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On-task Behavior During a Reading Task: Effect of Quality Physical Education

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In 2013, 68% of fourth-grade students performed at or above the basic achievement level for reading and only 35% of fourth-grade students scored proficient or above in reading in the United States on the National Assessment of Educational Progress (National Center for Education Statistics, 2013). With high demands for academic success placed on schools since the No Child Left Behind Act in 2001, schools and teachers have focused on core subjects such as mathematics, reading, writing, and science, and have neglected specialist subjects such as physical education (Hillman, Erickson, & Kramer, 2008). The Society of Health and Physical Educators (SHAPE, 2015) declares that physical education is important to provide students with a well-balanced curriculum that will educate a child physically, cognitively, and affectively. Research supports that students who are emotionally and physically healthy will perform better academically, are less likely to engage in risky behaviors, and miss fewer classes (The National Association of Sports and Physical Education [NASPE], 2011). The decline in the amount of time students spend in physical education and the push for high academic success in schools has led to an increase in the need to explore the effects a quality physical education program, taught by a qualified physical education teacher, has on academic performance.

Regular physical activity has many known health and fitness benefits (Hillman et al., 2009; Maher et al., 2006) but there is also evidence that physical activity may improve a student’s academic success. Physical activity affects a student’s cognitive function (Ratey, 2008; Hillman et al., 2009), behaviors (Ma, Mare, & Gurd, 2014; Maher et al., 2006), and academic achievement (Chromitz et
al., 2009; Trudeau & Shephard, 2008); however, more research is needed to understand the complexity and full impact that physical activity can have on a student’s academic performance. Furthermore, a larger question that remains is how might physical activity that is delivered through a quality physical education program affect a student’s academic performance? The purpose of this study was to examine the effect physical activity that is administered through physical education has on on-task behavior during silent sustained reading.

The findings of the research identified within this review are narrow as a result of the types of assessments used to measure academic performance, using current fitness levels as a variable, the setting the physical activity takes place in, and the duration of the physical activity. In several studies that include information about the relationship between physical activity and academic success, the authors used classroom grades as a form of measurement of academic performance instead of standardized testing. Using classroom grades as a form of measurement raises questions about the validity and reliability of the results (Shepard, 1996; Trudeau & Shephard, 2008). In other studies, the authors used fitness levels instead of the effect physical activity has on the body, which demonstrated the importance of fitness, but not the immediate response the body has to being physically active (Chomitz et al., 2009; London & Castrechini, 2011; Wittberg, Northrup & Cottrell, 2012). Many studies discussed in the following review took place either in a classroom or during recess. When physical activity takes place in the classroom, the teacher provides students with the physical activity breaks for 5-10 minutes during lessons (Ma et al., 2014; Maher et al., 2006). Though 5-10 minute physical activity breaks provided
students with positive results, other research shows that greater impacts may be made when students are physically active for 20-30 minutes (Chang, Labban, Gapin, & Etnier, 2012; Kubesch et al., 2009). Recess is an unstructured time that allows students to have a break away from structured work. Students are not required to be physically active during recess and therefore it is difficult to measure if the reason a student may display positive results after recess is due to being physically active or simply due to the student having a break away from structured work (Jarrett, 1998; Pellegrini, 1997). Finally, many of the studies discussed in the following review revealed positive correlations too small to be considered significant (Chomitz et al., 2009; London & Castrechini, 2011; Wittberg et al., 2012).

The following study explores the effect of an acute bout of physical activity on on-task behavior during sustained silent reading that occurs immediately following a physical education class. Unlike other studies in which physical activity and academic performance were examined, existing fitness levels were not an examined variable in the study. Instead, a physical response to physical activity was measured using on-task behavior. This study was also different from other studies identified within this review, due to quality physical education being the source of the physical activity as opposed to recess or physical activity breaks that happen within the classroom.

The significance of this study is that it will increase the understanding of the effect that physical education may have on a student’s on-task behavior while reading, which may result in improved academic performance. This study does not focus on standardized test scores but looks at on-task behavior. Research has shown
that physical activity provides an individual with many physical and social benefits but more research is needed in order to fully understand the potential impact physical education may have on academic performance (Centers for Disease Control and Prevention [CDC], 2013). This study explores the positive effects a physical education class may have on on-task behavior, which could potentially impact a student’s ability to learn and perform academically. Through this study, the researcher will attempt to contribute to the growing body of evidence that supports the positive effect of physical education on academic performance.
Since the implementation of the No Child Left Behind Act of 2001, there has been a focus and drive for every student to experience academic success within schools. The focus and drive for every student to experience academic success has lead to an increase in the amount of time students spend on subjects such as mathematics, language arts, and science, and a decrease in the amount of time students spend in specialist activities such as music, art, and physical education (Hillman et al., 2009). According to the 2012 Shape of the Nation Report, only three states (i.e., New Jersey, Louisiana, and Florida) require the nationally recommended 150 or more minutes per week or 30 minutes per day of physical education. According to the 2011 Youth Risk Behavior Surveillance System (YRBSS), only 31.5% of students nationwide had physical education five days per week. Also, according to the 2011 YRBSS, only 28.7% of students are physically active for 60 minutes on all days of the week, 49.5% of students are physically active for 60 minutes on five or more days of the week, and 13.8% of students are not physically active at all. In comparison, 32.4% of students watch televisions for three or more hours on school days (Eaton et al., 2012). Due to the lack of physical activity in schools and the increasing pressure for academic success, researchers have pursued finding connections between academic success and physical activity.

Many of the studies conducted have found positive correlations between physically fit individuals and academic scores on standardized testing (Chomitz et al., 2009; London & Castrechini, 2011; Wittberg et al., 2012). This information has created many questions related to the physical responses that happen during physical activity.
activity that may result in academic success. Academic success is driven by executive functions, which are defined as the ability to self-regulate by using cognitive abilities that affect a person’s behavior, social connections, and academic performance (Gapin & Etnier, 2010; Petersen & Posner, 2012). Some mechanics of executive function are working memory, comprehension, planning, inhibition, organization, and attention. A student who has the ability to be attentive is able to self-regulate by preventing impulsive behaviors, by relating to others, and by focusing on tasks, which allows them to improve their academic achievements (Duncan et al., 2007). Several studies have shown that physical activity may have a positive effect on a student’s ability to focus on tasks (Ma et al., 2014; Maher et al., 2006; Trudeau & Shephard, 2008). With the knowledge that on-task behavior is an intricate part of academic success and that physical activity may potentially increase a student’s ability to stay on-task, the connection between physical activity and on-task behavior becomes an area of interest. Furthermore, highlighting the lack of physical activity within a child’s regular school day leads researchers to question the potential a quality physical education program can have on a student’s academic success.

The following sections explore the relationship between physical education and on-task behavior in detail by examining: differences between physical activity, exercise, and physical education, effective physical education, physical activity and academic performance, types of off-task behavior, physical activity and on-task behavior, physical education and on-task behavior, on-task behavior and measurements, on-task behavior and time, and research on silent sustained reading.
Differences between Physical Activity, Exercise, and Physical Education

According to SHAPE (2015) physical activity is defined as “any bodily movement that results in energy expenditure” (p.3). Physical activity does not have structure or an outcome focused on physical gain. Physical activity is simply an act of moving one’s body and causing energy expenditure. Walking at the grocery store, playing tag, and mowing the yard are examples of physical activity.

Information about the relationship between recess and its effect on a student’s ability to learn is available in several studies. There are positive correlations between recess and a student’s ability to learn; however, it is unknown if the positive correlations are a result of a break away from learning or if the positive correlations are due to students being physically active (Jarrett, 1998; Pellegrini, 1997). Recess is a time where students are not in a structured environment. Students are not monitored in order to ensure they are involved in vigorous physical activity; therefore students may not receive the benefits of being physically active both for health purposes and learning purposes.

SHAPE (2015) defines exercise as “any physical activity that is planned, structured, and repetitive for the purpose of improving or maintaining one or more components of fitness” (p.3). Exercise changes a person’s fitness level and affects the person’s cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. Exercise has a defined purpose and is based on a plan that will allow an individual to reach their desired goal.

Much of the research available pertaining to physical activity and academic performance focuses on fitness levels (Chomitz et al., 2009; London & Castrechini,
2011; Wittberg, et al., 2012) or movement breaks that can take place within the classroom (Ma et al., 2014; Maher et al., 2006). Both types of structured physical activity have had positive effects on academic performance but more research is needed in order to conclude the full impact of structured physical activity on academic performance.

Physical education is different from both physical activity and exercise in several ways. SHAPE (2015) defines physical education as “an academic subject that provides a planned, sequential, K-12 standards-based program of curricula and instruction designed to develop motor skill, knowledge and behaviors for healthy, active living, physical fitness, sportsmanship, self-efficacy, and emotional intelligence” (p.3). Physical education may affect an individual on a greater level than both physical activity and exercise. Physical education has a defined purpose to affect an individual physically, cognitively, and affectively resulting in an individual who has the knowledge and habits to be healthy throughout their entire life.

**Effective Physical Education**

An effective physical education program that develops an individual physically, affectively, and cognitively is composed of four different components. The four components are policy, purposeful curriculum, appropriate instruction, and assessment (SHAPE America, 2015). By incorporating all four components into a physical education program, an enjoyable, well-designed program is created that has the ability to meet the needs of all students, develop the knowledge and skills needed to become lifelong movers, and keeps students active the majority of time (CDC, 2013; SHAPE America, 2015).
Policy plays an intricate role in creating a quality physical education program. Policy ensures that students are required to participate in physical education and that students cannot supplement physical education with activities such as sports or working out at a gym. Policy regulates class sizes to ensure that students receive the necessary attention from an instructor and can move safely. Policy also ensures classes are inclusive of all students and that qualified physical education teachers are hired (SHAPE America, 2015).

Effective physical education teachers have the necessary skills to create an environment where all students experience success and are given skills to become intrinsically motivated to become involved in physical activity for a lifetime. Pedagogical and content knowledge are two important components to being able to create a purposeful curriculum that is delivered through appropriate instruction. Teachers need to know the most effective teaching strategies to teach a variety of students and ensure that maximum learning and maximum involvement are evident within their classroom. Effective physical education teachers have the necessary skills to design and deliver a quality physical education curriculum that will affect a student not only physically and affectively but also cognitively. They are able to create meaningful lessons that achieve a purpose, are developmentally appropriate, align to the national and state standards, support goals and objectives, include assessments, and require students to be physically active for at least 50% of the time (CDC, 2013; SHAPE America, 2015).

Effective physical education teachers not only recognize the importance of pedagogical and content knowledge but also recognize the importance of being
aware of the most current and relevant knowledge that surrounds the physical education profession. An effective physical education teacher understands the necessity of professional development in order to learn and develop as a teacher. Effective physical education teachers value professional development and are willing to seek feedback from others in order to strengthen their teaching skills.

According to SHAPE (2015), assessment has multiple purposes including “providing concrete evidence of whether students have achieved grade-level outcomes, allowing teachers to reflect on effectiveness of instruction and providing evidence of program success” (SHAPE America, 2015, p.7). An effective physical education teacher ensures that assessments align to instruction, the desired outcomes, and national standards. Effective teachers use a variety of assessments to make sure students are progressing towards the desired outcomes. Effective physical education teachers assess students physically, affectively, and cognitively.

Schools should recognize the depth and need for policy, purposeful curriculum, appropriate instruction, and assessment within physical education to ensure a quality program. Effective physical education teachers, are essential to making a program that is well-design and has the ability to meet the needs of all students, develop the knowledge and skills needed to become lifelong movers, and keep students active the majority of the time (SHAPE America, 2015).

**Physical Activity and Academic Performance**

Many factors contribute to academic success including cognitive functions and behaviors. Research has been conducted on both cognitive functions and behaviors to potentially discover the relationship between physical activity and
academic performance however many questions still remain unanswered. One question that remains is how does physical activity that is administered through physical education affect a student’s on-task behaviors?

A meta-analysis conducted by Chang et al. (2012) provides an overview of the current information available on the impact acute exercise has on cognitive functions. The meta-analysis includes information about different factors that affect the relationship between physical activity and cognitive functions such as different age ranges, exercise intensities, different types of exercises (strength training vs. cardiovascular), different cognitive function assessments, and the timing that cognitive assessments are given. Three critical points, discussed within the meta-analysis, are that at least 20 minutes of physical activity is needed to produce greater positive cognitive results, participants score higher on assessments that were administered 11-20 minutes after the participants were physically active, and that participants who were tested in the morning had greater results compared to those who were tested later in the day. The meta-analysis includes information that supports the need for more research due to the lack of research available on younger children. The majority of research available on exercise and its effects on cognitive functions is on young adults ages 20-30. The meta-analysis also provides information that concludes that current fitness levels of participants could possibly affect cognitive performances since those who are unfit need to work harder to complete the physical activity task and therefore are more fatigued when completing the cognitive function tasks.

In a study conducted by Hillman et al. (2009), 20 preadolescent children
walked on a treadmill for 20 minutes and then were assessed cognitively through the Modified Flanker Task and the Wide Range Achievement Test 3. The Modified Flanker Task measures inhibitory control and the Wide Range Achievement Test 3 measures reading, spelling, and arithmetic skills. The participants were split into a control group who stayed at rest prior to taking the assessments and an experimental group who were physically active before taking the assessments. Participants, in the control group and in the experimental group, were connected to an electroencephalographic (EEG) to allow the researchers to physically see the areas of the brain that were active during the assessments. The EEG demonstrated a visual display of the difference in brain activity in those who were at rest compared to those who were physically active. In the participants who were active, a significantly larger part of the brain was active which supports the notion that changes in the brain during physical activity could positively impact cognitive functions. Interestingly, the results of the test assessments in this study concluded a positive change in inhibitory control, reading, and spelling but not in arithmetic. This study and others mentioned within this review of literature, validate the complexity of researching the connections between the brain and academic performance. Many findings in this study support different hypothesis previously made about the relationship between physical activity and academic performance but many questions, such as why was arithmetic not as significantly impacted by physical activity, remain unanswered.

More research is needed to fully understand the impact that physical activity has on a student’s academic performance. Academic performance encompasses many different aspects including a variety of executive functions and behaviors. As
Maher et al. (2006) states:

The importance of physical activity for overall physical fitness and health is well known, but the positive impacts of physical activity on increasing concentration, mental cognition, and academic performance and on reducing fidgeting, other self-stimulatory behaviors, and school-related stress are not as well understood. (p. 2086)

Off-task behaviors can impact academic performance negatively. Hofer (2007) discusses the effects off-task behaviors can have in a classroom. Many teachers spend a large amount of time correcting off-task behaviors, which can be disruptive to teachers, peers, and the students who are displaying those behaviors potentially leading to students having poorer academic performance (Hofer, 2007). Due to the high demand for academic success within schools, the importance of researching how off-task behaviors can be reduced through physical activity in order to improve academic performance becomes important.

Types of Off-Task Behavior

Off-task behaviors are any actions that a student displays that are not in accordance with the teacher’s directions. When students display off-task behaviors, they are not concentrating on the given task and the behaviors hinder a student’s learning. Off-task behaviors can be disruptive to the students displaying the off-task behavior, peers, and teachers by preventing a lesson from being taught effectively.

According Hofer (2007), there are two types of off-task behaviors, active and passive. Active off-task behaviors are disruptive and may hinder the learning of other peers. Active off-task behaviors also effect the teacher’s ability to teach the
class. Examples of active off-task behavior include, making noises such as humming, fidgeting such as swinging one’s legs or arms, and getting out of one’s seat. Passive off-task behaviors may be harder to notice since students are not disturbing their surrounding. Students who are passively off-task are not cognitively engaged in the lesson being taught. Passive off-task behaviors may not hinder the learning of other students or prevent the teacher from teaching but they have a negative consequence on the students displaying the passive off-task behavior. Examples of passive off-task behaviors include daydreaming, writing a note to a friend, a student placing their head on a desk, or staring out a window.

Both active and passive off-task behaviors require the teacher’s attention and can lead to frustration for teachers and a lack of learning within a classroom (Hofer, 2007). In order to create a successful learning environment, schools should create environments were off-task behaviors are minimalized and on-task behaviors are optimized.

Physical Activity and On-Task Behavior

Several research studies include information pertaining to the relationship between physical activity and on-task behavior. Many of these studies take place either at recess or within the classroom. Two conclusions were discussed in the studies below. First, devoting time to physical activity did not adversely affect academic performance. Secondly, many students within the studies showed an increase in on-task behavior following physical activity.

Pelligrini (1997) discussed the importance of recess in schools and highlights that it does not matter the age of an individual; all individuals are able to learn more
efficiently when breaks are given during tasks. Pelligrini (1997) states, “recess may play a critical role in fostering attentional skills in children” (p.37). Recess is a period of time given to students to take a break during learning, which may lead to better attention in class. Better attention is defined by staying on-task, by focusing on the teacher or working on written work. Students who work on a task for a longer period of time are expected to display more off-task behaviors. The research presented by Pelligrini (1997) is important because it cultivates the question of what type of breaks are needed to help a student be most attentive when returning to academic work?

Jarrett et al. (1998) studied the effects of recess on classroom behavior. In the study, 43 students in fourth grade were observed for off-task behaviors prior to and following recess. In the above study, students displayed less off-task behavior when they had breaks during instructional time. Unfortunately, the study does not look at the type of activities the students engaged in; therefore, physical activity is not connected with the increase of on-task behaviors that were displayed after a recess break.

Maher et al. (2006) researched the effect 10-minute exercise breaks called Energizers would have on a student’s off-task behaviors. Sixty-two, third and fourth grade students participated in this study. Off-task behaviors were defined as any behavior that was not on-task and includes both active and passive off-task behaviors. In the study, students on-task behaviors increased by 8% after an Energizer break and students who tended to be the most off-task during instructional time, were the students who showed the greatest on-task improvements after an
Energizer break.

In a study conducted by Ma et al. (2014), fifty students in second and fourth grade were given 4-minute physical activity breaks called FUNtervals during classroom lessons. The results of the study showed that students who participated in FUNtervals showed less off-task behaviors. Students who tended to have the worse off-task behaviors were the student’s who showed the greatest improvement in the reduction of off-task behaviors after movement breaks. Previous studies have observed that students with the highest off-task behavior benefited the most from physical activity interventions (Ma et al., 2014; Maher et al., 2006).

Physical Education and On-Task Behavior

Few studies are available with information related to the relationship between physical education and on-task behaviors. The few studies that are discussed in this article show a positive relationship between physical education and on-task behavior. The hypothesis that taking time away from academic learning to provide students with daily physical education can increase on-task behavior resulting in improved academic performance is also supported in the articles below.

Dwyer and Blizzard (1996) analyzed a study, conducted in 1978 by Dwyer, Coonan, Leitch, Hetzel, and Baghurst, that explored physical activity and on-task behaviors as well as academic performance and overall health. Five hundred and nineteen fifth grade students were separated into three different groups. One group was the control group, which maintained attending the traditional three half-hour physical education classes. The second group focused on the skill development learned in the traditional physical education classes but the duration and frequency
were increased to 75-minute classes that took place daily. The third group also met for 75 minutes on a daily basis but focused on fitness with the goal of raising heart rates. Students in this study were evaluated physically with height and weight measures, skinfold measure, and endurance fitness measurements. Their academic performance was rated with the ACER test, which measures arithmetic knowledge and the GAP assessment, which measures reading knowledge. Finally these students were measured on classroom behavior using the KAB Child Behavior Scale, which was filled out by teachers. The results showed that the overall health or physical changes that happened during the study were greater than the academic and behavioral changes. The fitness group showed the greatest improvement physically followed by the skill group that had physical education on a daily basis. The results of the study also showed that there was not a decrease in academic performance due to an increase in physical education and a reduction in class time in any of the groups. There was a possible relationship between daily physical education and arithmetic and reading but further research is needed to determine if this relationship is statistically relevant. Finally, this study showed that teachers felt their students displayed improved classroom attention after participating in daily physical education. It was suggested that the improvement in arithmetic and reading could be a result of improved classroom attention that was displayed by students after attending physical education on a daily basis.

In an article by Shephard (1996), a study called the Trois Rivieres experiment conducted by Shephard Lavallee, Volle, LaBarre, and Beaucage (1994) that included 546 in first through sixth grade was discussed. The results of this study
concluded that daily physical education did not worsen academic performance. This study not only supported that daily physical education does not worsen academic performance by taking away time from classroom learning but it also supported the notion that physical education may enhance academic performance. In this study, to many other factors effected the outcome, including teacher and student factors, to conclude that the academic gains were solely due to daily physical education. This is in part because classroom grades were the form of assessment instead of standardized testing.

Medcalf, Marshall, and Rhoden (2006) conducted a study involving four students with emotional behavioral difficulties. In this study, the four students were observed both prior to participating in physical education and after participating in physical education to see if any changes in their on-task behaviors were evident. Students had to remain on-task or focused on the assigned task for 30-second intervals. The results of this study showed an increase in the amount of time students spent on-task after physical education. The amount of time student’s showed an improvement in on-task behaviors varied between participants.

The above findings provide positive results between the relationship of students participating in physical education and on-task behaviors. None of the above studies show negative associations with physical education and instead demonstrate that taking time away from academic learning and spending more time in physical education can possibly improve academic performance by increasing the amount of time students are on-task in their academic classroom. Many of the above
studies require more evidence to understand the full impact physical education has on academic performance and more specifically on-task behavior.

**On-Task Behavior and Measurements**

According to Maher et al. (2006), the most meaningful measuring tool, a researcher can use to study on-task behavior, is observation. Observations need to have clear definitions to ensure reliability and validity (Ma et al. 2014). Partial Interval Recording is a measuring tool used to measure behaviors that can be hard to measure due to high rates of occurrence and do not have predictable beginnings and endings. Many of the above research studies used the Partial Interval Recording procedure to record on-task and off-task behaviors.

The first step to using the Partial Interval Recording procedure is to define the behaviors that are being monitored. Decide the length of time that the subject will be observed and then divide that time evenly into intervals. The above studies range from 5-second intervals to 30-second intervals. Any time the defined behavior was observed during an interval, a mark was made during that interval. It does not matter the length of the behavior or if the behavior does not occur throughout the entire interval.

**On-Task Behavior and Time**

Several studies have looked at the amount of time an individual needs to participate in physical activity in order to experience a positive gain in being attentive (Chang et al., 2012). In a study by Kubesch et al. (2009), a comparison was made between the impact of a 30-minute physical education program versus 5-minute physical activity breaks on attention. This research supports that a 30-minute
physical education program had a greater impact on a student’s ability to focus on a task when distractions were present. Kubesch et al. (2009) suggested that a cause for this finding is that with longer exposure to physical activity, there is an increase in serotonin in the brain and an increase in dopamine in the prefrontal cortex which both play a role in attention.

In a meta-analysis study, Chang et al. (2012) provides an overview of the current information available on acute exercise and its effects on cognitive functions. In the meta-analysis, different factors that affect the relationship between physical activity and cognitive functions such as different age ranges, exercise intensities, different types of exercises (strength training vs. cardiovascular), different cognitive function assessments, and the timing that cognitive assessments are given, were researched. Three critical points this article discusses are that at least 20 minutes of physical activity is needed to see greater positive cognitive results, participants score higher on assessments that were administered 11-20 minutes after the participants were physically active, and that participants who were tested in the morning had greater results compared to those who were tested later in the day.

**Pedometer**

Pedometers are an economical way to measure a student’s activity level both within a physical education setting and outside of the physical education setting. Pedometers count the number of steps an individual takes. In a physical education setting, pedometers allow teachers to assess which students are the most and least active, help students set personal fitness goals, help students to understand physical activity levels and patterns, help students be able to complete self-assessments, and
promote the value of physical activity (Morgan, Pangrazi, & Beighle, 2003).

According to Morgan, Pangrazi, and Beighle (2003), the average step for elementary students participating in a 30-minute physical education class is 1,600 for boys and 1,300 for girls.

**Research on Silent Sustained Reading**

Reading is an important component to the success of a child in school and later in life. According to Cunningham and Stanovich (2001), there are many positive cognitive abilities that develop from reading including vocabulary development, higher levels of decoding skills, spelling ability, verbal fluency, general knowledge, and reading comprehension. One program that teachers may use in their classroom is Silent Sustained Reading (SSR). SSR is a period of time given to students, that allows them to read silently and uninterrupted. SSR is intended to promote interest in reading by allowing students the opportunity to pick what they read out of a wide selection of reading materials. Siah and Kwok (2010) discussed research conducted to examine the relationship between SSR, attitudes towards reading leisure books, and student’s perception of the value of reading. The results of this study, support the notions that during SSR student’s were self-motivated to read and that student’s valued or showed positive feelings toward SSR. Chua (2008) asked over 200 first year secondary students about SSR’s effects on their reading habits. In the study, 88.74% of students engaged in reading during SSR time that was provided and many felt that reading was pleasurable and enjoyable. In this study, the amount of students who read at least one hour outside of school was also measured and SSR did not have an impact on those results.
Summary

With the pressure for students to perform successfully academically, the ability to stay on-task while reading is important. Reading helps students build skills such as comprehension, decoding, and vocabulary which will help them not only succeed in the academic world but will also help them in many different aspects of their life. Research has shown physical activity has a positive impact on a student’s cognitive function (Ratey, 2008; Hillman et al., 2009), behaviors (Ma et al., 2014; Maher et al., 2006), and academic achievement (Chromitz et al., 2009; Trudeau & Shephard, 2008) but the full extent of the impact of physical activity on academic performance is still not understood. Many of the behavior studies mentioned above, focus on classroom teachers giving students a physical activity break within lessons. These breaks tend to last only 5-10 minutes and research supports that 20-30 minutes or more of physical activity has the greatest benefit to students (Chang et al., 2012; Kubesch et al., 2009). This highlights the importance of not only giving students the opportunity to experience physical activity breaks within their classroom but to also be involved in a quality physical education program that requires students to be physically active for the majority of the time.

Many questions remain when discussing the connection between on-task behavior and physical activity such as how are younger populations affected, is it better to look at one bout of exercise or overall fitness levels to determine the impact of physical activity, will providing students with more time in physical education help students be more attentive and result in better academic performance? The focus of this study was to examine the effect of an acute bout of physical activity has
on on-task behavior during SSR that occurs immediately following a physical education class that was taught by a qualified physical education teacher. It is hypothesized that an acute bout of physical activity, administered through physical education, would increase on-task behaviors during silent sustained reading.
Method

Participants

The participants in this study were \((n=14)\) fourth grade students at a public school in Massachusetts. Due to accessibility, the students participating in this research study were from two different classes within the same school. The 14 students participating in this study were randomly selected from the individuals who return a signed consent form that included permission to participate in the study (Appendix A). The classes selected for this study participated in daily SSR, had physical education at least once per week, and consisted of students who were not on individualized education plans. In this study, 7 students were selected from each of the 2 classes (boys, \(n=7\), girls, \(n=7\)). Due to the amount of observational time required for each individual student, the sample was limited to 14 students.

Intervention

Physical activity. In this study, the independent variable was physical activity administered through a physical education class and the dependent variable was on-task behavior. Students experienced a 45-minute physical education class with the last 20 minutes of the class focusing on high-intensity activities. High-intensity activities required students to put forth effort and resulted in heavy breathing, sweating, and an increased heart rate. The activities provided to the students within this study included locomotor skills such running, galloping, and skipping in combination with calisthenics such as jumping jacks, planks, sit-ups, and line jumps. Within 10 minutes of finishing a physical education class, students returned to their classroom and began their SSR activity, which lasted for 15 minutes.
Physical education teacher training. In this study, the teacher that provided the physical activities was a qualified physical education teacher as described above and was able to create meaningful lessons that achieved a purpose, was developmentally appropriate, and required students to be physically active the majority of the time. The educational knowledge acquired by a qualified physical education teacher allows the teacher to recognize the physical changes that happen to a student during high intensity activities. The physical education teacher had a schedule that included the dates and times that students participating in the study needed to be engaged in high intensity activities.

Measurement

On-task behavior. When collecting data, observers used a check sheet (Appendix B) previously developed by Mahar et al. (2006) and coded on-task and off-task behaviors. On-task behaviors were defined as any behaviors, both verbal and motor, that adhered to the class rules and were appropriate within the learning situation. An example of on-task behaviors during SSR included sitting at a desk or designated location within the classroom while reading.

Off-task behaviors. Off-task behaviors were coded into one of three categories including motor, noise, and passive/other. “Motor off-task behavior was defined as any gross motor response that broke the rules and/or interrupted the learning situation” such as leaving one’s seat, walking around the room, waving, or displaying any acts of aggression such as throwing an object (Mahar et al., 2006). Noise off-task behavior included producing any noise. This noise can be made both verbally or with an object. Examples of noise off-task included but were not limited
to talking, humming, laughing, and tapping a pencil. Passive or other off-task behaviors were defined as a student not being actively engaged in the directed task but not being disruptive to others. Examples of passive or other off-task behaviors included but were not limited to daydreaming, staring out the window, chewing on a pencil, or thumb sucking. If a student was on-task but displaying a behavior such as chewing on a pencil, then this behavior was recorded as on-task.

**Pedometers.** During each physical education intervention, all students within the study wore pedometers to measure the amount of steps they took during the physical education intervention. Students began wearing the pedometers one week prior to collecting data to ensure the students knew how to wear the pedometers and to allow them to become familiar with the measuring instrument. Students wore the pedometers from the start to the end of the 45 minutes physical education class. At the end of the 45-minute physical education class, students reported the number of steps taken before clearing the pedometers and returning them. The goal was for boys to average 2,400 steps per class and for girls to average 1,950 steps per class.

**Observer Training.** Before the study began, all observers attended two training sessions to learn how to code both on-task and off-task behaviors. Observers received detailed definitions of both on-task and off-task behaviors. During the training sessions observers watched a video of a classroom and practice coding both on-task and off-task behaviors. The coding from the training sessions was used to ensure interobserver reliability. The number of agreements of both on-task and off-task behaviors were divided by the total number of possible observations. This number was divided by 100 to acquire a percentage of agreement between observers.
Before data was collected for the study, observers reached at least an 80% agreement on coding (Mahar et al. 2006). The alpha for interrater reliability during this study was ($a = .84$).

**Procedures**

Permission to conduct the study was requested and granted from the selected school district (Appendix C) and from the institutional review board of Bridgewater State University (Appendix D). Data collection lasted for 4 consecutive weeks beginning in March and ending in the beginning of April. Students were observed for 15 minutes two days a week for four consecutive weeks resulting in a total of eight observations. Four observations were the experimental observations, which took place during a period of sustained silent reading immediately after an acute bout of physical activity that was administered through a physical education class. Four observations were the control observations, which took place on a day the students did not participate in physical education immediately before the observation takes place.

During the intervention period, students’ on-task behavior were assessed for 15 minutes during SSR on both a day with a physical education intervention and a day without a physical education intervention each week. Students in the two fourth-grade classrooms were observed from 10:05 a.m. to 10:20 a.m. Three Apple iPads™ were used to record behaviors in each classroom. Students were asked to sit in the same locations each day and the Apple iPad™ were set up to record two or three different students at one time. The Apple iPad™ were used to record the behaviors of the participants during sustained silent reading. The application that was used on
the Apple iPad™ for recording students will be the basic camera application. Apple iPads™ will be set-up in the classroom a month before recording takes place in order to allow students to become comfortable with the Apple iPad™ in the academic classroom.

In an effort to improve inter-observer reliability, both primary and secondary observers were used within this study. Two primary observers and two secondary observers were trained to assess on-task and off-task behaviors. One primary observer was assigned to each classroom. Secondary observers observed approximately 50% of a class resulting in approximately four observations. Both primary and secondary observers practiced assessing on-task and off-task behaviors one week prior to data collection to allow observers to become familiar with the process and setting.

During the 15-minute observation period, observers assessed on-task and off-task behaviors of all 14 students. Each primary observer assessed seven students. Observers listened to a prerecorded CD that indicated when to observe the video and when to record on-task or off-task behaviors. Following the same protocol as used by Mahar et al. (2006), observers watched the video for 10-second intervals and then had 5 seconds to record the observed behavior. Observers recorded the observed behaviors by circling the corresponding code on the observation sheet. When the secondary observers were recording, they started the video at the exact time as the primary observers and listened to the same prerecorded CD.

After all observations were completed and coded, the number of times students displayed on-task behaviors while reading directly after a physical
education class were compared to the number of times spent displaying on-task behaviors without a physical education class to determine if there was a change when students participated in physical education.
Results

Statistical Analysis

A repeated-measures t-test was conducted to evaluate the impact of a physical activity intervention on percentage of students’ on-task behaviors during SSR. There was no significant difference between students’ percentage of on-task behaviors when SSR followed a physical activity intervention ($M = 95.20$, $SD = 3.15$) and when SSR did not follow a physical activity intervention ($M = 93.64$, $SD = 4.44$), $t(13) = -1.67, p > .05$. The mean difference in percentage of on-task behavior was 1.48 with a 95% confidence interval ranging from -3.40 to .43. The eta squared statistic (.18) indicated a medium effect size.

On-task Behavior

In this study, on-task behaviors were not significantly affected by the physical activity intervention that was administered through physical education. Only a medium size effect occurred. There was not a significance difference between the amount of times a student was on-task during the fifteen minutes of silent sustained reading on days where students participated in the 45 minute physical activity intervention $M = 95.20\%$ compared to $M = 93.64\%$ days they did not participate in the physical activity intervention.

Pedometer Results

During the physical activity intervention, students did reach the desired amount of steps. The average number of steps for all students was 2,804 during the physical activity intervention. The average steps demonstrate that students were physically active and engaged during the intervention. There were two students, one female and one male, who did not reach the desired amount of steps.
Discussion

Regular physical activity has many known health and fitness benefits (Hillman et al., 2009; Maher et al., 2006) but there is also evidence that physical activity may improve a student’s academic performance. Physical activity has been shown to affect a student’s cognitive function (Hillman et al., 2009; Ratey, 2008), behaviors (Ma, Mare, & Gurd, 2014; Maher et al., 2006), and academic achievement (Chromitz et al., 2009; Trudeau & Shephard, 2008); however, more research is needed in order to fully understand the impact physical activity may have on academic performance (Centers for Disease Control and Prevention [CDC], 2013).

Despite the benefits of being physically active, many students do not receive the required amount of physical activity during the school day (Hillman et al., 2009; National Association for Sport and Physical Education & American Heart Association, 2012). Physical education is one way to provide students with physical activity and therefore many questions remain about how physical education can impact a student’s academic performance.

The present study was designed to contribute to the growing body of information that supports the importance of physical activity through a quality physical education program in order to improve academic performance. On-task behavior has many implications for academic performance (Hofer, 2007). Students, who are able to stay on-task for longer periods of time, do not distract themselves, their peers, or the teacher from the learning process. The purpose of this study was to examine the effect of physical activity that is administered through physical education on on-task behavior during SSR. The hypothesized outcome was for
physical activity that is administered through physical education to have a positive impact on the amount of time a student stays on-task during silent sustained reading. Like many of the studies discussed throughout this paper, the positive correlations were too small to be considered significant (Chomitz et al., 2009; London & Castrechini, 2011; Wittberg et al., 2012).

In the present study, physical activity did not have a statistically significant effect on on-task behavior, however, several other studies that used a larger sample size have shown that physical activity has positive effects on on-task behaviors. In a study conducted by Maher et al. (2006), 243 students were included in the study that lasted for 12 weeks. In this study, Energizers, a classroom-based physical activity program, was effective in improving on-task behaviors. In a study conducted by Ma, Mare, and Gurd (2014), 44 students were included in the study that lasted for three weeks. In this study, FUNterval, a classroom-based physical activity program, was effective in improving on-task behaviors. In a study conducted by Grieco, Jowers, and Bartholomew (2009), 97 students were included in the study that lasted 80% of a school year. In this study, the Texas-I-CAN program was used which contains lessons with a physical activity component incorporated. On-task behaviors were increased with the Texas-I-CAN program. All three of these studies support that physical activity can help students stay on-task however, in all three studies the physical activity intervention took place in the academic classroom. This still leaves many questions unanswered about the relationship between physical activity that is administered through physical education and its impact on on-task behavior.
The purpose of physical education is to intrinsically motivate students to become informed and involved in physical activity for a lifetime in order for students to be healthy individuals. Physical education affects students physically, cognitively, and affectively but due to the limited time students participate in physical education, many questions remain about how physical education can impact academic performance. The results of this study did not produce statistical significance but there are still implications that physical education could improve on-task behaviors.

On-task behavior is just one aspect of the connection between physical education and academic performance. Many factors contribute to academic performance including cognitive functions and behaviors. Hillman, Erickson, & Kramer (2008) demonstrated that the brain becomes more active after exercise. Ratey (2008) discussed how physical activity builds new brain cells and how the physical education program at Naperville Central High School in Illinois has used this information to increase their students’ academic performance. Researchers have only begun to explore the different aspects of the connection between physical activity, especially when administered through physical education, and academic performance. Many questions still remain, such as: How can physical education improve math or reading scores; When a brain becomes more active during physical activity what skills does a student have better access to; and How can physical education affect a student’s behavior such as on-task behaviors?

**Limitations and Recommendations**
Several limitations identified in this study were the result of the resources available and the setting in which the study took place in. The eta-squared statistic of this study suggests that a follow-up study with a larger sample size is recommended. In order to have more statistically sound results changes should be made to this study.

Pedometers were used in this study since heart rate monitors were not available. The pedometers offer students a goal based on an average of steps but different factors such as weight, stress, and health issues can affect the amount of steps that are appropriate for that student to acquire. Heart rate monitors would allow each student to adjust their workout to maintain their individual target heart rate zone. This would eliminate any issues students may have with trying to reach an average number of steps that may not be realistic for that individual and take into consideration any health issues students may have.

Due to the structure of the academic classroom, this study took place in the morning. Students who have been sitting and working for a longer period of time may tend to be off-task more often (Jarrett 1998; Maher 2011). If the study had taken place later in the school day, after the students had been required to sit and work for a longer period of time, there may have been a greater change in the amount of time students spent on-task after the physical education intervention.

Due to the limited number of observers used within this study and the amount of time required to code each student, students were observed by an inter-rater only 50% of the time. For future studies, all students should be watched by a second observer to insure that all scores are as fair as possible (Maher, 2011). In this
study, observers were volunteers and in future studies observers should be compensated.

Only 14 subjects participated in this study due to the time restraints. As the results indicated, this was too small of a sample size to determine if student’s on-task behaviors were affected by the physical education intervention. The eta-squared statistic indicates that a follow-up study with a larger sample is warranted. A larger sample size may allow for a more diverse sample that will better help expand the understanding of the impact that a quality physical education program has on academic performance through improving on-task behaviors.

Conclusion

The findings of the current study were that physical education, in grade four, do not effect on-task behaviors during silent sustained reading. These findings of non-significance were likely due to a relatively small sample size and a follow-up study should be conducted with a larger sample size.
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Society of Health and Physical Education.


ON-TASK BEHAVIOR AND QUALITY PHYSICAL EDUCATION

102(12), 2303-2307. doi:10.2105/AJPH.2011.300515
Appendix A

Bridgewater State University Parental Consent Form

**Title of Research:** The Effect of Quality Physical Education on On-Task Behavior During a Reading Task

**Researchers:** Courtney McElroy-Yeider and Jennifer Mead

You are being asked permission for your child to participate in research. For you to be able to make an informed decision about whether you want your child to participate in this project, you should understand what the project is about, as well as the possible risks and benefits. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your child’s personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your child’s participation in this study. You should receive a copy of this document to take with you.

**Explanation of Study:**
This study is being done to look at how physical education can affect a student’s ability to stay on-task during reading. If you agree to allow your child to participate, your child will be asked to participate in their normal physical education class and normal library class. After participating in their normal physical education class and normal library class, your child will be asked to read for 15 minutes. During the 15 minutes of reading, your child will be video recorded with an IPAD. The video recording will then be used to collect data on if your child was on-task or off-task while reading.

Your child’s participation in the study will last till March 31, 2016. You child will be video recorded for 15 minutes two times a week for 4 weeks.

**Risks and Discomforts**
No risks or discomforts are anticipated.

**Benefits**
This study is important to science because it will help support the growing evidence surrounding the importance of physical education. Individually, your child may benefit if physical education helps them stay on-task while reading.

**Confidentiality and Records**
Your child’s study information will be kept confidential by not labeling any information with your child’s name. The video recordings will be destroyed once all data is collected.

Additionally, while every effort will be made to keep your child’s study-related
information confidential, there may be circumstances where this information must be shared with:
* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
* Representatives of Bridgewater State University, including the Institutional Review Board, a committee that oversees the research at BSU.

**Contact Information**
If you have any questions regarding this study, please contact:

Courtney McElroy-Yeider  
Email: mcelroy-yeiderc@chelmsford.k12.ma.us  
Phone Number: 978-251-5144

Jennifer Mead  
Email: Jennifer.Mead@bridgew.edu  
Phone Number: 508-531-1493

If you have any questions regarding your child’s rights as a research participant, please contact The Institutional Review Board, Bridgewater State University, (508) 531-1242.

By signing below, you are agreeing that:
- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
- you have been informed of potential risks to your child and they have been explained to your satisfaction.
- you understand Bridgewater State University has no funds set aside for any injuries your child might receive as a result of participating in this study
- you are 18 years of age or older
- your child’s participation in this research is completely voluntary
- your child may leave the study at any time. If your child decides to stop participating in the study, there will be no penalty to your child and he/she will not lose any benefits to which he/she is otherwise entitled.

Parent Signature: ___________________________________________ Date: ____________________

Printed Name: ____________________________________________

Child’s Name: ____________________________________________

Bridgewater State University Child/Minor Assent
I understand that my parent or guardian has given permission (said it is okay) for me to take part in this study about ________________________________ under the direction of Mrs. McElory-Yeider (Mrs. M.). I am taking part because I want to. I have been told that I can stop at any time I want to and nothing will happen to me if I want to stop.
Appendix B

Rater Score Sheet

<table>
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<th>TIME</th>
<th>ACTIVITY CODE</th>
<th>STUDENT ID:</th>
<th>RELIABILITY OBSERVER</th>
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General Activity: 
No. in Class or Group: 
Date: 
Grade or Subject: 
Time: Start _End_ |
Page of: 
Record Interval: 5 sec |
Observation Interval: 10 sec |
Observer: 
Teacher: 
Appendix B

CODE: O = Observed; N = Not Observed; M = Mixed
Appendix C

Letter of Cooperation

Byam Elementary School

Jason N. Fredette
Principal

25 Maple Road
Chelmsford, MA 01824
Tel: (978) 251-5144
Fax: (978) 251-5150

Letter of Cooperation

January 25, 2016

Office of Grants and Sponsored Projects
Bridgewater State University
Maxwell Library Room 200
Bridgewater, MA 02324

To Whom It May Concern:

Courtney McElroy-Yeider has requested permission to collect research data from fourth grade students at Byam Elementary through a project entitled The Effect of Physical Education on On-Task Behavior During a Reading Task. I have been informed of the purposes of the study and the nature of the research procedures. I have also been given an opportunity to ask questions of the researcher.

As a representative of Byam Elementary, I am authorized to grant permission to have the researcher recruit research participants from our school. Courtney McElroy-Yeider is also permitted to collect research data during school hours.

If you have any questions, please contact me at 978-251-5144.

Sincerely,

Jason N. Fredette
Principal
Byam Elementary School
Appendix D

Institutional Review Board Letter of Approval

February 10, 2016

Dr. Jennifer Mead
MAHPLS
102D Burrill Office Complex

Re: IRB Application – Case #2016105

Dear Dr. Mead:

This letter is to inform you that the Institutional Review Board (IRB) has approved (expedited) the research project titled, The Effect of Quality Physical Education on On-task Behavior During a Reading Task.

The approval for your study is active for a period of one (1) year from the date of this letter. You are expected to adhere to the procedures as outlined in your proposal. Any changes in procedures, protocol, or the consent form will require the approval of the Institutional Review Board. You are also expected to notify the IRB immediately in the event of injury to or any problem with the subject participating in the study.

As the principal investigator, you have primary responsibility for protecting the rights and welfare of human research subjects and for complying with the provisions of the Institutional Review Board.

Best wishes on the completion of your research project. Please contact me if you have any questions.

Sincerely,

[Signature]

Dr. Elizabeth Spievak
Chair, Institutional Review Board

ES/dfd