Effects of Antecedent Physical Activity on Engagement

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Abstract

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Research shows that longer periods of moderate-intensity exercises increase student engagement in the classroom. There is little research examining the effects of a 1-minute period of high-intensity exercise embedded into structured times in the classroom. This study examined the effect of high-intensity exercise on student engagement during a small group literacy activity in a kindergarten classroom. The study implemented an A-B-A-B design across three participants. During intervention conditions, one-minute of high-intensity exercise was implemented before the literacy activity. Whole-interval recording was used to measure student engagement during the subsequent five minutes of literacy activity. High-intensity exercise was associated with elevated levels of engagement for each of the three participants.

Introduction

As academic demands in the classroom increase, teachers are reporting higher rates of off-task behavior in the classroom (Tucker, 2007). These increased rates of off-task behavior may be related to children's need for movement. As the academic expectations on children have increased and times for physical activity (i.e., physical education, recess) have decreased (Slater et al., 2012), some children may find it difficult to focus and attend to instruction for long periods of time. The problem may be especially acute for children with special learning needs, such as autism or ADHD. Engaging in large group instruction throughout the day can be very challenging, resulting in increased off-task rates (Goodman, 2007).

Young children may also be negatively affected by the transition to longer, more structured school days. The number of kindergarteners in full-day programs has nearly tripled since the 1970s (Wirt et al., 2004), and there is evidence that kindergarten classrooms have become more structured and less play-based in the past decade (Bassock et al., 2016). For kindergarteners, the academic structure of the school day may vary from their home, play-based preschool or childcare environments. Following the rules and expectations of the classroom can be difficult for young students, especially in structured class times that allow few opportunities for movement and physical activity. Increasing the amount of physical activity in the school day may be a useful approach for supporting children's behavior and learning.

Providing opportunities for movement embedded into the day as an antecedent strategy may work as a mechanism to prevent challenging behavior before it occurs. Antecedent strategies are those that change the environment in a way that increases children's appropriate behaviors (Cooper, 2007). Physical activity could be considered an antecedent strategy if it prevents children from engaging in off-task or challenging behaviors in the classroom. The

Center for Disease Control and Prevention recommends one hour of age appropriate exercise per day for young children (CDC, 2015). However, research suggests that 50% of children engage in less than the recommended amount of physical activity per day (Tucker, 2008). One way to make this one-hour period more attainable for students is to break the exercise into shorter movement bursts that would accumulate to one hour throughout the day. This is a notable amount of exercise, which many children are not given the opportunity to complete, because of busy schedules, increased academic rigors and cultural factors. In addition to potentially increasing appropriate classroom behavior, the benefits of high activity levels can be life saving. Increased exercise for children prevents medical complications, such as obesity, type 2 diabetes, and heart complications (AHA, 2015).

Much research has been conducted on the positive effects of incorporating physical activity into the daily routine of the school day to increase appropriate behaviors in the classroom. Lang reviewed 18 research studies that examined children engaging in independent exercise away from their peer group or embedded into classroom activities. The effect of exercises, such as jogging, walking, swimming, biking, roller-skating, and snow-shoeing were a focus. Lang's review found that increased physical activity in young people on the autism spectrum decreased maladaptive behavior and increased adaptive behavior (Lang et al., 2010).

Unfortunately, children with disabilities are known to engage in less exercise than their typically developing peers (CDC, 1999). Children with disabilities are at higher risk of developing harmful conditions, due to their lower rates of physical movement. For students with disabilities, exercise increased on-task behavior (Nicholson et al., 2011; Powers et al., 1992; Kern et al., 1982), active participation (Nicholson et al., 2011), and social interactions (Ledford et al, 2014). Additionally, exercise decreased stereotypic behaviors (Celiberti, 1997; Levinson &

Reid, 1993; Powers et al, 1992; Kern et al, 1984). Evidence continues to grow about the benefits of incorporating antecedent exercise into the daily routines of student with disabilities in order to promote a healthier lifestyle and prevent challenging behaviors.

Research shows that exercise can improve behaviors of students in multiple positive ways. Celiberti et al. (1997) found jogging was associated with a sharp decrease in (a) self-stimulation and (b) out-of-seat behavior in a five-year old boy with autism. The reduction was greatest immediately following jogging and did not return to baseline levels over the forty-minute session. In this reversal design, the student walked or jogged on a track outside of the school by himself. Then, he returned to the classroom to continue class with his peers. This study shows that the benefits of exercise for students expand beyond improving one behavior.

Other researchers have looked at the dosage of exercise within the school day. Prupas and Reid (2001) studied the frequency of exercise necessary to effect behavior. They contrasted one ten-minute walk (or jog) session with three ten-minute walk (or jog) sessions. During the exercise, games were encouraged. Some children were hesitant to run alone, but participation increased when their peers were introduced. Alongside these variables, the researches also examined how the structure of a classroom affects behavior. They found that a higher frequency of exercise, in addition to a structured class, decreased a student's likelihood of stereotypic behaviors. This study provided evidence that antecedent exercise could be embedded effectively into whole group activities. Students showed increased participation with their peers, and all of the students in the group benefitted from the intervention.

Physical activity has also been used to promote academic engagement and outcomes. Nicholson (2011) studied the effects of exercise on academic engagement of four nine-year-old boys with autism in a multiple baseline design. The intervention was delivered during the natural

routine of physical education class. Students were not removed from their peer group, but instead participated in the jogging with their classmates during gym class. Data were recorded three times per week after physical education once the students returned to their classrooms. Nicholson found that each of the four students' academic engagement increased during intervention. However, upon post-intervention follow-up sessions, each of the four students engagement behavior returned to baseline levels (Nicholson, 2011). This design studied a naturalistic implementation of exercise into the day of the students and staff. The exercise is embedded into the day, in contrast to studies that remove students from their natural environment or peers.

Similarly, Luke et al. (2014) compared two antecedent conditions before a teacher-directed activity: in one condition, the whole class participated in physical activity for twenty minutes; in the other condition, the students engaged in center activities for twenty minutes. After each condition, the students transitioned to a teacher-led activity, which lasted for fifteen minutes (Luke, 2014). The study found a connection between the physical activity condition and the student's subsequent on-task behavior.

As research on exercise in the classroom grows, it is clear that there is a trend towards embedding physical exercise into daily routines. These interventions can be implemented for the whole class, instead of singling out a single student. This potentially reduces the stigma of the intervention and aligns with recommended practices, in addition to offering easier implementation for teachers. The Division for Early Childhood of the Council for Exceptional Children states that education should be provided in an inclusive environment as possible to expand learning experiences (DEC, 2014). Although inclusion is considered best practices, the body of research on inclusive exercise interventions is small. The existing research focuses on

moderate-intensity exercise, implemented for longer periods of time. To address gaps in the literature related to exercise dosage, this study examined the following research questions:

- Is there a functional relation between high-intensity exercise before an academic activity and student engagement for kindergarteners?
- What do kindergarteners like or dislike about the intervention?

Method

Participants

Three students participated in this study. All children were enrolled in a university-based early childhood education center that provided inclusive early intervention, preschool, and kindergarten services. All participants were enrolled in the kindergarten program and were midway through the kindergarten year at the time of the study. All participants received literacy instruction in a small group (tier two) intervention format. To be eligible for the study, each participant needed to be able to follow one to two step directions in a small group setting.

Participants were nominated by their teachers due to concerns with off-task behavior during structured group times. According to the teachers in the classroom, these students engaged in high levels of off task behavior, which detracted from their ability to access the content. The students' behavior also limited their access to participation in the general education curriculum and large group activities. Once participants were identified, those students' parents were contacted to provide an explanation of the study and request written permission for their child's participation. Parents signed a consent form. Participants were explicitly taught about the exercises, but they were blind to the study.

Participant 1 was a five year-old, Caucasian boy, named Frank. He did not have an identified disability, but required extra support in all academic areas. In literacy, Frank was focusing on letter identification and the sounds for the letters in his name. His teachers reported Frank was easily distracted during structured academic times.

Participant 2 was a six year-old, Caucasian, girl, named Susan. She was diagnosed with a developmental delay with Individualized Education Program (IEP) goals in speech and cognitive domains. She received academic instruction in the small group setting. In literacy, Susan was focusing on letter identification and sounds. She received additional services from a speech-language pathologist in the classroom.

Participant 3 was a six year-old, Caucasian, boy, named Tom. He had been diagnosed with a developmental disorder. He had an individualized education program goals in writing, reading, math, social and communication domains. He received academic instruction in the small group setting. In literacy, Tom was learning sound identification and blending. He received additional services from a speech-language pathologist and an occupational therapist in the classroom.

Setting

This study took place in an early education center affiliated with a large state university in the U.S. Pacific northwest. The education center served both children with special needs and typically developing children. The kindergarten program had two classrooms, serving thirty-five children total, including 17 typically developing children and 20 children with IEPs. All children were divided into homerooms, where they received general education instruction throughout the day. During free choice and a few other times across the day, the students were free to move

between the two classrooms. For most of the day, the general education curriculum was provided simultaneously in both classrooms. During literacy and math, one of the classrooms offered small group and specialized instruction.

The typical schedule in this classroom was as follows: arrival, morning meeting, snack, literacy, free choice, recess, lunch, and math. Four days per week, the schedule shifted slightly in the afternoon to provide gym time, science, or art after math. There was no academic instruction on Fridays, which were devoted to social skill instruction. Overall, the students received 40 to 65 minutes of recess or gym per day, and 60 to 80 minutes of unstructured free time inside per day. All study procedures took place during the literacy block, which occurred from approximately 9:45 a.m. to 10:45 a.m. Monday through Thursday.

During literacy instruction, there were twelve children and three to six adults present in the classroom. The adults included a head teacher, a paraprofessional, and a graduate student. An additional one to three related service staff was present. Literacy instruction began with a full group circle on the carpet. This circle time instruction included literacy activities, singing letter songs, and reading books. The class utilized the *Being a Writer* and *Being a Reader* curricula, in addition to individualized lessons for the group's needs (Center for Collaborative Classroom, 2016). At the end of circle, the teacher dismissed the students to small groups. At this time, the participants in this study received their small group instruction in the hallway outside of the classroom. The hallway where the study took place was 10 feet in width. The children were directed to sit on carpet squares, which had their names written on them. The carpet squares were arranged in a half circle with the teacher facing the children.

Experimental Design

This study used an A-B-A-B design. This design was chosen because on-task behavior is reversible. That is, without the implementation of the intervention, it is expected that the behavior will return to baseline levels. Also, the intervention can be easily applied and withdrawn between conditions. During the A-condition (baseline), the small group activity was conducted according to typical procedures for the small group literacy activity. During the B-condition (intervention), a one-minute exercise activity was implemented immediately before the literacy activity. The only change between the A-condition and the B-condition was a one-minute, high-intensity physical activity before the literacy activity.

Procedure

A second year graduate student (and author of this study) taught each small group lesson. The small group included five children, consisting of the three participants and two additional students. The additional students also needed extra support in academics. Throughout each condition, the teacher rotated through five literacy activities. Data collection began at the beginning of the activity and continued for five minutes. The literacy activities are shown in Table 1.1.

In all conditions of the study, the teacher used a group reinforcement system. The system was referred to as the "Teacher versus Kids Game." In the reinforcement system, the teacher gave at least five behavior specific comments to the group in each session. Every behavior specific comment was paired with a "kid point" to further reinforce the behavior. The game, and thus verbal praise and reinforcement, was applied consistently across all study conditions.

During intervention sessions, the teacher led the students in one minute of exercise before beginning the literacy activity. The five exercises were rotated through during each phase. As in baseline, data collection began at the beginning of the literacy activity and continued for five minutes. The intervention exercises are shown in Table 1.2.

Table 1.1

1. Bridge • Objective: blending letter sounds to make words • Materials: flashcards with consonant-vowel-consonant (ie, DOG, CAT, MAN) written on them in upper case letters • Process: show a card to the group. Slowly sound out the letter sounds and instruct a specific student to blend the sounds and make a word.
2. Hungry Thing • Objective: receptive rhyming • Materials: monster puppet, small play food items • Process: give each student a food item. Explain to the group with the puppet, "I'm Hungry Thing and I'm feeling very hungry. Remember, I say words a little funny, so you'll have to figure out what I mean!" Then lead the group in repeating the chant, "Hungry Thing, Hungry Thing, munch, munch, munch; Hungry Thing, Hungry Thing, what would you like for lunch?" As the puppet say, "I am feeling very hungry! I would like a big glass of PILK!" Student with the milk will pass the item to the teacher.
3. What's in My Bag • Objective: blending word sounds • Materials: small plastic toys in a large brown bag • Process: begin to pull out one of the items from the bag. Say, "What's in my bag? We'll have to wait and see. It beings with a ___ and ends with a ____." Example, begins with a /c/ and ends with a /at/

(cat).

4. Kaboom
    - Objective: letter and sound identification
    - Materials: cup, popsicle sticks with a letter written on one end, popsicle sticks with "kaboom" written on one end
    - Process: instruct a child to pull a popsicle stick out of the cup. Ask them what letter it is and the sound it makes. The child keeps the popsicle sticks that they pull out with letters on them. If the popsicle stick says "kaboom," the child has to return all of his sticks to the cup.
    - Note: all "kaboom" popsicle sticks were removed from the cup in order to prevent challenging behaviors during the activity
5. Letter Basketball
    - Objective: receptive letter and letter sound identification activity
    - Materials: two small bins, laminated letters, one balled up piece of paper
    - Process: two bins are placed in front of the students. Each bin has a laminated letter sheet propped inside the bin (as a back-board). The teacher gives the student the balled up piece of paper and instructs them to throw it into one of the bin. For example, "Throw the ball into the basket that makes the /e/ sound!"

Table 1.2

1. Simon Says: included exercises such as running, jumping and squatting
2. Mail Run: teacher spreads envelopes on the floor; students must run and pick up the envelopes and return them to the "mail box"
3. Frog Jump: students frog jump to teacher chosen destinations. The teacher gives the students specific challenges to encourage them throughout the minute.
4. Stream Jumper: teacher lays out a stream (blue paper taped together, making a 8 foot "stream"). The students jump back and forth. The teacher gives the students challenging to complete, such as running and jumping, and jumping with two feet at a time.

5. Crab Walk: students crab walk to teacher chosen destinations. The teacher gives the students specific challenges to encourage them throughout the minute.

Materials

In both baseline and intervention conditions, each child was instructed to sit on the carpet square with his or her name on it. A camera connected to a tripod was placed behind the teacher on top of the cubbies, facing the group of children. No microphones were utilized in this study. Video recording was used, so data could be coded after the sessions. Children sat in a half circle around the teacher. There were five literacy activities that rotated through in each phase. These activities were adapted from the Teaching Reading Sourcebook (Honig et al., 2008) or commonly used in the classroom. Specific materials for each literacy activity are listed in Table 1.1.

During the intervention phase, the teacher used a collection of hand-written exercise cards, which each had a specific one-minute exercise on the card. The cards included the title of the exercise and a picture example for the children. Before each exercise, the teacher would model the exercise for the children. Each exercise was high-intensity, meaning it was difficult to maintain for more than one minute. In addition to the exercise card explaining the exercise, specific materials for each exercise activity are listed in Table 1.2.

Response Measurement System

For each participant, the duration of on-task behavior was measured for the first five minutes of the literacy activity using whole-interval recording. Measurement began when the teacher raised her right hand and stated, “Now, we are going to do a literacy activity!” For the purpose of this study, on-task behavior meant following teacher directions within 3 seconds,

body oriented towards the teacher, on the carpet square (seating options: legs crossed, kneeling on carpet square or legs out straight), hands and feet to self, and only making on-topic comments. When the student looked away from the lesson for more than three seconds, they were considered off task. If a student had a bodily function that affected one of these perimeters (such as sneezing or coughing), the student was still considered on-task.

An example of an on-task behavior was a student sitting, facing the teacher or a peer if it was their turn. Comments needed to be connected to what was being talked about by the group. Holding a fidget was acceptable. If the student stands up, then sits down after two seconds, that student was still considered on-task. A non-example of on-task behavior was making off-topic comments to a peer or looking away for over three seconds.

Social Validity

At the end of the study, the researcher asked the participants about their experience. The interview took place in the hallway as a group and was filmed. Each of the five students was present. The researcher asked each of the children three questions, "Did you like the days with exercise or the days without exercise better?", "Why?", and "Is it easier or harder to learn after exercise?". The conversation lasted for approximately ten minutes.

Interobserver Agreement

To measure the reliability of the data, a second researcher watched and coded video-recorded sessions. The observer was blind to the purpose of the study and whether the sessions were in baseline or intervention. The second observer was trained by watching master-coded videos of the participants collected prior to the study. Trainings occurred until the observer

reached 90% agreement with three master coded videos. In the trainings, the behavioral definition was explained. Video models were utilized to further explain the target behavior and provide opportunity for practice data collection. Interobserver agreement was assessed on 25% of sessions in each condition for each participant. Interobserver agreement was calculated by using the interval-by-interval method (Gast & Ledford, 2014). The number of intervals with agreements was divided by the total number of intervals in the session (agreements plus disagreements). This number was multiplied by one-hundred to obtain a percentage interoberserver agreement score.

Procedural Fidelity Data

To collect procedural fidelity data, a procedural fidelity checklist was made for both the baseline and intervention conditions. After each session, the checklist was completed by the researcher to document that the components of the session were implemented as planned. The secondary observer completed the checklist for the 25% of sessions in which interobserver agreement data was coded. The procedural fidelity checklist for baseline conditions included eight components (see Table 1.3), and the procedural fidelity checklist for intervention conditions included 11 components (see Table 1.4).

Table 1.3

1. Carpet squares are set out before lesson
2. Say, “Now, we are going (insert activity)!”
3. Teacher raises arm to indicate beginning of data collection period
4. Activity lasts for five minutes

5. Camera is recording and facing children
6. PBIS system implemented (teacher vs kids)
7. Behavior specific praise is given throughout
8. Seated activity

Table 1.4

1. Carpet squares are out for the children to begin
2. Introduce the exercise (explain and model how the exercise is done)
3. Engage the children in exercise for one minute (within five seconds)
4. Direct all of the children to sit on their carpet squares again
6. Say, "Now, we are going to (insert activity)!"
7. Teacher raises arm to indicate beginning of data collection period
7. Activity lasts for at least five minutes
8. Camera is recording and facing children
9. PBIS system is implemented (teachers vs kids)
10. Behavior specific praise is provided
11. Seated activity

For each session, a percentage fidelity was calculated in order to determine the extent to which study procedures were followed as intended. Each aspect of the checklist was given either a positive (complete) or negative (incomplete) mark. The number of behaviors marked complete were divided by the total number of planned behaviors. This number was multiplied by one-

hundred to calculate a percentage. If fidelity dropped below 80%, the observer was retrained and the videos were recoded.

Data Analysis Plan

After estimating the duration of on-task behavior through whole interval recording, the data were graphed daily to visually represent the data set. Formative and summative data analysis was conducted using visual analysis of graphed data (Gast & Ledford, 2014). The researcher and faculty advisor examined level, trend and variability patterns across conditions, to determine if there was a functional relation between the exercise intervention and child engagement. Stable patterns in each condition were necessary before each phase change. Only data between adjacent conditions could be compared. Interobserver and implementation fidelity data were recorded as the sessions occurred to aid decision-making.

Results

Figure 2.1

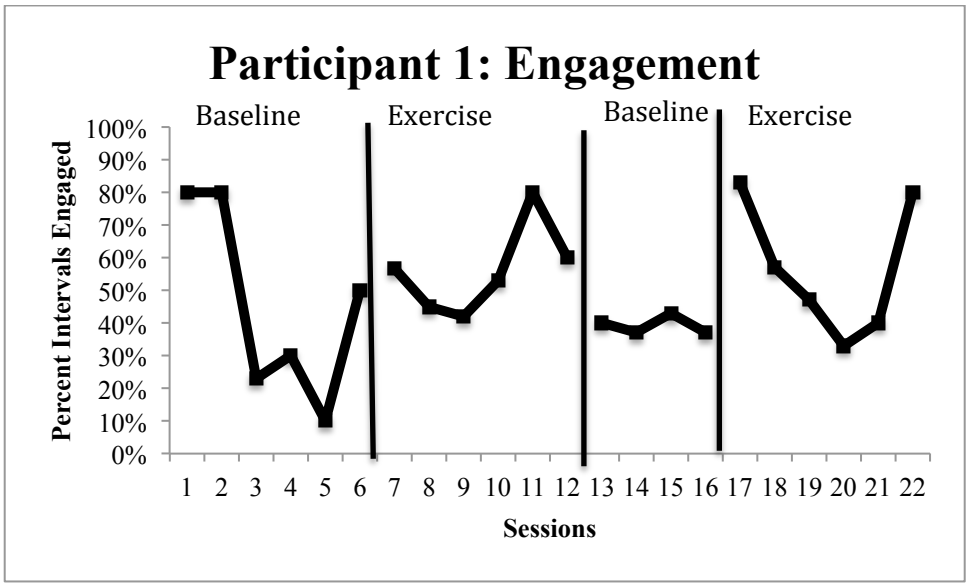


Figure 2.2

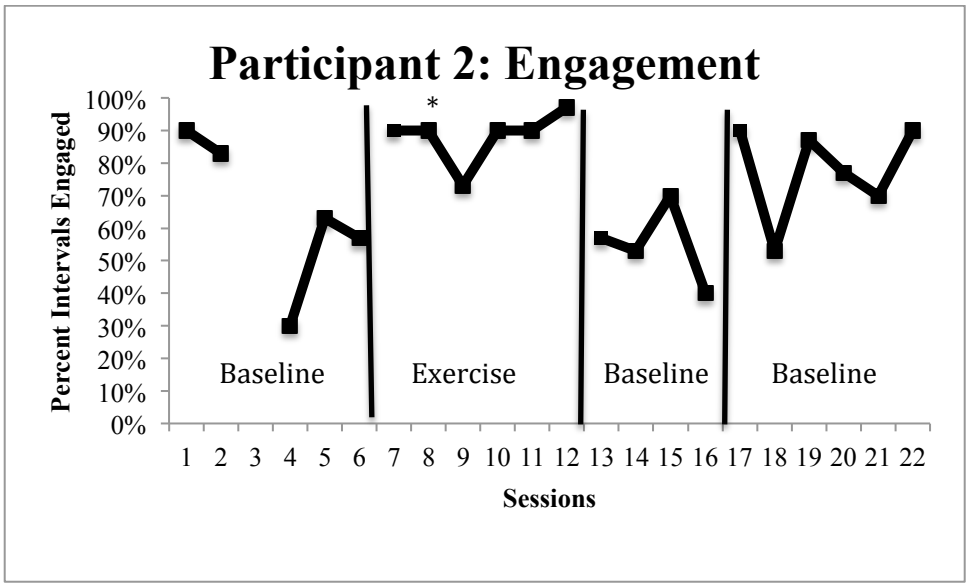
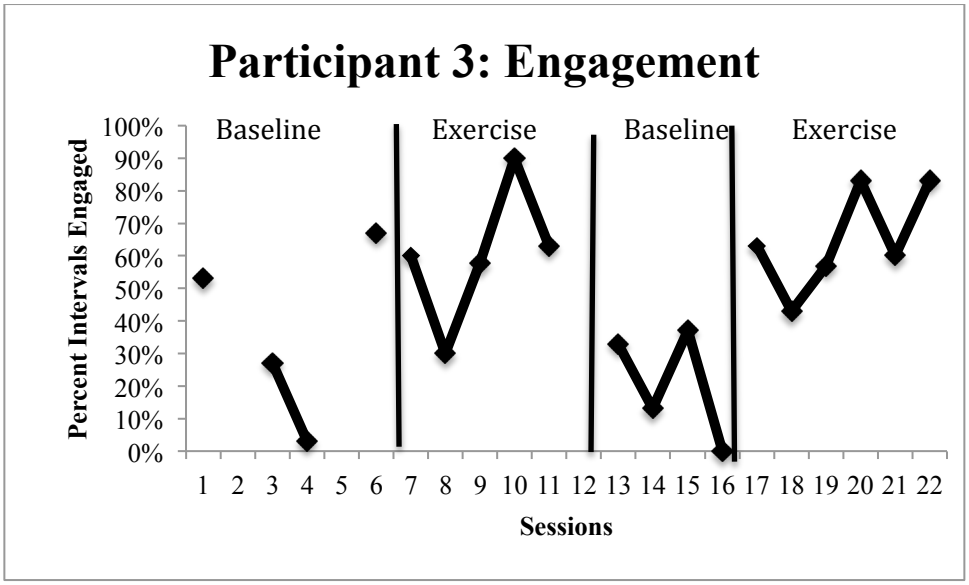


Figure 2.3



Frank

During the first baseline phase, Frank demonstrated a moderate level of engagement (M= 5.5% of intervals), but his engagement was highly variable with a range of 10-80% of intervals engaged. Engagement was high during the first two sessions, but it dropped and remained low over several sessions. There was slight upward trend on the last baseline session.

With the introduction of the intervention in the second condition, there was a clear change in level for Frank (M=56.2% of intervals). Data still showed some variability, but there was less variability than in the baseline condition. Frank's lowest percentage of engagement during this condition was 42%, which is notably higher than the 3 of 5 baseline sessions. Due to variability in baseline, 100% of data points overlap.

During the second phase of baseline, Frank's percent engagement was low and stable (M=39.3%). There was no overlap between intervention and the second baseline condition. His engagement during this condition ranged from 37-43%.

With the second phase of exercise, Frank's engagement increased in level (M=56.7%). There was more variability in this condition, but the data were notably higher than in the previous phase. The data ranged from 33-83%. Three of the five data points in this condition did not overlap with any of the data points in the previous condition.

Susan

In Susan's first baseline condition, she also demonstrated a high to moderate level of engagement (M=64.6% of intervals). However, her engagement was unstable between sessions with an overall range of 30-90%. Similar to Frank, Susan's engagement began high. During

session 3, she did not participate in the sessions due to illness. Upon return, Susan's engagement was much lower. The final baseline session was on a small downward trend.

Similar to Frank's results, Susan's level of engagement increased with the introduction of exercise (M=88.3%). In this condition, Susan's data stayed stable at a high level of 73-97%. Her lowest data point was higher than three out of five of her baseline sessions. Because her data in the first sessions of baseline were high, 83% of sessions overlapped between the two sessions. However, session 8 for this participant has an asterisk because the student refused to engage in the exercise, though it was available to her.

In this condition, Susan's engagement was dramatically lower than in the first phase of intervention (M=55%). Her engagement ranged from 40-70%. From the four data points in second baseline, there were no overlapping points with the previous condition. In the final session, her engagement dipped towards a downward trend.

For Susan, her engagement with exercise was high (M=77.8%). The data ranged from 53-90%. Session 18 was a particularly low engagement session for Susan, with the rest of her sessions notably higher than that point. Four of the six data points in this condition did not overlap with the previous condition's data.

Tom

Tom's engagement in the first baseline condition was low (M=37.5%). His engagement ranged from 3-76%. During session 2, there was no data for this participant due to a video error. In session 5, Tom had unrelated challenging behaviors in the classroom before the sessions began. He was unable to attend the study session as a result. His first and final sessions had much

higher engagement, with low engagement in the middle two sessions. His final session ended baseline with improved data.

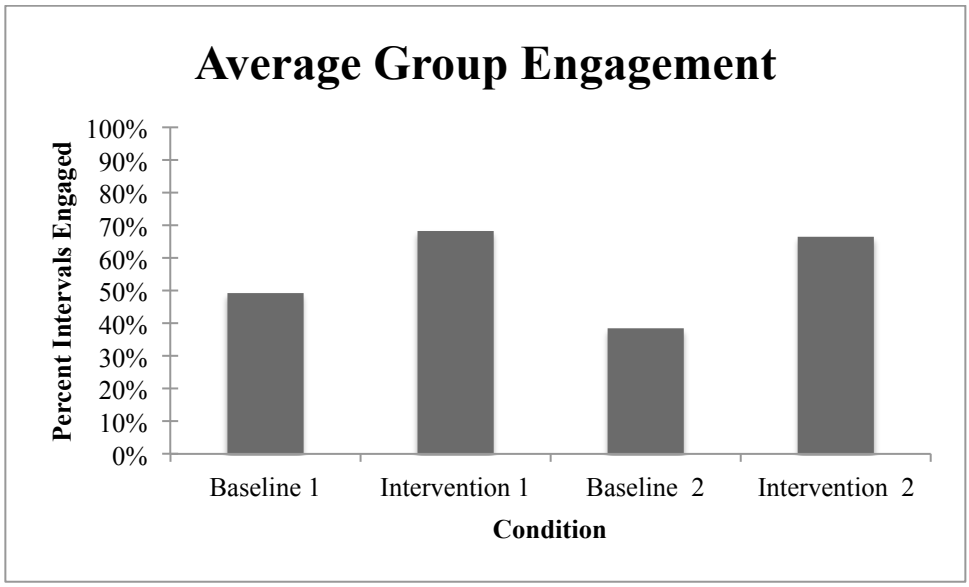
With exercise, Tom's level of engagement was higher than baseline (M=60.14%). His engagement continued to be wide ranging, with his lowest session at 30% of engagement. However, his highest session reached 90% of engagement, which is considerably higher than any of his baseline sessions. Due to the wide-ranging data, 80% of data points overlap between baseline and intervention.

Tom's engagement during baseline stayed relatively stable and low (M=20.8%). His data ranged from 0-37%. Two of the data points from this condition overlapped with one data point from the previous condition. The final data point for this phase ended on a downturn.

During the exercise condition, Tom's engagement was higher than the previous baseline condition (M=64.8%). His sessions showed moderate to high engagement. His engagement ranged from 43-83%. There were no overlapping data points between this intervention condition and the previous baseline condition.

Overall

Figure 2.4



Because the intervention was implemented with a small group of students, the group's average level of engagement across each condition was analyzed. The researcher chose to calculate the whole group average because it would closely align with how a teacher would experience the intervention. To a teacher, classroom behavior for the whole group might be more of a driving factor than engagement for one individual student. Average group engagement is shown in Figure 2.4. There was a clear increase in engagement each time the exercise intervention was introduced, relative to baseline.

In the first baseline condition, the average level of group engagement across all four participants was 49.2%. With the introduction of exercise, the average level of group engagement increased to 68.21%. When the study returned to baseline, the average group engagement fell below both the exercise condition and the original baseline to 38.37%. The final

phase reintroduced exercise before the literacy activity. With exercise, the group's engagement level increased again to 66.43%.

Social Validity

Table 2.5

	Frank	**Susan**	**Tom**
Do you like it better on the days we exercise or the days we do not?	Days with exercise	Days with exercise	Days with exercise
Why do you like exercise better?	"Because it is fun"	"Because I love to exercise"	"I really love exercise the most. I want to do it today."
Is it easier or harder to learn after exercise?	"Easier… because it makes me stronger"	"Easier"	"Easier"

Table 2.5 shows the results from the social validity portion of the study. Following the study, the children were asked three questions about their experience. These questions were asked verbally in the small group setting. Each participant was given an opportunity to respond.

Each of the three participants stated they enjoyed the days with exercise before the activity better than the days without exercise. When asked why, their responses differed. Frank stated that, "Exercise is fun." Susan and Tom said they "really love exercise." When asked if it is easier or more difficult to learn after exercise, all three participants stated that it is easier to learn after exercise.

Interobserver Agreement

Interobserver data was recorded for 25% of sessions for each phase. A doctoral student was recruited to serve as the secondary observer. He was trained before the study began. In the initial training, the researcher explained the target behavior and data measurement system. She provided examples and non-examples with the behavioral definition. Then, they reviewed example videos of the behavior. The secondary observer recorded data on the videos until he reached 90% agreement with the researcher.

Once the study began, the secondary observer was trained two additional times due to agreement below 80%. In the first training, the researcher clarified an issue with the children's eye contact to fulfill engagement requirements. The researcher clarified that the children could be looking at the teacher, a peer who is speaking, or the materials of interest to be considered engaged. In the second training, the researcher reviewed the target behavior definition and the secondary observer recorded data on video until they reached 90% agreement.

IOA was calculated by used the interval-by-interval approach (Gast & Ledford, 2014). The number of intervals with agreement was divided by the total number of intervals in the session. This number was multiplied by 100.

For Frank's sessions, the secondary observer's agreement was 87.6%. The average level of agreement was 87.6%. With Susan's data, there was agreement of 87.2%. The secondary observer scored an average of 85.5% agreement with the researcher.

Procedural Fidelity

Procedural fidelity was measured each session using the criteria shown in Table 1.3 and 1.4. In the first baseline condition, all sessions received 100% procedural fidelity. During the

first intervention condition, the range of procedural fidelity was from 82% to 100%, averaging 95.5%. Two sessions received procedural fidelity sessions below 100%. Session 8 received a procedural fidelity rating of 82%. This score is due to a video malfunction. The video camera stopped recording early and the session recording was cut short. Also, Susan refused to participate in the exercise for this session. Session 9 received a procedural fidelity score of 91%. This score was also caused by a video malfunction, which caused the session to be cut short. In the following baseline and intervention conditions, all sessions received 100% procedural fidelity.

Agreement on procedural fidelity was also calculated. The secondary observer scored the study's procedural fidelity from 25% of sessions in each condition using video recordings of the session. His results for the procedural fidelity of this study ranged from 86-100%. His average procedural fidelity score was 98%.

Discussion

This study examined the effects of a one-minute period of high-intensity exercise on student engagement. In the study, the implementation of exercise before a literacy activity was associated with increased levels of engagement across all three participants. The study was designed to replicate a true to life classroom experience. Each of the students, participants and non-participants, engaged in the exercise and the intervention occurred within the natural routine of the day. The teacher who usually taught this small group was the person to implement the intervention.

Although much research has been conducted examining a functional relation between exercise and improved student behaviors, this is the first study that examined a brief period of

high-intensity exercise embedded into a naturally occurring routine. Existing research on the connection between physical activity and student behavior has looked into moderate-intensity exercises that lasted for longer periods of time. Exercises that have been studied include jogging, walking, swimming, biking, roller-skating, and snow-shoeing (Lang, 2010; Celiberti, 1997; Prupas & Reid, 2001; Nicholson, 2011; Luke, 2014). In these studies, the participants exercised for time periods of up to twenty minutes before behavior measurement began.

Short-periods of high-intensity exercise, occurring within the natural routine of the classroom, were chosen due to the ease of application for classroom teachers. In the classroom, teachers would only need to implement a very short exercise activity to observe results. Additionally, having the whole class participate in the activity would increase the engagement of the entire class, instead of a few specific students. Whole class participation also prevents students with low-engagement from feeling isolated, because all of the students in the class do the exercise together.

This study showed results for each of the students, regardless of baseline engagement levels and disability status. Susan's baseline engagement levels were notably higher than the other two participants. Even given those high levels, her engagement was further improved with the implementation of exercise. Susan and Tom had developmental delay diagnoses. However, Frank was considered typically developing. This shows that exercise can improve engagement for all students, regardless of engagement levels or the presence or absence of delays.

Each of the participants stated that they preferred the sessions with exercise compared to the days with no exercise. When asked why that is, the participants either said because "exercise is fun" or "[they] love exercise." These responses provide insight into a potential behavioral mechanism that could explain increased engagement. According to the participants, they enjoyed

the exercise itself. It is possible that engaging in a highly preferred activity, such as fun exercises, prior to literacy contributed to behavioral momentum for positive engagement in literacy. Incorporating a highly preferred activity may have increased the likelihood that children would follow directions during the subsequent less preferred activity (Cooper et al., 2007)

This study had several limitations. Notably, the study group, which included participants and non-participants, was very small. In primary education, the average class size in the United Stated was 23 students in a 2010 survey (OECD, 2012). This study did not reflect this average class size that teachers would experience in a classroom. More students might cause barriers, such as the feasibility of implementing high-intensity exercise with an increased number of students.

Another limitation of the study was the setting. The study took place in the hallway. For this classroom, this is a routine place for some instruction to take place. However, most instruction does take place in the classroom and that setting would have been more universal for real life application. Additionally, the behavior measurement system, whole-interval recording, may have underestimated the children's engagement. Although the student's behavior was compared to their own behavior in the adjacent condition, which was measured using the same system, underestimation of engagement could show results that do not necessarily align with the reality.

Implications for Research and Practice

Future research should look at the durability of behavior change following high-intensity exercise. The current study only observed students for five minute immediately following exercise. Future studies should examine how long the benefits of exercise sustain across settings

and activities. Teachers could use that research to decide how often they should implement short intervals of exercise.

Additionally, future studies should examine differences between types of high-intensity exercise, particularly cardio versus strengthening. The exercises that were implemented in this study were a mix of cardio and strength training. More information on the types of exercises that produce positive behavior change would provide classroom teachers more information for implementation.

Conclusions

Although research shows that longer periods of moderate-intensity increase engagement, there is little research on the effects of implementing high-intensity exercise into the classroom. In addition to lowering rates of obesity and related diseases, providing opportunities for high-intensity exercise in the classroom increases levels of student engagement. This study shows an applied way to incorporate exercise into the classroom by embedding it into structured times to benefit all students.

References

American Heart Association. (2015). Physical Activity Improves Quality of Life. Retried on November 9, 2016 from: http://www.heart.org/HEARTORG/HealthyLiving/PhysicalActivity/StartWalking/Physical-activity-improves-quality-of-life.

Bassok, D., Latham, S., & Rorem, A. (n.d.). Is Kindergarten the New First Grade? *AERA Open, 2*(1), AERA Open, 2016, Vol.2(1).

Celiberti, Bobo, Kelly, Harris, & Handleman. (1997). The differential and temporal effects of antecedent exercise on the self-stimulatory behavior of a child with autism. *Research in Developmental Disabilities, 18*(2), 139-150.

Center for the Collaborative Classroom. (2016). *Being a Reader*. [kit]. Alameda, CA: Center for the Collaborative Classroom.

Center for the Collaborative Classroom. (2016). *Being a Writer*. [kit]. Alameda, CA: Center for the Collaborative Classroom.

Center for Disease Control and Prevention. (2015). How much physical activity for children need? Retrieved on November 6, 2016 from: https://www.cdc.gov/physicalactivity/basics/children/index.htm

Center for Disease Control and Prevention. (1999). Physical Activity and Health: A Report of the Surgeon General. Retrieved on November 9, 2016 from http://www.cdc.gov/nccdphp/sgr/disab.htm.

Cooper, J., Heron, Timothy E, & Heward, William L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, N.J.: Pearson/Merrill-Prentice Hall.

Division of Early Childhood of the Council for Exceptional Children. (2014). Recommended Practices in Earl Intervention/ Early Childhood Special Education. Retrieved on November 6, 2016 from: https://www.dec-sped.org/recommendedpractices.

Gast, D., & Ledford, Jennifer R. (2014). *Single case research methodology : Applications in special education and behavioral sciences* (Second ed.). London; New York: Routledge.

Goodman, G., & Williams, C. (2007). Interventions for Increasing the Academic Engagement of Students With Autism Spectrum Disorders in Inclusive Classrooms. *Teaching Exceptional Children, 39*(6), 53-61.

Honig, B., Gutlohn, L., & Diamond, L. (2008). *Teaching Reading Sourcebook.* Novato, CA: Academic Therapy Publications.

Kern, L., Koegel, R., Dyer, L., Blew, K., & Fenton, P. (1982). The effects of physical exercise on self-stimulation and appropriate responding in autistic children. *Journal of Autism and Developmental Disorders, 12*(4), 399-419.

Kern, L., Koegel, R., & Dunlap, L. (1984). The influence of vigorous versus mild exercise on autistic stereotyped behaviors. *Journal of Autism and Developmental Disorders, 14*(1), 57-67.

Lang, Russell, Koegel, Lynn Kern, Ashbaugh, Kristen, Regester, April, Ence, Whitney, & Smith, Whitney. (2010). Physical Exercise and Individuals with Autism Spectrum Disorders: A Systematic Review. *Research in Autism Spectrum Disorders, 4*(4), 565-576.

Ledford, J. R., Lane, J. D., Shepley, C., & Kroll, S. M. (2014). Using Teacher-Implemented Playground Interventions to Increase Engagement, Social Behaviors, and Physical Activity for Young Children with Autism. *Focus on Autism and Other Developmental Disabilities*.

Levinson, L., & Reid, G. (1993). The Effects of Exercise Intensity on the Stereotypic Behaviors of Individuals with Autism. *Adapted Physical Activity Quarterly, 10*(3), 255-268.

Lowe, Allen, Jones, Brophy, Moore, & James. (2007). Challenging behaviours: Prevalence and topographies. *Journal of Intellectual Disability Research, 51*(8), 625-636.

Luke, S., Vail, C., & Ayres, K. (2014). Using Antecedent Physical Activity to Increase On-Task Behavior in Young Children. *Exceptional Children, 80*(4), 489-503.

Nicholson, Heather; Kehle, Thomas J.; Bray, Melissa A.; & Van Heest, Jaci. (2011). The Effects of Antecedent Physical Activity on the Academic Engagement of Children with Autism Spectrum Disorder. *Psychology in the Schools, 48*(2), 198-213.

Organization for Economic Cooperation and Development. (2012). How Does Class Size Vary Around the World? *Education Indicators in Focus*, (9), 1-4.

Powers, S., Thibadeau, S., & Rose, K. (1992). Antecedent exercise and its effects on self-stimulation. *Behavioral Interventions, 7*(1), 15-22.

Prupas, Andrea, & Reid, Greg. (2001). Effects of Exercise Frequency on Stereotypic Behaviors of Children with Developmental Disabilities.*Education and Training in Mental Retardation and Developmental Disabilities, 36*(2), 196-206.

Slater, S., Nicholson, L., Chriqui, J., Turner, L., & Chaloupka, F. (2012). The Impact of State Laws and District Policies on Physical Education and Recess Practices in a Nationally Representative Sample of US Public Elementary Schools. *Archives of Pediatrics & Adolescent Medicine, 166*(4), 311-316.

Tucker, P. (2008). The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly*, 23, 4, 547-558.

Wirt, John, Choy, Susan, Rooney, Patrick, Provasnik, Stephen, Sen, Anindita, & Tobin, Richard. (2004). *US Department of Education,* US Department of Education, 2004.