

The LiiNK Project[®]: Comparisons of Recess, Physical Activity, and Positive Emotional States in Grades K-2 Children

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Abstract: The purpose of this study was to explore the physical activity patterns and emotional states differences among elementary school students at two private schools with differently structured school days. Students at one school received the LiiNK Project[®] pilot intervention, which included an additional two 15-minute recess breaks (unstructured outdoor play) throughout the school day and a 15-minute character development lesson three to four times weekly. Students at the comparison school received only one 30-minute recess daily and no additional character development curriculum. Grades K-2 children from two schools (N=262) wore pedometers for one school week and were observed for emotional expressions during recess. A univariate ANOVA revealed that intervention school students took significantly more steps on average than comparison school students, $F(1, 260)=0.784$, $p<0.0001$. Significant interactions were found for average number of steps between school and grade, $F(2, 250)=4.298$, $p<0.05$, school and gender, $F(1, 250)=4.660$, $p<0.05$, and grade and gender, $F(2, 250)=6.919$, $p<0.001$. Another univariate ANOVA revealed that during recess, intervention school students displayed significantly higher percentages of positive emotions than comparison school children, $F(1, 52)=15.332$, $p<0.0001$ and significantly lower percentages of not-positive emotions than comparison school students, $F(1, 52)=13.900$, $p<0.0001$. Overall, K-2 students who received multiple recesses and a character curriculum called Positive Action were significantly more active during the school day and displayed higher percentages of positive emotions on the playground than comparison school students.

Keywords: Sedentary Behavior, Play, Positivity, Pedometers, Early Childhood.

INTRODUCTION

Sedentary lifestyles have contributed to the rise in child and adolescent chronic diseases over the past 20 years [1, 2]. Several organizations [1, 3] have stated that this may be the first generation of children who will die before their parents due to sedentary lifestyles. The school climate has contributed to this issue. Due to a decline in student achievement and less order in the classroom environment, state mandates and school personnel have become much more focused on classroom productivity and remaining indoors where the child's environment can be controlled and focused on academics. As a result, a decline in physical education and recess has occurred in the school, while after school tutoring, homework, and screen time/technology are on the rise [4].

Child developmental theorists have emphasized play as a fundamental part to the healthy development of a child [5, 6]. Over the years, this concept has been implemented in the elementary school environment as recess. Recess has typically been defined as a short break in the school day when children can play outside. Recess in the schools has drastically declined from at least an hour daily 20 years ago to presently no more than 15-20 minutes daily [7]. This has led to a deficit in a child's ability to learn socially and emotionally [8],

which is vital to children's healthy development [9, 10]. Social emotional learning (SEL) takes place when children can "understand, express, and regulate the emotional aspects of life in ways that contribute to positive developmental outcomes in academic as well as social arenas" [11]. The importance of unstructured, outdoor play and physical activity in the development of the whole child is very important to the overall health of the child [7]. Developmentally, lack of play in a child's life can lead to heightened anxiety, narcissism, and lack of direction [5]. When play is available, research has shown it leads to happiness, self-control, improved physical activity levels, creativity, problem solving and socialization skills, and empathy [5, 8].

The LiiNK Project[®] (Let's inspire innovation 'N Kids) is an ongoing research study inspired by the Finnish educational system. The goal is to improve the quality of the classroom and the whole child focus through improvement in physical skills and SEL through three key strategies [12].

1. Increasing the amount of time allotted during the school day for unstructured, outdoor play. This consists of four, 15-minute recesses--two before lunch and two after lunch--totaling 60 minutes daily. If the school already has one 15-minute recess included daily, this results in an increase of 45 minutes daily for unstructured, outdoor recess. The intervention school modified the number of recesses LiiNK[®] required daily in order to accommodate the very intense

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curriculum in place for grades K-2 (two foreign languages plus English taught daily). So the treatment for this second year of the intervention offered three-15 minute recesses daily. Recess cannot be withheld for discipline issues or to make up missed work. Unstructured recess for this intervention is defined as free play that is directed by the children themselves with no adult influence.

2. Introducing a character development curriculum called Positive Action (PA) three to four times weekly at 15 minutes each as part of the overall classroom content by grade level. Integrating PA creates common social and emotional skill development throughout the school culture and creates a safer space to work and learn. The traits emphasized are trust, honesty, respect, confidence, self-esteem, and empathy.
3. Requiring three full day teacher/administrator strategic trainings to prepare for the LiiNK[®] intervention. These training days are scheduled for the spring semester before the intervention begins the following first day of the new school year. The first training is focused on changing the teachers' mindsets related to being outdoors and taking time to re-energize themselves and their students. The second training focuses on how to implement multiple recesses daily and teach the PA curriculum. The third training puts all the strategies together so that the launch of this intervention can be seamless.

The purpose of the present study was to determine the physical activity and emotional differences between grades Kindergarten (K), 1, and 2 students receiving the LiiNK Project[®] intervention (intervention group) and students following a traditional school day schedule of only one 30-minute recess and no added character curriculum (comparison group).

METHOD

The Institutional Review Board (IRB) approved the LiiNK Project[®] study protocol. Administrators and teachers of the two schools then gave permission to collect LiiNK Project data. Finally, parents/legal guardians provided informed consent for their children to participate; if informed consent was not obtained then that child was not included in the study. Children could decline participation even if the parent gave consent. Participants were in no way pressured to

participate in this study, and no incentives were offered for participation.

Participants

Two north Texas private schools agreed to participate in this study. One of the schools was identified as the intervention school and the other was the comparison school. Students from grades K-2 were included. This study was comprised of 262 students (intervention=137, comparison=125). Participants at the intervention school (K=46, 1=43, 2=48) and the comparison school (K=36, 1=47, 2=42) were similar in number across grade levels. Similar numbers of males (intervention=65, K=19, 1=20, 2=26; comparison=69, K=22, 1=27, 2=20) and females (intervention=72, K=27, 1=23, 2=22; comparison=56, K=14, 1=20, 2=22) participated between the two schools. Less than .05 percent of the students at either school were on ADHD medications; over 93% of the population at each school was White; and neither school had reduced lunch programs.

Pedometers

Pedometers were used to measure the physical activity levels of children throughout the school day. The pedometer chosen for this study was the Robic M339 3D Motion Sensory Memory Pedometer. This pedometer contained a tri-axis motion sensor which allowed it to be worn anywhere on the body to count steps taken throughout the school day. The pedometers were worn on a loose necklace under the shirt at the center of the chest for one school week (5 days) during school hours only (8:30 a.m. - 3:30 p.m.) by grade level. The pedometers were programmed to reflect average stride lengths for each grade level, which were calculated from the normative height and weight charts for each age group [13, 14]. All data was collected over a four week period with similar weather conditions.

Each participant was assigned a pedometer number and he or she wore the same pedometer for the duration of the week. Several exclusion criteria were used to make sure that the data was clean and fair across the two schools: 1) if a pedometer was removed for more than one hour during a single day; 2) if teachers reported that a student arrived late, left early, or went to the nurse for more than a few minutes; 3) students who wore their pedometer less than four days; and 4) if a pedometer malfunctioned. Pedometers that malfunctioned were replaced with a new fully

functioning one. The student would then wear the new pedometer for the correct amount of days. At the end of each school day, investigators were present to collect the step counts from each pedometer and to ensure the pedometers were still working correctly.

Recess Observations

Fifty-seven recess observations were conducted at the intervention (N=30) and comparison schools (N=27) over the course of five weeks in conjunction with the pedometer data collection. Observations were conducted to record facial, bodily, and vocal emotional expressions of randomly selected children at recess in order to measure emotional states. The observations were split similarly across grade level and gender at each school. At the intervention school, observations were evenly dispersed between morning and afternoon recesses. Observation durations were similar across the intervention school (M=11.39 minutes) and comparison school (M=11.63 minutes). The intent was to observe recess for the full 15-minute duration. Because of transition time out to the playground at each school, play time was slightly shorter than the allotted 15 minutes. Also, one recess at both schools was cut short due to assemblies. To ensure consistency and validity across raters during observations, several practice sessions took place. Once validity was secured, the raters were assigned to observe one child for the required 15 minutes of a specified recess at the intervention school and two children per specified recess at the comparison school since they were 30 minutes in duration.

After each recess, the investigators independently transcribed their observations and coded the emotional states according to a modified version of Durbin's [15] categories to better represent emotions of children in a free play setting. After coding was completed, the investigators collaborated on what was similar and different between the observations and the interpretations. The modified emotional expression categories included positive emotions, not-positive emotions, and other emotions. Each category of emotion included facial, bodily, and vocal cues. Displays of positive emotional states included smiling, laughing, saying positive things, skipping, clapping, and high-fiving. Examples of not-positive emotional states included frowning, scowling, crying, saying negative things, hitting, and kicking. Finally, there were emotions observed that did not fit into the positive or not-positive categories, but were important to include in the data gathering. These emotions were assigned to an "other"

category including descriptions of having a calm, determined, or concentrated face. Table 4 shows examples of all emotional categories.

Statistical Analyses

Descriptive statistics determined means and standard deviations of demographic data. A univariate ANOVA determined if there were significant differences between average steps taken by school (intervention or comparison). Further, the ANOVA determined the interactions and main effects of school type (intervention or comparison), grade (K, 1, 2), and gender (male or female), with average steps per child. A univariate ANOVA was also calculated to determine significant positive emotion and not-positive emotion differences by school and gender. A Scheffé post hoc was run on all significant differences and interactions at a confidence level of .05.

RESULTS

Physical Activity Patterns

A univariate ANOVA showed that the intervention school students took significantly more average daily steps (M=6833.52) than comparison school students (M=6266.77), $F(1, 260)=0.784$, $p<0.0001$. The analysis revealed significant interactions between school and grade, $F(2, 250)=4.298$, $p<0.05$, school and gender, $F(1, 250)=4.660$, $p<0.05$, and grade and gender, $F(2, 250)=6.919$, $p<0.001$, for average daily steps. There was no significant interaction among school, grade, and gender, $F(2, 250)=0.450$, $p=0.638$. Main effects were also confirmed for school, $F(1, 250)=34.265$, $p<0.0001$, grade, $F(2, 250)=41.106$, $p<0.0001$, and gender, $F(1, 250)=137.101$, $p<0.0001$, on average daily steps.

Table 1 displays means and standard errors of average daily steps for the school by grade interaction. Post hocs revealed that grade K intervention students took significantly more steps than grade K comparison students, $p<0.012$, and grade 1 intervention students took significantly more steps than grade 1 comparison students, $p<0.0001$. However, no significant difference was found between grade 2 intervention and comparison students, $p=0.065$, on average daily steps.

When examining physical activity levels by grade for both schools combined, post hocs revealed significant differences between grades K and 1 and between grades K and 2, $p<0.05$, but no significant difference was found between grades 1 and 2 for average daily

Table 1: Average Daily Steps Taken for School by Grade

School	Grade	Mean	SE
Intervention	Total Grades	6833.52 ^a	112.33
	K	5979.98 ^c	146.316
	1	7360.65 ^e	149.392
	2	7199.24	141.545
Comparison	Total Grades	6266.77 ^b	124.64
	K	5416.46 ^d	167.050
	1	6155.45 ^f	144.153
	2	6815.31	150.963

Note. ^a and ^b – mean scores that do not share common superscripts for school by grade are significantly different at $p < 0.0001$.

Note. ^c and ^d – mean scores that do not share common superscripts for school by grade are significantly different at $p < 0.05$.

Note. ^e and ^f – mean scores that do not share common superscripts for school by grade are significantly different at $p < 0.0001$.

steps. In other words, 1st and 2nd grade students, overall, took significantly more steps than kindergarten students, $p < 0.05$, but 1st graders and 2nd graders did not significantly differ in their step counts.

Table 2 shows the means and standard errors of average daily steps for the school by gender interaction. Post hoc for the school by gender interaction revealed that males and females at the intervention school took significantly more steps than males and females at the comparison school, $p < 0.05$. Also, post hoc revealed that males took significantly more steps than females within each school, $p < 0.0001$.

Table 2: Average Daily Steps Taken for School by Gender

School	Gender	Mean	SE
Intervention	Male	7431.96 ^a	122.358
	Female	6261.28 ^c	115.615
Comparison	Male	6979.04 ^b	118.570
	Female	5279.10 ^d	133.072

Note. ^a and ^b – mean scores that do not share common superscripts for school by gender are significantly different at $p < .05$.

Note. ^c and ^d – mean scores that do not share common superscripts for school by gender are significantly different at $p < .05$.

Note. ^a and ^c – mean scores that do not share common superscripts for school by gender are significantly different at $p < .0001$.

Note. ^b and ^d – mean scores that do not share common superscripts for school by gender are significantly different at $p < .0001$.

Table 3: Average Daily Steps Taken for Grade by Gender

Grade	Gender	Mean	SE
K	Male	6130.08 ^b	153.029
	Female	5266.35 ^b	160.923
1	Male	7482.80 ^a	144.153
	Female	6033.29 ^b	149.392
2	Male	8003.62 ^a	145.328
	Female	6010.92 ^b	147.324

Note. ^a and ^b – mean scores that do not share common superscripts for grade by gender are significantly different at $p < .0001$.

Table 3 displays the means and standard errors of average daily steps for the grade by gender interaction. Post hoc for the grade by gender interaction revealed 1st and 2nd grade males took significantly more steps than kindergarten males and all females, $p < 0.0001$.

Emotional States

Table 4 delineates the emotional expression categories and lists types of behaviors observed for each category (See Procedures section for more detail on Durbin's [15] work on emotional expressions). One observation from the comparison school was not

Table 4: Positive, Not-Positive, and Other Emotional Expressions and Behaviors Observed During Recess

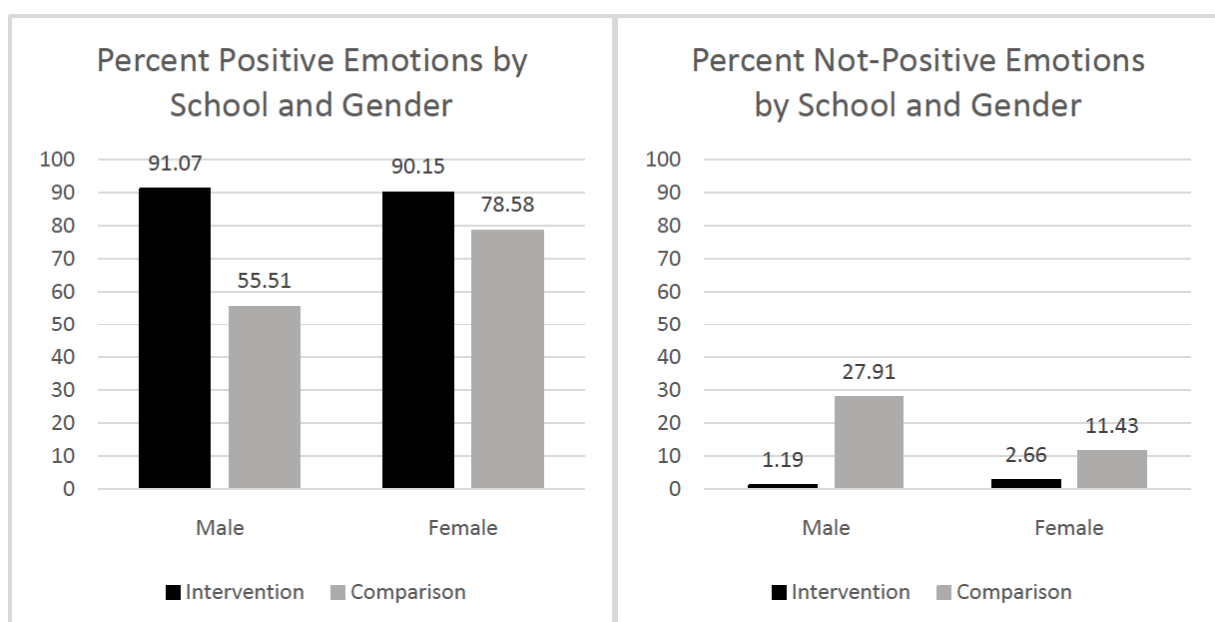
Category	Emotions	Behaviors
Positive	Happiness/joy, content, excitement, surprise, celebration	Smiling, laughing, giggling, positive statement, jumping, clapping, hopping, skipping, cheering
Not-positive	Sad/upset, angry, aggressive, annoyed/irritated, frustrated	Frowning, scowling, pouting, negative statements, kicking, hitting, angry or frustrated expressions
Other	Concentrated, perplexed, element of surprise	Determined expression, hit in the face with object and surprised reaction

included in analyses, because it was distinct from all other observations: The student observed displayed malicious (e.g. hitting another student) and happy (e.g. smiling) behaviors simultaneously.

Positive, not-positive, and other emotions observed were each calculated as a percentage of total emotional expressions for each student. When examining the percentage of positive emotions expressed during recess, a univariate ANOVA revealed a significant difference between the schools, $F(1, 52)=15.332$, $p<0.0001$. Intervention school students displayed significantly higher percentages of positive emotional states ($M=90.61\%$) than comparison school students ($M=66.15\%$). Intervention school males ($N=15$, $M=91.07$, $SD=11.77$) and females ($N=15$, $M=90.15$, $SD=9.12$) displayed significantly higher percentages of positive emotions at recess than comparison school males ($N=14$, $M=55.51$, $SD=28.25$) and females ($N=12$, $M=78.58$, $SD=33.83$), $p<0.0001$. Another univariate ANOVA revealed a significant difference between the intervention and comparison

schools for not-positive emotions during recess, $F(1, 52)=13.900$, $p<0.0001$. Intervention school males ($N=15$, $M=1.19$, $SD=4.611$) and females ($N=15$, $M=2.66$, $SD=5.88$) displayed significantly less not-positive emotions during recess than the comparison school males ($N=14$, $M=27.91$, $SD=27.60$) and females ($N=12$, $M=11.43$, $SD=22.703$). Figure 1 shows the differences between positive and not-positive emotional states between the two schools by gender.

Due to a smaller sample size for observations, the data could not be analyzed by school, grade, and gender, and still yield reliable results. For this reason, the data was analyzed by school and gender. An interaction effect approached significance for school type and gender, $F(1, 52)=3.972$, $p=0.052$, and perhaps with a larger sample size, significance would have been reached. Although a significant main effect was found for school ($p<0.0001$), no significant main effect was found for gender on percentage of positive emotions during recess. No gender main effect was found for not-positive emotions at recess, $F(1,$

**Figure 1: Emotion type by school and gender.**

52)=2.486, $p=0.121$, and there was no significant interaction for gender by school on percentage of not-positive emotions at recess, $F(1, 52)=3.556$, $p=0.065$.

DISCUSSION

The LiiNK Project[®] intervention teaches to the Whole Child model by incorporating physical health and social emotional health components through increased free play and the Positive Action (PA) curriculum [7, 9]. The results of the present study support strategic interventions for promoting physical activity and positive emotions of grade K-2 students, and also point to a connection between physical activity levels and positive emotional states expressed during free play.

Physical Activity Patterns

Children who received multiple outdoor, unstructured play breaks throughout the day (totaling 45 minutes) were more active during the school day ($M=6833.52$ steps) than students who only had one 30-minute recess daily ($M=6266.77$ steps). This was expected because the intervention school students had more opportunities for outdoor, unstructured play than the comparison school students. It is noteworthy that intervention school students had only 15 extra minutes of recess when compared to comparison school students, indicating that multiple free play experiences may encourage children to be more active than getting only one break per day.

Males took significantly more steps than females across each school and within each school. These results parallel current research, indicating that males are more active than females [16]. Older males were also more active than younger males, while females were not much different in activity levels between kindergarten, 1st grade, and 2nd grade. Even though males are more active, neither male nor female children are meeting the recommended 60-minutes of daily physical activity [17]. In fact, most children receive either one or no recess breaks during school [18] and spend approximately eight hours or more of sedentary time daily [19, 20]. Most children engage in at least two hours of screen time (e.g. television, computer games) daily, but for American boys, this increases to more than three hours of screen time daily [19, 20]. With the increased recess time this intervention provides, sedentary time is being replaced with active time, which could lead to improved health outcomes [17].

When examining the physical activity patterns by grade level only, intervention school students in grades K and 1 took significantly more steps than comparison school students in grades K and 1, respectively. However, grade 2 intervention school students did not take significantly more steps than grade 2 comparison school students. In fact, children in 2nd grade at both schools were the most active group in this population. This may be an indication that children need more activity as they get older. Results from the LiiNK Project[®] show that comparison school children are more off-task and move around the classroom more than intervention school children [21]. It is probable that 2nd graders at the comparison school were active on the playground and more off-task in the classroom, which could explain why their step counts were similar to intervention school students. However, this is a guided assumption because the pedometers did not track activity by time. But, if intervention school students are getting their energy out at the playground, and they are more focused and engaged in the classroom lessons, interventions like the LiiNK Project[®] could help to improve health and learning to benefit the whole child.

Kindergarteners took the least amount of steps. Kindergarteners at both schools did have approximately one hour less of school time each day, but their results were not analyzed differently because kindergarten students at their respective schools received the same amount of recess as 1st and 2nd graders. Therefore, it may be assumed that grade K students are less active during their recess breaks than older students. This was the third year the intervention school was involved in the LiiNK Project[®], but the first year that the Kindergarteners received the intervention. First and 2nd grade intervention school students had received the project for one to two years, and therefore may have been more accustomed to play, explaining their higher activity levels. If the higher activity levels of older intervention school students is a result of two years of the LiiNK Project[®] (and therefore two years of increased activity), kindergarteners may follow in a similar pattern.

Emotional States

Intervention school students demonstrated significantly higher percentages of positive emotional states, and significantly less not-positive emotional states, during recess than comparison school students. The results of this study align with play theory in that males and females benefit emotionally from multiple

opportunities daily to socialize, learn, and explore in an unstructured environment [5]. Differences in the two playgrounds at each school may have contributed to types of behaviors exhibited. The comparison school playground offered a large blacktop with a basketball hoop, and students had access to basketballs, soccer balls, and kick balls. The intervention school, on the other hand, had no black top and no sport-type equipment (e.g. balls).

Students at the comparison school were often observed playing dodge ball and basketball, during which many of the not-positive emotions were observed, such as anger, frustration, and sadness. Investigators noted comparison school students getting angry, and even physically violent, about so-called unfair refereeing and poor athletic performance. On the other hand, students at the intervention school did not play as competitively, and females at both schools were not observed playing competitive games nearly as much as males. Females were more often observed socializing, walking, and swinging. Another contributing factor to the differences in emotional states observed between the two schools could be that the intervention school students received the Positive Action[®] lessons that teach to trust, honesty, respect, empathy, confidence, and self-esteem.

Blinding of raters was not possible because the length of recess itself (15 minutes or 30 minutes), was a clear indication of which school the raters were observing. In order to minimize rater bias effects, in-depth trainings were held alongside pilot observations to ensure that observers were conducting assessments similarly across both schools. When reviewing these results, it is also important to remember that these observations were conducted during recess to capture a natural environment. Therefore, caution should be used when generalizing these results to the overall happiness of the children at each school. Although observations are considered a reliable indicator of emotions, sometimes observable behavior may not be congruent with emotional experiences [22].

IMPLICATIONS

This study is among few that investigate the relationships between free play, physical activity, and emotional states among young children. It is plausible to report that the results are a direct outcome of the LiiNK Project[®] intervention, as the intervention and comparison schools were matched almost identically on all other factors (e.g. school type (private),

demographics, socioeconomic status, length of school day, high-level curriculum taught).

The results of this study provide evidence that outdoor, unstructured play time and character lessons increase physical activity levels and improve emotional states. Students who receive the intervention also thrive academically [12], which aligns with previous research supporting the relationship between physical activity and academic performance [23]. Interventions such as the LiiNK Project[®] should be considered in efforts to develop the whole child. It is vital to restore play, reverse sedentary behavior, and improve emotional states among young children.

Future research should focus on the relationships between play, physical activity, and emotional states among young children as well as older elementary- and middle-school aged children. Also, these relationships should be explored in a public school setting, as the current study was conducted among a private school population. Future studies should also consider the use of accelerometers as opposed to pedometers so step counts can be measured by time.

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