical activity and different aspects of academic performance (including academic behavior) with only 1.5% of these associations resulting in negative findings. Furthermore, while increasing the amount of time for physical activity during the school day decreases the amount of time available for direct

instruction, research does not show a negative correlation for a shift in time allotment to negatively impact academic scores (Ahamed et al., 2007; CDC, 2010; Trost, 2007).

An additional concern with increased academic demands is the amount of time students are expected to be on-task. Some research studies have explored the connection between increased physical activity and the positive effect on task focused or on-task behavior (Mahar et al., 2006; Janssen et al., 2014). Mahar et al. (2006) define on-task behavior as “verbal or motor behavior that followed the class rules and was appropriate to the learning situation” (p 2088). While other researchers use terms such as attention to task, self-regulatory behaviors, and achievement-related behaviors, all are terms that relate to on-task behavior in that the actions of the students are focused on and conducive to learning.

In an educational system that relies heavily on didactic teaching to meet stringent grade-level standards, knowledge of research related to increasing on-task behavior in elementary school students may be helpful for teachers. However, there is a limited body of research related to variables that might impact this important academic behavior at the early childhood level. The purpose of this study was to add to that body of literature by exploring the connection between physical activity and on-task behavior in the kindergarten classroom. Specifically, the study was designed to answer the following questions: (1) Does student engagement in physical activity breaks at different intervals throughout the day increase on-task behavior during small group and independent work of kindergarten students? (2) Does physical activity have an increased effect on kindergarten students’ on-task behavior immediately after the physical activity?

Literature Review

Physical Activity and Health

There is serious concern that young children are not getting the physical activity (PA) they need for good health. According to a Child Trends Data Bank report (2014), obesity is a major concern for American children. More than one in twelve preschoolers and one in six elementary school age children have a body mass index in the 95th percentile for their age and gender and are considered obese. Obesity is an important health concern, as obesity places children at a greater risk than their peers for physical health problems such as high cholesterol, asthma, type-2 diabetes, and adult obesity (CDC, 2007). Academic achievement for obese students may also be a concern, as a study by Roberts, Freed, and McCarthy (2010) found that children with low levels of aerobic fitness and obesity often scored lower on standardized tests.

A decrease in physical activity is one factor which may contribute to increased obesity in children. Physical activity is defined by the CDC as “any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a resting level” (Physical Activity Guidelines Advisory Committee, 2008). Physical inactivity is associated with health risks such as heart disease, diabetes, hypertension, and cancer and may contribute to anxiety and depression (Kohl & Cook, 2013). Conversely, regular physical activity may reduce the risk of these health concerns, and build muscle strength, improve self-esteem, and decrease anxiety and stress (Physical Activity Guidelines Advisory Committee, 2008). In addition, research in neuroscience is exploring the positive effect of exercise on nerve transmitters and brain function (Berg, 2017; Chaddock et al., 2010). Preliminary findings are beginning to show scientific validation for Dewey’s (2010) philosophical theory of dualism.

Given the many benefits of physical activity, the U.S. Department of Health and Human Services *Physical Activity Guidelines for Americans* (2008) recommends that children and ado-

lescents engage in 60 minutes or more of daily physical activity. The guidelines suggest the majority of these 60 minutes should be spent in moderate or vigorous intensity aerobic physical activity (MVPA). Breslin, Morton, and Redistill (2007) found that kindergarten students were able to recognize the signs of MVPA by checking different parts of the body for their heart beat (i.e. chest, neck, wrist). The Physical Activity Guidelines (2008) also recommends that muscle-strengthening and bone-strengthening activities should be included on at least 3 days of the week (USDHHS, 2008).

Physical Activity and School

Educational trends at the beginning of the 21st century found America in a push toward more academic rigor. With the implementation of No Child Left Behind (NCLB) in 2001, schools began to remove many parts of school culture that were not geared toward academic achievement. This trend toward focusing on cognitive domains while ignoring the importance of social, emotional, and physical domains continues, as rigorous common core standards are implemented for even the youngest learners in our public school systems (Hirsh-Pasek, Golinkoff, Berk, & Singer, 2009). Yet child development theorists from the early 1900's have recognized the interplay between these domains as important toward growth of full potential (e.g. Dewey, 1910; Piaget, 1936). Fortunately, there is a growing body of current research that seeks to support the symbiotic relationship between the physical domain and cognitive domain (e.g. CDC, 2010; Tomporowski, Davis, Miller, & Nagliere, 2007; Conyers & Wilson, 2015).

Most elementary school children spend 30–35 hours per week in school (National Center for Educational Statistics, 2007-2008). Thus, schools have an opportunity to counter act the propensity toward obesity, poor fitness, and sedentary lifestyles while strengthening a relationship between the physical and cognitive domains by increasing physical activity during the school

day. Schools are such likely candidates for making a difference in the physical activity of children that the *2013 Comprehensive School Physical Activity Programs Guide for Schools* (CSPAP) was issued to help make this suggestion a reality (CDC, 2013). The goal of any CSPAP is to develop and implement a plan to increase physical activity throughout the entire school. A well planned and executed CSPAP has the potential to impact student health, academic performance and behavior, change school culture, and send a positive message about the importance of physical activity to students, family, and the community (Brusseau & Hannon, 2015; Carlson et al., 2015).

A concern many educators and administrators face is that the intense pressure for students to meet academic standards leaves less time in the school day for activities that are deemed non-academic. For this reason, some schools have decreased time allotted for recess and physical education (School Health Policies and Programs Study, 2006; American Academy of Pediatrics, 2013). Statistics from the *2006 School Health Policies and Programs Study* (SHPPS) found that 32.2% of elementary schools did not provide daily recess for students in all grades in the school and only 3.8% of elementary school provide the recommended 30 minutes daily of physical education (SHPPS, 2006). However, several studies show that taking time for physical activity did not have a negative impact on academic performance (e.g. Ahmed et al, 2007; Trudeau and Shephard, 2008). The American Academy of Pediatrics (2013) issued a policy statement in regard to their stand on the importance of recess for the development of the whole-child (i.e. cognitive, social, emotional, and physical domains), stating that “recess is a crucial and necessary component of a child’s development and, as such, it should not be withheld for punitive or academic reasons” (p 183).

In contrast to the increase of time allotted for academic rigor, some research suggests a positive connection between physical activity and cognitive function or academic performance. A study by Donnelly and Tambourine (2011) found moderate intensity classroom-based physical activity improved scores on a standardized academic achievement test by 6% compared to a decrease of 1% for control groups. An analysis comparing standardized test results with fitness test records of students in grades 3-11 found a positive association between fitness and academic performance (Van Dusen, Kelder, Kohl, Ranjit, & Perry, 2011). Additional research related to the integration of physical activity with learning activities found that third-grade children scored higher on mathematics and reading tests than third graders that did not participate in physical activity (Mullender-Wijnsma et al., 2015).

While some research found improvement in academic performance linked to physical activity, other research found little effect on academic performance. A 2008 literature meta-analysis by Tomporowski, Davis, Miller and Naglieri of 16 research studies with 20 standardized test measure conducted with children from kindergarten through ninth grade found 10 positive associations and 10 inconclusive or no effect associations between the two variables. Rosalind et al. (2016) found physical activity to have no effect on academic performance of 10 year olds participating an Active Smarter Kids (ASK) PA program at school. An important review by Trudeau and Shephard (2008) found that while PA did not have a significant effect on academic performance, the extra time spent in PA of up to one hour daily did not have a negative effect on academic achievement even though there was a decrease in time spent on academic content. A study by Ahamed et al. (2007) of fourth and fifth grade students involved in a school based physical activity intervention resulted in similar findings. That is, while physical activity increased

by an average of 47 minutes per week, there was no significant difference in academic scores after the intervention when compared to baseline scores (Ahamed et al., 2007).

Physical Activity and On-Task Behavior

As educators are pushed to focus on academic rigor, students are expected to exhibit on-task behavior for longer periods of time. On-task behavior is part of the cluster of skills referred to as executive function. Executive function is a general term for a variety of cognitive processes involved in goal-oriented behavior such as focused attention and memory, managing impulsivity, and self-monitoring (Davis et al., 2011). Shaul and Schwartz (2013) found that strong executive function skills was a positive correlate to both emergent literacy and emergent math knowledge in preschool-age children. Thus, pathways to improved executive functions (EF) in young children should be examined. MRI imaging of 9-10 year old children by Chaddock et al., (2010) observed differences in brain volume of particular regions of the brain indicative of improved executive function associated with higher levels of aerobic fitness. This study also showed enhanced inhibitory control during a task assessment of higher fit 9-10 year old children compared to their lower fit peers.

Within executive functions, on-task behavior has been categorized as “academic behavior” shown to have an impact student learning (CDC, 2010). A study by Mahar, Murphy, Rowe, Golden, Shields, and Raedeke (2006) define on-task behavior as “verbal or motor behavior that followed the class rules and was appropriate to the learning situation” (p 2088). One variable related to on-task behavior of elementary age students that has been given research consideration is physical activity. In other words, what effect might increased physical activity have on on-task behavior. The relationship between these specific variables for elementary school students has been minimally researched. One school study by Janssen, Chinapaw, Rauh, Toussaint, and

van Mechelen, (2014) involving 10-11 year olds, found that a 15 minutes break of moderate intensity (e.g. passing and dribbling a ball) improved selective attention. A study involving twenty-four elementary schools (grades 1-6) in six California school districts engaged in comprehensive school-wide implementation of PA breaks found that a minimum break of 10 minutes of PA was associated with less off-task and inattentive classroom behavior and helped students meet the recommended 30 minutes school physical activity (Carlson et al., 2015). A study by Mahar et al. (2006) measured on-task behavior of 243 third and fourth grade students before and after a 10 minute PA break. The study found an increase of on-task behavior for both groups with the least on-task students showing the strongest gains (20% increase). Conversely, a study by Ahamed et al., (2007) found no effect, either positive or negative, of physical activity to on-task behavior. The CDC 2010 report entitled *Associations Between School-Based Physical Activity Including Physical Education, and Academic Performance* analyzed 43 research articles to explore the relationship between different types of school-based physical activity and academic performance outcomes. In the summary of findings, they found 86% of the articles had at least “one positive association with academic behavior outcomes” (p. 28).

The evidence exists for a need to further examine the effect of classroom-based physical activity on task-focused behavior in elementary school children. None of the studies for this review explored the connection between PA and on-task behavior in kindergarten students. Additionally, none of the study designs gathered information about on-task behavior during small group and independent work time such as during centers. This is a critical issue for teachers of young children, as it is often during center time that teachers work with small groups of

children for intensive literacy and math instruction. The fact that teachers are “unavailable” during this time, makes it necessary for the rest of the class to work independently by exhibiting on-task behavior. Therefore, this study hopes to fill a gap in current literature by exploring the connection between physical activity and on-task behavior of kindergarten students during small group and independent work.

Method

Participants and Setting

Participants were 16 kindergarten students attending a public elementary school in rural northern New England. The participants were selected by convenience sampling from one kindergarten class. They ranged in age from 5-6 years old with a median age of 6 years, 1 month old. The gender of the students were 50% female and 50% male. Nineteen percent of the students had an Individualized Education Plan (IEP). All 16 participants spent 90% or more of the school day in the regular classroom. Parents of participants signed an informed consent form. The principal of the elementary school reviewed the study and signed an administrator consent form. The study was reviewed and approved by the Institutional Review Board of the local state university.

Research Design

This experimental research study used a mixed-method approach with an emphasis on quantitative data. Quantitative data was gathered to assess whether the dependent variable of kindergarten students’ on task behavior during small group and independent work time was affected when an intervention of frequent physical activity breaks was applied. The quantitative component used a time-series design, also referred to in Creswell (2015) as an A-B design. This type of single design is frequently used in school settings for behavioral analysis and utilizes a

pretest period (i.e. A; baseline phase) during which behavior is observed and measured. This period is followed by the application of an intervention (i.e. B; intervention phase) with observations and measurements of behavior continuing. In a similar study, Mahar et al. (2006) employed this design with the justification that it is often used in behavior-modification studies to show the cause and effect relationship between variables before and after intervention. Creswell (2015) notes that this design is useful to examine how A relates to B, but due to maturation, history, and testing conditions it is challenging to confirm a “probable cause” relationship between the variables.

The purpose of the baseline (pretest) phase of this study was to establish average percentages of on-task behavior during predetermined 20 minute periods. These observation periods took place three times weekly for two weeks. The daily schedule followed the established routine typical of the kindergarten school day. For qualitative purposes, the baseline phase helped establish an image of what typical on-task behavior looked like for this sample.

The intervention phase of this study was designed to see if there were any changes in average percentages of on-task behavior of the kindergarten sample if they were given physical activity (PA) breaks throughout the day. The study also wanted to compare observations of on-task behavior immediately before and after PA breaks to examine the data for differences in pre-PA and post-PA on-task behavior. To achieve these goals two different styles of intervention observation periods were designed and are labeled as observation A (continuous observation) and observation B (split observation) throughout the remainder of this study. The data collection section of this manuscript details the two observation methods.

Intervention

Physical activity(PA) breaks were the intervention applied in this study. The physical activity intervention was conducted three times daily, five days a week for three weeks. This period began as soon as the two week baseline was completed. The PA breaks took place first thing in the morning, mid-morning and mid-afternoon. The three selected PA activities were: running or walking around the gym at the start of the day, 10 minutes of participation with an interactive website designed to get kids moving (GoNoodle.com) , and a 10 minute PA break outside. Much of the research done regarding implementation of physical activity breaks at the elementary school level, analyzed the effect of 10-15 minute PA breaks (e.g. Carlson et al., 2015; Janssen et al., 2014; Mahar et al., 2006; Mahar, 2011). The amount of time spent in PA by other studies was a deciding factor for the length of the PA breaks for this study.

The physical activity intervention design was intended to increase physical activity throughout the day in increments that would start the day with PA and then intersperse a PA break, half-way through the morning and afternoon academic blocks. The three selected PA activities were: running or walking around the gym at the start of the day, 10 minutes of participation with an interactive website designed to get kids moving (GoNoodle.com) , and a 10 minute PA break outside.

The research setting school participates in the 100-mile club, a national program designed to encourage kids to get physically active through walking and/or jogging 100 miles by the end of the school year (100mileclub.com). Due to participation in the 100-mile club, the first physical activity intervention of the day began with walking and jogging around the gym. Students arrived at school between 8:35 and 8:50. When students got to school, they went right to the gym where the classroom teacher was waiting for them. Students began to walk, skip or jog around the gym as soon as they were ready and were allowed to do so until the morning bell

rang; students were allowed to take breaks as often as they wanted. When the morning bell rang, every child stopped running, recorded his or her number of laps to the teacher (a system for this was in place through 100-mile club), and went to the classroom.

The second physical activity intervention took place daily between 10:00 and 10:30 and lasted approximately 10 minutes. At this time, the kids participated with [GoNoodle.com](https://www.gonoodle.com). A variety of PA options exist on this site. Some research regarding physical activity and on-task behavior found that moderate to vigorous physical activity (MVPA) had the most positive affect on task-focused behavior (Janssen et al, 2014). Based on these findings, at least one of the daily GoNoodle activities encouraged vigorous physical activity while others were selected for variety and perceived enjoyment by the participants.

The final physical activity intervention took place between 1:45 and 2:15 and lasted approximately 10 minutes. This was a free choice outdoor PA time. Students were given balls, hula hoops, and jump ropes as options, but were not required to play with any of them. The only directions given to participants were that they should try to keep moving during this 10 minute PA time (e.g. walking and talking with friends, playing chase, trying to hula hoop, running around the playground, playing with equipment, etc.). There were a few days when weather did not permit outside play; on those days an additional [GoNoodle.com](https://www.gonoodle.com) activity was done instead.

Instruments

On-task behavior (i.e. dependent variable) data was collected using a modified Planned Activity Check (PLACHECK). PLACHECK is a recording tool that provides a momentary time-sample. This allows an observer to identify the number of children engaged in a specific behavior at a specific time (McKay, 2008). A benefit of this tool is that data is easily quantified to determine the mean percentage of students engaged in on-task behavior. To provide validity

and reliability, on-task behavior was clearly defined by the following observable criteria: A student demonstrates on-task behavior when he or she exhibits all three of the following: eyes oriented towards work or task activity, body in own spot, and using materials appropriately.

Qualitative data was collected using observational field notes. These notes included descriptions of things seen and heard during the observation as well as reflective insights.

Procedure

Data collection during baseline phase. Baseline data collection for on-task behavior occurred three times per week for a total of six data points. Data was collected through 20 minute observations using the PLACHECK tool. Four of these data points were collected between 10:30-11:15 a.m. and two were collected between 1:40-2:15 p.m.. During each 20 minute observation period, students were engaged in independent or small group literacy or math work. The observation period was captured through video recording using an iPad attached to a tripod and analyzed by the researcher later in the day.

Using the PLACHECK tool, each 20 minute observation was divided into 1 minute intervals for a total of 20 checks. During each 1 minute interval individual students were observed for 5 seconds and given either a check for on-task behavior or a dash for not on-task. A student had to exhibit all three on-task criteria (i.e. eyes oriented towards work or task activity, body in own spot, and using materials appropriately) for the entire 5 seconds to get a check. The observations were done in a clockwise, systematic pattern so that when the 1 minute interval began again, students were observed in the same order. Upon completion of the 20 minute observation, each 1 minute interval was tallied and summarized by recording the number of students on-task and the total number of students observed in that interval with a right slash separating the two numbers (e.g. 5/16).

Data collection during intervention observation A. Intervention Observation A data collection occurred three times per week for a total of five data points. Data was collected through 20 minute observations of students during independent and small-group work at literacy and math centers. The PLACHECK tool was used for on-task behavior data collection, using the same protocol as the baseline period. Three of these data points were collected between 10:15-11:15 a.m. and two between 1:50-2:15 p.m..

Data collection during intervention observation B. Intervention observation B collection occurred three times per week for a total of four observations. A split observation method was used for each data point. Using this method, the 20 minute observation periods were divided into a 10 minute observation of literacy or math centers, followed by [GoNoodle.com](https://www.gonoodle.com) physical activity break, immediately followed by another 10 minute observation period of literacy or math centers. The established protocol for systematically using the PLACHECK tool for data collection was strictly adhered to. This method of observation provided eight data points for analysis.

Data analysis. On-task behavior was quantified as the mean percentage of students on task during each 20 minute observation period for the baseline phase and intervention observation A. The mean percentage of on-task behavior for each observation of the baseline phase was compared to the mean percentage of on-task behavior for each intervention observation A phase. The mean percentage of on-task behavior for each week of the baseline phase and each week of intervention observation A phase was also used for comparison.

On-task behavior analysis for intervention observation B was done on each of the 10 minute segments to determine the mean percentage of students on-task immediately prior to PA and immediately after PA. An analysis of the Pre-PA and Post-PA mean percentages was used

for comparison. All mean percentages were determined using the data provided from observations using the PLACHECK data collection tool.

Reliability and Validity

Measures were taken to enhance the reliability and validity of this study by selecting an objective data collection tool for the independent variable of on-task behavior. The planned activity check (PLACHECK) is a momentary time sampling tool frequently used to collect data for behavior analysis. Similar studies utilized a momentary time sampling tool to measure the variable of on-task behavior (Mahar et al., 2006; Grieco, Jowers, & Bartholomew, 2009). By being precise in defining observable characteristics of the on-task behavior, ambiguity in meaning was avoided and consistency in data collection was improved. The PLACHECK tool was used consistently for baseline and intervention data collection.

Measures were taken to create similar conditions for observations. All observations were limited to independent or small group center work. Every attempt was made to observe kids on the same three days each week (i.e. Monday, Thursday, Friday), and within the same hour of day in the morning or afternoon. During the intervention phase, the predetermined interventions were administered at the same time each day, for the same amount of time and in the same order.

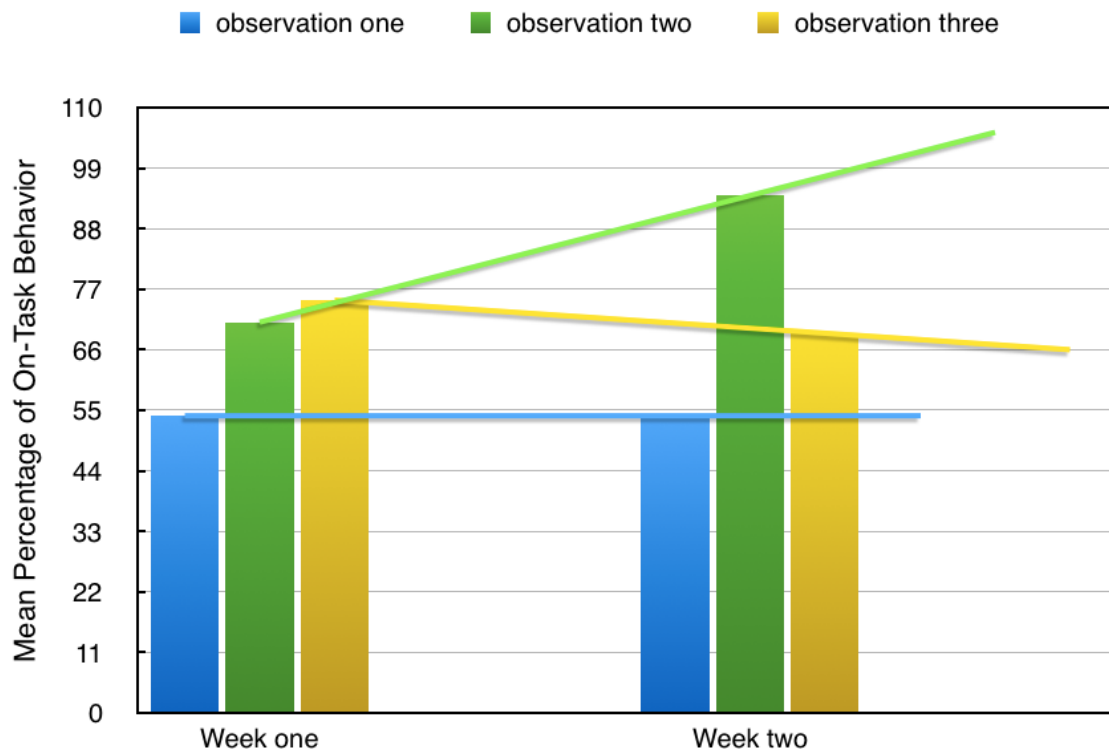
An internal threat to the validity of this study is the historical events occurring during the five weeks of the study. These included snow days, early release snow days, some special celebrations, and a week long winter vacation. These events were beyond the researcher's control, but could compromise validity of data because student behavior is often effected by the lack of consistency in schedule and the excitement of special celebrations. An external threat to the va-

lidity of this study is that the researcher is also the classroom teacher of the sample and the sample is too small to be able to generalize the findings to the general population of kindergarten students in the northeastern part of the United States.

Results

Baseline

Analyses focus on the effect of physical activity on on-task behavior in kindergarten students during small group and independent work time. Since a central point of this study is change in behavior over time, results are visually depicted in figures which reveal behavior for



each week of the study.

Two weeks of baseline observation yielded 6 measurements. Results of the baseline data collection period are seen in Figure 1 and depict the mean on-task behavior for three observation periods completed each week. An increasing trend of on-task behavior can be seen as week one progressed from 54% , 71% and 75% respectively. The three day mean for week one was 67%. Week two began with the same low percentage of students (54%) on task, followed by a dramatic rise in on-task behavior for the second observation, with 94% of students on task. The three day mean for on-task behavior of week two was 72 %. This mean was significantly impacted by the high percentage of on-task behavior during the second measurement.

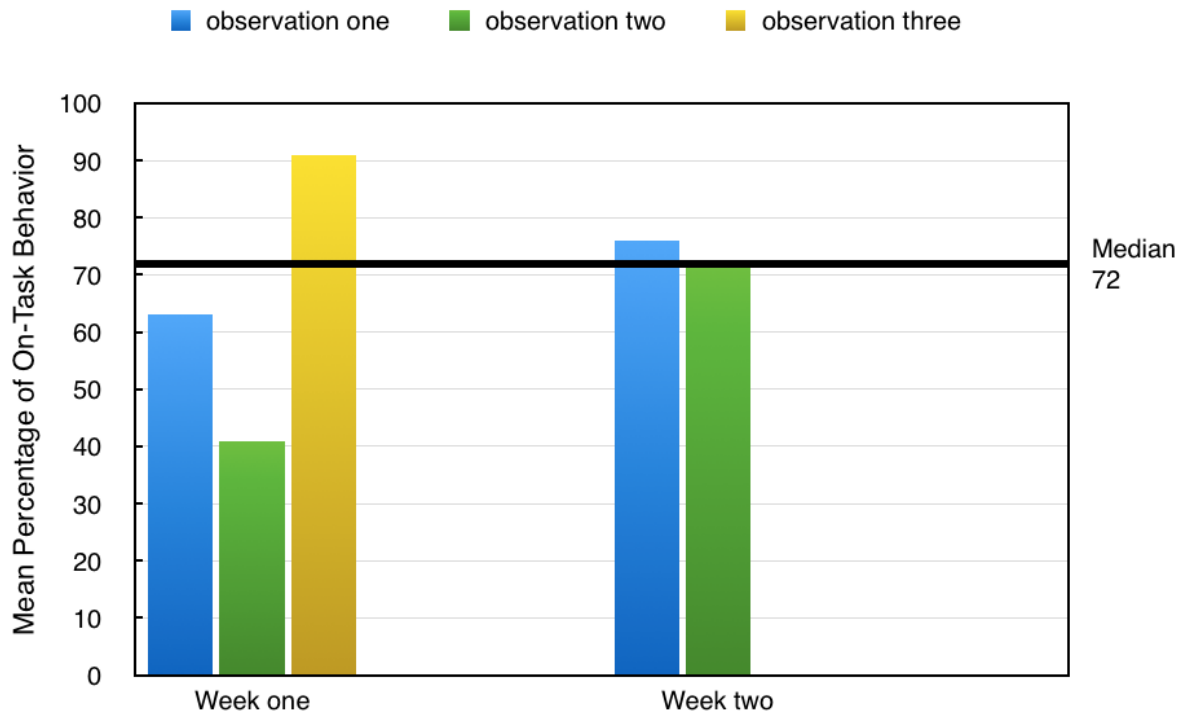
Observation A

Figure 2 presents a graph of average on-task behavior for the first five observations of the physical activity intervention period (i.e. observation A). The first week of intervention obser-

Figure 1. On-task behavior during two weeks of baseline shown as a percentage of each 20 minute observation period using a continuous observation method. Trend lines show a comparison of observation points between weeks.

vations show sharp inconsistencies in on-task behavior from one day to the next. The week started with 63% of students on-task which was an increase of 9% over observations done on the first day of the week for both baseline weeks. The three day mean for week one observation A

was 67%. This mean is identical to the three day mean of week one of the baseline period. This



comparison shows no change in on-task behavior during the initial week of PA implementation.

During the second week of intervention (see Figure 2) on-task behavior shows a more consistent pattern. Observation one of week two displays 76% of students on-task followed by 72% during observation two, indicating only a 4% variation between the two observations. The two day mean for week two was 74%.

A statistical comparison of the 6 day mean from the baseline weeks (69.5%) and the 5 day mean from observation A (68.6%) indicate that there was a marginal (.9%) decrease in

Figure 2. On-task behavior during first two weeks of intervention (observation A) shown as a percentage of each 20 minute period using a continuous observation method. Median line added to offset the extreme variation during week one.

on-task behavior during intervention observation A period when compared to the baseline period. Based on this data, physical activity has no positive affect on on-task behavior and may have a negligibly small negative affect.

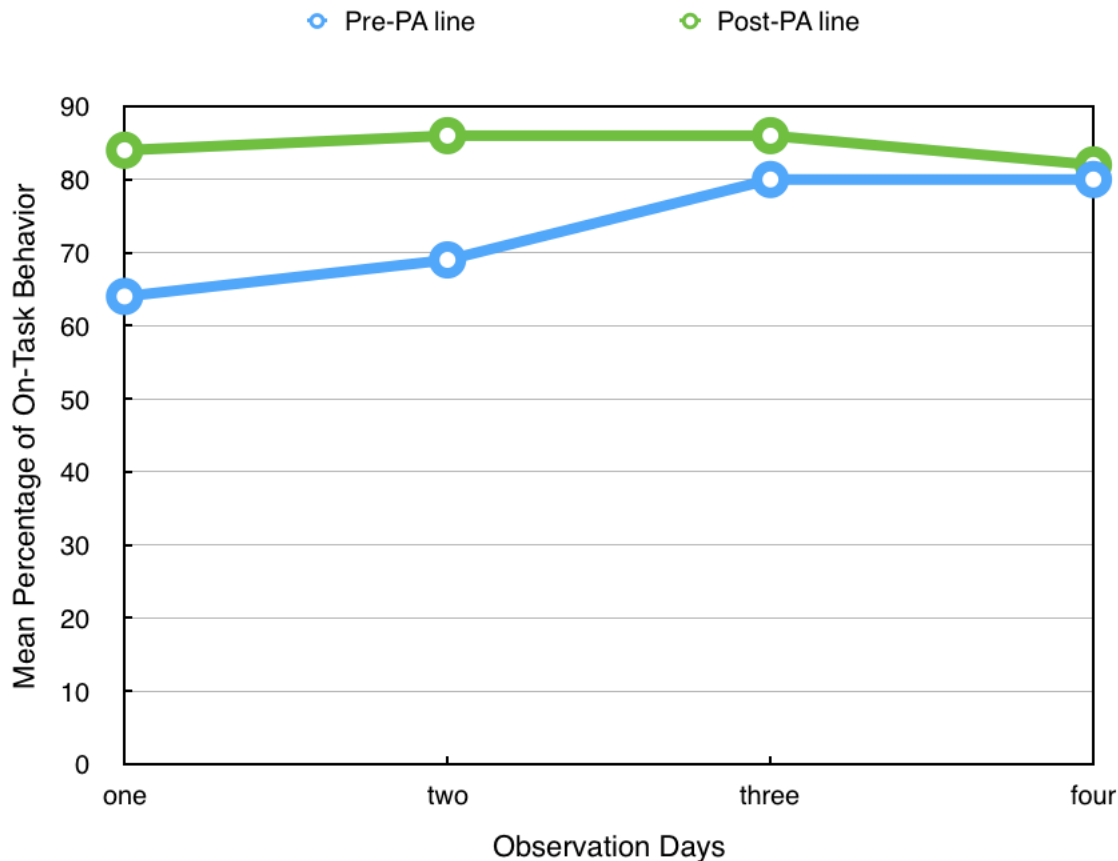
Observation B

The final four observations of the intervention period were collected using the split observation method and are referred to as observation B. Eight data measurements were taken during these four observations.

The results displayed in Figure 3 show the mean percentage of on-task behavior during observation B. For the purpose of comparison, data from each observation point is displayed as pre-physical activity(PA) and post-physical activity(PA). The pre-PA measurements were taken 10 minutes prior to physical activity. The post-PA measurements were taken for 10 minutes immediately after the physical activity.

Observation B data (see Figure 3) reveals an increase of on-task behavior immediately following physical activity. This is evidenced in all of the split observation periods. A comparison of observation 1 shows a 20% increase in mean on-task behavior from pre-PA(69%) to post-PA(84%). Observation 2 shows a 17% increase from pre to post-PA. Observation 3 indicates a 6% increase from pre to post-PA and observation 4 reveals a 2% increase from pre to post-PA.

This data confirms an improvement of on-task behavior for at least 10 minutes after physical activity.



Qualitative Data

On-task behavior for this study set observable parameters around the behavior for the purpose of consistent quantitative data collection. The results of the quantitative data collection and analysis gave a statistical snapshot of student behavior. Seeking to understand the data from a qualitative perspective, required an understanding of what on-task behavior looks like in kindergarten. A significant observation of on-task behavior in this sample can be seen from the wide variety of body positions during center work at a table with enough chairs for six students. One student stood and moved slightly from one foot to the other while working on a writing task. Two students at the same center were seen sitting in a chair with feet on the floor and no body

movement other than the flow of the hand and an occasional glance upward . Still another student, set to the same task, was observed in a precarious position with knees on the chair, toes hooked over the back and elbows on the table as the only body-part keeping him from tumbling to the ground. At a different center, one child, who is taller than classmates, was on her knees while she worked at a table. While the body positions of these children were all different, they shared a commonality in that each child was exhibiting on-task behavior as defined by the quantitative data collection tool used for this study (i.e. PLACHECK). That is to say that their eyes were focused on their work, they were using materials appropriately, and their bodies were in their own spot.

Similarly, another feature of on-task behavior can be seen in focused conversations that occurred around the work-task at hand. Many examples of students looking away from their work to ask or answer a question of a peer were observed. Such questions as: “Where does (teacher’s name) want us to put this?”, “Do you know how to spell brother?” , “I don’t get this.” and “Can you help me_____?” are examples of a few of the appropriate on-task, work-related discussions that were heard between peers during observations. Sometimes the answers to these questions required a lengthy amount of peer collaboration which took the focus off of one student’s own work (the peer helper) and put it on the other student’s work. Using Mahar et al.’s (2006) definition of on-task behavior as verbal and motor behavior pertinent to the learning situation, these students were on-task despite the fact that one of the visual observations used in PLACHECK require a student to have eyes focused on his or her own work.

In contrast to on-task behavior, off-task behavior also shared some characteristics and can add depth to the quantitative data presented here. Off-task behavior was seen when a student focused on something other than his or her work, and was often accompanied by verbal or physical

actions that disturbed the work of kids sitting next to the off-task individual. Using the PLA-CHECK data collection tool this behavior would be simply be marked by a dash to indicate not on-task, but what did this behavior look like? During one of the baseline observations five students were at a literacy center activity. One student looked up from her work and asked the boy next to her “Did you get to stay up late to watch the game?”. The boy looked up from his work, answered her with excitement, and an animated exchange between them began. Moments later, another student began to share his experiences of the game and was drawn into the conversation. One other student looked up briefly and continued his work, while the last child continued her work after making a statement “I didn’t watch it.” Although this conversation was meaningful to these three students and they stayed seated and used an appropriate voice level the whole time, they were marked as off-task for several minutes of the observation. Off-task behavior due to social conversations among the students were frequently observed.

One final example of off-task behavior seen frequently was a misuse of or excessive focus on materials. Some students were observed spending minutes looking for the shortest pencil, their favorite color scissors, the glue stick with the most glue, or the glue stick with the purple glue not the white glue. Others were observed sorting all of the crayons in their container by color before using any of them or using the crayons as straight lines to form a frame around their papers. One child quickly got her scissors but then proceeded to make multiple snips until she had a small pile of paper cuttings in front of her. Common use of dice was to roll them just hard enough to make them roll off the table so the child had to scramble down to retrieve them. These are all common examples of what off-task behavior may look like in kindergarten.

Instances of off-task behavior were observed to have a domino effect or contagion on some children seated at the same table. Whether it was an off-task conversation, a competition

for certain preferred materials, or misuse of materials, there was usually at least one child at a center who either joined in the off-task behavior or quietly watched in distraction (i.e. lost on-task focus) as the conversation or misuse continued. Off-task behavior frequently resulted in more than one child at the table being coded as off-task during quantitative data collection.

Discussion

This study explored the connection between physical activity and on-task behavior. It was specifically designed to see if adding physical activity breaks throughout the day would increase kindergarten students' on-task behavior during small group and independent work time. The findings of this study revealed a negligible (.9%) decrease in mean on-task behavior after physical activity breaks were implemented during intervention observation A. The decrease was so minute, that no effect of PA on student on-task behavior, either positive or negative, is more relevant to this discussion. This finding is consistent with a study by Wilson, Olds, Lushington, Petkov, and Dollman (2016) who found that a 10-minute activity physical activity break with elementary school boys aged 10-12 years old did not have an effect on the students' on-task behavior.

There could be many factors related to this statistical finding for the current study. This kindergarten classroom had established a predictable daily routine during the six months prior to the study. Part of the routine was established with the consideration of limiting transitions; transitions seem to take students' focus off work-related tasks and frequently require extra time for students' to redirect their focus when on-task behavior is expected. When physical activity breaks were implemented, there was a change in the routine and an increase in the number of transitions for the students. The observations done during the first week of intervention (i.e. observation A) show some extreme variations in on-task behavior which could be attributed to

these changes in schedule and transitions. As the study progressed, and the PA breaks became part of the new routine, on-task behavior began to show more consistency.

The second intervention observation period (i.e. observation B) of this study was designed to examine the effects of physical activity on students' on-task behavior immediately after the PA was implemented. The findings of this part of the study revealed an increase in mean on-task behavior immediately following the physical activity break (i.e. post-PA) when compared to pre-PA observations. These findings are consistent with a study by Mahar et al. (2006) that utilized a similar data collection design of pre-PA and post-PA observations. The Mahar et al. (2006) study found an 8% improvement in on-task behavior between the pre- and post observations. The same study found that the least on-task students during baseline observation had the largest gain in on-task behavior (20%) after a 10 minute physical activity break. There are also brain-imaging studies that support improved cognitive-control in relationship to physical activity and aerobic fitness. Using functional magnetic resonance imaging (fMRI), Chaddock et al., (2010) found more efficient neural connections in a specific area of the brain (i.e. Basal Ganglia) responsible for cognitive control and memory in higher fit children when compared to lower fit children.

Qualitative data collected through observational field notes during the current study recorded changes in student behavior immediately after PA breaks, which may be indicators of these physiological effects. Examples such as a quiet, calm line walking to the classroom after running laps in the morning or coming inside after being outdoors for a PA break, in contrast to a typically boisterous line with students needing reminders to keep hands to self or voices quiet. Calm bodies were frequently seen (and often commented on by specialists or others who worked

with the sample) immediately after a PA activity; while this (i.e. calm bodies) was not a measurement of being on-task, it did appear to be a change from baseline behavior that may be attributed to the immediate effect of physical activity breaks.

An increase in on-task behavior immediately after the PA break could be attributed to the timing of the break itself and not necessarily the physical activity aspect of it. The American Academy of Pediatrics (2013) notes that children need a break after intense periods of concentration in order to refocus cognitive attention and that some countries give primary school children a 10-15 minute break every hour in consideration of this need. A study by Janssen et al. (2014) examined the effect of different types of breaks on selective attention in 10-11 year olds. This study found that while moderate to vigorous physical activity had the most positive impact on selective attention, even a passive break had some positive effect on selective attention compared to no break at all. These findings would indicate that a break need not be physically active in nature to provide some beneficial effects.

Implementation of PA breaks in this study increased kindergarten students' daily physical activity by 30-40 minutes per day. The increase added up to an additional two and a half hours (or more) of physical activity per week. This increase could help establish patterns of PA behavior, improve physical fitness, and give students opportunity to experience physical activities they may not have been exposed to before. Not only did additional PA breaks help meet the CDC's (2008) recommendation of 60 minutes of daily physical activity for children, but the cumulative effect over the course of 175 days of the school year could contribute to improved physical fitness for students. Through step counts measured by a pedometer worn by students participating in a classroom based physical activity break, Mahar et al. (2006) projected that participants

would walk approximately 70 additional miles per year just by engaging in one classroom physical activity break daily. Congruently, the 16 students in the current study ran a cumulative total of 59 miles during the three weeks of PA intervention.

While academic achievement was not a measured variable in this study, it is important to note that the classroom teacher of the sample, reports meeting all curriculum requirements despite having 30-40 minutes less instructional time per day. This is in keeping with the findings of the CDC (2010) literature review of 50 studies examining the association between school-based physical activity and academic performance factors, including academic behaviors. Despite a wide variety of research designs, methods, and results, most studies mentioned in their discussion that giving up some instructional time for physical activity breaks did not effect learning outcomes negatively.

Contrary to some patterns in education, learning is not just about the cognitive domain. Philosopher John Dewey(1910) recognized that the physical environment plays an important role in education. The idea of teachers trying to fill kids' minds with information while ignoring the reciprocal relationship between the body and the brain is contrary to what Dewey believed. The manipulation of the daily schedule to provide an opportunity for kids to engage in physical activity as an additional (not replacement of) aspect of learning cannot be underestimated.

Qualitative data collected during field observations of the three daily physical activity breaks recorded some examples of these moments of learning. One child who lacked initial coordination in a reciprocating foot pattern to make running efficient was transformed into a runner as he was given the opportunity to learn by doing. There were no teachers or occupational therapists trying to "teach" him how to make his gate more efficient; instruction was not what was needed, time and opportunity to practice were the essential elements. Another group of children

could be seen experimenting with hula hoops. They were seen trying to wiggle them around their torsos, arms, and necks. They used them as a harness for one child to step in and be the horse while others held on to the outside as reins. They even used them as hoops to through a ball through. These opportunities to free play with hula hoops gave kids an opportunity to be physically activity, but they also provided experience with force and motion and cooperative learning. Conyers and Wilson (2015) use the term “body-brain system to convey how the interactions of thinking, feeling, and physicality can enhance the development of new knowledge and skills” (p. 39). This statement fits perfectly with John Dewey’s theory and the multi-faceted benefits of physical activity breaks.

A discussion of this study would be incomplete without mentioning observations related to the positive mood of the sample students related to physical activity breaks. This positive mood permeated the group as squeals of “Yay! PA time!” or reminders to the teacher from the students “Don’t forget PA time!” While we began to develop a new schedule, kids started to measure the rhythm of the day based on PA breaks: “After math we go outside for PA, right?” Requests for certain GoNoodle.com activities become frequent and while there were mixed levels of appeal for some of the site’s activities, there were other activities that the entire class would cheer for. It is uncertain whether this positive mood was a reaction to being given a break or the effect of the physical activity itself. However, a review by Hecht (2013) explains that neurochemicals released in the brain during exercise increase activity in parts of the brain associated with positive emotions and could contribute to a positive mood. These findings allow for the possibility that participants in the current study exhibited an increased positive mood as a result of the physical activity involved in the break.

Limitations

This study had several limitations. The sample size was small and generalizations of findings could not be made to other kindergarten populations except within kindergarten classrooms in the same building where school culture and teaching practice are similar. The study was designed and conducted by a solitary researcher who was also the sample classroom teacher. This could result in bias when collecting and sharing data. The relatively short length of time during which the study took place (i.e. five weeks) was riddled with incidence of schedule changes due to snow storms, special events, a holiday, and school vacation. These timing factors could be considered a confounding variable with an effect on students' on-task behavior (Cresswell, 2015).

Conclusions and Implications for Practice

For the greatest impact on students' on-task behavior, teachers should consider the timing of physical activity breaks when implementing them. On-task behavior improved immediately after a physical activity break. Further research is needed to explore whether there is a residual or lingering effect of PA breaks.

While time spent on physical activity breaks decreased the amount of instructional time by 30 minutes daily, all required curriculum was still taught despite this decrease. The long-term health benefits to children outweigh the relatively small amount of time used for breaks and help children meet the U.S. department of health and human services (2008) recommended 60 minutes of daily physical activity. In addition, PA breaks created informal learning opportunities that involved the whole child and all domains of learning (i.e. social, emotional, cognitive & physical). Exploration of the effect of PA breaks on social-emotional aspects of elementary students' school-life would provide valuable information to add to the body of literature related to the effects of physical activity.

In conclusion, policy makers, administrators, and educators should make themselves aware of the growing body of literature related to the effects of short physical activity breaks on school related behaviors. Given the academic rigor demanded of students at an early age, the propensity toward more sedentary lifestyles, and the responsibility schools have to model and encourage healthy habits, classroom physical activity breaks should be implemented as a way to enhance the well-being of the whole-child.

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