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BRIEF REPORT

Effects of Brief Mindfulness Practice on Reading Performance Among Racially Minoritized Adolescents

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This research evaluated the effects of a year-long mindfulness intervention in a predominately Black student sample in an urban high-poverty middle school. Five English Language Arts classrooms ($n = 56$) were randomly assigned to brief daily 5-min mindfulness practice or an active control. Students were measured at three time points throughout the school year on standardized curriculum-based measures of reading performance. Results indicate that students in the mindfulness condition had significantly higher reading scores (sentence-level comprehension and fluency) than students assigned to control condition at the end of the school year. Our findings indicate that brief mindfulness practice may indirectly affect performance in specific academic skills.

Impact and Implications

This article provides the first empirical evidence indicating that brief mindfulness practice (i.e., 5-min daily) may support reading among a sample of predominately Black and economically disadvantaged youth. This work provides initial support for the utility of mindfulness practices to indirectly affect reading performance of adolescents and details a viable universal classroom practice that shows promise for historically marginalized students.

Keywords: mindfulness, academic interventions, classroom-wide supports, universal intervention, reading

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Reading comprehension is the process by which meaning is constructed through interactions between the text and the reader (Durkin, 1989). In 2017, 64% of eighth-grade students fell below proficiency levels on measures of reading (National Center for Education Statistics, 2017), which is problematic because reading comprehension is foundational for success in virtually all other academic subjects (Okkinga et al., 2018). Low reading comprehension is especially concerning in middle school, as English Language Arts (ELA) instruction spends little time teaching foundational reading skills as instructors devote increased time on reading to learn curricular content (Langer, 2001), and thus there is a need for targeted intervention to support reading ability among adolescents. Unfortunately, interventions aimed at supporting students' reading comprehension are often time and resource intensive (Suggate, 2016), restricted to specific academic content areas (e.g., social studies; Swanson et al., 2017), and implemented outside of a general classroom setting (e.g., for students with disabilities; Solis et al., 2012). Furthermore, there continues to exist persistent racial and socioeconomic disparities in reading outcomes, particularly for students of color in poverty relative to White students in poverty (Paschall et al., 2018). As such, there is a significant need for brief effective interventions for adolescents from historically minoritized backgrounds to bolster reading comprehension in general education settings.

One innovative, effective, and increasingly popular school-based intervention modality is mindfulness-based programming (MBP; Felver et al., 2016; Roeser et al., 2023). Mindfulness is commonly defined as "the self-regulation of attention so that it is maintained on immediate experience" and "an orientation that is characterized by curiosity, openness, and acceptance" (Bishop et al., 2004, p. 232). Meta-analysis of the therapeutic effects of MBPs with youth found that universally small positive effects across diverse outcome

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variables, with largest effects observed among academic performance ($g = 0.34$; Klingbeil et al., 2017). However, virtually all of the extant literature exploring effectiveness of MBP on academic performance has examined *academic achievement* (e.g., quarterly grades, standardized achievement tests; Flook et al., 2015) and not specific *academic skills* (e.g., curriculum-based measures of reading). As an academic skill, reading comprehension requires readers to exercise metacognitive skills by monitoring their understanding of the text, asking questions as they read, and integrating what they are reading with prior knowledge (Durkin, 1989). Through the practice of paying attention to internal experience (e.g., cognitions), MBP may be particularly beneficial in the superordinate domain of reading comprehension via improvements to subordinate metacognition (Klingbeil et al., 2017) and other domain-general cognitive skills (e.g., attentional control; Kim, 2020). Despite the potential of MBP for improving reading skills in youth, to-date there is no published clinical trial examining the utility of MBP for improving academic skills among racially diverse adolescent populations.

This research addresses gaps in the literature by examining the utility of a brief MBP (i.e., daily mindfulness practice) as a time- and resource-efficient tool to indirectly improve adolescent reading comprehension among a sample of predominantly Black adolescents from a low socioeconomic status urban public school setting. Given that large racial disparities exist in reading achievement (Musu-Gillette et al., 2016; Paschall et al., 2018), the selected student sample is important for evaluating a potentially equity-promoting solution to improve reading achievement among historically marginalized groups. Consistent with prior literature, we hypothesized that students in the MBP condition would demonstrate significantly greater gains in reading measures (e.g., comprehension) over the course of the school year relative to students in an active control condition.

Method

Participants

This study took place at an urban middle school in a small city in the northeastern United States. Most students enrolled in the school were Black (70%) and economically disadvantaged (88%). Only 8% of the school's students, and 4% of Black students, achieved proficient scores on the state's ELA assessment (New York State Education Department, Office of Information & Reporting Services, n.d.).

Seventh-grade students across five general education ELA classrooms who were not identified as limited English proficiency or English language learners were eligible for participation. Eligible students ($N = 91$) received recruitment documents to bring home seeking consent for research participation. Most parents/legal guardians provided consent ($n = 56$, 62%) and these students were subsequently approached for assent (presented orally and in writing), which was unanimously provided. Some parents did not return consent forms ($n = 22$, 24%) or declined consent ($n = 13$, 14%). Demographic characteristics of study participants were representative of the school and are presented in Table 1.

Research Design

Two teachers were recruited to participate in this study; one teacher taught two classes of seventh-grade ELA and one teacher taught three classes. A cluster randomized controlled trial design was used, with classrooms within teachers ($n = 2$) randomly assigned to mindfulness ($k = 3$) and control ($k = 2$) intervention conditions.

Interventions

Seventh-grade students had ELA class every school day, and teachers delivered the interventions at the beginning of every ELA class period. *Intervention fidelity* was assessed via teachers' self-reported administration of intervention content during each ELA class period using a article and pencil intervention log. The percentage of ELA classes students attended during the intervention phase served as our measure of *intervention dosage*.

Mindfulness

ELA teachers played one of four mindfulness practice audio tracks, adopted from a widely implemented MBP, *Learning to BREATHE* (L2B; Broderick, 2013). The audio tracks were about 5 min in duration and representative of standard guided mindfulness practices, including body scan, awareness of feelings, awareness of

Table 1
Demographic Characteristics

Demographic characteristic	Total study sample ($n = 56$)	Mindfulness condition ($n = 36$)	Control condition ($n = 20$)
Gender—female	50%	50%	50%
Race/ethnicity			
American Indian/Alaska Native	2%	0%	5%
Asian	4%	5%	0%
Black or African American	78%	78%	80%
Hispanic or Latino	0%	0%	0%
White	16%	17%	15%
Educational disability[a]	18%	14%	25%
Economically disadvantaged[b]	80%	75%	90%

[a] Defined as student qualifying for special education and having an Individualized Education Program (IEP). [b] Defined as student's household's annual family income being equal to or less than 185% of the amount under the annual United States Department of Health and Human Services poverty guidelines for the applicant's family size for the applicable year.

thoughts, and loving-kindness. Each track included instructions on regulating attention to somatic sensations (e.g., breathing) and guidance on engendering mental habits (e.g., nonjudgment, kindness toward self and others).

Given the lack of familiarity of MBP for these adolescents, the second author provided three 15-min supplemental mindfulness activities to each classroom. At intervention onset, students received a presentation that defined mindfulness and set behavioral expectations while the audio tracks were played. At midintervention, students completed mindful listening practice by noticing the quality of a rung tone bar. Near postintervention, classrooms were guided through a mindful eating exercise by noticing smells, tastes, and textures of a provided snack.

Control

Students assigned to the active control conditions completed "Do Now" tasks (e.g., brief writing assignment on an assignment book), which were created by the participating ELA teachers. These "Do Now" tasks were designed to match the time requirements of the mindfulness audio tracks (e.g., 5 min), and were implemented to supplement the school's ELA curriculum.

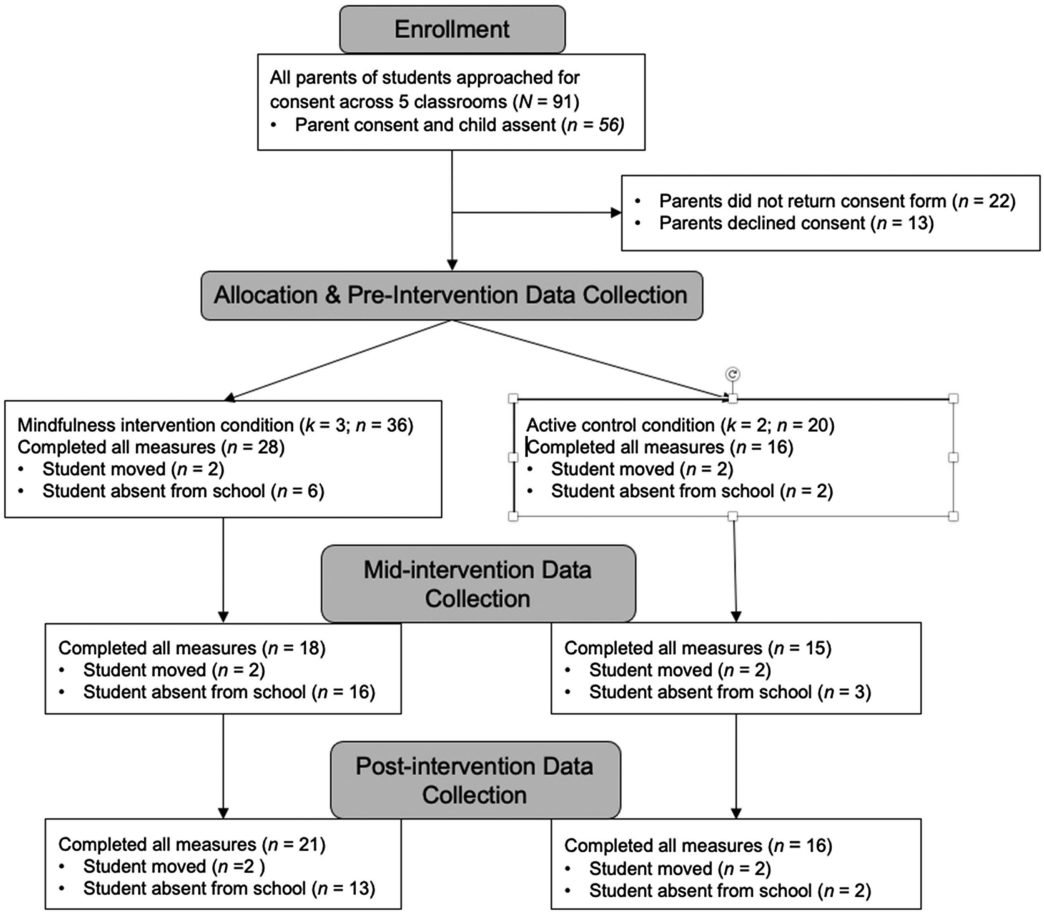
Measures

Data were collected in students' ELA classroom and during their typical class time at three time points: preintervention (September), midintervention (January), and postintervention (May). Data collection at each time point occurred during two consecutive school days, with a makeup session scheduled the next week for absent students. Due to consistent student absences and three students moving out of the district, there were missing data at each time point (see Figure 1, for participant flow).

Reading

STAR Scaled Scores. The STAR reading assessment is a computer-adaptive, norm-referenced broad reading measure for students in first through 12th grades. During this assessment, students are required to choose the best word to complete a sentence following reading a brief reading passage. Adequate psychometric properties have been reported for seventh-grade students, including internal ($\alpha = .93$) and test–retest reliability ($r = 0.83$; Renaissance, 2015). The STAR reading assessment was administered at three time points: preintervention, midintervention, and postintervention.

Figure 1
Participant Flow During Study Phases



AIMSweb Maze. The Achievement Improvement Monitoring System (AIMSweb) Maze (Shinn & Shinn, 2002) is a norm-referenced, standardized curriculum-based measure used to assess sentence-level reading comprehension and reading fluency (January & Ardoin, 2012) of students in Grades 1–12. The AIMSweb Maze is administered to groups as a single 3-min assessment; each Maze passage is 150–400 words in length, and the raw score is the number of correct responses. Adequate psychometric properties have been reported for seventh-grade students, including concurrent validity ($r = 0.50$–0.66) and test–retest reliability ($\alpha = .64$–$.91$; Tolar et al., 2012). We included the easy practice test (Shinn & Shinn, 2002) in our administration to ensure that students understood the task. The decision to use the AIMSweb Maze measure in addition to the STAR assessment was made because the participating school erroneously informed us after preintervention time point that they were discontinuing STAR assessment data collection and that there would be no mid- or postintervention reading data available. Therefore, we administered the AIMSweb Maze beginning at midintervention time point; the school later reversed this decision and collected STAR assessment data across the school year.

Analytic Strategy

The a priori decision was made to include intervention dosage as a covariate in all analyses. We employed multiple imputation procedures to address anticipated missing data due to student absences during data collection (see Supplemental Materials). We also included a self-report measure of mindfulness (Comprehensive Inventory of Mindfulness Experiences–Adolescents; Johnson et al., 2017) as an intervention manipulation check; however, this variable was dropped from our final analysis due to significant missing data (see Supplemental Table 1) and the low reading skills in this sample which likely confounded accurate self-reporting of psychological attributes. Preintervention between condition demographic data were analyzed to determine additional covariates to include in subsequent analyses.

Due to the degree and hierarchical structure of missing data in this study, we used a two-level imputation approach (multivariate imputation by chained equations; van Buuren & Groothuis-Oudshoorn, 2011), along with a linear mixed model to analyze 100 imputed data sets. A two-level (i.e., students nested within classroom) linear mixed-effects regression model evaluated mindfulness intervention effects on reading over time. Imputation was conducted using the "pan" package (van Buuren & Groothuis-Oudshoorn, 2011; Zhao & Schafer, 2018) in R statistical software package (R Core Team, 2022). Pan employs the Gibbs sampler for the two-level linear model with homogeneous within-group variance, a variant of the multivariate linear mixed-effects model (Schafer & Yucel, 2002).

Results

Data Screening and Imputation

We explored missing data for both reading outcome variables at each time point and most contained more than 10% missing data variables (range 4%–27%). As statistical analyses may be biased with this degree of missing data (Bennett, 2001), multiple imputation procedures (Schafer, 1997) were employed (see Supplemental Materials, for details of the multiple imputation procedure).

Intervention Dosage and Fidelity

There were 156 school days between pre- and postintervention measurement time points. Intervention dosage (i.e., student attendance to ELA classes) did not differ between intervention conditions, $t(54) = 1.22$, $p = .23$; students in the mindfulness condition attended 86% of classes, and students in the control condition attended 91% of classes. Regarding intervention fidelity, one teacher reported delivering interventions 115 days during this time period (74%), and the other reported 146 days (94%).

Baseline Data Characteristics and Covariate Identification

All outcome measures at preintervention time point, student demographic characteristics, and intervention dosage were not different between study conditions ($p > .05$). Students' preintervention STAR Standard Scores were evaluated as a function of classroom, condition, and student demographic characteristics. The only differences found were between classrooms, $F(4, 51) = 5.29$, $p < .05$, and between students with ($M = 376$, $SD = 158$) and without ($M = 512$, $SD = 172$) educational disabilities, $t(54) = 2.31$, $p = .025$; these variables were therefore included—in addition to intervention dosage—as covariates in all subsequent analyses.

Reading: AIMSweb Maze Scores

We examined the interaction between the fixed effect of condition assignment and the slope of AIMSweb Maze reading comprehension scores across two time points (i.e., mid- and postintervention) to evaluate for intervention effects. Additional fixed effect covariates in the model included preintervention STAR score (to account for preexisting baseline differences on reading comprehension), educational disability status, and intervention dosage. Pooled results of 100 imputed data sets were interpreted (see Supplemental Table 2). These analyses indicated statistically significant intervention effects of mindfulness intervention on reading comprehension, with a significant interaction between condition assignment and time ($\beta = 4.41$, $t = 2.54$, $p = .013$). There was also a main effect of time ($\beta = 6.11$, $t = 1.22$, $p < .01$) and no main effect of condition assignment ($\beta = -1.99$, $t = 3.64$, $p = .58$). Interpretation of raw score values (see Table 2) indicated that participants assigned to the mindfulness condition increased in their reading performance over time relative to students assigned to the control condition.

Reading: STAR Standard Scores

We used a similar linear mixed-effects regression imputation model to evaluate mindfulness intervention effects on STAR scores across all three time points, with included covariates of educational disability status and intervention dosage. Pooled results of 100 imputed data sets did not find any statistically significant main effects (time and intervention assignment) or intervention effects (time by intervention interaction) on the STAR reading assessment ($p > .05$; see Supplemental Table 3).

Discussion

Our study expanded upon prior literature to evaluate the extent to which brief MBP can be implemented to support academic skill

Table 2
Study Variable Descriptive Statistics (Unadjusted Values)

	Mindfulness			Control		
	Preintervention	Midintervention	Postintervention	Preintervention	Midintervention	Postintervention
Measure	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
STAR standard score	495.42 (204.24)	463.03 (279.92)	548.86 (251.96)	474.48 (111.20)	418.83 (125.13)	482.62 (110.08)
AIMSweb Maze	[a]	16.43 (7.43)	21.70 (18.80)	[a]	17.10 (6.50)	18.80 (5.54)

Note. AIMSweb = Achievement Improvement Monitoring System.
[a] Data were not collected at this time point.

performance among adolescent students. Students who received a brief mindfulness intervention read 4.41 more words correctly on a 3-min curriculum-based measure over the course of a school year relative to students in an active control condition. These results indicate positive effects of mindfulness practice on measures of reading among a sample of predominately Black and low-income students. Given the large disparities apparent in standardized measures of reading (Musu-Gillette et al., 2016), our results provide promising preliminary support for the benefits of time-efficient MBP to improve educational outcomes among historically minoritized adolescents.

Our findings also provide some evidence to support the utility of MBP specifically for increasing measures of reading performance. We found that students who received MBP improved their scores on the AIMSweb Maze relative to students in the control condition. Given that AIMSweb Maze measures sentence-level comprehension and fluency (January & Ardoin, 2012), future research should evaluate the extent to which MBP is beneficial for strictly reading comprehension relative to other related reading skills such as fluency. However, contrary to our hypothesis, students who received MBP did not also improve their performance on the STAR when compared to students in the control condition. This null result may be due to our small sample size, which created a lack of power to detect our hypothesized effect (see Supplemental Materials).

Similarly, we hypothesized that MBP would be particularly useful in bolstering reading comprehension given demonstrated improvements in metacognition as a result of mindfulness training. However, it is important to note that other mechanisms may be responsible for improvements in academic skills following MBP, such as attention regulation (Klingbeil et al., 2017) or other subordinate domain-general cognitive skills (Kim, 2020). Future research should consider the hierarchical relation of attention regulation and other cognitive skills related to both mindfulness and academic performance to empirically explore indirect effects of MBP on academic outcomes.

The mindfulness stress buffering account (Creswell & Lindsay, 2014) suggests that MBP improves academic performance through reductions in stress—which also indirectly affects attention regulation—that may operate as a barrier to learning. Such an explanation is particularly relevant for our study given our sample consisted of economically disadvantaged and historically marginalized adolescents who face an inordinate number of environmental stressors (Levy et al., 2016). Future research should continue to attend to the mechanisms by which MBP demonstrates its positive effects on a variety of measures of academic performance.

Future research should consider direct measurement of mindfulness as a psychological construct. Such measurement may include self-report measures of state mindfulness (e.g., Comprehensive Inventory of Mindfulness Experiences–Adolescents; Johnson et al., 2017); however, self-reporting mindfulness has significant limitations (see Grossman, 2011) and other measurement methodologies have been recommended (Felver et al., 2018). Measuring mindfulness could allow for testing of direct and indirect pathways related to observed changes in academic skills, which may in turn inform development of future mindfulness-based academic interventions and supports.

Limitations

Classrooms in this study were randomly assigned to either the mindfulness or the control conditions; however, students within these classrooms were not assigned to their respective condition at random. Although baseline examination of demographic differences between groups suggested that classroom composition was similar, it is possible that assigning students to classrooms based on scheduling logistics may have inadvertently introduced bias into the sample. Similarly, observed differences in reading may also be attributable to a lack of equivalent instruction. Although we included classroom and preintervention scores as a covariate in all analyses, and both teachers utilized the same reading curriculum, it is possible that students received differential instruction as a function of their classroom environment that was not fully accounted for in our experimental design and analyses. Student average attendance during ELA class periods was used for a measurement of intervention dosage; however, this measurement is limited in that it does not account for teacher's imperfect fidelity of intervention delivery. Future research employing similar study designs should include a more precise measurement of student-level intervention dosage that accounts for both student attendance and intervention fidelity.

The current research experienced high rates of missing data, and thus employed multiple imputation methods to predict the values of the missing data. The high rates of missing data were not unexpected for two primary reasons. First, missing data rates of 15%–20% are common in educational and psychological studies (Enders, 2003). Second, this specific study took place in a high need urban public school setting where 44.1% of the student population displayed chronic absenteeism in the 2017–2018 school year (New York State Education Department, Office of Information & Reporting Services, n.d.). While analytic results were consistent across both the original and imputed data sets, the observed results should be interpreted with caution due to the large percentages of missing data.

Finally, it is worth noting that our sample may have limited the generalizability of our findings. Although we consider use of an understudied population of predominately Black urban middle

school students a considerable strength of our study, it is possible that the observed results may not generalize to other student populations of different grades or socioeconomic backgrounds. In addition, bias may have invertedly been introduced through the informed consent process such that students experiencing lower reading skills or greater stressors may have been less likely to opt into participation in the study (Pokorny et al., 2001).

Future Research

Our results provide some support for the utility of MBP in fostering improvements in students' reading performance. However, given the novelty of our research questions and the limitations inherent in our design, further research is warranted. Specifically, research should examine the extent to which MBP may indirectly improve reading comprehension above and beyond interventions that explicitly teach reading comprehension skills (e.g., reciprocal teaching; Palinscar & Brown, 1984). In addition, research should measure and directly compare study implementation characteristics (Baelen et al., 2023) and core program components (Felver et al., 2023) to explore how effective MBP is relative to other well-established interventions to provide more persuasive evidence for the benefits of MBP for reading comprehension.

Central to mindfulness-based intervention studies is a question concerning the necessary dosage to impact the outcome variable. The present study observed differences in reading comprehension performances between the intervention and condition assignment at only postintervention, which translates to the students in the mindfulness classrooms having completed daily 5-min mindfulness tracks for approximately 8 months. Therefore, future research should explore the necessary dosage for daily mindfulness audio tracks to impact student reading performances by having more than three time points. Additionally, it will likely be beneficial for future research to employ different mindfulness strategies to explore if similar results can be replicated. As an example, future work could complete the entire L2B (Broderick, 2013) MBP, instead of only brief guided practices via audio tracks, may yield similar patterns of results as those observed herein.

Conclusion

Many American students struggle with reading, and the racial and ethnic disparities across measures of reading outcomes are well documented (National Center for Education Statistics, 2017). It is imperative to design interventions to address student reading comprehension abilities as this skill is associated with overall academic progress and has serious implications for students' later societal and life outcomes (Okkinga et al., 2018). Mindfulness-based programming have generally been employed in schools to address behavioral and psychosocial concerns (Felver et al., 2016; Roeser et al., 2023). The current research is the first empirical evaluation of MBP for student reading performance in racially minoritized, high-poverty, student sample.

Results from the current research indicate that brief daily mindfulness practice may positively and indirectly affect adolescent student reading performances. Future researchers should first attempt to replicate these results and then explore how different MBPs may impact reading comprehension abilities, as well as other academic skills such as spelling, mathematics, and writing among diverse student samples.

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