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PEDAGOGY

The Acute and Chronic Effects of GoNoodle Brain Breaks on Reading Fluency Among Elementary School Children

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Abstract

There is growing evidence that increased physical fitness and physical activity (PA) rates are positively associated with academic achievement. Recent efforts toward Comprehensive School Physical Activity Programs (CSPAP) include the use of PA breaks during academic learning activities. This study examined the acute and chronic effects of PA breaks (via GoNoodle) on the reading fluency of 384 elementary school children. Reading scores (words per minute, reading accuracy, and words retold) increased significantly in certain chronic and acute conditions. Findings provide additional support of the growing body of research for the use of PA for enhancing academic achievement, specifically reading fluency.

In the era of the high-stakes testing across the education landscape, teachers are looking for any advantage to help their students succeed. One foundational area of particular interest that affects all other learning is the attainment of reading skills (literacy). Reading fluency (i.e., reading quickly, accurately, and with proper expression) gained national prominence when it was included in the Reading

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First guidelines of the No Child Left Behind Act of 2001 with a major emphasis on fluency *instruction* and *assessment* (Cunningham, 2001; National Reading Panel, 2000).

Not surprisingly, reading skills (i.e., reading with greater fluency, accuracy, and comprehension) increase when students read more. Children who are skilled readers read in greater volume and gain more enjoyment than less skilled readers (Clarke et al., 2013). They possess faster phonological processing for letter-sound application and self-testing that provides them with growth in vocabulary and comprehension (Clarke et al., 2013; McGill-Franzen et al., 2002).

Literacy deficiencies, on the other hand, are usually addressed through specific interventional strategies (most often workbooks and flashcards, ghost reading, etc., as remediation activities). Critics of these strategies argue that removing students in need of literacy intervention has the unfortunate result of these students reading thousands fewer words than proficient readers or those in teacher-led reading groups (Allington & Gabriel, 2012; Neuman & Celano, 2001; Serafini, 2010), thus, inadvertently, widening the reading gap. Not surprisingly, teachers are open to additional interventional strategies including the judicious use of physical activity (PA).

Physical Activity Trends and Academic Achievement

The connection between physical education outcomes (PA rates, fitness, etc.) and academic achievement has long been suspected but has received serious study only relatively recently. The inclusion of PA breaks throughout the academic day is an idea that is a part of a larger approach to increase health-enhancing PA referred to as the whole child, whole school approach. Operationalizing the goals of the whole child, whole school approach has led to the creation of the Comprehensive School Physical Activity Program (CSPAP). A CSPAP is a multidimensional structure that strives to maximize the school environmental effects on student PA rates. The five dimensions of a CSPAP, thought to make a positive contribution to children's overall PA rates, include (a) staff involvement, (b) PA during school (e.g., classroom activity breaks such as GoNoodle), (c) physical education, (d) PA before and after school, and (e) family and community engagement. In regard to PA, there are several products designed for movement integration in the classroom, including GoNoodle videos (see Dugger et al., 2020, for a comparison

of the functionality, utility, and appeal of these products). GoNoodle videos are avatar-led, set to music, last 5 to 10 min, and incorporate a variety of PA patterns. They also incorporate a variety of integrated academic learning content (Dugger et al., 2020). In this study, we used the free, online version of GoNoodle PA breaks (https://www.gonoodle.com/) to assess their possible effects on reading fluency.

Concurrent to the pursuit of a variety of interventional strategies designed to increase academic achievement, including reading fluency, the effects of infusing PA have also been explored. Over the past 15 years or so, a growing body of evidence has shown a positive relationship of PA rates and fitness scores to school attendance and academic achievement (Beddoes et al., 2020; Castelli et al., 2014; Castelli et al., 2007; Castelli et al., 2011; Chomitz et al., 2009; Grissom, 2004; Kamijo et al., 2014; Rasberry et al., 2011; Welk et al., 2010).

Other research has also suggested that the inclusion of PA breaks in a classroom setting or used during academic lessons has increased the overall rate of academic engagement within that classroom (Erwin et al., 2011), particularly when the teacher models and participates (Ernst & Pangrazi, 1999). Also, children have been observed to demonstrate on-task behavior during academic tasks following PA breaks (Grieco et al., 2009; Mahar et al., 2006). Further, evidence has revealed an increase in math test scores for eighth-grade students who have been exposed to a moderate-to-vigorous bout of PA (MVPA), compared to a nonactive group.

The possible effects of PA as an academic interventional strategy have produced a variety of examinations whose collective findings have been considered in three published systematic reviews and meta-analyses of the literature (Norris et al., 2015; Owen et al., 2016; Watson et al., 2017). Due to space considerations, we provide only a brief overview of their findings, recommendations, and conclusions and refer the reader to the papers referenced herein for complete details.

These analyses considered the results of some 88 studies examining the basic question of the effects or relationship of PA on indices of school engagement such as academic achievement (e.g., standardized test scores), classroom behavior, and cognitive function (Watson et al., 2017) or more general indices of school engagement (behavior,

emotions, and cognition; Hillman et al., 2011; Owen et al., 2016). An additional major purpose of many of the papers included in these systematic reviews was the degree to which PA breaks contributed to overall PA levels of children and adolescents. However, exploring the measurement, the amount, quality, or intensity of the PA during these breaks is not central to this study's research question but is for use as a manipulation check only.

A variety of research designs (e.g., cross-sectional, interventional, quasi-experimental, experimental) were employed, each with its strengths and weaknesses noted in the systematic reviews. Many of these studies reported having to operate within constraints common to working within the public school setting. Admitting to their respective limitations, the various authors urged caution in the interpretation of their singular results, something common to any study. However, the value of these meta-analyses is that the limitations of a single study begin to give way to a preponderance of evidence across the entirety of the extant literature.

Watson et al. (2017) further drew a distinction between the types of PA breaks as (a) *active breaks* with no intended connection to academic content, (b) *curriculum focused* with an intentional connection to academic content, and (c) *physically active lessons* wherein PA is fully integrated into subjects other than PE. The intervention type of our study falls primarily under the active break category where the form of physical activities has no overt connection or alignment to any academic subject matter. Any connections that may have occurred were coincidental.

The question of the acute and chronic effects of PA breaks was also examined in these analyses. Notably, there seems to be a consistently stronger acute effect raising the possibility of reactivity (novelty) and the question of exercise intensity (Owen et al., 2016). Conclusions from these studies include (a) PA breaks during class time, of moderate to vigorous intensity, seem to have small to moderate immediate effects and small chronic effects and (b) more pronounced effects associated with greater PA intensity (Egger et al., 2019; Schmidt et al., 2016). The mechanism by which an exercise intensity effect occurs deserves further inquiry.

Yet, there are other dimensions of PA, besides quantity or intensity, that also merit examination. For example, Uhrich and Swalm

(2007) explored a bimanual, cross-hemispheric motor task (cup stacking) over a 5-week period and found positive improvements in reading comprehension.

While most reading fluency studies examine the effects of instructional strategies (workbooks and flashcards, ghost reading, etc.), this study focuses on whether PA breaks might also have a positive effect on the specific academic outcome of reading fluency. If so, it may be that PA breaks present teachers with an additional effective strategy to increase reading fluency while helping children and adolescents achieve PA recommendations. Therefore, this study assesses the acute (immediate) and chronic (long-term) effects of PA breaks via GoNoodle on indices of reading fluency.

Method

Participants and Setting

Participants (n = 384, 208 males, 176 females) were members of 16 second-grade (n = 8) and third-grade (n = 8) intact classes ($r_{\text{class size}}$ = 20–30) in four elementary schools located in the Intermountain West. School demographics were 70% White, 28% Hispanic, and 2% other ethnicities (Asian, Black, Pacific Islander) with 50% of the students receiving free or reduced lunch. All procedures received university and district IRB approval before the study began. Parental consent and student assent forms were signed and returned prior to data collection. All classrooms were configured with individual student desks arranged in rows, groups of four, or partners, including a large carpeted space sufficient to accomplish PA breaks.

Research Design

Researchers were granted access to the end-of-year DIBELS (version: Next; Good & Kaminski, 2002) scores for each of the 16 intact classes that were assigned to one of four distinct treatment groups in a 2 acute (with or without immediate PA break) × 2 chronic (with or without a history of daily PA breaks), quasi-experimental, factorial design (Figure 1). Each group was represented by two second-grade and two third-grade classes. Dependent variables of interest included measures of reading fluency (WPM, RA, and WR) and PA rates (via steps per minute pedometry). Of primacy in this

Figure 1
Research Design: 2 Acute (With or Without Immediate PA Break) × 2 Chronic (With or Without a History of Daily PA Breaks), Quasi-Experimental, Factorial Design Matrix

	Acute PA: Participated in a GoNoodle PA break activity just prior to taking DIBELS assessment	No-Acute PA: Did not participate in a GoNoodle PA break activity just prior to taking DIBELS assessment
Chronic PA: Daily GoNoodle PA break activities during school year	Group A: Both chronic and acute PA breaks Grades 2 and 3 (n = 96)	Group B: Chronic PA breaks only Grades 2 and 3 (n = 96)
No Chronic PA: No GoNoodle PA break activities during school year	Group C: Acute PA break only Grades 2 and 3 (n = 72)	Group D: No chronic and no acute PA breaks Grades 2 and 3 (n = 120)

Note. Factorial design for 2 (chronic) × 2 (acute) treatment conditions. Each cell had two second-grade and two third-grade classes.

study were *both* the acute (immediate) and chronic (history of daily PA breaks), as compared to no-acute or no-chronic, use of PA breaks on reading fluency.

Instruments

As a result, federal grant monies funded the development and testing of valid and reliable literacy assessment tools designed to measure literacy constructs (e.g., phonemic awareness, phonics, fluency, vocabulary, and comprehension). One approved and widely adopted reading fluency assessment program is the Dynamic Indicators of Basic Early Literacy (DIBELS; Good & Kaminski, 2002). The DIBELS consists of several subtests that measure phonemic awareness, phonics, and oral reading fluency (ORF). Embedded in the

ORF is a comprehension measure via the Retelling Fluency (RTF) as measured by the number of words retold (WR). The DIBELS also measures reading accuracy (RA) and fluency via words per minute (WPM). The DIBELS has gained widespread use in the United States as a measure of early reading skills and, coincidentally, is required statewide, independent of this study. The DIBELS (including its subtests to measure WPM, RA, and WR), has been found to be valid and reliable (Martin & Shapiro, 2011). The DIBELS is quick and efficient (1–3 min/student) to administer and can identify students in need of remediation. Free for educational use, the DIBELS materials are available for download (Acadience, 2021; Serafini, 2010). In the subject district, reading fluency proctors administer DIBELS three times yearly (beginning, middle, and end of year) to identify at-risk students for reading difficulties. For the purposes of this study, access was granted only to the end-of-year DIBELS assessment scores.

This study used the World-Class Instructional Design and Assessment (WIDA; https://wida.wisc.edu/resources), a language proficiency test for English as a second language (ESL) that assesses ability to read in English (Solano Flores, 2016), to assess if ESL student reading fluency scores were affected by ESL status as a possible confounder variable. The WIDA is required statewide for all ESL students on a yearly basis.

Students were instructed on the use of uniaxial Walk 4 Life pedometers (model LS 2525). The pedometers were worn and recorded steps per minute during GoNoodle PA breaks. Total steps were recorded, and steps per minute were calculated. Pedometry was used only as a measure of total steps taken during the GoNoodle activities and not as a measure of exercise intensity (i.e., MVPA) or its contribution to individual PA levels.

Procedures

All teachers and district DIBELS test proctors attended a training meeting, which helped ensure fidelity across the study. Data were collected by classroom teachers (pedometer step counts, PA breaks weekly frequency) and district personnel (DIBELS, WIDA).

Classes in Groups A and B engaged in the free, online GoNoodle exercise program for 10 to 12 min/day for the entire school year. GoNoodle videos were selected from three categories (Kids Bop, Moose Tube, and Fresh Start Fitness) that (a) achieved time

requirements and (b) contained music with 120 to 160 musical beats per minute (Brewer et al., 2016) for better MVPA rates. The primary investigator checked in with teachers weekly to assess the degree of compliance and reported a high degree of fidelity in Groups A and B. Classes in Groups C and D did not engage in the GoNoodle exercise program. Thus, Groups A and B were considered to have a "chronic history" of brain break use in the classroom, whereas Groups C and D were not. Similarly, Groups A and C experienced acute use of GoNoodle PA breaks. Classes in Group D experienced neither chronic nor acute PA breaks and acted as controls.

Data Collection

On the day of DIBELS testing, Groups A and B participated in an online GoNoodle activity projected on the front wall. Immediately prior to the activity, students were prompted to reset their pedometer. Following the activity students recorded their step counts, which were then collected by the teacher and entered into a data sheet. Groups B (chronic) and D (no chronic) had neither an acute GoNoodle PA break nor donned a pedometer. Student in Groups A and D participated in regularly scheduled classroom activities.

All four groups were escorted to the media center, where they were allowed to sit quietly for 2 to 3 min before DIBELS assessment administered by trained and certified district proctors. All participants from Groups A and C (acute PA break) received DIBELS testing within 30 min of the cessation of the GoNoodle PA break.

Data Analysis

All statistical procedures were completed through IBM SPSS (version 25) software. Descriptive statistics (means, standard deviations, etc.) were calculated for all response variables (Table 1). Pedometer counts were used as a manipulation check that the PA breaks were equally administered (i.e., if class average step counts did not differ across groups). Although not central to the research question, an estimate of MVPA via steps per minute (Graser et al., 2011) was calculated and reported. WIDA scores were examined for any preexisting or ancillary ESL conditions as potential covariates. Socioeconomic status via free and reduced (FRL) lunch data was examined as a possible confounding variable. Gender differences were also examined (Table 2). Through correlational analysis, the

relationships among variables of interest were examined (Table 3). Univariate and multivariate normality as well as multicollinearity were examined via appropriate tests.

A two-way factorial MANOVA analysis was conducted for WPM, RA, and WR. Follow-up post hoc examinations were conducted for assessment of any gender or between-group differences. Main effects for chronic and acute use of PA breaks as well as their interaction were examined and compared across treatment groups. Specifically, comparisons were examined for Group A (both chronic and acute PA breaks) compared to Group B (chronic PA breaks only), Group C (acute PA breaks only), and Group D (control: neither chronic nor acute PA breaks). With multiple pairwise comparisons, effects sizes via Cohen's *d* were calculated for noted group differences. Where applicable, partial eta-squared was also calculated for main and gender effects.

Results

Table 1 shows descriptive statistics for selected dependent variables by treatment group. For the entire population considered ($n = 384$), participant DIBELS reading scores averaged (a) $M_{WPM} = 86.6$ ($SD = 31.2$), (b) $M_{RA} = 2.92$ ($SD = 1.1$), and (c) $M_{WR} = 32.9$ ($SD = 18.8$). Overall gender differences (Table 2) revealed that boys scored significantly higher on all three fluency indices, WPM: $F(1, 383) = 38.4$, $p < .001$; RA: $F(1, 383) = 17.2$, $p < .001$; and WR: $F(1, 383) = 50.2$, $p < .001$. These findings were similar to those by Watson et al. (2019). No significant gender-by-group interaction effects were noted.

The WIDA score for ability to read in English was $M_{WIDA} = 3.5$ and was not significantly different across treatment groups, indicating no preexisting differences in English reading ability between groups. The mean for socioeconomic status (FRL) was 1.54 ($SD = .50$) and did not differ significantly across groups, indicating no preexisting socioeconomic differences between groups.

Mean step count (for Groups A and C only) was 99.2 ($SD = 42.1$), suggesting low to moderate PA rates (Graser et al., 2011) and was nonsignificant across groups. In other words, PA rates during the GoNoodle activity breaks were essentially the same; the chronic group was no more active than the acute group. Two conclusions can be drawn from this: (a) the acute group did not experience a temporary bout of reactivity to the GoNoodle activity and (b) the

Table 1

Means and Standard Deviations Across Words per Minute, Accuracy, and Words Retold by Condition

Chronic use of brain breaks	Acute use of brain breaks	Group	*N*	Words per minute		Accuracy		Words retold	
				M	***SD***	***M***	***SD***	***M***	***SD***
Chronic	Acute	A	96	92.63	30.78	3.16	.99	37.41	19.19
	No Acute	B	96	87.20	31.14	2.98	1.05	29.39	16.71
	Total		192	89.92	31.00	3.06	1.02	33.40	18.39
No Chronic	Acute	C	72	87.96	32.19	3.04	1.03	36.61	19.64
	No Acute	D	120	80.51	30.25	2.63	1.10	30.03	18.52
	Total		192	83.30	31.16	2.78	1.09	32.49	19.17

Table 2
Means, Standard Deviations, and Eta-Squared for Measures of Reading Fluency by Gender

Measure of reading fluency	Gender	*N*	*M*	*SD*	η^2
Words per minute	Male	208	95.19***	28.50	--
	Female	176	76.50	31.27	--
	Total	384	86.61	31.19	.093
Reading accuracy	Male	208	3.12***	1.03	--
	Female	176	2.69	1.06	--
	Total	384	2.92	1.06	.044
Words retold	Male	208	38.70***	18.15	--
	Female	176	26.15	17.17	--
	Total	384	32.94	18.76	.12

Note. Boys demonstrated significantly higher reading fluency on all three measures.
*** $p < .001$.

manipulation produced a similar total-steps response in each of the classes and may serve as a simple check.

Bivariate correlations (Table 3) revealed relationships among selected variables were in the anticipated direction. There were significant, positive correlations between FRL status and reading fluency scores—students not on FRL demonstrated a small to moderate relationship to fluency scores (Table 3). Further, DIBELS fluency and WIDA scores demonstrated strong, positive correlations (Table 3).

Univariate normality indices for WPM, RA, and WR were in acceptable ranges ($r_{skewness}$ = -.52–.04, $r_{kurtosis}$ = -1.0 – -.44). There was, however, a violation of the assumption of multivariate normality via a significant Shapiro–Wilk (SW) test (SW_{WPM} = .98, $p < .001$; SW_{RA} = .83, $p < .001$; SW_{WR} = .98, $p < .001$). Further, an indirect test of multivariate normality was conducted through a Mahalanobis *d* of 11.46, with a three-variable, critical value of 16.27, which provided indirect support for multivariate normality. Last, Box's test of equality of covariance matrices was nonsignificant, indicating an adjusted *p* value was not necessary. Levene's test of equality of error variances was also nonsignificant. Nonetheless, in consideration of a

Table 3
Correlations of Measures of Reading Fluency, Free or Reduced Lunch, and WIDA Scores

Variable	Free or reduced lunch	WPM	Accuracy	WR	WIDA
Free or reduced lunch		.34**	.14**	.22**	.35**
WPM			.52**	.67**	.87**
Accuracy				.50**	.60**
WR					.81**
WIDA					

Note. WIDA = World-Class Instructional Design and Assessment; WPM = words per minute; WR = words retold.
* $p < .05$. ** $p < .01$. *** $p < .001$.

significant Shapiro–Wilk test, a Pillai's trace (PT) adjusted value was used hereafter in the factorial MANOVA omnibus test.

Significant main effects for group ($PT_{WR} = .10$, $p < .001$; $d = .21$, $\eta^2 = .034$) and gender ($PT_{Gender} = .13$, $p < .001$, $d = .63$, $\eta^2 = .13$) were noted, allowing for follow-up comparisons via Tukey's HSD. No significant interaction (Group × Gender) effects were noted. Significant gender effects were noted with boys scoring higher than girls on WPM, $F(1, 376) = 38.73$, $p < .001$; RA, $F(1, 376) = 17.22$, $p < .001$; and WR, $F(1, 376) = 50.22$, $p < .001$. Small to medium effect sizes (i.e., small = .2, medium = .5, and large = .8) were noted via Cohen's d (Cohen, 1990) and are indicated in text where appropriate.

Words Per Minute (WPM)

Group A ($M_{WR} = 92.63$) scored significantly higher than Group D ($M_{WR} = 80.51$; Tukey, $p = .003$; $d = .38$) on WPM. Group C ($M_{WR} = 87.96$) scored significantly higher than Group D ($M_{WR} = 80.51$; Tukey, $p = .048$; $d = .24$) on WPM. Thus, there was a significant acute main effect (Groups A and C vs. Group D) of GoNoodle PA breaks on WPM. However, no chronic main effect (Group B vs. Group D) was noted, suggesting that increases in WPM were primarily affected by an immediate bout of PA but not a cumulative effect.

Reading Accuracy (RA)

Group D (M_{RA} = 2.63) scored significantly lower on RA than Group A (M_{RA} = 3.16; Tukey, $p < .001$; $d = .50$), Group B (M_{RA} = 2.98; Tukey, $p = .007$; $d = .32$), and Group C (M_{RA} = 3.04; Tukey, $p = .001$; $d = .38$). Thus, there were both chronic and acute effects associated with GoNoodle PA breaks on RA.

Words Retold (WR)

Group A (M_{WR} = 37.41) scored higher on WR than Group B (M_{WR} = 29.39; Tukey, $p = .008$; $d = .46$) and Group D (M_{WR} = 30.03; Tukey, $p = .001$; $d = .39$). Group C (M_{WR} = 36.61) also scored significantly higher on WR than Group B (M_{WR} = 29.39; Tukey, $p = .01$; $d = .40$). Group C (M_{WR} = 36.61) scored significantly higher on WR than Group D (M_{WR} = 30.03; Tukey, $p = .001$; $d = .35$). Once again, there was a pronounced acute main effect on WR.

Discussion

The purpose of this study was to examine the possible effects of PA breaks via GoNoodle on indices of reading fluency (WPM, RA, and WR) as measured within the DIBELS reading assessment tools. Following recommendations of previous works, we employed an intervention design with a control group over an entire school year, and used standardized, valid, and reliable measures (DIBELS, and WIDA). We sought to isolate the effects of PA on a single academic outcome, reading fluency, as opposed to more generalized measures of school performance.

While many teachers are beginning to recognize the value of PA for increasing school engagement (Barney & Deutsch, 2009; Owen et al., 2016), there may be much more to it than the ambiguous pursuit of *burning off excess energy*. Indeed, the results of this research suggest that increases specifically in reading fluency also seem possible. A single bout of exercise, for example, can improve the automation of some aspects of cognition (Audiffern et al., 2008; Hagervost et al., 1996; McMorris & Graydon, 1997) such as reaction time, speed of information processing, and higher-order cognition (planning, scheduling, inhibition, and working memory; Kramer et al., 1999; Owen et al., 2016). It is also noteworthy the gender effect

favors the males. For them, exercise seems a more especially effective intervention.

Further, while reading fluency, in and of itself, is a desirable outcome, it may also be a critical gateway to comprehension. Increased reading fluency may free mental processes toward achieving deeper levels of meaningfulness. Wolf and Katzir-Cohen (2001) describe a process that moves readers from reading accuracy to reading with greater ease and speed and to ever-increasing success. Thus, it is understandable that teachers would welcome any variety of strategies that achieve increased reading fluency, including the possible contribution of PA breaks.

Acute Effects of Physical Activity Breaks in the Classroom

The results reveal that the most pronounced effects of PA breaks occur immediately following bouts of PA on measures of reading fluency. This finding aligns with those in studies summarized in Owen et al. (2016). There also appears to be more of a cognitive benefit than previously recognized (Hillman et al., 2011). This finding also supports research (Phillips et al., 2014) examining the effects of single-bout PA but does so with a shorter activity episode via GoNoodle activity breaks and with a lower PA rate with young children. However, some evidence suggests that some acute bouts of PA may or may not have an effect on cognition (van den Berg et al., 2016). Further, PA breaks may not be any more effective than sedentary breaks, and there is a need for more research in that area (Owen et al., 2016). While the relative merit of PA breaks versus sedentary breaks is an interesting question, if the only valued outcomes were academic, social, or emotional, we believe that the contributions of PA have merit of their own. A suggestion from Ratey and Loehr (2011), with which we agree, is the need for ongoing research to further clarify the beneficial effects of PA on school engagement; cognition; and specific, foundational academic outcomes such as reading fluency.

Chronic Effects of Physical Activity Breaks in the Classroom

While it is gratifying to see that acute PA bouts have an immediate effect on reading scores, it is also important to consider the possibility that there might be a cumulative effect from the chronic

use of PA breaks. Results of the this study reveal children who take part in chronic and acute PA breaks may have better reading fluency than children who do not take part in such PA breaks. Though it is possible that the acute factor may account for the largest part of the variance, a chronic effect appears to exist to some degree in this study. This leads us to conclude that there may be academic value in the consistent practice of including PA breaks in the classroom. Additionally, as physical educators, we fully support the contribution such PA breaks make to the overall accumulation of healthful exercise habits that may extend in the critical years of adolescence in which PA declines (Blaes et al., 2011).

Limitations

Results and inferences of this paper extend only to second- and third-grade students and only in DIBELS testing at the end of the school year. We suggest a follow-up study that (a) tracks reading fluency pre-, mid-, and postyear to assess if there is a tipping point for chronic effects and (b) to test the effects of PA on reading fluency (amid all academic pursuits) through sixth grade or perhaps beyond. While it is encouraging to see chronic effects, they were weaker than we would have hoped for. This may not be surprising given ingrained characteristics of any kind are more stable and much more difficult to move in a given direction. While not of primacy in this study, there were no strict controls for the amount of MVPA during the PA breaks, rather just a simple use of GoNoodle products. Future studies can look at the dose-response, perhaps using heart rate telemetry.

As is underscored in the systematic reviews cited herein, there have been many different research designs employed to examine this or similar questions. Each, including this study, has it strengths and its weaknesses. With a quasi-experimental design, this study lacked full randomization at the student level given the children were members of intact classes—a common problem for field-based research in the public school setting. We were further given access only to the end-of-year DIBELS scores. Having access to the pre-, mid-, and posttest scores would have been ideal. Therefore, we recommend additional research in this area seek to include measures from throughout the year to assess the within-group differences as well as the between-group differences. While we did have a control group,

its comparative value must only be acknowledged with respect to the end-of-year DIBELS assessment.

Conclusion

Though the effects sizes were small to medium, we view the results of this study as encouraging. Reading fluency comprises a complex set of skills and to find a link between it and PA is noteworthy. It supports similar findings cited earlier in this paper—academic activities seem to benefitfrom PA. PA, we know, affects the health of children and the question of whether "healthy kids learn better" seems to be gaining traction in today's educational landscape. Although the results of this study may support this proposition, they do so only tangentially. We encourage additional research that investigates the connections between PA, health indices, and academic performance.

As the weight of evidence of the mind–body link continues to mount, perhaps educators, school administration, and parents should reconsider the long-held position that PA takes valuable academic learning time away from kids (Owen et al., 2016). Physical education, classroom activity breaks, before- and after-school PA programs, and community outreach (all components of a CSPAP) probably make a more significant contribution to academic achievement than is realized or accepted. Making a place for PA seems to hold merit for educating the whole child.

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