



Adding Mindfulness to an Evidence-Based Reading Intervention for a Student with SLD: a Pilot Study

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Abstract

Students with specific learning disability (SLD) are at a greater risk for reading difficulties, academic stress, and deficits in self-efficacy. There are several research-supported interventions used in schools that are effective in increasing reading skills (e.g., reading fluency) but do not explicitly address academic stress or deficient self-efficacy. A possible solution may be the addition of mindfulness techniques, as they have been shown to support a wide range of related student outcomes. Incorporating mindfulness through an app-based delivery approach may be beneficial in this scenario as they are low cost, easily accessible, and a simple tool to help meet the unique social-emotional and academic needs of students with SLD. The current study examined the extent to which adding a brief, app-based mindfulness intervention to an already established evidence-based reading fluency intervention (paired reading) would improve reading fluency, academic stress, and self-efficacy for a student with an SLD in reading.

Keywords Learning disabilities · Reading · Academic achievement · Mindfulness

Special education law (Individuals with Disabilities Education Improvement Act [IDEA], 2004) defines specific learning disability (SLD) as a disorder in one or more of the basic psychological processes involved in understanding or in using language (spoken or written) that may manifest itself in the ability to listen, think, speak, read, write, spell, or to do mathematical calculations. Though the representation of students with SLD in special education has decreased slightly over the past several years (38% in 2013 to 33% in 2019), SLD continues to be the largest percentage of students represented in special education (National Center for Education Statistics

[NCES] 2019). Given its inherent challenges, children with SLD often require unique educational supports to succeed. Determining effective interventions to help students with SLD succeed in the educational setting, both for academic and social-emotional needs, is essential.

Reading Fluency

It is estimated that 80% of children with SLD struggle primarily with reading (Lyon et al. 2003). Many students with an SLD in reading experience difficulties in reading fluency (Bashir and Hook 2009; Chard et al. 2002; Mercer et al. 2000). Reading fluency is a complex construct concerning skills involved in reading text as a coherent whole, as opposed to reading individual words (Altani et al. 2020). In addition to accurate word recognition, automaticity (fast, effortless word recognition) and prosody (reading in a manner that expresses meaning through intonation) are also key components of reading fluency (Kuhn et al. 2010). The development of reading fluency is particularly crucial in constructing meaning from text, as it transforms reading into an automatic process that requires little attention to word recognition while reading (Bashir and Hook 2009; Chard et al. 2002; Mercer et al. 2000).

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Reading fluency is one of the primary educational goals for children in elementary school, especially in earlier grades, because it enables students to move beyond sight word reading and read novel text (Meisinger et al. 2010). Prior research suggests that students who struggle with reading fluency are less likely to learn content-area knowledge in class due to poor comprehension (Jenkins and O'Connor 2002). These students may also experience less motivation to read due to increased frustration and stress (Dudley 2005; Morgan and Fuchs 2007). As a result, dysfluent readers may not read as often, causing their reading skill development to lag behind peers who read more fluently (Meisinger et al. 2010). Consequently, students with SLD may quickly fall behind their peers. Because many students with SLD struggle in this area (Bashir and Hook 2009; Chard et al. 2002; Mercer et al. 2000), explicitly targeting reading fluency skills through evidence-based interventions (EBIs) is critical in helping students develop strategies to cope with their disability.

Reading Fluency Interventions There is a plethora of research identifying EBIs that can be implemented in schools. The most widely utilized academic interventions that specifically target reading fluency include general reading practice (Samuels 1979), paired reading (PR; Topping 1995), and repeated reading (Rashotte and Torgesen 1985). The current study utilizes a PR approach, which requires an interventionist to read a passage aloud while the student follows along silently, using their finger. The student then re-reads the same passage aloud to the interventionist, which alternates back and forth (Fuchs et al. 2000; Reading Rockets 2019). PR involves modeling and error correction for mispronounced or omitted words and hesitations greater than four seconds (Li and Nes 2001; Topping 2012). PR interventions can be used with any age or grade-appropriate book and are relatively simple to implement. Additionally, PR is effective when administered by teachers, teachers' aids, researchers, and skilled peers (Topping et al. 2011; Topping 2012). In a systematic review conducted by Topping and Lindsay (1992), PR interventions produced average gains in reading accuracy 2.1 times larger than control gains. These studies also yielded effect sizes (ES) in the large range for reading accuracy (ES = 1.6–2.2; Topping and Lindsay 1992).

PR interventions are effective for increasing reading fluency skills across many populations including students in urban school settings (Veerkamp et al. 2007), students who have emotional and behavioral disorders (Sutherland and Snyder 2007), children in foster care (Osborne et al. 2010), and students from around the world (McKinstery and Topping 2003; Murad and Topping 2000). In a large-scale randomized controlled trial (RCT) conducted by Topping et al. (2011), a PR peer intervention was evaluated in 80 schools in Scotland with 9 to 12-year-old students. Results of this study revealed that cross-age tutoring (tutees and tutors from grades separated by

at least 2 years) showed greater effects than same-age tutoring in the long-term. Short-term, students from low socioeconomic families, students with lower reading abilities (determined by teacher judgment and/or class test results), and girls improved significantly as a result of the peer PR intervention (Topping et al. 2011).

SLD and Academic Stress

Students who experience reading challenges may also experience significant stress in the academic environment (Panicker and Chelliah 2016). Academic stress refers to psychological pressure, distress, tension, worry, and anxiety over one's ability to perform academic activities (Ang and Huan 2006). Sources of stress may include school-related work demands, the school climate, relationships, social and performance expectations, evaluation, and interpersonal conflicts (Bedewy and Gabriel 2015; Sinha 2014). While exact estimates of students with SLD who encounter academic stress are unknown, research suggests that 70% of students with SLD experience higher anxious symptomatology than their typically developing (TD) peers (Nelson and Harwood 2011), and anxiety is a person's specific reaction to stress. Moreover, students with SLD have been found to have lower levels of resilience, meaning they might have inadequate coping skills and fewer resources to rely on in stressful situations (Panicker and Chelliah 2016). Academic performance is adversely impacted when students have challenging cognitive, psychological, and behavioral responses to school-related sources of stress (Ang and Huan 2006; Liu and Lu 2012).

Academic stress can lead to maladaptive behaviors and negative outcomes. Many students skip school-related activities, including social and evaluative situations, to avoid aversive stressful experiences (Kearney and Spear 2012). Moreover, frequent levels of stress generated from daily school routines can cumulatively undermine a student's emotional and cognitive ability to perform and deal with academic demands over time (Conley and Lehman 2012). Thus, lower academic achievement results when high stress stifles a student's motivation, emotional regulation, or mental ability to engage in learning activities (Struthers et al. 2000). Chronic academic stress can lead to poor academic adjustment, engagement, performance, and retention (Kadison and DiGeronimo 2004). Because of academic difficulties, students with SLD are more at-risk for academic stress (Panicker and Chelliah 2016), and this stress can negatively impact their emotional, behavioral, and educational functioning over time (Johnson 2017). Thus, academic stress may prevent students with SLD from performing to the best of their ability in the school setting. These negative outcomes warrant a need for simple, low-cost techniques to reduce academic stress experienced by many school-aged youth, including students with SLD.

SLD and Self-Efficacy

Along with experiencing significant levels of academic stress, students with SLD often report lower and/or inaccurate expectations for success compared to their TD peers (Gans et al. 2003; Butler and Schnellert 2015). Self-efficacy, which is defined as one's beliefs in their capability to succeed at a specific task (Bandura 1997), is a strong predictor of success within many academic domains (Meece et al. 1990; Spinath et al. 2006). Students with high self-efficacy tend to engage more adaptively in the learning process by using effective learning strategies, persisting in the face of challenge, and setting ambitious goals for themselves (Klassen and Usher 2010; Simpkins et al. 2006).

Some of the best determinants of self-efficacy are prior successes and failures (Bandura 1997). It is believed that students with SLD often have poor self-efficacy due, in part, to a history of academic struggles and failures (Butler and Schnellert 2015). Receiving encouragement and managing physiological arousal levels can lead to increases in self-efficacy (Bandura 1997). However, students with an SLD may not receive as much academic encouragement as their TD peers because their teachers perceive them as overconfident while lacking ability (Klassen and Lynch 2007). Furthermore, poor self-efficacy can create self-fulfilling prophecies, which further reinforce negative beliefs.

The Effects of Mindfulness on Academic Stress and Self-Efficacy

Mindfulness practices could help to manage physiological states for students with poor self-efficacy and SLD. Mindfulness is to exist in the present moment and become more aware (Langer and Moldoveanu 2000); it is a psychological state characterized by giving one's complete attention to experiencing the present without emotional reactivity (Van Vugt and Jha 2011). Mindfulness can be conceptualized as a skill (composed of awareness and acceptance), which can be taught through the administration of mindfulness-based interventions (MBIs; Renshaw 2019). A growing body of research has demonstrated positive effects of MBIs on social-emotional, cognitive, and academic outcomes (e.g., Ramsburg and Youmans 2014; Sedlmeier et al. 2012; Felver et al. 2014). For example, mindfulness may reduce symptoms that interfere with performance tasks associated with anxiety disorders (Vollestad et al. 2012). Mindfulness may also reduce academic anxiety levels either directly or indirectly by enhancing students' ability to execute additional coping or problem-solving strategies to deal with the stress associated with academic demands (Beauchemin et al. 2008). Given that negative physiological arousal, such as anxiety, inversely relates to self-efficacy, engaging in mindfulness practices may

positively affect self-efficacy. Some recent research supports this notion. For instance, Hanley et al. (2015) found a positive association between mindfulness and academic self-efficacy with college students following test failures.

As students with SLD are likely to experience academic stress and are at a higher risk for experiencing social-emotional problems as compared to their TD peers (Johnson 2017), mindfulness interventions may be especially well suited to meet the needs of these students. While MBI studies of students with SLD are minimal, research has shown that integrating mindfulness meditation practices into the daily activities of students with SLD can reduce anxiety symptoms, externalizing behavior problems, inattention, and increase academic achievement (Beauchemin et al. 2008; Haydicky et al. 2012). Studies also show that adults and children with SLD who participate in MBIs qualitatively report enjoying mindfulness practices and continue to use them post-intervention (Beauchemin et al. 2008; Mahoney-Davies et al. 2017). Taken together, students with SLD who engage in mindfulness may theoretically experience less academic stress and have more confidence in their reading skills, which, in turn, could positively impact their academic skills.

Mindfulness Interventions in Schools MBIs originated in clinical settings and have since evolved to be a useful tool utilized in schools (Zenner et al. 2014). Although there are many different techniques to teaching mindfulness processes, schools tend to rely more heavily on programs that follow a mindfulness-based stress reduction (MBSR) approach (Renshaw 2019; Semple and Burke 2019). MBSR focuses primarily on mindfulness processes (e.g., breathing exercises), with no other therapeutic processes incorporated in the curriculum. Common features found in school-based MBI curriculum include psychoeducation regarding mindfulness, exercises for practicing mindfulness, psychoeducation regarding emotional and/or behavioral regulation strategies (to be used in addition to mindfulness), and exercises aimed at practicing these learned regulation strategies (Renshaw 2019; Renshaw and Cook 2017). This intervention type has been adapted for use in classroom settings but can be used outside the class on an individual basis as well. In addition, MBIs are effective and deemed feasible when administered by teachers and other trained school personnel (e.g., school psychologists, school counselors; Renshaw 2019; Semple et al. 2017).

Common barriers that may prevent schools from adopting MBIs are the cost involved, and the time required to train school personnel and administer the interventions (Renshaw 2019). A possible solution to these barriers could be to use application-based delivery approaches to mindfulness. Mobile devices (e.g., smartphones and laptops) are increasingly accessible to the general population, providing greater practicality for school personnel and students to utilize their applications. In addition, applications aimed at delivering

mindfulness are low cost (some even free) and require no training/implementation time on behalf of school personnel. Like in-person MBIs, app-based delivery methods have been found to have a beneficial impact on several life outcomes (e.g., stress, well-being, emotional regulation; Economides et al. 2018). Further research investigating the effectiveness of MBIs is needed, especially with children and in the school setting.

The Current Study

There is a high incidence of SLD in school-aged students (NCES 2019). Students with an SLD in reading experience difficulties in both fluency and comprehension (Chard et al. 2002). As strong fluency is a prerequisite to comprehension, the development of strong fluency skills in this population is essential (Bashir and Hook 2009). Furthermore, there is a link between SLD, academic performance, academic stress, and self-efficacy. Specifically, students who have SLD are more at-risk for poor academic performance (Cortiella and Horowitz 2014); poor academic performance may impact academic stress (Panicker and Chelliah 2016); and subsequently, lower-self-efficacy (Butler and Schnellert 2015), which theoretically may continue to result in negative academic outcomes. Determining an effective and feasible intervention to implement in school settings for students with SLD is imperative. However, it is important for students with SLD to receive interventions that not only increase their reading skills but also address academic stress or deficient self-efficacy. Mindfulness has been shown to support a wide range of student outcomes such as wellbeing, stress, self-esteem, self-regulation, positive behavior, and academic learning (Ramsburg and Youmans 2014; Sedlmeier et al. 2012; Felver et al. 2014). Thus, it is pertinent to extend the research to students with SLD. However, the research on the effectiveness of mindfulness and SLD is minimal. As such, the current pilot study evaluates the relative effects between a brief app-based mindfulness intervention merged with a PR intervention on reading fluency skills, academic stress, and self-efficacy.

Method

Research Design

We implemented an alternating treatments (AT) single-case design (SCD) to examine if a brief app-based mindfulness intervention plus a PR intervention (PR+M) improved on reading fluency skills, academic stress, and self-efficacy above and beyond a PR intervention in isolation for a fourth-grade student with SLD. Randomization of condition implementation occurred prior to data collection.

Participants

Researchers collaborated with relevant school personnel to identify children who have an SLD in reading and who may benefit from a brief app-based mindfulness intervention merged with a reading intervention. School personnel recommended participants based on prior knowledge and did not utilize or access Family Educational Rights and Privacy Act (FERPA) protected information (e.g., IEP records). The participant in the current study, Eli (pseudonym), was a 10-year-old biracial (White and Tongan) male in fourth grade with an SLD in reading. Eli was in a general education classroom for most of the school day and in a special education setting during reading periods. He experienced reading difficulties, as evidenced by performance below national norms for his grade (< 133 words read correct [WRC] per minute; Hasbrouck and Tindal 2017) on initial reading curriculum-based measurements collected pre-intervention and per teacher report (rated as *Very Below Grade Level* on a pre-intervention survey). In addition, he experienced academic stress due to his deficits in reading (rated *Somewhat Stressed* by teacher; *Fairly Stressed* by mother). Eli's mother and teacher also briefly participated in the current study. Both individuals identified as White. At the time of data collection, Eli's teacher had been teaching for nine years and knew Eli for one of those years.

Measures and Materials

Pre- and Post-intervention Surveys Researcher-designed surveys were used pre- and post-intervention to collect relevant demographic data from Eli's mother and teacher, as well as their perceptions of Eli's current reading skills and academic stress. The pre-intervention survey, intended for parents, asked for information such as their racial/ethnic identity, services their child receives at school, and when these services started. The teacher pre-intervention survey asked for information such as how many years they have been teaching, how long they have known the child, and any additional information about the student they think would be helpful for researchers to know (e.g., student strengths, previous interventions). To better understand Eli's reading difficulties and academic stress, researchers asked Eli's mother and teacher pre- and post-intervention to (1) rate on a 5-point Likert scale their child/student's current reading level (options ranged from *Very Below Grade Level* to *Far Above Grade Level*), and (2) rate on a 5-point Likert scale their child/student's current level of academic-related stress (options ranged from *Not Stressed at All* to *Very Stressed*). All surveys were administered to Eli's mother and teacher online through the survey hosting website, Qualtrics (Qualtrics 2018).

Curriculum-Based Measurement Reading Twenty different curriculum-based measurement reading (CBM-R) (English) probes at the fourth-grade level from FASTbridge© were used to measure reading fluency skills (i.e., rate and accuracy; Christ et al. 2018). During this assessment, Eli was asked to read a passage (around 250 words in length) for 1 min. Researchers evaluated Eli's ability to read both quickly and accurately by taking the words read correctly in that minute and subtracting the number of errors made to obtain the total number of words Eli read correct per minute. Mispronunciations, word substitutions, omitted words, hesitations (words not pronounced within 3 s), and reversals (two or more words transposed) were all scored as errors. CBM-R is a commonly used standardized measure in schools to identify potential reading difficulties and progress monitor academic growth (Christ and Silberglitt 2007). General estimates of test-retest reliability for CBM-R aimed at measuring reading fluency (not specific to FASTbridge© CBM-R) are within the range of .89 and .97 (Christ and Silberglitt 2007; Howe and Shinn 2002).

Self-Efficacy Measure Self-efficacy to read a grade-level passage at a particular rate was measured using structured interview questions derived from prior "microanalysis" measurement research. Microanalysis measures of self-efficacy entail administering interview questions about participants' expectations for success on a task they are just about to complete (Cleary et al. 2012). For the current study, this measure was administered prior to Eli completing his second (out of three) reading passages. The interviewer asked, "Using this chart, where one means that you are *Not at All Sure* and seven means that you are *Very Sure*, how sure are you that you can read to this point or further on the next try?" Consistent with Bandura's (2006) recommendations for self-efficacy measurement design, the microanalysis self-efficacy measure was administered across three gradations of difficulty. Specifically, the interviewer presented Eli with increasingly difficult WRC criterion for him to assign how confident he was in his future reading skills (i.e., improving his WRC by one or more words, two or more WRC, and three or more words). Microanalysis items must be adapted for each use; however, similar microanalysis self-efficacy measures have been used in prior research and have shown adequate internal consistency (Callan; et al., 2019; Cleary et al. 2015; DiBenedetto and Zimmerman 2010) and to be predictive of achievement (Callan et al. 2019; Cleary et al. 2015).

There are several defining features of microanalysis interviews, including the measurement of self-regulated learning (SRL) processes (e.g., self-efficacy, goal setting, planning, strategy use, or reflection), targeting SRL in relation to a single task, and measurement in real-time. SRL entails a cyclical system of cognitive and metacognitive sub-processes that facilitate achievement in various academic domains (Schunk

and Greene 2017). Self-efficacy is one SRL process that is particularly relevant to measure for students with SLD because they often report insufficient levels of self-efficacy (Klassen 2010) and because self-efficacy significantly predicts achievement and supports the use of other essential SRL processes including goal setting, strategy use, and positive self-reflection (Zimmerman 2008).

Although prior research has not used SRL microanalysis with a reading task, the authors followed guidelines for designing SRL microanalysis measures provided by Cleary et al. (2012). Prior research indicates that SRL microanalysis measures often strongly predict achievement in a variety of domains such as athletic performances (Cleary and Zimmerman 2001), mathematical problem-solving (Callan and Cleary 2018), and creative problem-solving (Callan et al. 2019; Rubenstein et al. 2019). In addition, SRL microanalysis measures, such as those used in this study, have typically displayed strong reliability with Cronbach alphas ranging from .88 to .95 (Cleary et al. 2015; Cleary and Zimmerman 2001).

Headspace Headspace© is a guided mindfulness meditation application that can be used for both adults and children. It is available on iOS and Android mobile devices, as well as on the computer via the Headspace© website (www.headspace.com). A systematic review conducted by Mani et al. (2015) found Headspace© to have the highest-scoring mindfulness-based iPhone application as per the Mobile App Rating Scale (MARS) when compared with other leading competitors (e.g., Smiling Mind, iMindfulness; Average total = 4.0). The MARS rated the applications on classification, app quality (e.g., engagement, functionality, aesthetics, information quality), and satisfaction. For the current study, we used child-specific guided mindfulness exercises aimed at calming (i.e., breathing exercises). This specific set of exercises was intended for users between the ages of 9 and 12. Each mindfulness session on Headspace© lasted approximately 5–10 min. Eli completed each session via an iPad set up by the researchers, with the additional use of headphones.

Of the many mindfulness meditation applications available, the current evidence-base for Headspace© is minimal, particularly with regards to child populations. However, in general, mindfulness practices (e.g., meditation) have been found to have positive, though small, effects on academic, social, emotional, behavioral, and physical health outcomes in youth (Klingbeil et al. 2017). Headspace© may show promise in adult populations across various similar outcomes (Bennike et al. 2017; Bostock et al. 2019; DeSteno et al. 2018; Howells et al. 2016). One RCT, conducted by Economides and colleagues (2018), investigated whether an introductory mindfulness meditation program delivered via the Headspace application positively impacted stress, affect, and irritability, relative to an active control (10 excerpts from

Andy Puddicombe's audiobook *The Headspace Guide to Meditation and Mindfulness*). While both interventions effectively reduced stress associated with personal vulnerability, only Headspace© had a significant positive impact on irritability, affect, and stress resulting from external pressure. Given these positive outcomes in adults and the research base supporting that mindfulness practices are effective in child populations, Headspace© might work equally with children.

Subjective Units of Distress Scale The Subjective Units of Distress Scale (SUDS; Wolpe 1958) ratings were used following each session to measure level and change in Eli's self-reported feelings of stress. The SUDS has been used in prior studies to measure child and adult self-reported levels of discomfort (Kaplan et al. 1995), as well as disturbance or distress (Harris et al. 2002). A SUDS rating from 1 (*no anxiety; no distress*) to 6 (*high anxiety; maximum distress*), adapted from the Fear or Feeling Thermometer used in prior studies (Kendall et al. 2004; Silverman et al. 2001), was used for the current study. Significant correlations have been found between SUDS ratings and pulse and hand temperature, which is a biological marker of distress (Thyer et al. 1984), the Global Assessment of Functioning (GAF) Scale ($r = -.45$) and MMPI-2 ($r = .35$; Tanner 2012), and the State-Trait Anxiety Inventory ($r = .69$; Kaplan et al. 1995).

Social Validity Survey The degree that the experimental meditation procedures were perceived by Eli's teacher and parent as socially important and acceptable and that the outcome was effective (Horner et al. 2005) was assessed using a social validity survey created by the researchers. Participants were asked to rate three items with various statements about the intervention program using a 5-point Likert scale (1= *Not useful* to 5= *Very useful*). They were also asked to rate two items about Eli's reading level and academic stress post-intervention using a 5-point Likert scale (1= *Very below grade level* to 5= *Very above grade level*; 1= *Not stressed at all* to 5= *Very stressed*). Lastly, Eli's teacher and mother were asked to respond to an open-ended question regarding perceptions of intervention effectiveness.

Procedures

Participant Recruitment Eli was recruited from an elementary school in the Western United States via a referral by his general education teacher and vice principal due to the demonstration of below-grade reading levels, academic stress, and a special education classification of an SLD in reading. Researchers coordinated with his teacher in contacting Eli's family and obtaining informed consent.

Research Assistant Training Research assistants for the current study were the first and second authors. They were both

Educational Specialist (EdS) graduate students in school psychology. Both researchers first attended one training session (led by the third and fourth authors) in which a walk-through of the study's measures and procedures were presented. Both researchers also independently completed a series of FASTbridge© CBM-R (English) training modules online and were required to listen to various audio recordings of children reading, while electronically marking errors for scoring practice and reliability. In addition to meeting reliability through FASTbridge©, researchers also met research inter-rater reliability (85% or greater) with their supervisor.

Pre-intervention Parent consent and student assent were obtained. Prior to intervention implementation, Eli's mother and teacher completed a brief demographic questionnaire online through Qualtrics. On the same online platform, Eli's mother and teacher answered questions involving their perceptions of Eli's current reading skills and academic stress.

Pre-intervention Target Assessment Though an AT design that compares the effectiveness of two interventions does not require a baseline condition (Kratochwill et al. 2013), we completed a target assessment to measure Eli's pre-intervention reading fluency skills, reading self-efficacy, and academic stress levels. During this initial session, a researcher administered a grade-appropriate (i.e., 4th grade) CBM-R probe, and then asked Eli to rate his confidence (self-efficacy) in getting to increasingly further words in the text (WRC). The remaining two CBM-R probes were then administered, and Eli was asked to rate his perceived level of academic stress related to the task (SUDS). This session lasted approximately 30 min and was video recorded so an outside observer could review for (1) session implementation fidelity and (2) CBM-R scoring fidelity.

Intervention Sessions Following the target assessment, the two alternating interventions (PR and PR+M) were implemented. The order of these interventions was randomly determined by researchers using an online random number generator. Intervention sessions were conducted at Eli's school in the library during school hours, four times per week (once a day) for two weeks (eight sessions total; four PR and four PR+M). Sessions were administered by the two trained graduate student researchers, who alternated going into Eli's school to implement the interventions. The intervention sessions lasted approximately 35 min for both the PR condition and the PR+M condition. All intervention sessions were video-recorded so an outside observer could review the videos for (1) session implementation fidelity and (2) CBM-R scoring fidelity.

PR Condition During the PR sessions, Eli was first asked to follow along silently and with his finger. Simultaneously, a researcher read a passage from a fourth-grade-level book

(*Who Was Abraham Lincoln?* by Janet B. Pascal) aloud to him. This book was picked by researchers based on its reading and interest level, as well as Lexile score. The Lexile Framework for Reading is a scientific approach that places both the reader and text on the same developmental scale (Smith et al. 2016). *Who Was Abraham Lincoln?* is said to have a grade-level equivalent of 3.9, an interest level for grades 2–5, and a Lexile measure of 720 Lexiles (grade-level for fourth-grade ranges from 735 to 1160 Lexiles; MetaMetrics Inc. 2021). Because of Eli's reading difficulties, this grade-level text was deemed to be at the frustrational level (problematic text for the reader, with fewer than 93% known words; Gickling and Armstrong 1978).

During the PR sessions, the researcher then prompted Eli to read the same passage back to them out loud. If he came to a word he did not know, the researcher would wait 4 seconds, help him pronounce the word, and ask that he repeat the word back to them. Following, he would continue to read. This PR lasted approximately 15 min. Directly following the PR intervention, the researcher administered three CBM-R probes and recorded Eli's errors and WRC per minute. Eli then rated his perceived level of academic stress related to the reading task (SUDS).

PR+M Condition First, Eli was asked to complete the PR only intervention procedures, as described previously. He was then asked to complete a guided mindfulness session aimed at calming and relaxing on the Headspace© application. This mindfulness session included simple breathing exercises and took approximately 3 min to complete. Directly following the brief mindfulness session, a researcher administered three CBM-R probes and recorded Eli's errors and WRC per minute. Eli then rated his perceived level of academic stress related to the reading task (SUDS).

Post-intervention Target Assessment Post-intervention target assessment data were collected to measure Eli's reading fluency skills, self-efficacy, and academic stress levels following the 10-day study period. A researcher administered the first CBM-R probe and asked Eli to rate his confidence in getting to increasingly further words in the text (WRC). As with before, the remaining two CBM-R probes were then administered and following, Eli rated his perceived level of academic stress related to the reading task (SUDS). This session lasted approximately 30 min and was video recorded so an outside observer could review for (1) session implementation fidelity and (2) CBM-R scoring fidelity.

Post-intervention Following the conclusion of all sessions, data were collected from Eli's teacher regarding her perceptions of the intervention (e.g., effectiveness and feasibility) by completing a social validity survey online via Qualtrics. It is important to note that Eli's mother was asked to complete a similar social validity survey but failed to do so. Researchers

made several attempts via email to obtain this information with no success.

Treatment Integrity and Inter-Observer Agreement During each session, the researchers completed a checklist of intervention steps to ensure treatment integrity. Throughout the intervention, 100% of the steps were completed. Of the video recorded intervention sessions, 50% of randomly selected sessions across phases were examined by an independent rater trained in the intervention procedures. This rater confirmed that 100% of the steps were completed by the interventionists for each session reviewed. The same sessions were also examined to determine inter-observer agreement (IOA) for CBM-R probes. Prior to this examination, the independent rater was trained in using CBM-R probes and met research inter-rater reliability (85% or greater) with another outside trained researcher. IOA was calculated by first totaling the agreements of the WRC per minute between the researchers and the independent rater. This number was then divided by that total plus the total number of disagreements and multiplied by 100. The average IOA across all passages administered in the current study was 96.21%.

Data Analysis Plan

Reading Fluency We conducted visual analysis by evaluating changes in level, trend, variability, immediacy of the effect, and overlap (Kratochwill et al. 2013). For all phase comparison visual analyses, PR was considered the first phase and PR+M was considered the second phase. This order was chosen because PR is an established EBI, and the study evaluated if adding mindfulness further improves reading fluency. While visual analysis is common in SCD research, there are several highlighted issues with this approach, such as subjectivity in showing reliable intervention effects, hidden trends in data undetected by visual analysis, and reporting only clearly significant effects (Kazdin 2011). Including effect size measures can complement visual analysis. Thus, we calculated a measure of effect size to help determine intervention effectiveness—Nonoverlap of all Pairs (NAP). NAP is an index of data overlap between phases, frequently used in single-case research. For this analysis, PR was treated as the baseline and PR+M was treated as the intervention. We also descriptively compared pre- and post-intervention target assessment results.

Self-Efficacy and Academic Stress We descriptively evaluated changes in self-efficacy pre-post intervention using the micro-analysis target assessment data. We calculated and compared the averages of the three self-efficacy scores pre- and post-intervention. We descriptively evaluated changes in academic stress over time using SUDS data across all 10 intervention sessions.

Results

Reading Fluency Skills

Level analyses indicated that the mean WRC per minute in the PR+M phase was 52.25, which was greater than mean WRC per minute during the PR phase (49.25). Trend analyses showed the slope for the PR phase (.29) in comparison to the PR+M phase (.08). Variability analyses indicated that both PR (SD = 4.35, range= 45–55) and PR+M (SD = 4.27, range= 47–57) phases yielded comparable variability. The PR+M intervention showed a faster immediacy of the effect (the second session in the phase); however, a slight decrease in WRC per minute occurred during the remainder of intervention sessions. The PR condition resulted in a more gradual increase in WRC per minute over time. A notable increase in reading fluency skills from pre-intervention target assessment (44 WRC) to the post-intervention target assessment (56 WRC) was documented. The proportion of data that overlap between the PR and PR+M phases was .38. NAP results indicated that 72% of data improved from the PR to the PR+M phase (see Fig. 1).

Self-Efficacy and Academic Stress

During the pre-intervention target assessment, analyses revealed that Eli's mean self-efficacy score was 5.33 (out of 7) across the three self-efficacy questions. This was slightly less than his mean self-efficacy score during the post-intervention target assessment session (5.67). Based on data obtained through the SUDS, Eli's academic stress did not change over time. He rated himself as a 1 (*no anxiety; no distress*) throughout the study's duration, despite parent and teacher reports of heightened levels of academic stress.

Social Validity

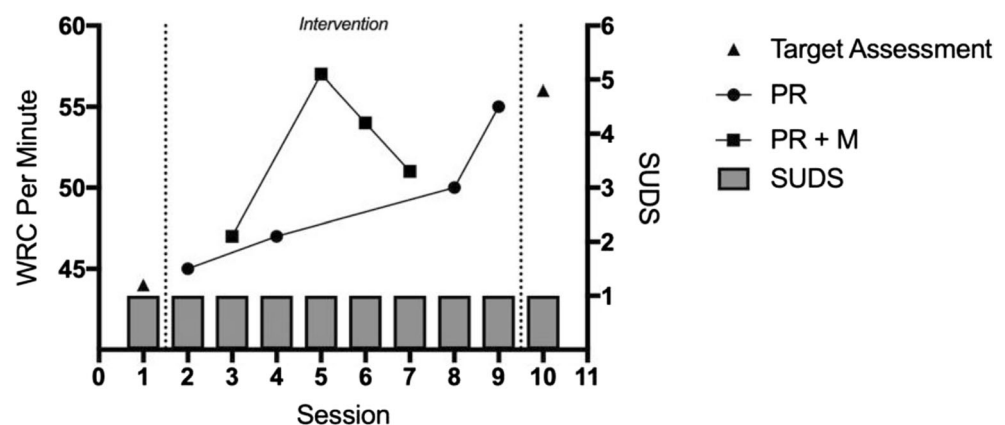
Analysis of the data provided from the teacher social validity survey indicated that the app-based mindfulness intervention

was perceived by Eli's teacher as not only useful in improving overall reading skills and academic stress, but it was also perceived as being feasible to implement in the classroom with her students in the future. It is important to note that although she reported that the intervention was useful and feasible, she still noted that Eli's reading level and academics stress were not at age or grade-level expectations following the intervention.

Discussion

In the current study, we examined the effects of a brief app-based mindfulness intervention added to an EBI for reading fluency skills (PR) and its impact on student-reported self-efficacy and academic stress for a fourth-grade student with an SLD in reading. Though previous research has suggested that interventions of greater duration and intensity are more effective and desirable (Ross and Begeny 2015), Eli showed improvements immediately following intervention implementation. Overall, Eli's reading fluency skills improved as a result of both interventions. Due to unclear patterns (Roane et al. 2011), visual analysis results did not clearly conclude whether PR or PR+M was superior. Analyses of level and immediacy suggested that the PR+M intervention resulted in better reading fluency skills, while analyses of trend supported that the PR intervention led to better reading fluency skills. Analysis of variability was almost identical. However, NAP effect size results suggested that PR+M condition resulted in more improvements. Taken together, results suggest that it is possible that a PR+M intervention may result in slightly higher reading fluency skills. Although the design met WWC standards with reservations, and one participant is acceptable for an AT design (Kratochwill et al. 2013), these results should be interpreted with caution. Additionally, due to both interventions demonstrating effectiveness but with an unclear pattern of which condition was superior, relative effects may not be established with certainty (Axelrod 2017). Our current data suggests that it is possible that the trend we observed would

Fig. 1 Alternating Treatment Single-Case Design graph visually representing Eli's reading frequency and academic stress. *Left y-axis* is reading fluency, measured in words read correct (WRC) per minute. *Right y-axis* is self-reported ratings of academic stress, measured on a scale of 1–6. The *x-axis* denotes session number. PR paired reading only condition, PR + M paired reading plus mindfulness condition



continue, and both interventions would be deemed effective. However, it is also plausible that an increased dosage of the PR+M condition would change this trend. In our study, the participant received only four PR+M intervention sessions (25 min of mindfulness total), which may be insufficient to show noticeable effects, as this dosage is less than the average of mindfulness-based interventions for youth in schools (Felver et al. 2016). Although our study's purpose was to evaluate the effectiveness of a brief mindfulness intervention, additional sessions may be beneficial. More research is required to supplement and corroborate these pilot data results before making absolute claims regarding the benefits of adding mindfulness to PR.

With regard to academic stress and self-efficacy, our data do not support a relative effect between either of the interventions and these outcome variables. Although parent and teacher reports indicated that Eli experienced low self-efficacy and high academic stress, Eli did not self-report these concerns. There was a slight improvement in Eli's self-efficacy. However, this difference is arguably not clinically meaningful. Eli's self-reports of moderate pre-intervention self-efficacy and low academic stress could have impacted the lack of variability and observed ceiling effects. These self-reports may be accurate and representative of Eli's actual levels of academic stress and self-efficacy, or Eli could have not fully comprehended the constructs given his age rendering his self-reports inaccurate. Social validity results showed that the intervention was feasible to implement in the classroom setting and improved Eli's reading fluency skills. The takeaway from these results is that implementing this intervention in the classroom is doable and possibly meaningful, though further research is needed.

Limitations and Future Research

Although results obtained in this pilot study are promising, several limitations must be considered. First and foremost, the inclusion of one participant in a SCD implies that findings cannot be generalized to the entire population of students with an SLD in reading. Our findings provide proof of concept that adding a brief mindfulness component to evidence-based reading interventions may be impactful for students with SLD, which provides a rationale for additional replication studies using single-case or group design methodologies that will result in larger samples. These studies are required to determine actual effects and before making generalizing claims about adding a mindfulness intervention to enhance the effectiveness of reading fluency EBIs further.

Another potential limitation is the use of the AT design. As mindfulness is a skill, it is conceivable that carryover effects across conditions could occur. Although plausible, it is unlikely because Eli did not have access to the mobile application

outside of the intervention and he was not prompted, nor did he have time, to engage in mindfulness directly before progress monitoring. As a result, it is not likely that his mindfulness skills were interfering with the PR condition. Next, due to the nature of the applied research and time restraints associated with the school district and university schedules, only four repetitions of the alternating intervention sequence took place. According to What Works Clearinghouse (WWC) standards for SCD research, five repetitions are necessary to meet standards (Kratochwill et al. 2013). Therefore, this study met with reservations. Further research should consider additional repetitions of the alternating intervention sequence.

Eli did not indicate poor self-efficacy or high academic stress at baseline (i.e., pre-intervention target assessment), resulting in a ceiling effect. This could have occurred due to individual factors, such as his own perceived perception or ability to understand and report on these constructs accurately. Future research may consider measuring teacher perceptions of academic stress and self-efficacy continuously over time in addition to student self-reports of these constructs to gain a more holistic picture of the impact on these variables. Also, the scaling of the self-efficacy (microanalysis) and academic stress measures (SUDS) may serve as a limitation. Both the microanalysis and SUDS used a Likert-type scale between 1 and 6 and 1 and 7, respectively, which may not be sufficiently sensitive to measure change. Research should examine these issues further. In addition, future research should further investigate the relationship between academic stress, self-efficacy, and mindfulness with an evidence-based reading intervention with revised measures that allow for more variability.

Next, child and parent social validity data were not obtained. Though a subjective measure, this data is important to collect. Assessing social validity is important for determining whether the intervention is perceived by participants as socially important and acceptable, and that the outcomes were effective (Horner et al. 2005). Future research should include social validity measures for all participants. Finally, while intervention treatment fidelity was established, it is possible that differences in the rapport building with the two interventionists, in such a short period of time, may have hindered the results of our study.

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Declarations

Ethics Approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Utah State University on March 23, 2018 (Protocol # 8717).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

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